Interaction in the museum: Observing, supporting, learning
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3. The label as means of improving interaction in the informal setting

3.1 The user-languages of the museum: part 1 - supporting visitors

There are several limitations to the conventional ways in which most museum professionals create labels. First among these limitations is, in the absence of a theory, the inability to recognise and develop constraints on the visitor, and to consistently implement preferred ones. Museums have traditionally had a limited notion of the visitor, and treated the label merely as an instrument by means of which to inform them, a demonstration of the wisdom and learning of the museum professionals responsible for writing the label and corroborating its assertions. This is not to say that labels were written without long and thoughtful consideration. What will be argued, however, is that the label writers mainly restricted themselves to three distinct types of constraints – in keeping with the ‘grand narratives’ of their time. In my terminology these three sets of constraints can be recognised as user-languages – the language of textual authority, the language of observation, and the language of variables. These languages have long been used to accomplish aims such as conveying information, telling a story, or documenting historical data. In this section I will argue that each language has its advantages and disadvantages, and notably that the later ones subsume the previous ones. It will be seen, however, that none of the three user-languages yet confers actorship, in the sense I have defined, which may account in part for the practice of ‘visiting’ common to museums, as opposed to that of ‘use’ which characterises libraries.

This section begins with a description of the user-language that confers the most rudimentary properties on the visitor – the user-language of textual authority – in order to indicate how one may recognise its labels. The same is done for the user-language of observation, and its extension, the user-language of variables. For obvious reasons the examples used are largely historical, drawn from museums over the past several centuries. Such examples provide a useful means to develop my theory. To the degree the theory is useful, the easier it should be to recognise what is happening in museums at present, particularly if and when these three user-languages are still being used.

In a later section the user-languages of problems and of games will be looked at in more detail. They appear to subsume the three languages mentioned above, and to confer more, and more interesting properties. They have been used only rarely in the museum setting, and as a consequence, many of the labels to be examined have been created by the author and his colleagues during the course of this re-
search. In this way, the theory has been used as a tool for creating new kinds of
museum experiences, and to explore the effectiveness of new kinds of labels and of
the user-languages on which they are based.

3.1.1 Textual Authority

The user-language of the label that appears to dominate early forms of exhibition is
that of an appeal to authority – of the curator, the researcher, the academic – usually
known and legitimised through texts. The label that implements this user-language
presumably creates in the user the desirable property of being more knowledgeable,
at least insofar as the label can be assumed to represent such knowledge. Strictly
speaking, authority creates the property of obedience when the user fears undes-
irable sanctions. In the museum setting, it can be argued that the label creates
authority by implementing the ‘authority of the authority’, and thus may also confer
the corollary undesirable properties of acceptance and detachment in the museum
user.

The language of authority is perhaps the first experience in the human learning
process. A child quickly learns that certain things are not to be touched, or done,
solely on the basis of parental authority. A burned hand may teach best, but few
are the parents that willingly allow a child’s curiosity to do them grievous injury.
Despite the fact that such authority is commonly grounded in fear of an undesirable
consequence – the parental fear of a burned hand, the child’s fear of a spank to the
backside – it is but a short step from ‘don’t touch because it will hurt you’ to simply
‘because I said so’ as the ground of a child’s ontology. Much of the physical universe
is conjured into being in the act of learning a natural language, and the authority that
underpins the ascription of name to object or experience is often that of the parent.
This primary grounding of ontology in authority easily allows a radical shift from the
specific to the general. The appeal to authority is a common feature of rhetoric, and
in this sense authority is bound to certain kinds of arguments, and as such may form
part of a well-defined user-language, in which the elements of discourse are corro-
borated by alluding to the authority of the ancients, antique civilisation, the canons
of science etc., authority having lost any real relationship to the fear of physical
reprisal or retribution.

The user-language of textual authority operates when discourse, debate and
learning are conducted in terms of references to texts, and the authority of those
texts may rest on other texts. Knowledge, and therefore learning, is conferred by
reference to texts, and the proper structuring and citation of texts is warrant for knowledge. Agreement is solicited in terms of confirmation, and competence is defined in terms of the quality, quantity and authority of the texts brought to the discourse. Users are not deemed competent if they can cite only their own observations, nor if they can solve what they define as problems, but only if they are able to cite texts in support of their position. Generating new texts is the activity of those already deemed competent in the citation of texts, and the warrant for new texts is based upon the citation of existing texts. Textual authority has a long history, and continues to play a major role in many academic disciplines.

As witnessed by the following examples, the appeal to textual authority can be found in the labels of virtually all museums of science, technology, history and art, past and present. Insofar as the curator represents the voice of authority, and the label implements this authority, the curatorial texts establish the truth concerning the museum object, and this is the truth that the visitor is expected to accept. In many modern museums, the bulk of a curator’s time is taken up by research. This research is directed towards the end of establishing the scientific, empirical truth about a particular matter – attribution or antecedents in the case of a work of art, scientific veracity in the case of a science museum – and this truth is then implemented in a label. The activity of generating texts is solely in the province of the museum – the visitor is not considered competent to write their own texts, nor to draw their own conclusions.

Let us consider the following example, drawn from an internationally-acclaimed exhibition of Russian icons, designed and developed in part by the author.

*The Gates of Mystery: the Art of Holy Russia* opened at The Walters Art Gallery in Baltimore in August 1992, the first stop in its tour of museums that included the Dallas Museum of Art, the Chicago Art Institute and the Victoria and Albert Museum. Originally the exhibition was designed to begin with a non-narrative audiovisual as the visitors entered, showing the celebration of the Russian Orthodox liturgy at Christmas, Epiphany, Easter and Pentecost, and highlighting the way in which the icon figured spiritually in the Orthodox ceremony and physically in the Orthodox church. For reasons unrelated to the curatorial intent of the exhibition, the audiovisual was replaced with a large panel of introductory text, establishing the idea of the icon, and the political and ecclesiastical history of the Russian state. This text was meant not only to establish that the exhibition was of
Russian icons in all media, but that the exhibition was divided into two parts: the first dealing with the eternal liturgy, or Heaven and the second dealing with Russian icons as they developed out of Byzantine models into a distinctively Russian art form, art history, or Earth. This distinction was made physically in the exhibition by a change of colour: Heaven (liturgy) was purple, Earth (history) was green.

Heaven and Earth

Icons exist in both heaven and earth. They are gates to the mystery of Orthodox spirituality, and silent witnesses to the length and breadth of Russian history. The icon is the point where heaven meets earth. It is heavenly truth in earthly form, the Word made flesh. Wooden planks, fish glue and earthen pigments are transformed into God through the faith of the artist. The icon becomes a window on eternity, the divine beauty that is eternal salvation. On earth, Orthodox Christians repeat timeless acts of devotion, themselves mortal players in an unfolding history, subject to change and decay. In heaven, Christ and his Saints sit in Glory, venerated for eternity by choirs of angels. Overwhelmed by the splendor of Byzantium, which his ambassadors describe as ‘heaven on earth’ Prince Vladimir of Kiev converts his people to Orthodoxy in 988. A century later, Kievan Rus is swept away by the Mongols, who in turn are defeated by a warrior saint, the Prince of Moscow, Dimitri Donskoj. Holy Russia rises once again and Moscow is hailed as a ‘Third Rome’, the heir to Constantinople, the ‘second Rome’ founded by Constantine the Great in A.D. 324. Heaven is filled with the ‘divine and uncreated light’ that blinded the Apostles at the Transfiguration of Christ. For Saint Simeon the New Theologian heaven is full of ‘fire uncreated and invisible, without beginning and immaterial’. Heaven is beyond time, and permeated with divine fire. In the third century, St. Athanasius writes ‘God became man that man might become God’. The uncreated light, visible on earth in the form of the icon, is what allows man to become God.

What can we observe about the user-language of the above label? What does it tell us about the maker of the objects? The maker of the label? The reader of the label?

First of all, the introductory text is highly narrative. It does not cite objects, it cites spiritual events and states. The tone of the text is magisterial, as if delivered from the throne of God. The text is telling a story, and the reader is obliged to take the truth of the story on faith in order to enter into the spirit of the exhibition. The maker of the objects in the exhibition is at this point largely invisible it seems to be the voice of the museum, stately, disembodied and serious, that speaks through the labels, setting the stage for the objects that will be seen, and aware of its own artifice in
making them visible. The reader is given certain clues in both text and setting, although they are not put as such. The icon is a gate to the spiritual. The icon is part of another culture. The icon is the key to a certain kind of transformation.

What can a visitor make of this? The text demands acquiescence – the reader must enter into the cadence of the text and listen to the story as it unfolds. The visitor is defined as a listener, a hearer of stories, and the museum a storyteller. The artist, the icon painter, the icon itself, are all as yet invisible features in a story yet to be told to a passive listener, a supplicant in the temple of art as a penitent in the House of God. This tone is not entirely inadvertent (although it could easily have been so, insofar as the top-down ‘from on high’ textual strategy is common in institutions of ‘high’ culture) – to understand the objects of the exhibition in their ecclesiastical context is in some measure to enter into the relationship with the art that it exacts in context – the icon is more than an object of veneration, it participates in the Divine Essence, and to appreciate the icon the visitor must be prepared to accept in some measure, however temporary, the paternalistic binome that is part of the context that explains the object itself. In eliding the maker of the object, the exhibition aims to evoke the relationship between the museum and the visitor that is the practical and spiritual relationship between the believer and the Church, mediated by the ecclesiastical object become transparent – a ‘window’ on the other. Three has become two in the space of the label. At their most emaciated, labels that rely largely on the user-language of textual authority content themselves with naming and dating the work in question, and this is primarily what happens in all museums endowed with collections of objects. The barest ontological minima needed to transform a private collection into a museum by means of a label are the name of the creator of the object, where it was found and its date of its creation. How can such activity be called the label? Are even time, date and provenance vehicles of the museum’s authority – of its active structuring? These attributes would have had little importance in the Middle Ages, when art was considered a craft and the artist merely a tool for the patron’s aspirations to divine or secular favour. These ontological minima themselves clearly betray the origins of the modern museum, which can be found at the time when the idea of the author and the Age – the political individual and that of history as progress – were first enunciated in the late 18th century. It is arguably no coincidence that the modern museum appears at the time of Goethe, Locke and the American and French Revolutions. As the anthropologist Richard Handler notes ‘... simple concepts of chronology do not help us evaluate and understand objects from some neutral perspective ... the museum’s dating of them interprets them in terms of a philosophy of time and history that is read into, not out of, them.’
The same can be claimed of the identity of the object. ‘A painting, we say, is a Monet, and a mask is Kwakiuti. I would argue that both kinds of statements about identity are embedded in interpretive frames … [i]t is easy to imagine different understandings of human creativity and of the relationship of humans to material objects. One might, for example, develop a theory of creativity that does not privilege individuals. In this perspective, artists might not be seen as self-contained creators but as participants in a tradition … Similarly objects themselves might not be seen as discrete artworks but as moments in an artistic process that produces a series of objects, none of which would be granted the ontological status of an isolated thing … This is not to say that this alternative perspective could not be used to impose identities of some sort on museum objects. It is, however, to argue that any particular identity of an object will not be intrinsic but something that is read into it.’

The visitor may wonder, the visitor may even hesitate, but in the final analysis must put her faith in the label and in the authority implemented by the label. Rarely is the visitor encouraged to challenge the authority of the label, and rarer still, put this authority to the test by doing experiments. In the best of cases, the label confers new knowledge on the visitor, in the worst, the visitor is puzzled, doubtful, or unwilling to accept the label’s authority, notably if the new information does not conform to prior or preconceived knowledge. In either case, the visitor is a passive recipient of material generated by an invisible actor who has both access to resources unavailable to the visitor, and access to greater authority. The relationship tacitly implied by the label is that described in reception theory – there is a sender, a message, and a receiver. In the eyes of a museum who creates labels based on this model, a successful label is one in which the message, generated by the museum, based on the authority of the curator, is perfectly received by the visitor, who is the passive receiver, a tabula rasa. That this view has been seriously called into question has not had a significant influence on its popularity. Labels, particularly in museums of art and history, continue to largely implement the authority of the curator, whose research, and biases, underpin the museum’s work.

When one authority meets another in the museum on the ground of the label, it clearly highlights the way in which the label implements its authority. In the absence of a counter authority, the label attempts to implement authority as an unquestionable one-to-one relationship between the visitor and the unseen expert by conferring knowledge on the visitor. This is a that. A is a B. The visitor, the reader of the label, is assumed to have nothing to contribute. She is a passive receiver of a putative truth generated somewhere external to her, and beyond her capacity to
create. The role the visitor is ascribed is endorsement, that of the museum, instruction. The property the visitor gains comes from acquisition – by adding another ‘fact’ to a repertoire, her store of knowledge is enhanced. The visitor is more knowledgeable than when she arrived by virtue of having assimilated new information. The elision of the museum, or more precisely its identification with the authority that guarantees the information it is making available, generally goes either unnoticed or unremarked upon. Only rarely are we given an opportunity to unmask the label-making role of the museum, to make it visible and accountable, to hear a challenge to its authority.

The New Yorker author Terence Monmaney interviewed the palaeontologist Robert T. Bakker in the Smithsonian Institution’s Museum of Natural History as part of an article published in May 1993. The interview allows us to look at the role of the museum relative to the labels it writes, and the authority it relies upon. A lengthy excerpt is revealing (see also chapter 1):

'We stopped for a few moments at the exhibit on Dimetrodon, the fin-backed reptile that predated the dinosaurs. It was represented by a nearly complete fossil skeleton, alligator-size, displayed in a shoulder-high case … The plaque says that the Dimetrodon is “a primitive mammal-like reptile”, and says little else, as if either you get it or you don’t. But this is not the “Mona Lisa” – it needs help. Bakker shook his head. “See, this misses the ecological context. This is all ancestor worship.” Then he acted out a stern pedagogical encounter. “Why is this object important?” he intoned. Whining, he answered, “Because it’s the ancestor of mammal-like reptiles.” then he reverted to his normal demeanour. “No. This is the world’s first top predator. Before this, you can’t identify an animal that’s strong enough to kill and eat anything else. The first king of the beasts. Ecologically a big deal. Does the plaque tell you that? No.”

'We stopped at a sign on dinosaur temperature control. Warm-blooded or cold-blooded? The Smithsonian, it turns out, was enemy territory, a redoubt of inertial homeothermy – the theory that dinosaurs, though metabolically cold-blooded, were so large that they held the little heat they generated and thus gained the advantages of warm-bloodedness. “Oh, no” Bakker shrieked, like a distressed damsel. It became clear that he was not having much fun. So you don’t want to listen to this? “I’ve heard it a thousand times,” he said. Why is it here if it’s not true? „Because this is the standard doctrine, and it has got to be defended: ‘Dinosaurs were successful because they were big and the climate was warm.’ That’s all you have to know! Big – it was warm. Big, tropics. Big, tropics. Bigtropics – bigtropicsbigtropicsbigtropics.” I read aloud from
\textbf{The dinosaur's bigness probably helped them conserve heat.} "But that's true no matter what your metabolism. The bigger you are, the less rapidly you'll lose heat."

'Their capacity for prolonged strenuous activity would have been limited more by their size and their anatomy than by their ability to use oxygen.' "That's a nonsense statement. Prolonged strenuous activity – maximum aerobic exercise, right? That's limited by only two things, lungs and heart. And we know that dinosaur lungs and hearts were avian" ... 'Warm-blooded animals use oxygen more effectively than cold-blooded animals.' "That's incorrect", he said, sounding a little steamed. Oxygen utilisation by cold-bloods was part of his doctoral research. '... allows them greater endurance ...' “Absolutely wrong” 'Thus birds and mammals are more continuously active,' “They're more continuously active because they have larger hearts and lungs.” ... 'Small dinosaurs would still have depended mostly on external sources of heat, as do reptiles and baby birds.' Now Bakker was laughing hysterically. "I don't know where they got the idea that baby birds are cold-blooded."

It is clear from the above example that when confronted with the process of making knowledge, in this case as a researcher in the field, that the museum's desire to be seen as a purveyor of incontestable fact can be called dramatically into question. By masking or eliding the museum's role in writing the label (the label gives the impression of presenting authoritative scientific truth) it denies any but the specialist a means to judge the contingency and complexity of the subject at issue.

To overcome what it sees as the limitations of the user-language of textual authority, the museum community generally responds by attempting to create new texts, texts which nevertheless employ the same user-language. For instance, the concerns of modern museums for the creation of a context in which the visitor can situate the object has required an amplification of the object label, which has generally increased in length, and been dispersed around the exhibition in the form of graphic panels that often combine charts, maps, photos, illustrations and text, a display technique related to the label pioneered in the 1930s at American World's Fairs. The expanded notion of the label and the graphic panel now form the bulk of the interpretive armament of the modern museum.

A comparatively recent exhibition attempted to challenge the faith put in attribution and authority, the exhibition Fakes, at the British Museum in 1990. Nevertheless, the exhibition relied largely on the user-language of textual authority, that is to say, it used label texts that were themselves classic in their appeal to the reader to endorse their truths – truths that themselves were not always necessarily visible.
or open to challenge. Thus the museum chose to treat the subject of the untrustworthiness of texts by writing newer, arguably equally untrustworthy texts.

Label: 75 Furry Trout

The belief that the fauna of Canada included furry fish is said to date from the seventeenth century, when a Scotsman, who had written home about the 'abundance of furried animals and fish', was asked to send an example of the latter and obliged. In recent years furry fish have been produced by Ross Jobe, of Sault Ste. Marie, Ontario, using rabbit fur. The accompanying text suggests 'that the great depth and extreme penetrating coldness of the water in which these fish live, has caused them to grow their dense coat of (usually) white fur.' In the early 1970s an enquirer, believing it to be genuine, brought one of these fish to the Royal Scottish Museum which, recognising it as a hoax, did not retain it. The story got out, however, and public demand to see the furry fish was so strong that the Museum had to 'recreate' it. This furry fish is, therefore, a fake twice over. GNS

L 270mm

National Museums of Scotland

Each of the elements of the story, including a reference to 17th century literature, must be taken at face value in order to appreciate the object displayed. The visitor leaves with a new piece of information, but one taken on faith. One can imagine numerous similar labels, each alluding to older texts and making similar claims, each perfectly plausible, in the manner of the labels written by the Museum of Jurassic Technology. See Weschler, L. Mr. Wilson's Cabinet of Curiosities, New York: Pantheon; 1995

In the examples cited above, the museum user is called upon only to accept, and to endorse, the truth of the label. The label is thus assumed to confer the properties of acceptance and passivity – even a label about an object itself called into question. The user comes away from the museum with new knowledge, but knowledge to be taken on faith. The user has become passive in the face of the new knowledge, in the sense that she can 'either take it or leave it', and was not invited to play more than a minor role in its creation. The user-language of observation, that strives for better seeing on the individual level to ensure better believing (see next section), is not relevant when it comes to the Russian icon – or the furry trout. The user is not asked to believe the evidence of her observation, but to accept the authority of the writer as warrant of the label's truth.
3.1.2 Observation

Application of the user-language of observation marks a new awareness of what writing a label may involve. This language clearly is associated with the appearance of science, and just like science aims to organise individual observations of the physical world. In the museum setting, in contrast to labels that employ the user-language of textual authority, labels that employ the user-language of ‘observation’ help the individual visitor to see, that is to become an authority in seeing for herself. In the user-language of observation, observations are the ‘currency’ of the language – individual observations are to be confirmed and disputed in terms of observations reported by other individuals (usually ‘authoritative’ experts or scientists). Were this to be otherwise we would be in the realm of miracles, rather than of science – noting that during the Middle Ages ‘the miraculous was widely perceived as part of nature which provided a paradigm for the explanation of the world and its apparent aberrations’. \(^\text{20}\) Note the shift in emphasis: the user is allowed a certain extra freedom (she herself must see), although there is still the obligation to make a comparison between what each individual sees and what is reported as having been observed by others. There is a shift in procedure therefore, though not of allegiance. Although the user is recognised as an observer, she will but serve a new master.

The label confers this property in the museum setting by identifying opportunities to observe, identifying what is to be observed, and identifying opportunities to observe wherein these observations have value. It assumes the user does indeed ‘see’ the whole, as well as the individual instances. While textual authority still occasionally has to supplement the user’s experience, and continues to ‘authorise’ being knowledgeable, as seen in the examples above, the user-language of observations, like a good lens, gives the user the opportunity to observe, examine, and to confirm, specific aspects of the world around them, as well as how they belong together.

Due to its roots in the nascent rationalism of the Enlightenment, among the museum’s first uses was as an instrument of observation, and by means of its practices of collection – the ordering of its collections, and its labels – it revealed aspects of the world that otherwise were invisible. The better the museum – the more comprehensive its collections, the more coherent its organisation and the more scientific its labels – the better the quality of the observation. As Valéry had inscribed over the entrance of the Palais de Chaillot in the 1930s ‘Things rare or things beautiful, collected here in learned manner, instruct the eye to see, as it has never seen before, all the world’s existing things’. The plurality of observation made possible by the

\(^{20}\) see Rubin, M. 
Corpus Christi, Cambridge: CUP; 1991
museum was controlled and channelled by its labelling, the implied ontology of which served to homogenise the nature of each observation, so that the many observers were compelled to repeat and confirm observation by others, as prescribed by the label. The museum label, insofar as it implied a certain ontology, was considered as a passive, objective element, despite the broader and varied agendas of the museum institution for private, moral, social and scientific reform. Even if the intent of the label was to have an effect on the visitor, the effect was one way – the visitor was to be converted to the truth, and as a consequence, to become transformed. With very few exceptions, the idea that the user of the label should initiate an action to become active does not occur in museum literature until well into the 20th century.

As an instrument for seeing, the first task of the early museum was to allow visitors to see farther, by bringing closer objects they would not have been able to see otherwise. Shorn of its magical powers, the cabinet of curiosities was a means of displaying the rare, the beautiful and the strange, often without the regard for taxonomy shown by later collections. A rare shell could be seen side by side with a fragment of antique sculpture, or next to a jewel-encrusted Gothic reliquary or an oriental rhinoceros horn cup. At the same time as the telescope was bringing the stars within reach, artefacts collected on voyages of discovery to the New World were bringing native plants, objects, and natives themselves from the New World to the capitals of Europe. The visitor could start to see for herself.

The first descriptions of the objects in Tradescant’s Ark, which may be assumed to be their first labels, are recorded in the 1656 catalogue that accompanied the collection, compiled largely by Elias Ashmole, an amateur alchemist and later one of the founders of the Royal Society, who was to purchase the collection.

1656 label ‘Cup of rhinoceros ... hornes’ [cat. pg. 52]
1685 label ‘Poculum ex Rhinoceratis cornu conflatis’ [B no. 465]

The label for the rhinoceros cup 21 can be used as an example of the approach to exhibition taken by the collection’s custodians the Tradescants Elder and Younger, and of the changes that were a consequence of the collection’s purchase by Elias Ashmole in 1659 (he took possession only in 1674 – over the objections of the Younger Tradescant’s wife, Hester) and its subsequent donation to Oxford University in 1679. The horn of the rhinoceros was believed to have numerous qualities in the early 17th century, when this cup is thought to have been fabricated. Powdered
it was meant to be eaten as an aphrodisiac, in the form of a drinking vessel, rhinoceros horn was believed to ‘sweat’ in the presence of poison, and liquid drunk from it was believed to cure cholera. The cup displayed in Tradescant’s Ark, was of an oval, flaring shape following the outline of the horn, and carved in the form of a five-petaled hibiscus flower. The stem of the blossom is carved fully in the round, and branches to form a steady base on which the cup stands. The motif and the carving point to fabrication in the Orient, where the horn was a great rarity.

The label is uninformative, but in English, which indicates it was directed to a lay audience, perhaps even the ‘rude vulgars’ who would be interested in the curiosities of the collection. The collection was open to the public, upon payment of a small fee, and the interest of the public almost certainly was in the variety of natural oddities contained in the collection, rather than more academic, taxonomic concerns. The authority of the attribution rested in Tradescant’s account of his purchase of the object on one of his botanical travels to the continent. The language was that of observation, and the collection allowed visitors to see and wonder at curiosities of nature and ethnographic specimens collected on long travels from distant places – places they could not otherwise ‘see’, and to which they would have had little prior access save through engravings in books and oral accounts.

For the objects of the collection, seeing was believing what others were said to have seen, and the object labels, however terse, told the viewer what it was they were seeing: the mantle of an Indian chief, the statue of an Hindu god, or a white-spotted snake. At the time, the ordinary viewer was presumably in no position to contradict the authority of the label, and critical evaluation of the veracity of the attributions (through other, and additional observations) had to wait until the Ark was installed at Oxford and attended by full-time Keepers.

Thirty years later, as part of the new Ashmolean collection at Oxford University, the label is now in Latin, no more informative, but addressed to an educated and literate elite. The statutes of the new museum reflect this shift: ‘[Article] 11. That the Rarities shalbe shewed but to one Company at a tyme, & that upon their being entered into the Museum, the dore shall be shut and if any more Company or Companies come before they be dispatcht, that they be desired to stay below, till that the other come forth.’ 22 While exemplary in its concern for the well-being of the collection, a concern well-warranted at the time (the first robbery in the collection occurred in 1689, when a single large party had been admitted, contrary to the statutes), it is a far cry
from the ‘variety of objects which daily present themselves to them, or may easily be seen once a year ...’ mentioned by Hooke in 1638.

The authority of the label rested on that of the Keeper, although insofar as the Keeper’s scholarship was open to challenge, so was the authority of the label itself. In 1734 a German scholar wrote with sceptical distaste ‘in a case I found a very well-wrought Indian idol, or as the Custos called it, a Brachmanus. He declared that the stone was unknown, but it appeared to me as a sort of steatite, from which the Indians normally make their gods ... The ridiculous fellow who was showing us the specimens and who is a Sub-Custos (the Custos himself, Mr. Parry, cannot show visitors over the museum for guzzling and toping) announced in all earnest that the material for these gods was made of rice, boiled and then dyed.’

Tradescant’s collection of wonderful rarities and oddities, closeted in an Oxford museum attic, had ceased to be wonderful, its rarities jumbled and at odds with its oddities, and had to await the 19th century to be rescued from decrepitude. The relationship between the Keepers, the labels, and the visitor, however, had been firmly established, and the user-language of authority which the museum promoted, coupled with the user-language of observation made possible in the new museum instrument of vitrines and labels, laid the groundwork for the museum experience as it would become popular for the next three centuries.

The museum collection, as it evolved over the course of the 18th century, was not only to be a place where things could be seen for the sake of their rarity. Imperial expansion and the exploration of the New World meant that increasingly the strange, the rare and the unusual became the commonplace, and the museum’s mission was soon obliged to become more than a shop window for the curious passer-by. This change of direction was already apparent in Elias Ashmole’s ambitions for Tradescant’s collection, and it was clear from the statutes, from his choice of Keepers and from the Latin texts of the collection’s labels that the collection was meant to serve the needs of scholars, and contribute to the advancement of knowledge. The collection was not to be merely a window, but a lens, not just a means of seeing, but an instrument for better seeing in terms of what others supposedly were also seeing. It was not enough for a visitor merely to see a new oddity, but to see it ‘better’ – to learn more about it, to be able to describe it in terms of a wider framework. Thus museum visitors were not charged merely with their own observation, but had to take a small step towards being actors in the museum setting, contributing as well as corroborating observations.
The art museum is the public face of art history, and its collections differ from private collections in their being presented to the public, and interpreted by means of the label, whereas a private collection, while it may be interpreted by its owner, remains private largely by virtue of its lack of the label, which by definition implies unknown and unknowable viewers. The art museum also tends to function as a lens, an instrument for increasing the quality of possible observations by assembling a great number of similar works in the same place. In the art museum, as the art historian Michael Baxandall notes at length, the bulk of the art museum experience is not about looking at pictures, but about talking about looking at pictures, wherein the label is the means of constructing the visitor’s dialogue about art. Here the visitor, in addition to the personal affective impact of the work itself, spends a large amount of time communicating to others the nature of the encounter, in terms of the work. The work quickly becomes a support for discussion about the nature of the experience of the work.

Statistics conducted at major museums corroborate the fact that the museum visit is a fundamentally social experience, that visitors are rarely unaccompanied, therefore to look at the nature of the museum experience as a social experience supported by the collection is largely warranted. Moreover, seen in this light, the label is seen to be the fundamental museum support, as it is the label that guides, frames, and to a large degree imposes the framework in which visitors interact in the museum. The ‘seeing’ of the visitor is thus mediated and facilitated by the degree to which the label can construct a discourse around an object, the degree to which this discourse can call upon supplemental information to enlarge the visitor’s ‘field of vision’, and the degree to which the label can implement certain properties in the visitor.

A good lens has the capacity to bring things closer, to reveal greater detail, to see better what is there to be seen. The museum in this way acts as both telescope and microscope, to bring the far near, and to reveal unsuspected detail. The user-language of observation is central to this instrumentality, and the optical nature of the instrument is central to the large majority of museum labels, be they in museums of art, science, or history. This emphasis on observation, and on the ability to corroborate by seeing is often (although not always) complemented by a textual dimension that calls upon the user-language of authority, and serves to confirm the adequacy of the visitor’s seeing. The ontological link created by the label is still a key feature of the encounter – the visitor is expected to see what the label says others also see. Nevertheless, contextual information provided by the label can be
a support for dialogue, and, depending on its sufficiency, can serve to recognise the visitor and her need to reflect, consider and discuss the visual encounter by means of additional information provided by the label, thus confirming Bourdieu's observation that the label is often construed as a key sign of concern on the part of the institution for the visitor.

At its simplest, the label helps the visitor see by telling her what is there, by making a propositional statement about the material presence of the object. This minimum is often supplemented by an implied narrative that alludes to the story of the object's creation – why the painter painted it, of whom, under what conditions, and in what manner. The following example, taken from The Wanderers, an exhibition of Russian 19th century paintings held at the Dallas Museum of Art in 1989, tells the visitor conditions of the painting's provenance that would otherwise be unknown. What new information does the visitor receive? The relationship of the subject to the painter, and by inference the reason for the portrait the fact that the costume is Ukrainian that the artist painted many different kinds of people. Although the label implements the user-language of observation – the visitor's observation – the visitor is nonetheless asked to corroborate the curator's editorial comment about other, to the visitor invisible, paintings in acquiescing to the particularity of the painting viewed as described.

Label/1989: Portrait of A. I. Sliusareva, N.N. GE

Agayifa Ignatievna Sliusareva (1856-1903), wife of the artist's son is depicted as a young woman in Ukrainian costume fetching in her charm, simplicity and frankness. Portraiture was quite important in Ge's work. Among his portraits of writers and public figures who played an important role in the spiritual life of the 1870s and 1880s, there are, however, a great many portraits of people who were seemingly unexceptional. In each one, though, the artist defines the value and significance of the human individual, and his portrait of Sliusareva is, no doubt, one such work.

In the exhibition Copier/Créer at the Louvre in 1993, the visitor is given the additional visual material of the work by which the painter was inspired, in the form of a black & white photo as part of the label. In this way, the label is able to support comparison between the work and other works that may have had an influence on it, information the visitor might be unaware of otherwise (but also might not agree with if such other works had been available). Moreover, the curator imputes specific motivations to the artist, and attempts to tell the visitor what the artist was attempting to do and how. While the visitor is asked to take the curator's belief on faith,
she is also directed to another work in the event that she wants to corroborate or refute the curator’s position. In this case, the seeing of the visitor has been materially enhanced, despite the relatively spare style of the label itself.

Label: 101 Giacometti – Didoufri
Didoufri
Ink
Provenance: Collection Mme. Alice Tériade
Paris, Galerie Yoshii

Here again Giacometti is trying to find the major planes corresponding to the first cutting of the red sandstone, the features of the IVth Dynasty Pharaoh seeming to reveal themselves progressively, according to the same process that dictated the work of its Egyptian sculptor. The Yoshii collection possesses a second drawing, very close in spirit, probably executed following the same photograph and at an earlier time, more faithful to the original, showing notably the cracks with greater precision, by means of fine hatching.

In the Louvre label, the visitor was given additional information about the artist’s intent, and about the existence of the artist’s works on the same theme, and would have been able to pursue the analysis of the work in greater depth if desired. However, this additional investigation would have been difficult to undertake, and insofar as it would have presented a real challenge, can be considered in certain ways as actually discouraging further looking. However, in the case of the exhibition Mi-Vrai/mi-faux at the Musée de la civilisation in Québec in 1992, the visitor was actively encouraged by the labels to investigate the object and come to her own conclusion. By using direct questions and concealing the label texts as an incentive to reason from the material evidence available, the label promotes not only increased knowledge about the object, corroborated by the curator’s authority, but the development of the skills that underpin the curator’s own competence.

Introductory copy: Similis
The first dilemma we are faced with is to situate ourselves among the multitude of objects we encounter. Are they real? Are they imitations? In the end, aren’t they simply obscure copies? Certain distinctions should be made. Behind every object taken out of the context in which it was created or used there lies an enigma which sometimes masks its identity and its degree of authenticity. Alone, the object lies before its judge. Often it is silent. Let us sharpen our critical faculties and become curiouser [sic].

\[\text{Mi-vrai, mi-faux, Québec: Musée de la civilisation; 1992}\]
Let us open our eyes and allow these objects to speak to us. They have messages to deliver ...

Do you want to test your knowledge and sense of observation? Are you curious as to the true identity of these objects? To confuse you, we have only partially identified them. Voluntarily omitting several details, confronting you with the object on its own. Observe them meticulously, allow them to break the silence, and before reading the explanations and the answer found behind each of the four cabinets, judge for yourself.
You’ll see ...

Label (concealed verso):
The furry trout is a ruse that has trapped many. Lay persons are easily convinced that fish swimming in the icy depths of Arctic waters are covered with fur. In reality fish do not need warmth because they are cold-blooded animals. This furry trout, a replica made by a Sault Ste. Marie taxidermist, Ross C. Jobe, is wrapped in a simple synthetic fur.
Collection: National Museums of Scotland, Edinburgh

Rationalist science is based on a formalised process of shared witnessing, and one would therefore be justified in believing that science museum labels, as science itself, would make appeals to corroborate by observation. More often, however, science museum labels appeal to the authority of Science as a corpus of completed and proven results and discoveries, generally beyond the intellectual reach of the average visitor. The truths of science and technology have replaced those of religion, and are expected to be taken on faith by the science museum visitor. The science museum is one of the few places in which an ordinary citizen encounters science in action, or purportedly in action, and often has more in common with a church than with a research laboratory. This emphasis on the authority of science is closely related to the science museum’s perceived mission as part of the formal educational system, and the science museum often positions itself as an extension of the classroom. As former director of the Palais de la Découverte Michel Hulin wrote just before his death in 1988, ‘fundamentally without a doubt, the Palais is a sort of scientific super-high school, devoted to the presentation of experiments and documents to go along with courses, but endowed with experimental capacities and documentary resources that exceed those of an ordinary establishment of secondary education.’

30 Taken from an unpublished internal discussion paper Le Palais de la découverte, son présent, son avenir: un survol rapide, 19 octobre 1987
31 Transcribed by the author, 1993
Look at the tornado. Three coils heat the water in the basin, and the steam is thus put into motion with the help of a fan at the top of the cylinder. The vapour condenses into fine droplets of water to give a thick mist. If you press on the button, the fan stops. What do you notice?

When you push on the button the mist disappears. The fan is therefore the cause of the condensation of the steam. In effect, while turning, the fan creates a depression in the centre of the cylinder. The rotating steam is attracted to the depression. As its speed increases its temperature drops as a consequence. The water vapour condenses.

The condensation of the steam into fine droplets of water is the direct consequence of the depression created by the fan.

According to Maturana ‘The intention of doing science is to explain ... and it is in the context of explaining that it must be understood that scientific explanation is the criterion of validation for scientific statements ... it must be recognised that a modern scientific community is a community of observers that use the scientific explanation as the criterion of validation.’ In other words, in order to participate in the community of scientists, one must accept the set of criteria established for correct observation, and take part in the scientific process of observing and confirming. However, in the case of this exhibit, the exhibit user has no choice but to confirm the truth of the label, having no recourse to experiment, no access to additional information, no indication of the community in which consensus was reached about the principle involved. The visitor is active, insofar as she provokes the phenomenon, she is a participant insofar as she witnesses the phenomenon, but the witnessing is not that of a scientist, whose witnessing itself has authority through the community of scientific observers, but that of a passive spectator, whose sole role, like the penitent at the altar, is to confirm the revealed mysteries of science.

As demonstrated by the examples above, labels employing the user-language of observation, while conferring additional properties absent from those labels relying solely on textual authority, are quite limited in the properties they add. Although the user-language of observation helps the visitor become an ‘observational’ authority, it does not help her to become anything else – for instance a real actor able to use her ‘self-authorised’ observations in another context.
3.1.3 Variables

Strictly speaking, the user-language of variables is only an extension of the user-language of observation – the reach is greater, but the ‘currency’ of the language, observations, remains the same. Still, this user-language allows for many new features. It suggests to the visitor that a large variety of different observations can be ordered and compared by herself. The user-language of observation alone is not often able to cope with the enormous possible variation, nor marshal the expression of this variety in a meaningful way. The user-language of variables provides a means of ordering observations, through a description of the relations between variable parameters. When the user-language of variables is used to augment and extend the user-languages of authority and observation in the museum, the label confers on the visitor the property of being able to discuss, compare and control a domain of observations, even when some of its elements are not directly visible.

As we have seen from the above, since their emergence in the late 18th century from the unravelled pieces of the magical and talismanic neo-platonic cabinets of the late Renaissance, via private collection, museums put a premium on the user-language of observation. The museum was considered an instrument that would help its users see better. The user-language of observation not only permitted visitors to see new objects, to see objects in greater detail and with greater accuracy, but, still using the optical metaphor, to ‘see’ invisible phenomena, and with even less basis in actual vision, to ‘see’ relationships between objects and abstract concepts. This latter kind of ‘seeing’, albeit couched in terms of sight and observation, still owes a large debt to the user-language of authority, as the existence of the invisible concepts shown must first be vouchsafed by those who can already ‘see’32, and to an even greater extent, to the user-language of variables, which orders the observations into groups of ‘observations of observations’.

Museums, and their labels, reflected this new philosophy of History. Art museums displayed their collections in order to show the progress from the barbaric Middle Ages to the Renaissance, the schools of painting of each country progressing ever onwards towards enlightenment (despite digressions and lapses of ‘good taste’ such as Mannerism). Beginning with the work of Thomsen in Copenhagen in 1816, archaeology and history museums showed the Ages of Man, and his progress from primitive society to the present, following on Mahudel’s work in the late 18th century.34 Science museums showed the fruits of industrial progress – the machines and tools that made Man’s lot lighter (ignoring the problems of depopulation of the countryside, the destruction of the crafts, and child labour).

\[\text{32} \text{ See Shapin, S. A Social History of Truth,}\]
\[\text{Chicago: University of Chicago; 1994}\]

\[\text{34} \text{ Described in Walsh, K., The representation}\]
\[\text{of the past, London: Routledge; 1992}\]
Natural History museums, organised since the early 18th century according to the taxonomic principles of Linnaeus, reshuffled their collections to demonstrate the truths of evolution according to Darwin's theories of species variation and natural selection.

We can take the museums founded by the Convention of 1794 in France as an example. In the Louvre, the casual visitor could see the history of art as a single evolutionary promenade, the scholarly user could see the development of schools of painting, and the artist could better his skills by scrupulous copying. At the Conservatoire des arts et métiers, the apprentice could see new developments in technology, the journeyman could see how to improve his own efforts, while the factory owner could find the key to the reorganisation of industry. At the Muséum de l'histoire naturelle, the researcher could see the infinite variety that inhere in a single species the lay visitor the natural order of the natural world, first, taxonomically arranged according to the schema of Linnaeus, later, confirming the truths of evolution — a theory wedded to the idea of variation and variables in the physical environment. The labels of the Muséum de l'histoire naturelle reflect the ordering system used by the museum, and as a consequence, confirm the truths of the natural world that the museum endorses.

Label/late 19th c. Musée de l'histoire naturelle, Paris
27 Crustacés
Décapodes Brachyures (Crabes)
Gécarcins Trichodactyles, etc.

By means of labelled specimens, organised according to a specific system, the user could not only see what was there, but also the physical expression of the relationship between what was there and what wasn't. In the museum of natural history, the visitor saw with her own eyes the variety possible within a single species, but also a concrete and visible expression of the species' relationship with one another.

The act of seeing confirmed the truths of both observations, and the ontology of the label enshrined the relationship between object, order and observation perfectly.

The visitor, by means of the museum, could see diversity, see progress, see evolution, and see history.

Moreover, the museum, and more particularly the World's Fair exhibition, became an instrument for seeing other 'truths' – such as Manifest Destiny, and the ascen-
dance of the people of the civilised white-skinned western nations at the expense of the primitive peoples over whom the lofty and detached Hegelian Idea had necessarily triumphed. From the vantage point of the museum the visitor was able to see past the horizon of the real to the ideologies beyond. That these truths be doubted was not to be countenanced, nor that the museum as an instrument could show them. At the Universal Exposition of 1937 in Paris, the doors of the Palais de la Découverte opened for the first time to show the invisible forces of nature – static electricity, momentum, kinetic energy, electromagnetism – which it did by means of spectacular demonstrations, such as the world’s largest Van de Graaf generator, which threw sparks metres long, and the huge electromagnet capable of holding a heavy metal chain in mid-air. The motion of electrical charges was made visible, as was the powerful electromagnetic field. It was therefore but a short step to render visible the triumphs of French science, and the incontrovertible benefits of scientific progress, which was the Palais’ founder, Nobel Laureate Jean Perrin’s express purpose.\(^{37}\)

The Palais was ‘to render manifest these origins [of science] and make the public understand that, in the past, but also in the future, we cannot hope for anything new, nothing that changes the Destiny seemingly forced upon man, except by Scientific Research and Discovery. In this palace we wish to create a living exhibition where will be found, as much as possible, shown in a spectacular fashion with the most modern resources, the fundamental discoveries that have enlarged our intelligence, assured our domination of Matter, or augmented our physical security.’\(^{38}\) The Palais was to become ‘a great popular university, plunging its roots in the people of Paris and giving to them that education that they lack and that they desire. For the People display towards Science a confused trust, albeit deep. They hope, they expect from this liberating Science a growing freedom, already begun, that will render to all, thanks to the pleasures of a healthy and harmonious life, the superior joys of Art and Reason.’\(^{39}\)

Despite its emphasis on the invisible aspects of science, and the premium it put on experiments, these experiments were generally available to the visitor only in the form of demonstrations of already discovered principles. For practical reasons, as well as for ideological ones, the visitor was not encouraged to call generalisations into question, nor even to see herself as a potential participant. The visitor was assumed to be ignorant, needing to be shown the light of science, a science necessarily ‘vulgarised’ in order that it be understood by the lay public. However, in the use of real scientists to demonstrate what use could be made of observations, there

\(^{37}\) see J. Eidelman’s article on the creation of the Palais in ‘Vulgariser la science,’ Schiele and Jacobi eds. Paris: Champ Vallon: 1992

\(^{38}\) Jean Perrin, La Science et l’Espérance, pp. 150, Paris: 1938

\(^{39}\) op.cit.
were the seeds of an approach that would put the language of variables into the museum setting, as it had long been in scientific practice itself.

The user-language of variables is an integral part of the sciences, and as a consequence, quickly became part of the lexicon of the science museum label. In the late 1960s, the American physicist Frank Oppenheimer founded the San Francisco Exploratorium as ‘a garden of natural phenomena’, in which a visitor could wander at will, exploring at first hand phenomena and scientific principles underlying them. Inspired by the demonstrations he had seen at the Palais de la Découverte and by accounts of the interactive children’s gallery at the Science Museum in London, Oppenheimer imagined a museum in which the visitor could ask the question ‘what would happen if ...?’, which is to say a museum that tried to augment the user-languages of authority and observation, with that of variables. In fact, possibly as a consequence of having been blacklisted in the McCarthy witchhunts of the 50s (he was the brother of Robert Oppenheimer, head of the Manhattan Project), Oppenheimer showed an acute aversion to the language of authority, and encouraged the kind of exploration that he believed was the basis of good science – no question was a bad question at the Exploratorium.

The Exploratorium is often claimed to be the first of a new generation of institutions – the interactive science centre. Proponents of these institutions claim they are not museums, as they lack collections of objects, and instead rely upon exhibits that elicit natural phenomena to convey the principles that underlie them. Nevertheless, these phenomena are consistent and repeatable events, and thus in some ways can be said to constitute a collection, albeit of ephemeral and transient phenomena – a collection that ultimately stands for a virtual collection of abstract scientific principles.

The user-language of the Exploratorium, and of the majority of its many imitations worldwide, is still the user-language of observation, albeit extended as the user-language of variables, by means of which visitors are encouraged to manipulate variables to bring about different sensible effects. The objects in the Exploratorium collection must be brought into being by means of the visitor’s activity, and the visitor is encouraged to elicit for herself a phenomenon, and to understand the principle that gives rise to it. The spatial organisation of the Exploratorium in a single large space encourages this activity, and the visitor is encouraged to wander from exhibit to exhibit,
making connections according to her own interests and at her own speed. The exhibits themselves are considered 'working prototypes' and staff are discouraged from insisting that there is any single 'correct' way to use them.

The Exploratorium deliberately decided not to place an emphasis on questions in its labelling. First of all, it was felt that posing a direct question, such as 'do you see the difference between the figure on the left and that on the right' would intimidate those for whom the difference was not obvious, or elicit spurious observations. Second, it was felt that to formulate the question was to limit the range of observations available to the visitor, although the visitor is told in advance what it is they should be doing and, as a consequence, noticing. This can be seen in part as a consequence of having 'objects' that are phenomena, which first have to be seen before they can be examined. The emphasis on the user-languages of observation and variables, however, tends to distort the actual history of science, suggesting that science is a series of discrete revelations and discoveries, rather than a social process of debate and consensus-building, rooted in a historical context. The short-comings of the user-language of variables, still central to the 'official' post-facto description of modern science, are also in evidence in the Exploratorium. The ease with which the phenomena are elicited and thus made visible, (due to the careful and professional skills of the Exploratorium staff) betray the contingent nature of real scientific investigation, which often proceeds from ill-defined starting points and difficult procedures before a phenomena can be wrested from its context and made visible and significant.

The Bernoulli Blower, one of the many well-known exhibits developed by the Exploratorium, is designed to show the principle of lift due to unequal air pressure generated by airstreams of different relative speeds – the faster the airstream, the lower the pressure – therefore an object will be pushed towards the zone of lower pressure in the case of a disparity. If the object in question is light (such as the beach ball in the Exploratorium exhibit) and the pressure differential great enough, it can be made to hover in the air and apparently defy the force of gravity. This effect is startling, and the exhibit is a popular favourite in many science centres, where young visitors spend comparatively long periods putting the ball back into the airstream to see it hover as they move the blower nozzle. The label follows the style developed by the Exploratorium for all its exhibits:

**Label: Bernoulli Blower/1970s – The Exploratorium**

To do and to notice: Hold the ball with both hands and pull it slowly out of the air stream.

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* Brumen, R. The Exploratorium Cookbook I. San Francisco: Exploratorium; rev. 1984

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Notice that when only half the ball is out of the airstream you can feel it being sucked back in. If you then let go of it, it will oscillate back and forth without falling to the ground.

What's going on: When the ball is pulled partially out of the airstream, the air that is moving fast along the side of the ball exerts less sideways pressure on the ball than the still air in the room. An airplane wing is shaped so that the air moves faster over the top of the wing than it does over the bottom of the wing. The lower pressure on the top of the wing produces a suction which holds the airplane up, or, more accurately, the high pressure on the bottom of the wing pushes the airplane up and balances the downward effect of gravity.

The premium put on the user-languages of observation (notice the effect) and variables (try moving the ball towards you) can be seen in the exhibit text, although as a consequence the openness claimed on the part of the institution is less in evidence than might be desired. The visitor is carefully told how to elicit a particular phenomenon, and is then told the conventional scientific explanation for the effect. The ontological assertion is clear: what the visitor feels (and will consistently feel if she follows the instructions) is the Bernoulli effect. The label is an extension of the object, and imposes a framework on it, in much the same way as a label in the Museum de l'histoire naturelle is an extension of the specimen it describes. Between the incontrovertible experience and the label there is no room for doubt, however, it is doubt that characterises the scientific enterprise. Moreover, in linking the phenomenon experienced by the visitor in one context with a scientific principle underlying a major technology (flight) the label writers optimistically rely on the visitor to make the necessary connections. In evaluations done on similar exhibits this optimism is called seriously into doubt, and it is rare to find any evidence of understanding of the principle of lift following exposure to the beach ball floating above the Bernoulli Blower, regardless of the manifest popularity of the exhibit among young visitors.

One of the aspects of the Bernoulli principle that remains invisible, and puzzling, is the history of the invention of flight. The exhibit shows how easily the principle can be put into practice. The exhibit suggests an ontological link between the scientific principle and the technological artefact – an aircraft wing. Nevertheless, what accounts for the centuries of observation of bird's flight, by observers as well-trained and talented as Leonardo Da Vinci, that resulted in different and unsuccessful models of lift? What was the key to the successful observation? The historical aspect of science, technology, and even art, is largely unexplored at the Exploratorium, while the history of science provokes significant questions.
Nor is the user-language of variables limited to science museums. In the exhibition *Space and Distance*, held at the Chicago Art Institute in 1948, the user-language of variables is used to challenge the visitor to compare paintings in which the distance is constant but the space changed, and vice versa, in order to see how different époques and different cultures manipulated both. Designed by the curator of modern art, Katherine Kuh, the exhibition was strung with coloured ropes to emphasise the difference between the two concepts. In two shadow boxes of different sizes cut-out figures showed the effects of scale on the illusion of space. A Miró reproduction was partly repainted to show how colour altered the perception of space. Renaissance paintings from the museum's collection were put side by side with modern ones in order to illustrate 'how the twentieth century artist attains space through colour, whereas the [earlier] artist is more interested in perspective and distance which he attains through line.'

The show was followed several years later with other exhibitions that challenged the visitor to experiment, compare and contrast, *How Real is Realism?* and *From Nature to Art*, in which she explored the debate between naturalism and abstraction in art – a highly charged issue in the 40s and 50s. Kuh was exceptional for the time in her concern for the non-specialist visitor, and she eliminated technical language as much as she could from her labels. 'Those in the "know" glibly discuss dynamic symmetry, spatial relations, plastic values, and architectonics, but to the average museum visitor, these are enigmatic technicalities.' The secret language of the art specialist is apt to antagonise the questioning layman. 'His ego is wounded and he retires, armed with deadly and familiar clichés: "My little boy Johnny could do better than that".' Her prime concern was to explain art visually – that is to say, in its own terms, and found that by creating a particular kind of label, one that asked the visitor to question, she could engage the visitor far better than had she provided the 'answers'.

*Label: from Still Lifes come to Life/Chicago Art Institute 1945*

*Note how these objects are consciously arranged.*

*They are unified by using one color – brown.*

*Diagram shows how light areas are opposed to dark in this painting.*

*Copy of painting with other objects shows that arrangement is more important than subject.*

*By introducing one strong color balance is lost.*

*By eliminating any part – like the mushroom – the entire composition is greatly weakened.*
Her concern for interpretation (although she herself hated the word, as she felt it sounded too condescending) was equally manifested in the architecture of the entire exhibition space. Her exhibitions were designed to heighten curiosity and create a sense of surprise – ‘asymmetrical installations were followed by rest spaces, objects placed above or below eye level, and materials arranged in units instead of sequentially. Most intriguing was the use of non-art materials in order to relate art to other aspects of life. Driftwood from Lake Michigan and crudely fashioned ceramic toys were just as effective in demystifying high art in these exhibitions as technological devices such as color charts, X-rays of paintings or stereopticon.’

Kuh tried to keep the texts of her labels to a minimum, and would deliberately keep the language simple, the words short, and use the words ‘seeing’ and ‘looking’. In her zeal for lean texts she would often eliminate words, giving the label texts a telegraphic urgency. What was important was to look, and to see. Kuh placed a large emphasis on comparisons, often putting an original work and an altered replica side by side, the label asking the viewer to evaluate the difference between the two – in Kuh’s Gallery of Art Interpretation, the user-language of variables was an indispensible tool for the understanding of fine art.

Already at a very early moment the user-language of variables was developed as an extension of the user-language of observation in the practice of science. It was quickly assimilated in museums of all kinds. However, while conferring the property of control to the visitor, it is not sufficient to make her more than a manipulator of relatively small variations, as the range of her ability to generate variety herself, and hence her field of action, remain highly constrained.

3.2 Labels and their languages: part 2 – supporting users

When it comes to research into museum labels, there are limits to what can be learned from examining the work of others, for several key reasons. Just looking at existing labels poses several difficulties. First, there is no guarantee that all the relevant information about the label, the institution that created it, and the conditions of its creation is available. Second, the full intent of the museum cannot be adduced solely from the label, especially if the label is taken from exhibitions or settings from another time or another culture. Finally, an experimental framework cannot be created, however provisionally, unless changes can be made and their effect measured, either quantitatively or qualitatively. Due to these contingencies, serious research into labelling has been rare and difficult to conduct. In order to do
In-depth research into labelling and the effectiveness of labels in supporting interaction, it is necessary to actually make labels, which is to say, to create exhibitions, and ultimately, to create museums. This is a luxury denied to most researchers. However, if such an experimental framework cannot be created, the research programme is seriously impaired.

In the following examples, these drawbacks were overcome by making exhibitions — and by making the exhibition itself a tool for research into the effectiveness of the label. Each of the following exhibitions was developed by the author and his colleagues in response to the perceived failures of earlier exhibitions, and served as a means of testing the theory developed in these pages. These exhibitions were developed while many of the ideas in this study were still maturing, and many of the terms used in the study — notably user-language — were not explicitly part of the discussions that shaped the exhibitions. However, it became clearer with time (documented in the papers the author and his colleague Drew Ann Wake presented at international conferences between 1990 and 1994) that there was an increasingly explicit recognition of the effectiveness of specific user-languages in conferring actorship — and on specific strategies for increasing the likelihood of visitor acceptance.

3.2.1 Problems

The user-language of problems, while it often subsumes the user-languages of textual authority, observation, and variables, is not merely an extension of them. In the user-language of problems, the 'currency' is not authority, nor is it observations or ordered observations, it is problems — some observation or observable state of affairs the user wants achieved. In the case of labels that employ the user-language of problem, the problem space may be indicated from the outset, even by others — a puzzle, a riddle, a challenge — but in all cases, the problem and its relevance must be sufficient, and be internalised by the user, who then makes it her problem. This internalisation of the problem, that is of an action horizon which may be, and often is, determined by others (but is preferably self-determined, as in some of the examples), signals a key difference between the user-language of problems and preceding user-languages — labels developed using this language confer on the user a discretionary power over alternative solutions or actions, that is the property of agency.
In 1989 the author, his partner Drew Ann Wake, and the consultants Coopers & Lybrand undertook a survey of over one thousand households in the Canadian province of Alberta to find out Albertans' attitudes towards science and technology. This survey was undertaken as one of the means of identifying strategies to accomplish the two goals of the Science Alberta Foundation: to raise the level of scientific and technological culture in Alberta, and to encourage young Albertans to consider careers in science and technology. Following the results of this survey, and the desire on the part of the Science Alberta Foundation to encourage women and girls to become interested in science and technology, the target audience for the exhibition *Beyond the Naked Eye* was women. The survey material had indicated that women had a very high interest in medicine, but often professed no interest in science. The goal, therefore, was to encourage women and girls to take a greater interest, and participate in, science and technology as traditionally defined.

The exhibition *Beyond The Naked Eye: The Inside Story of The Human Body* explored the field of radiology. The exhibition's planner, Drew Ann Wake, in conjunction with the author and the Calgary architect Gordon Filewych, wanted to create an approach that conformed to the contours of the actual science as it is currently practised, and not be merely a translation or popularisation of a scientific subject. Accordingly, she contacted all of the major hospitals of the province and asked them to work with the Science Alberta on the exhibition. The radiologists were thrilled that someone was going to take a serious look at their discipline, and by the time the exhibition opened, it had incorporated exhibits developed by twelve hospitals and over one hundred individual medical doctors.

The key challenge for the exhibition planner was to find a way that members of the general public could learn to read medical images. Modern radiology has at its disposal a range of tools of varying precision. Since the invention of x-rays, no fewer than four new technologies have been developed that allow doctors to see within the human body: X-rays, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Nuclear Medicine, in addition to microscopy.

However there is an inherent imprecision in these technologies. No matter how clear the actual image, the interpretation lies ultimately in the ability to decipher the meaning of a mixture of unresolved shapes and shadows. The language of observation demands clear 'seeing', and the images generated by the new technologies are often unclear or ambiguous, similar to the imprecise contours of the planets revealed to Galileo when he first pointed his Dutch telescope towards
the heavens. There are two specific areas where this imprecision may present itself. On the one hand, the images may fail to show critical detail. On the other hand the image may give so much information that the interpretations conflict. The exhibition therefore had to teach visitors not to make immediate assumptions based on the images, but to weigh and balance a variety of hypotheses before making a diagnosis.

As she entered the exhibition, the visitor was encouraged to pick up a clipboard, put on a lab coat, and watch a short video prior to learning about the medical technologies arranged on the central tables. The exhibition was divided into five sections, representing five medical technologies: X-rays, computed tomography (CT), magnetic resonance (MRI), nuclear medicine and microscopy. Each area was composed of two parts, a central area where visitors learned the skills of understanding the images, and an outer ring where visitors were challenged to solve case studies based on real people's experience. To explain advanced medical technologies to a lay audience the exhibition used analogies, and the entire exhibition employed the user-language of problems – each case study posing a challenge to the visitor, to internalise a medical problem and search for a diagnosis that is relevant to herself.

For example, the concept of Computed Tomography was explored by letting visitors compare a model of the brain with a series of medical images of a patient with a brain tumour. Three simple challenges of increasing difficulty outlined the advantages and limitations of this particular kind of scans. Each visitor was given an apple or a potato with a small spot of dye hidden in it. The challenge was to find the location, size and shape of the spot of dye by making a maximum of three horizontal cuts in the apple. This was analogous to the work of a medical specialist who has to integrate a series of CT images into a three-dimensional understanding of the patient's anatomy – each scan a horizontal slice through the patient's body. The exhibition labels use familiar language to make the visitor feel at ease with the subject matter.

#3 Be a Brain Surgeon!

You've always thought you'd make a great brain surgeon. Cool hand. Quick mind. Patience of a saint. Well, now is your chance to try your hand at it.

a. If doctors suspect a tumour within the brain, they will use CT scans to help find out where it is located and how big it is. But, they will also want to make as few scans
as possible. Take an apple (or a potato) out of the jar and put it on the cutting board. Imagine it is a brain. Your challenge is to find a 'tumour' hidden inside.

b. Now is your chance to practise brain surgery! Each of the apples (or potatoes) has been injected with dye in one spot, like a tumour inside the brain. Use what you have learned about CT images to find the location and size of the dye spot. But, you can only make three horizontal cuts in the apple.

**Brain teaser #3:**

Would it be easier to find the spot if you could cut vertically as well as horizontally?

Having learned the basic principles of CT scans the visitor could then try to solve up to sixteen case studies arranged in folders on the tables in the exhibition. Each folder contained a case history and a series of medical images taken from actual subjects, for instance, how CT scans can help identify brain haemorrhages. The material in the case studies was also written in the first person, making a direct appeal to the reader to examine the images and solve the case.

The designers were aware, having prototyped the exhibition to coincide with the opening of *The Body in the Library* (described below), that visitors were immediately drawn to the case studies. In fact, the exhibition had first been formulated on the assumption that its subject matter would be the 'art' of medical images, based on data that showed that women, and in fact most visitors, were more attracted to art than to science. When the exhibition was shown organised according to the model of an art exhibition, using the beauty of medical images as a starting point, it was quickly obvious that women, rather than being attracted to the 'artistic' qualities of the medical image, which in the case of computer-generated images is very high, would first ask of any troubling image 'did the patient survive?'. It became quickly clear that the interest in medical images lay not in their intrinsic merits as images, but in the immediate engagement they provoked on account of their humanity – when viewing a broken neck or a brain tumour, we respond first as human beings, then as art critics.

As a consequence, although beautiful medical images were still included in the exhibition, the focus of the exhibition was redirected towards disease and illness, rather than art, and this focus remained central throughout the rest of the exhibition prototyping process. Moreover, as the key link to the material seemed to be the
emotional and affective charge communicated by the desire to know the outcome of the case studies, the exhibition had to take into account the desire on the part of the visitors to engage directly with the case studies, without first learning the science that would allow them to unlock the secrets of the images.

This was achieved, albeit only in part, by making the case studies challenging – the visitor who had not at least partially mastered the science of an imaging technology was frustrated in her ability to diagnose a case study. While in certain respects this meant that over-eager visitors risked ‘failing’ the case studies, it provided a non-coercive feedback mechanism to ensure that visitors learned the material in the central tables prior to engaging with the case studies. Attentive visitors soon learned that the better they had mastered the scientific bases of the medical imaging technology, the better their performance, and hence the greater their satisfaction, with diagnosing the case studies. However, Science Alberta staff running the exhibition noted that of all the problems associated with the exhibition, the most significant was the fact that visitors were so drawn to the case studies that they often did not first learn the underlying principles, and that the spatial disposition and overall design of the exhibition was not sufficient to ensure that visitors first understood the science before attempting to tackle the case studies. The designers never completely solved the problem of having visitors working on case studies before they fully understood the imaging technologies, and the exhibition architecture did not play an active role in directing visitors first to the centre tables, then to the case study tables. The floorplan allowed, and to some extent encouraged, freeflow circulation, which was at odds with the ‘one-two’ nature of the exhibition’s overall conceptual organisation.

Several factors influenced the ways in which the exhibition functioned.

First of all, the exhibition and its labels explicitly recognised the presence of the visitor and the interest the visitor has in the workings of the human body. The interest on the part of the visitor in the outcome of another human being’s health guaranteed an immediate engagement with the subject matter. This tends to confirm the findings of educators such as Donaldson** that context plays a major role in the willingness to engage with scientific material and engage in science learning. A visitor learns if she perceives a sufficient reason to learn. In this case starting with the known interests of the visitor provides sufficient reasons to engage with the material. In the case of *Beyond the Naked Eye*, the immediate empathy felt by the visitor provided sufficient reason to engage with the material. Moreover, it has been...
repeatedly shown that the general public shows a particularly high degree of interest in medicine and human health. Beyond the Naked Eye not only addresses normal human fears and curiosity about the workings of the body, but allows visitors to understand and come to grips with the fact of their own illnesses and those of their family and friends. As one of the exhibition staff reported 'Many of the questions I had to field were related to transplant operations ... Most often these questions came from the family of a patient who was waiting to undergo an operation. In short, by choosing a subject matter of compelling, though individually different, interest to a large number of visitors, they were prepared to engage with the exhibition's difficult material – the properties of acceptance and of engagement were conferred by the visitor to the label.

Second, the exhibition consciously used the user-language of problems. Rather than insisting that the visitor first understand the science behind the medical imaging technologies, she was able to engage with any of the elements of the exhibition as she wished. By casting the exhibition in terms of medical problems, the visitor was prepared to undertake complex scientific and medical interpretative challenges, which might otherwise have been considered too difficult or too abstract. However, in order to understand the images required the viewer to understand the science, or at least the basic principles of the science, underlying the technology. Thus it was desired that each visitor be prepared in terms of general competences. Each had to first visit the tables that acquainted them with the science, before going on to the exhibit areas that contained the case studies and challenges. This was accomplished (with some success, as noted above) by making an understanding of the technology a condition of solving the problem. Therefore, if a visitor had not visited the table introducing the basics of the technology, it was unlikely that they could make any but the simplest diagnosis. To get the most out of the case studies, some of which were quite difficult, the visitor soon found out that she should do the introductory challenges first. However, the attraction of the case studies was so strong that many visitors rushed to the medical images without first stopping at the introductory tables, and as a consequence, the case studies were less rewarding. Nevertheless, by using the visitor's desire to make a correct diagnosis and solve the medical problem, the exhibition made learning the technology a consequence of the problem-solving activity, rather than its sole reward.

What were the consequences of having designed an exhibition that made medical skills available to ordinary visitors?
First, as Drew Ann Wake writes ‘preliminary evaluation of the exhibition seemed to indicate that the public was able to assimilate and use the new information presented. It was found that children as young as eight were able to solve the problem of reading CAT scans quite effectively. In fact, they became so skilled at understanding the medical images that they could put a series of eight cross-sections of the body, in the correct order, from brain to belly button.’ In addition, the political goals set by the client, the Science Alberta Foundation, appear to have been met. The exhibition began its tour of the hospitals of Alberta in May of 1992. The designers were pleased to find that it drew large numbers of women, and most importantly, women with their young daughters. On many occasions these visitors stayed for several hours, with the girls completing every one of the exhibits.

Second, having rejected the science centre as the prime venue for the exhibition, the designers of Beyond the Naked Eye found that the audience attracted within the hospital setting was very different from that of a museum or science centre. The exhibition was visited by hundreds of hospital patients: people suffering from illnesses ranging from a broken arm to a brain tumour. It also attracted family members who were distressed about their loved one’s illness and anxious to understand it better. The exhibition served as a support system, not only increasing the user’s ability to deal with medical information, but to cope with the facts of illness – even as defined in the context of her family or of herself. The guest book was full of comments about how greatly they appreciated the opportunity to learn about the newly developed instruments of science that help doctors diagnose, understand and treat illness.

This exhibition, like The Body in the Library (discussed below), by the same planner, Drew Ann Wake, and the author, was based on a belief that, given the proper context, and recognition of the user’s needs and existing competences, a visitor is capable of undertaking, appreciating and exploiting processes and modes of reasoning normally associated with scientific investigation. In the case of The Body in the Library, visitors showed themselves able to reason from minimal and sometimes misleading evidence, in Beyond the Naked Eye, visitors were able to understand, interpret and propose diagnoses from ambiguous and uncertain images, a competence normally associated only with trained physicians and radiologists. In fact, a preliminary evaluation of the exhibition showed that some visitors had sufficiently mastered the interpretation of medical images well enough to rival the diagnoses of first and second-year medical students. This can be interpreted as signifying that the exhibition had indeed succeeded in achieving being a support
system, and in being supported by the interests of the visitors. Moreover, it helped to create and sustain the ‘flow’ experience (discussed more fully in chapter 2).

As described above, in 1989 the author, his partner Drew Ann Wake, and the consultants Coopers & Lybrand undertook a survey of over one thousand households in the Canadian province of Alberta to investigate public attitudes towards science and technology as one of the means of identifying strategies to accomplish the two goals of the Science Alberta Foundation: to raise the level of scientific and technological culture in Alberta, and to encourage young Albertans to consider careers in science and technology.

The first of the target audience groups selected was those who had shown themselves to be ‘nervous’ about science. How could their participation be stimulated? It was unlikely they were going to attend a science museum. Since about 80% of Albertans have cards to their local libraries, the Foundation decided to build a science exhibition that would tour the libraries of the province as a means of reaching audiences who would never take advantage of an exhibition if it were in a traditional science museum. 67

The second question was what kind of exhibition could be developed that would not scare non-scientists away. Drew Ann Wake undertook a brief analysis of the reading material that people were seeking, in conjunction with the provincial librarians. It was shown that the most popular form of literature was detective fiction – the murder mystery. In addition, educational research had already shown provisionally that non-scientists put a greater premium on the context of learning than scientists, for whom a scientific problem was sufficient motivation in itself. 68 As a consequence, the Foundation decided to create an exhibition that took as its starting point the competences already developed by readers of murder mysteries. It was called The Body In The Library: Forensic Science and the Art of the Murder Mystery. The exhibition was intended to be rigorously scientific, and in order to vouchsafe the scientific aspects of the exhibition a number of highly-placed specialists in the field participated in its development. The Royal Canadian Mounted Police put their Forensic lab at the design team’s disposal, the Calgary Police prepared fingerprint materials, and the Chief Medical Examiner of Alberta was a source of constant advice.

67 This description taken in part from Wake, D. A.
and Bradburne, J. Priming the Pump: Building a Science Network in Alberta, unpublished paper.
Paris: Palais de la Découverte, 1993

68 In particular we looked to the work of Sheila Tobias
The exhibition was realised in 1989 by Drew Ann Wake and the author, working for the Science Alberta Foundation in Calgary, Canada. The design looked like a set of oversized book covers on the outside (to fit in with the libraries it visited), and was modelled on the form and organisation of a forensic laboratory on the inside (to reflect the real practice of forensic science). In the centre of the exhibition was the body of a young woman – the victim, Ruby Keene. Around the periphery were seven laboratory tables, each representing a different scientific discipline within the practice of forensic science. In this setting, Drew Ann Wake developed a public programme called S.O.S., or Save Our School, designed as a game for an elementary school audience and for family groups. On entering the exhibition, visitors were told that a crime wave had hit the fictitious Granite School. Their challenge would be to study the evidence on one of the tables – Toolmarks, Fingerprints, Blood and Fluids, Ballistics, Hair and Fibres (the organisation of real forensic science laboratories in Canada) – and to reach a conclusion before moving on to the next lab. Visitors could start at any table, and would generally move to the next challenge when its users had completed their investigation. The object of the programme, and of the exhibition, was to assemble enough evidence to identify the wrongdoer who had been perpetrating the crimes at Granite High School.

One of the unique features of the programme was that the material on each of the tables might have more than one correct answer, like real forensic work. For example, in the Toxicology lab the visitors were told that the criminals had vandalised the science classroom, and as a result the science teacher had been bitten by one of three escaped creatures: a rattlesnake, a black widow spider or a bee. Each of the tables had a variety of research material available: real samples, working microscopes, chemical tests and extensive written material that invited the visitor to read and investigate in order to arrive at a conclusion. Using the research materials provided on the table, it was possible for the visitor to put together a convincing argument for either the spider or the snake.

A sample of this text material shows how the material was presented in cartoon form:

Text for Logo:S.O.S.

Text for Title:The Case of the Victim Of Venom

Box # 1. It is a day like any other at Granite Public School, until …

Box # 2. Jake and Annie walk into science class …

Box # 3. Chaos!!!
Bubble: The snakes! The spiders!! The bees!!!

Bubble: They've escaped!!

Box # 4. Then, from the back of the room...

Bubble: Oooohhhhh!

Box # 5. It's the science teacher...sweating, delirious with pain...

Bubble: He's been bitten! We have to help him!

Box # 6. Was it a snake? A black widow spider? A swarm of bees?

Text across the bottom of the page: Will Jake and Annie find the answer ... in time to save the teacher's life????

CLUES: The Challenge: The teacher's life can be saved if doctors can inject him with an anti-venom that will take away the effect of the poison. In order to know what kind of anti-venom to use, Jake and Annie must first find out which of the animals has bitten him: the rattlesnake, the black widow spider, or a swarm of bees. Two clues, and the research notes in this kit, will help them solve the mystery.

The clues encouraged the visitor to take a close look at the evidence, and supplied them with information that would help them come to a conclusion. The nature of the clues can be seen in the examples below:

Clue #1: Bites and Stings

Take a close look at the three specimens included in the science kit. There is a rattlesnake skull, a black widow spider, and a bumble bee. Each of them leaves a very different mark on its victim.

The rattlesnake has fangs that are attached to the skull at a fixed angle. When the snake bites, its two fangs bite down on the victim and the sacs on each side of the jaw squeeze the venom through the fang into the wound. In this rattlesnake jaw, one of the fangs has broken, so you can see the hollow passage through which the venom is injected.

A black widow spider also has fangs. Spider fangs, however, pivot sideways to grasp and hold their prey. At the end of each fang is a tiny hole which is connected to the poison sacs. When the spider bites, the poison glands squeeze the venom down the fang into the bite.

A bee stings with a single hollow prong that extends from its abdomen. If you look carefully at the specimen of bumble bee, you can see a drop of venom at the very tip of the stinger. The bumble bee has a smooth stinger, so that it can sting its victim several times.

Which one of these three animals could not have bitten the teacher?
To find the answer, first study the illustration of the teacher's wound. Then, read the research notes that accompany this kit.

Clue #2: Venom

Scientists who study toxins divide venoms into two groups.

Hemo-toxins (hemo means blood in Greek) enter the blood stream. They weaken the walls of the veins and arteries, causing the body to bleed inside. Often, the part of the body that was attacked will swell up so that it is two or three times its normal size.

Neuro-toxins (neuro means nerve in Greek) attack the nervous system, preventing messages from the brain from reaching other parts of the body. The victim often suffers intense pain and begins to vomit. [...] Now that you have studied the scientific evidence, what is your inference?

Which of these three animals was responsible for the bite on the teacher's leg?

Finally, the exhibit table included extensive research notes, compiled from available studies such as *Spiders of the World**, in the case of the Black Widow Spider, which was one of three research notes in this particular exhibit.

At the end of the exhibition, when the audience had visited all seven tables, they were asked to consider three questions: 1. What is the name of the person responsible for the crime? 2. Can you give a physical description of the criminal. 3. If you wanted to question the suspect at his place of business, where would you look for him?

The mystery was organised so that visitors would require different levels of information to answer the three questions. The first question – the criminal's name – could be answered on the basis of evidence from the Fingerprints lab alone. The second question could be answered by drawing on evidence from several labs – the more evidence that was collected, the better the physical description of the criminal would be. The third question, about the suspect's place of business, could not be answered by direct reference to any of the material in the labs. Two pieces of evidence spoke indirectly to the question. This was an attempt to mimic the often contingent evidence from a normal break and entry. The connection was not obvious, and offered many possibilities for the formulation of personal problems.

How well did the public do in answering the three questions that summed up the exhibition? After visiting the Fingerprints lab, almost all of the visitors knew the thief's name. This provided almost everyone with an incentive to continue. After
visiting all seven labs, most visitors could provide a more or less detailed description of the criminal. Adult visitors tended to focus on physical features while the children were equally observant of what might be called the cultural attributes, such as his T-shirt, and a ring emblazoned with a skull and crossbones. The third challenge, identifying the thief's day job, was extremely difficult, and took on an enormous importance for visitors. It was not uncommon for visitors to return three or four days in a row, until they managed to fit fifty or more clues into a pattern. Even with this amount of work, only about 10 of the 3000 visitors in the first weeks were able to attempt an answer that made sense of all the pieces of evidence – all of them were boys between the ages of 9 and 13.  

How did the audience respond to being given an exhibition in which they did the work – in which they solved the mystery? First, the public reacted with enthusiasm when the evidence in an individual lab was open to interpretation. It was found that families or groups of students debated long and enthusiastically. There was an inflexible rule in the exhibition that the staff would not provide answers, so visitors, who most often arrived in groups, or if alone, quickly 'teamed up' with others, had to reach a mutually satisfactory conclusion before moving on to the next station. At the end of each organised visit, each group was encouraged to stand up and explain the problems they had formulated for themselves as well as their conclusions.

What are some of the key features of this exhibition?

First, it started with the visitor, and was designed to test the following question. Could an exhibition reach people who do not ordinarily visit science centres, by starting with their interests, and their activities? Thus rather than developing an exhibition for the science centre and expecting people to come, it was developed for the public library, a familiar, appropriate, and often-used institution. Moreover, rather than developing an exhibition based on explaining the principles and practices of science as science, the skills of forensic science were learned as a consequence of an activity deemed interesting in itself – solving a murder mystery.

Second, it assumed the visitor was capable of solving complex problems. Could the visitor bring existing skills to bear on a complex analytical problem, if it was placed in a familiar and relevant context? By making the assumption that the visitor was already familiar with and interested in murder mysteries (and was used to internalise these as problems and to solve them), the exhibition was designed to require those skills as the principal means of generating scientific investigation.
Third, it wanted to show science as it was practised. Could an exhibition capture the contingent aspects of scientific practice, and not deceive or disappoint the visitor? Scientific enquiry is often open-ended, imprecise, and inconclusive, and the exhibition recognised the constructed aspect of science by creating the possibility to argue for several ‘correct’ outcomes. The importance of the difference between evidence and proof, central to science, forensic science and jurisprudence, was communicated in a way that engaged the visitor in the very real process of investigation, reasoning and debate.

How were these concerns expressed in the exhibition’s labelling?

First, by using popular culture. The most obvious sign of the exhibition’s popular bias was the overscale bookcovers that served as the exterior enclosure of the exhibition. The design of the exhibition’s interpretative material exploited popular forms of communication – the murder mystery, the book, the cartoon – and cast the experience in the form of a complex intellectual puzzle. In appropriating forms that appealed to user’s existing interests, in spite of the purely scientific and technical competences demanded by the exhibition’s challenges, the labels put the user at ease, recognised their existing abilities, and in a non-trivial way helped them to be able to perform the tasks the exhibition demanded of them. Evaluations done of the exhibition during its tour of Alberta’s public libraries confirm the fact that visitors stayed as long as it was necessary to complete the seven tables, returned when necessary, and generally indicated that they were prepared to become engaged by the exhibition’s scientific material.  

In designing the programme and its support material as a complex problem to solve, the exhibition challenged the traditional ways in which interactive exhibitions are organised. In a traditional hands-on science centre, either the exhibits are stand-alone, discrete experiences, each of them self-contained and isolated or the exhibits are grouped, often somewhat arbitrarily by a given theme – light, matter and energy, waves, etc. In the case of The Body in the Library, the user-language of problems (combined with the indispensable clipboard on which conclusions were recorded) allowed a non-arbitrary grouping of material, which nonetheless allowed a cumulative, non-linear exploration of the material. The structure of the problem framed the behaviour of the visitor in overall, goal-oriented terms, without constraining the ways in which they internalised problems and arrived at the goal. Moreover, unlike traditional exhibition organisations, wherein the visitor often gets bored and opts out, seeking more exciting exhibits (the notorious ‘pinball effect’ where visitors
bounce from one exhibit to the next), once the visitor has engaged with the exhibit, she rarely leaves it without coming to a provisional conclusion, and often returns several times in order to solve the problem. The exhibit thus supports the visitor to create an enduring action space, and exercise her skills in it, thereby supporting the function of the exhibit. In this way, the engaged behaviour that normally characterises puzzle table and puzzle exhibits, which hold visitors up to ten times longer than traditional hands-on exhibits\(^\text{46}\), is built into an exhibition of forensic science.

The user-language of problems can thus be said to help elicit visitor behaviour normally not found in the museum or science centre, by providing the visitor with an opportunity to develop a personal goal, thereby conferring the property on the visitor of actorship, and by encouraging the visitor to confer the properties of acceptance and engagement on the exhibition. As noted above, 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. The report on the first twelve months of the exhibition’s tour records the following anecdote told by a staff volunteer: ‘One evening a mother and her two pre-teenage children came to *The Body in the Library*. They took a lively interest in the programme, and debated the results of each of the experiments. They stayed until closing, finishing three of the tables. The next afternoon at 4:30, the son was back. He stayed an hour and completed two more tables. The next afternoon he was back again, this time with a friend. They stayed another hour, completed the final exhibits and then made their guess about the culprit. As they were heading out into the snow and cold, I asked them how long they would spend on the bus getting home. ‘Oh’ they replied, ‘we rode down on our bikes. It’s about 45 minutes each way.’\(^\text{66}\) This behaviour is often not displayed in the ‘traditional’ science centre or museum\(^\text{67}\), and can be taken as an indication of the comparative success of the exhibition’s approach to its subject, its public and its labelling.

Second, by being open to change. The material developed for the exhibit tables themselves was designed to be changed, on a daily basis if necessary, during the first months of the exhibition, according to the comments of visitors and staff using the exhibition. The introductory panels were made to be easily changed, the research files could be readily supplemented, and the exhibits themselves were simply constructed and easy to modify. At the level of the exhibition elements, volunteers
and staff were able to closely examine the kinds of problems visitors were having with the text material, and change it readily. Treating the exhibition as a perpetual prototype, and building this flexibility into the design also had important effects, as it allowed librarian-users to change the material in response to the specific demands of their situation. It also allowed the exhibition to remain open to change, thereby enhancing its stability as a support system.

On a more general programming level, the exhibition's deliberately built-in flexibility allowed organisers to respond to visitor variety. For instance, three programmes were developed for the exhibition: S.O.S. (described above) for schoolchildren Alibi, for teenage high school students, and a programme for adults. To some extent the design of these programmes thus were based on a model of each of the three target user groups. Each model was *a posteriori*, however, and not *a priori* as implicit in for example, the user-language of textual authority. Thus, during the first weeks of the exhibition, it was found that the programme designed for an adult audience did not work as well as had been anticipated. On the other hand, the S.O.S. programme, first designed for younger users, proved to be enormously popular among users of all ages, and its challenges, far from being trivial, were taken seriously by children and adults alike, and was soon described as a 'family' programme. Moreover, the S.O.S. programme worked well in both structured and unstructured situations.  

The Alibi programme, which demanded that the visitor discover the identity of a murderer by sifting through forensic evidence, attracted a great deal of attention from the schools, who booked the exhibition almost completely during the day, and from walk-in visitors, who would often spend several hours working on the problem before returning the next day with their written answer.

The degree to which the exhibition was designed to respond almost immediately to the needs and preferences of the users was a measure of its recognition of their importance and existing competence, while the constraints imposed by the labelling of the exhibition itself: in terms of subject matter, process, and intent, served to define a user-language of problems in which the visitor's actorship was conferred, recognised, enhanced, and confirmed.

Finally, by encouraging people to create their own activities after their experience of the exhibition. From the outset the exhibition had an explicitly activist goal—it served as a means of galvanising community activities: librarians used the exhibition to introduce their users to new material, teachers used the educational programmes developed to accompany the exhibition. The library staff were very
enthusiastic and particularly ambitious and innovative in their promotion of the exhibition. In addition to facilitating the SOS and Alibi programmes, they planned and organised four additional programs. The first adult programme, 'Clues to Writing Mysteries' was led by a local author, Adelaide Schartneer, who shared her writing experiences and explained the essentials of a good mystery and how to research and write in that genre. ‘Murder Stalks the Stacks’ featured the forensic unit of the local RCMP. The scene of the crime from Alibi was re-enacted and the audience was shown what the police do in their forensic study of the murder crime scene.

‘You, the Jury’ was the final adult programme. Several members of the local Bar Association explained the roles and procedures of a court room, followed by the trial of a suspect from the Alibi programme. The audience was asked to vote on the guilt or innocence of the suspect. ‘Mystery Theatre’ was a children’s programme featuring mystery story theatre and mystery films. These activities supplemented the exhibition’s programmes, and taught the importance of debate and the contingency of science, and through these activities the entire community often joined to try to solve the challenges of the exhibition (and support it as a support system).  

As can be seen from the above two examples, the user-language of problems, and labels developed using that user-language, was able to confer on users an important and desirable property – actorship (and allow the visitor to maintain actorship in using the labels). In the two examples described in detail above, it can be seen that the labels identified, legitimised, and unlocked the agency of the user – the user became involved, initiated activities, directed those activities independently (often seeking out new resources), and sustained those activities, in some cases (such as the boys who returned to The Body in the Library) over often protracted periods of time and in the face of considerable hardship. Unlike the user-languages described earlier, labels that employ the user-language of problems recognise the agency of the user, and support them in being actors. It is also clear by contextualising the material in terms of the user’s existing interests, and using elements drawn from popular culture that the user was prepared to accept the labels and be ‘taken in’ by the challenges they posed.

3.2.2 Games

As implemented by a label, the user-language of problems confers the property of agency to the user, a highly desirable outcome. What more can we expect from an effective label? In the user-language of problems, the agency remains isolated,
individual, located in the user who has internalised the problem as her problem (even when part of a group or family visit). The user-language of games takes advantage of the user-language of problems and the agency it confers, but creates an additional property – other players. Labels that employ the user-language of games displace, for the first time in the museum setting, the emphasis from the content of the experience to the experience itself – the relationship with the variety that others can bring into the space of the museum. Other actors are always able to introduce more variety than that which can be found in nature (even though the latter appears inexhaustible) – as they appear to be able to ‘step out’ of any variety-limiting framework. 76

It is important to note that puzzles, games, and simulations, while they each confer the property of other players (either real players, in the case of a game like football, or virtual players, as in many computer games), are different, and cannot be lumped together in every respect.

PUZZLES. A puzzle, whether a simple jigsaw or a complex topological challenge, has a defined outcome, and once solved, provides few further rewards (few puzzles are solved a second or third time once the secret is known, and puzzles such as Rubik’s cube depend on their repeat play on the fact that success is often circumstantial, and not linked to the intellectual solution). If the puzzle is sufficiently challenging, or if random elements are introduced that prevent the outcome from being readily repeated, puzzles can be profitably re-played again and again. However, as they are in some key respects ‘closed’, they cannot respond to changes in the player’s skill, and become less and less challenging as the player’s skill increases. A quiz, which relies on content challenges, rather than process challenges, is more vulnerable to exhaustion as the player’s skill increases, nevertheless, the popularity of quiz-like games such as ‘Trivial Pursuit’ show that, with a sufficiently challenging range of content or knowledge-based questions, repeat play can be sustained. In puzzles and quizzes, the other player is largely implied – it is the person who constructed the challenge in the first place, the unseen player who is ‘beaten’ when the puzzle is solved.

GAMES. A game structures play and provides users with the space to identify personal goals and closure rules. Most importantly, a game provides a measure of improvement, and is both open to and structures the infinite variation on behalf of the players, who voluntarily sustain the play. In most games, such as football, hockey, tennis, cricket, called finite games by Carse, there must be a way to win. In other games, far fewer in number (but not rare), such as tag, the goals is not to win, but to sustain play. These

76 See Carse, R.
games Carse calls infinite games. In a finite game the rules must stay fixed by conventional and inviolable by the players in order that closure is achieved. In an infinite game, the rules can be plastic in order that the players can sustain play as long as they desire.

SIMULATIONS. Simulations provide the user with an external set of demands, often associated with real situations. A flight simulator is a good example, so is SimCity, so is the Tamagotchi, a virtual pet. The engagement is sustained as long as the demands are seen to be relevant, internalised as authentic. Engagement relies on the continuous feedback, and the escalation of the level of difficulty as a consequence of sustained play. The other player conferred by the simulation is the environment which responds to the actions of the human player or players. Simulation fails when the authenticity of the demand cannot be sustained, often as a consequence of the inability to provide an increasing level of difficulty, or a sufficient narrative context. The simulated plane crashes, the city runs out of parkland, the Tamagotchi dies – the player goes to dinner. Although provided with a ‘goal’ – keep the plane in the air, keep the city growing, keep the Tamagotchi alive – lacking finite closure rules, a simulation sometimes functions like an infinite game – it lasts as long as the player wishes to keep playing.

In the autumn of 1992, Drew Ann Wake and the author were asked to consider designing a new permanent exhibition, provisionally entitled The Living Planet at Science World in Vancouver, Canada. The project was originally intended to treat the future of science and technology in the province of British Columbia. Following a proposal made by Drew Ann Wake in consultation with the author, an exhibition strategy was developed to look at the resource industries of the province – fishing, forestry, and mining.

Mining is the most important industry in the Western Canadian province of British Columbia, and in recent years the issues surrounding land use have been sources of intense conflict between industry, the environmental movement, government and native peoples. Science museums and science centres, however, are normally reticent to play an active role in the debates that surround the uses of science and technology, often contend that science is a neutral activity, and that the role of the science centre is solely to teach visitors the ‘facts’ about science. This attitude has been challenged by several writers in recent years and by the author and his partner, whose work in Alberta (described above) challenged the assumption that science centres should remain aloof to the real concerns of its visitors.
After lengthy discussion, and in part as a consequence of substantial mining industry support for the project, Science World chose the earth sciences as the theme for the first exhibition, on the assumption that the earth sciences were fundamental to understanding the importance of mining in British Columbia. At the same time, several recent studies conducted by the author and others had already established that public interest in the earth sciences was particularly low and that the public's interest in the earth sciences was only piqued by an interest in natural catastrophes such as volcanoes and earthquakes, and then rarely.

In terms of approach, there were two clear alternatives to treating 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 desiring to put the earth sciences 'in context', we would link geological themes to the 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 the traditional path: separating scientific fact from social issues. We would treat the earth sciences as unsullied by concerns about survival.

The alternative was clearly more challenging. Thus instead of an exhibition on the earth sciences, the designers, Drew Ann Wake and the author, proposed to look at how the geological sciences are constructed in a political and economic context: in short, an exhibition on mining. The exhibition, eventually to be entitled Mine Games, would deal with the issues surrounding the mining industry in the province of British Columbia, issues that had been increasingly the subject of heated debate in the press, on television, in parliament, and in the streets. Based on the conviction that visitors are better prepared to engage with science learning tasks when there is sufficient context and motivation to do so (a belief supported by earlier exhibitions such as The Body in the Library and Beyond the Naked Eye, described above) the designers re-focused the exhibition, not on geophysics, despite the putative advantages of exploiting the public's interest in volcanoes and earthquakes, but on the social issues that surround resource exploitation in the province of British Columbia.

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, it was possible to 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. In a fundamental sense, an exhibition on mining, in a province where the mining industry played a major role in the economy, and where the public was demonstrably interested in the future of the province, provided the opportunity to try to create a new kind of exhibition – using new approaches, setting new goals, implementing new languages – and testing the latter to identify which might serve as user-languages.

The exhibition *Mine Games* was thus a means to further test the assumption that visitors are better prepared to learn when the science is placed in a context that is personally important to them, an assumption we already felt confident in following our work in Alberta. Moreover, it gave the author another opportunity to explore the deliberate manipulation of user-languages as a means of shaping visitor interaction. As in the exhibitions described earlier, the notion of user-languages was rarely used explicitly in discussions within the design team, nevertheless, as will be clear from the description of the exhibition, the author employed the theory developed in this study in guiding the implementation of the *Mine Games* exhibition. Specifically this took the form of two guiding principles: a context that mattered, and an exhibition strategy based on games.

Initially, we considered using a real British Columbia example as a means of creating the context for the debate around mining. It soon became clear that by using a real example, we risked having visitors whose minds were made up, reducing their ability to consider the issue from many points of view. So instead we decided to link the exhibition, from beginning to end, by the fictitious town in northern British Columbia – Grizzly, B.C.

According to the narrative, the people of Grizzly have gained their livelihood over the past half century by logging the surrounding forests. Suddenly, last summer, the traditional pattern of life changed dramatically. First, the provincial government announced that a wilderness park would be established on the outskirts of the community. This sounded the death knell for the local logging company, which had depended on an ever-more precarious supply of timber. Then, only months later, a large copper/gold ore body was discovered barely a kilometre from town. Over the last few months, the townspeople have looked on as the representatives of the mining company evaluate what may be one of the largest mineral deposits in the
world. Gossip rages in the restaurants and at the mall, as the residents of Grizzly debate what the future will hold. Should the town cast its lot with the mining company, and gain the jobs and security that a major mine will offer? Or should the town reject the mine and use its spectacular setting to promote wilderness recreation and tourism?

Clearly, there was a temptation to create an exhibition that asked for a clear, yes/no decision: should the mine in the Grizzly valley go forward or not? But early in the project we realised that the ‘no’ option would provide an easy escape for urban visitors who do not want to engage in discussing the issues. So we elected to create a more complex situation in which visitors are asked to put themselves in the shoes of the residents of Grizzly, and find compromises that will allow Grizzly to have a mine, while the integrity of the environment is maintained. In effect, visitors are charged with the key responsibility that faces all British Columbians today: to find a secure economic future that can coexist with the environment. What we did in the Mine Games exhibition, then, was create a cultural context in which the science and technology of the exhibition could be understood – a framework that would give drive and direction to the way our audience would contribute, both as individuals and as players.

From a design perspective, the exhibition was developed to look like the board games that all Canadian children have at home – chess or Monopoly. Imagine an exhibition hall that contains four gameboards blown up so that each contain a hundred square metres or more. From an intellectual perspective, each of the games is made up of several hands-on activities linked to a computer game. We deliberately made the activities difficult, so that it can take more than an hour to solve all of the clues. Moreover, the visitor must play all of the hands-on activities, solve all of the clues, in order to be able to play the computer game. The computer game begins with a quiz, designed as a job application, and unless you have mastered the information, you will not get the job.

The visitor begins the Mine Games exhibition by picking up a clipboard with ‘gameplans’ describing each of the exhibit areas. The visitor keeps track of the outcomes of hands-on challenges on the gameplan, and uses these answers while playing the computer games. Significantly, by making the gameplans an integral part of the exhibition experience, the visitor is free to explore the exhibition in whatever order she wants, marking the results on her gameplan as she completes the exhibits.
In this way the exhibits can sustain the narrative of Grizzly, their results cumulative, but the entire experience remains non-linear (its parts could be visited in any order).

How were the exhibition’s objectives expressed in the labels, and did the labels contribute to achieving them? The exhibition deliberately used the narrative of Grizzly to ensure a global context for visitor engagement, and structured their activity within the exhibition as a game in which they were responsible for helping to resolve the dilemma faced by the residents of Grizzly. The premises of the game were outlined with the first text encountered by the visitor.

Mine Games
Games That Challenge You To Decide The Future ...

Welcome to Grizzly, a town in turmoil! A year ago, Grizzly’s only industry shut down. Then, a huge ore deposit was discovered on the edge of town. Can the residents take advantage of the jobs. And preserve the wilderness, too? The decision is yours.

Rules of the Game: 1. Your Job. You have been hired as a mediator between the town and the mining company. Can you design a plan that will please both parties? 2. The Clues. This exhibition looks like a group of gameboards – and that’s what it is! Each game is made up of hands-on clues that will help you win a computer game. 3. Gameplan. Take a clipboard from the wall. For each game there is a plan that will help you keep track of your answers. 4. Your Hosts. Grizzly residents will be your hosts. Maxine, the Mayor. Bob, the President of NorthStar Mining. Lenny, the business guru. Share their excitement – and their fears.

In order to engage with the exhibition, it was essential that the visitor was familiar with the topography of the Grizzly valley. A large three-dimensional model showed the features of the valley, accompanied a text which served to give the visitor her first challenge, as a way of encouraging her to become familiar with the topography of the Grizzly valley. It ended with the challenge: Where would you hike to watch the sunset? The first game the visitor encounters is High Stakes!, and its label texts followed and elaborated the exhibition’s game strategy.

High Stakes! The game that challenges you to
Find Your Fortune ...
Grizzly is buzzing with gossip of gold!
Two of the world’s richest ore deposits lie beneath this lush, green valley.
It is your job to find them. Go for broke!

Rules of the Game: 1. Your Job. You are the Exploration Manager for NorthStar Mining. Your boss gives you some chunks of rock, a few fossils, and a map. Will you hit the bonanza – or lose your shirt? 2. The Clues. Each of the eight hands-on activities is a clue to the location of the ore. You will need every one of them to win this game. 3. The Computers. Begin your search with $200,000. But watch out – the stakes are high. Every decision will cost you thousands of dollars. 4. Your Host. Bob, the President of NorthStar Mining, is your host. He’s a great guy – as long as you’re making money. After all, you are betting his bottom dollar!

Scientific and technical information needed to understand the games’ challenges was found on distinctive exhibition elements:

**Reading the Rocks**

When geologists search for ore, they look for clues in “drill core”. A hollow bit is used to drill holes thousands of feet underground. Then, long columns of rock are brought to the surface. By examining core from different holes and varying depths, geologists can assemble a 3-D picture of the earth beneath their feet.

In the High Stakes! area there are eight exhibits, and a table with four computers. Each of the eight hands-on exhibits is itself structured as a game with a specific challenge. The visitor was expected to note the answers to the exhibit challenges on her clipboard. Each of the answers provided a ‘clue’ to the global challenge of locating the ore body on the outskirts of Grizzly. For instance, the first exhibit challenged the visitor to determine if there was any evidence in favour of the mining company’s claims that gold could be found in the Grizzly Valley.

**All That Glitters**

“Gold! At NorthStar Mining, we’re under a lot of pressure to find a whopper gold deposit. But you’ll never find anything by sitting at your desk. You have to get out and hike through the valley, panning the soil. Watch for a glitter – but don’t get fooled!”

**Clue #1**

Pan the soil from three locations in the Grizzly Valley to see if the soil contains gold.

1. Swish each of the gold pans in a circular motion until shiny metallic particles begin
to collect along the ridge. Collect as many particles as you can. 2. Are the particles gold? If so, they will appear as dark gold flakes. “Fool’s gold” (pyrite) is silvery. If you find gold, mark the location on your map with a “G”. ? Is any area of the valley likely to contain a gold deposit?

All eight of the hands-on exhibits in the High Stakes! cluster followed a similar pattern.

After the visitor had worked through the hands-on exhibits in a particular area, she was ready to play the computer game. The computer game is an integral part of each area, and is what makes each area a true game. The computer was designed in such a way as to be extremely challenging if the visitor has not assimilated the information from the exhibits – and unforgiving of mistakes. Once the visitor has lost her turn at the computer, she must wait five minutes before she can log on again, five minutes in which she can go back and gather information that will help her play better. The information on her clipboard, ‘clues’ that she will have gathered from the exhibits, were part of her ‘logging in’ to the computer. If the information was partial, or incorrect, the player was encouraged to return to the exhibit area before playing the computer game. In this way the visitor’s behaviour was left open-ended, but as the exhibits give important clues to play the computer game, it structured how the visitor plays the game. Pinball behaviour was minimised, and the careful collection of information encouraged, while still allowing the visitor to choose her own pacing, manner and ordering of the exhibit experience.

Each of the exhibit areas functioned in the same way, and each one provided the visitor with a challenge to respond to, and a reason to respond that was both personal, and part of the overall narrative of Grizzly. For example, in Wild Things! the visitor had to protect the valley from the consequences of potentially dangerous acid rock drainage, and in Blast It! the visitor was challenged find a way to safely exploit the ore left in a mine abandoned at the beginning of the century. The challenges are real, and must be met by assembling a series of information, and acquiring specific skills on the computer games.

We hoped to demonstrate that by deliberately structuring the exhibition by means of the user-language 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. 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.

Both The Body In The Library (described above) and Mine Games are non-linear insofar as its activities can be done in any order (with certain key exceptions noted below), and both are cumulative within the framework of the overall parti pris. Central to Mine Games is the user-language of games. In a game, rules structure activity that can be fruitfully played again and again. In a game such as Mine Games, every re-playing the outcome of the game is different, determined by the nature of the play. As distinct from the user-language of problems, the user-language of games structures the visitor’s experience in terms of different players with competing interests (including players that are roles in a story), and allows the possibility of repeated play, as every game can have a different outcome. Games are structured in terms of players, rules, and goals, and are not exhausted by the finding of a solution, as is a problem. In a game there is no ‘right answer’.

A key difference between The Body In The Library and Mine Games is that The Body In The Library is structured primarily as a problem, and that it has a largely pre-determined and knowable outcome. The visitor’s engagement with the problem consists of finding a way to the probable answer by means of clues and deduction. In this way, The Body In The Library deliberately models itself on the detective novel, a kind of intellectual puzzle. Mine Games, on the other hand, is similar to a true game, such as Monopoly, Risk, or chess. (The determinacy of The Body In The Library is mitigated in SOS in one exhibit, where a plausible case can be made for two possible conclusions, and in the Alibi programme, developed for High School students, in which participants are challenged to create an argument indicting a particular character in the murder mystery)

By exploiting the user-language of 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,

("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 Dunsmith 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.“
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. 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. 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.

How successful were the attempts to create an exhibition with the user-language of games? To answer the question it is useful to quote at considerable length from the conclusions of a report on the exhibition made by Drew Ann Wake after Mine Games had been open to the public for six months:

The game format has proved to be successful for a variety of visitors, including families, young people and professionals. A study was taken by conducting a short conversation with each visiting group over the first eight weeks after opening, and on this basis the audience was broken into three groups.

i. The Enthusiasts. It appears that approximately 18% of the audience becomes engrossed with solving the problem and will stay for hours engaged in solution activities. Many people returned to Mine Games repeatedly. Some families were very organised about attacking the exhibition and came back week-end after week-end. Others travelled from as far away as Victoria (two hours) or the Interior of British Columbia (three hours) to play a game every month or so.
These families sometimes became familiar to volunteers and staff members who took the same shift each week. For example, one seven year old boy spent an entire Sunday afternoon mastering one game, while his grandmother sat patiently, helping him out. The next Sunday morning he appeared, clapped the volunteer on the back and said cheerfully: “Well, I’m back!” His grandmother, who was following with three other grandchildren in tow, added less brightly: “And so am I.”

This confirms Csikszentmihalyi’s belief that there is a proportion of the population that is keen to be challenged intellectually. The percentage of enthusiasts is significant when compared with data collected for more traditional stand-alone hands-on exhibits. Minda Borun’s early work at the Franklin Institute showed that visitors stopped at large numbers of exhibits in the gallery, but actually spent time learning and understanding at only one out of ten of these exhibits ... Therefore, if almost one in five visitors tries to master one game, this represents a high level of interest compared to traditional exhibits.

ii. Mild Interest. A much larger proportion of visitors showed a mild interest in Mine Games. Approximately 45% of the visitors spent some time trying one or more of the exhibits or the computer game.

Included in this “mildly interested” was a small percentage of visitors (5%) who engaged the staff in conversation about the meaning of the Mine Games exhibition as a whole, and the future of mining in the province, but did not want to play the exhibits or computer game. This was interesting as it suggested that for a small proportion of the audience the exhibition served as a lightning rod for political and social concerns. Some of these visitors were from the mining industry and others were from towns where mining was carried out or proposed. In most cases they did not play the games because, as one visitor from Mount Washington said: “I have been to a lot of meetings on this subject and I already know what I think.”

iii. No Interest. About 20% of visitors had no interest in the Mine Games exhibition at all. These visitors often walked slowly across the floor from entrance to exit and left the hall. When approached, they most often said that they did not wish to put in the time or the effort of participating in a game. Some stated that they had tickets to the Omnimax theatre, which would conflict with their completion of the game. A few said they had no interest in the subject matter of mining.
2. Youth Audience. Our conclusion was that the games work with their intended audience-teenagers. The attendance has included numbers of teenagers, both with their schools, their families and with their peers.

Unquestionably, the greatest draw for the teenagers is the computer games, and not the hands-on aspects of the exhibition. Teenagers who were visiting with schools were encouraged to play the games in pairs or small groups, and were expected to try the hands-on exhibits first. However, those who came with their peers played in a much looser co-operative competitive form, starting with the computer games and working backwards to acquire information and data from the exhibits as required.

Teenagers are occasionally recalcitrant about committing the time to play the game, and parents have been heard to cajole them by citing their interest in games at home. “At home I can’t get you away from the computer, so what’s your problem now?” This suggests that parents have noticed the intended link between computer games and teenagers, and are not above using it to stimulate interest.

The competitive aspect of the games is key for this group. On one occasion, teenagers who had been working at the High Stakes! game for several hours were found browsing among visitors at the Wild Things! game. “We don’t want to play Wild Things!,” they explained, “We are just hoping that someone will accidentally drop a clue that will help us win High Stakes!.”

At a recent high school gathering, one member of the team asked the room how many of them had played the computer games at Mine Games and half the class raised their hands, despite the fact that the school had not gone on a class visit. This suggests that there is a market among teenagers for games that are of professional quality.

It is clear from the above that the Mine Games exhibition represents a substantial improvement on many of the exhibitions commonly found in science museums, and was able to sustain, at least in a significant number of cases, the kind and quality of engagement and interaction considered to be desirable. Moreover, given the large investment of time on the part of some visitors, and their proven desire to return to the exhibition, it can be provisionally argued that some added value had been produced, possibly some real learning, an argument bolstered by the fact that proficiency at the computer games allowed us to observe increases in ability – at least insofar as playing the game is concerned.
The theory developed in this study suggests that while the user-languages of problems and games both confer the property of actorship on the user, only the user-language of games confers the property of other players. This conviction was at the heart of the strategy to make an interactive theatre the culminating experience of the Mine Games exhibition. An interactive theatre gave the author the opportunity to create a forum for the discussion of scientific and technological issues in a public institution – a forum where the activity and agency was conferred on all players – and was acknowledged. The property of other players conferred by the user-language of games was at the core of the educational, social, and political ambitions of the Mine Games exhibition.

If the challenge of the modern science centre is to find new ways to support 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. In creating an interactive theatre, we tried to create a place where visitors generated, in a non-trivial way, real ideas, answers, and opinions about the ways in which issues can be resolved. As the issues that face the mining industry in British Columbia were 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.⁸¹

We cannot pretend that the idea of having the audience implicated in the outcome of a piece of theatre is entirely new. In the early decades of the century Bertolt Brecht pioneered what he called ‘epic theatre’, in which the audience was meant to participate in, and take responsibility for its opinions and actions. ‘Epic theatre] turns the spectator into an observer but arouses his capacity for action [and] forces him to take decisions.’ The audience was there to actively participate, not just to be passively entertained.

In 1948 Brecht wrote ‘We need a type of theatre which not only releases the feelings, insights and impulses possible within the particular field of human relations in which the action takes place, but employs and encourages those thoughts and feelings which help transform the field itself.’⁸² Central to this approach is the belief that the audience is comprised of thinking, intelligent human beings, an assumption not often made in conventional theatre, cinema, or indeed, in most science centres. Brecht insisted on the intelligence of his audience. He wrote in 1936 ‘It is a common truism ... that the audience, once it is the theatre, is not a number of individuals...
but a collective individual, a mob ... [our] theatre holds that the audience is a collection of individuals, capable of thinking and reasoning, of making judgements even in the theatre it treats it as individuals of mental and emotional maturity, and believes it wishes to be so regarded.'

Even earlier, in 1926, he wrote 'The one tribute we can pay the audience is to treat it as thoroughly intelligent ... I give the audience the incidents baldly so the audience can think for itself. I need a quick-witted audience that knows how to observe, and gets its enjoyment from setting its reason to work.' Brecht's theatre put the audience to work.

Some years later the potential of the 'quick-witted audience' was exploited by a Czech World's Fair designer working with the Prague theatre company, Laterna Magika, Emil Radok. In his revolutionary Kino-Automat at Expo '67 in Montréal, audiences of 100 people were asked to choose the outcome of a tangled melodrama involving an unfaithful wife, her unsuspecting husband and a policeman. At key moments the audience would choose one of three possible outcomes by means of buttons in the arms of their chairs, and the film would continue on the basis of the outcome selected. Remarkably, and perhaps fatalistically, despite the number of choices and plots theoretically possible, the ending was always the same.

After Radok, the idea of interactive theatre was debased by several different designers, each of whom were entranced with the idea of the audience making choices, but unable to translate these choices into a meaningful experience. The term interactive theatre soon became synonymous with pollable seating, and, instead of determining the outcome of the experience, visitors in the new theatres – dubbed 'Choice Theatres' by Disney, and 'Futures Theatres' by Canadian World's Fair designers working in Vancouver and Brisbane – were given questions to which they responded, and their responses shown on the big screen. At their best, these theatres allowed audiences to express an opinion and have it endorsed. At its worst, the audience was polled and polled and polled again on the same issue using different questions, to see whether or not they would change their opinions. Worse still, the results of some of these theatres were sold to private marketing agencies. The audience's role in the process had become trivial – its decisions were limited to the choices put to them, and its variety reduced to yes and no, agree or disagree. These limitations, it was said, were a consequence of the technology itself, which could not cope with the special kind of variety an audience is able to generate.

We were very critical of these so-called interactive theatres on several counts.
First, in many of them, the visitor’s choices have no material effect on the outcome of the experience. The visitors vote, their opinions are registered, and the experience moves on. It is notable that visitors do in fact want to be active participants. In the Futures Theatre at the 1986 World’s Fair in Vancouver, the audience’s participation was strictly limited to expressing an opinion by means of pollable seating, and having the decision displayed. Nevertheless, when the final question, ‘do you think your opinion matters?’ was answered in the affirmative, the audience routinely burst into spontaneous applause.

Second, the visitor’s participation is shaped by the way the question is posed, not by the issue. The visitor’s variety is largely determined by the nature of the question, and, more importantly, by the limited number of possible answers to choose from. In effect, the audience is merely doing a collective multiple choice questionnaire. The richness of real interaction is completely absent. There is no debate, there is no meaningful abstention, there is no revisiting the question or recasting it in different terms. The audience is there to answer questions that other people set.

Finally, in the few cases where the audience can in fact choose among alternatives, the alternatives are non-cumulative, and seem an end in themselves. Generally speaking, the audience chooses to get information, and for the most part this information is neutral – it leads nowhere. For instance, in some interactive planetaria, the audience can choose between several topics that it wants to explore (often as few as three), the decision being made by means of a majority vote. Thus the audience does materially influence the direction the show takes. However all this participation succeeds in doing is transforming the theatre into a kind of collective interactive dictionary, in which the majority decides what to look up. It becomes, in effect, a clumsy, limited, collective database, and even were the choices to be more abundant, the overall result would be as disappointing.

With this in mind, when we began designing the Mine Games exhibition, we took two starting points for the interactive theatre. First, we rejected systems which limited the audience’s answers to yes or no questions, second, we were unwilling to believe that the technological limitations of the interactive theatre experience should deter us from encouraging non-trivial participation of our audience – especially given the overall decision to cast the exhibition in the user-language of games. After all, Radok had shown us that an interactive, pollable theatre did not have to be overwhelmed by an infinity of possible scenarios. Moreover, our own work combining a live host with widescreen cinema at Expo ’86 had proved the effectiveness
of a real actor in coping with and shaping the variety generated by a live audience, while at the same time using a sophisticated multimedia support.

In a paper delivered in Prague in 1991, the author had proposed that one of the roles of the modern science centre, and, in a broader sense, the museum, is to take advantage of its function as a public space, and to reclaim the openness inherent in the practice of science. The science centre must put this spirit of challenge, question and discovery in the hands of its visitors. Finally the science centre must become a place where debate about science, its benefits, its liabilities, its role in modern society, can be conducted in the manner of science itself. In this way our science centres can be a model, not only for other museums, but for debate and democracy in a world rapidly closing in on itself to the exclusion of both. With this in mind, we designed the Hotseat! interactive theatre.

Hotseat! is a circular amphitheatre sheathed in copper, located at the back of the Mine Games exhibition space, immediately adjacent to the exit. On either side of the entrance, the structure is clad in recycled printing plates, still showing the traces of newspaper headlines. Inside the theatre are six sections of steep tiers seating up to 75 people. Above the entrance, visible from any point in the theatre, is a large, 16-screen videowall. The entire experience lasts approximately 40 minutes. Hotseat! is the culmination of a visit to Mine Games. This experience was originally intended for a very specific target group - young adolescents and teenagers, and was designed to encourage them to discuss and debate issues among themselves in order to help the fictional residents of Grizzly decide whether and how to have a mine in their community. The object of the Hotseat! game was to build consensus around the contentious issue of a land use plan for the Grizzly Valley.

The Hotseat! audience plays the role of the studio audience of a live, call-in talk show, conducted during the first public meeting between the mining company and the townspeople of Grizzly. The purpose of the call-in show is to build consensus about the best way to develop the region. In Grizzly, the mining company presents its plan for the long-range development of the community and the people of Grizzly respond. The audience is challenged to use the material they have learned throughout the exhibition to create a vision of the future that can accommodate all of the interest groups. The talk show host plays the role of facilitator and mediator, asking the audiences help imagine a land use proposal that would satisfy the conflicting inte-
rests in the region. The host uses the 16-screen videowall above the entrance to the Hotseat! theatre to understand the complexities of the mining company's proposal. In order to help the audience come up with reasonable suggestions by adding additional information into the experience, the host can ask for the opinions of experts, who also appear on the videowall.

Fundamental to the dynamics of the experience are the concerns expressed by the community residents to the company's proposals. These concerns are based upon deeply felt, and often opposing views of what the future of the community should be after the mine has left in ten years. Should Grizzly become a developed northern ski resort? Should it preserve the wilderness and concentrate on building a tourism based on hiking and camping? Should it preserve its historical past as the basis of a new tourist economy? None of these concerns is scientific itself, as each is grounded in values as well as facts, but making credible modifications to the company's proposal in order to ensure a certain kind of future involves an understanding of what science can and cannot contribute. The host helps the audience move through each of the community concerns, concerns that not only place the community in opposition to the company, but place the interests of some residents in conflict with others. Saving the old townsite in order to build on historical tourism, for instance, places at risk some of the moose herd that traditionally feeds the local Native Indian band.

The central goal of Hotseat! was to create a means for visitors to see how their knowledge of the science and technology of mining can be brought to bear on complex social issues such as the planning of a new mine. The purpose of the game was to challenge visitors to use the skills and knowledge they had acquired in the exhibition to select a solution to a complex mining issue. The game is deliberately co-operative and not competitive, with the goal of reaching a consensus.

How does this form of interactive theatre address the concerns expressed earlier?

First, the audiences choices do have a real effect on the outcome of the experience. The solutions reached by the audience differ from presentation to presentation. Whatever the result of the audience's deliberations, it must satisfy the requirements of the key interest groups: the mining industry and the community representatives. Any position that successfully mediates the interests of all these participants must draw not only on scientific knowledge, but economics, sociology, history and ecology – in short, on the full experience of the participants. Depending on the
suggestions the audience makes to address community concerns, the community representatives, or the mining company, could decide not to accept the suggestion, and the host asks the audience to reconsider their choice. If the audience is unwilling to consider fresh possibilities in order to arrive at a plan that both the company and the community can live with, the Hotseat! can be wound to a close. Although the goal of the Hotseat! is to reach consensus, the audience can decide whether it wants to move towards consensus or not. There is no ‘right’ answer – only different audiences.

Second, the audience is asked to suggest real possibilities, rather than relying on the traditional pre-determined yes/no choices. They are free to suggest any of a myriad of possible solutions, and they have to defend those suggestions publicly. The host mediates the discussion, and calls upon experts to answer questions posed by the audience. These experts can either be pre-recorded interviews at the Grizzly town meeting, or potentially a live video feed from a real scientist on call during the Hotseat! presentation. In this way the audience is encouraged to come up with a wide range of suggestions based on their own experience, and on their experience of the exhibition, suggestions that can be corroborated or corrected in light of scientific evidence. The issue under discussion of course limits the scope of the audience’s suggestions in certain respects, but right or wrong, their suggestions are not limited by the form in which the question is put.

Finally, the multimedia technology used – the 16-screen videowall and its computer interface – does not function like a database. The audience is not being asked to decide by majority vote what topic they want to see. Instead the technology functions as a resource. New information is provided by experts when the host feels that the audience needs additional information to fuel its deliberations or enlarge its exploration of the issue. The consequence of a suggestion by the audience is a response from the community that allows them to evaluate how well they have been able to negotiate a solution, and where to look to find a better one. The answer always lies with the audience – not in the technology. The technology is a support for audience interaction. The drama of the Hotseat! is that audience members debate issues with other participants, instead of merely vying with one another to call up topics on the screen. The Hotseat! is not a generic database, dealing with pure, value-free information. It is a support system for debate around an important issue.
Moreover, the issue is deeply rooted in the experience of the province of British Columbia, and is based on concerns that had British Columbians from every walk of life – from the environmentalists to mining executives – in the streets during 1993 and 1994. The issues in Hotseat! were fundamental, and the Hotseat! theatre was a commitment on the part of the host institution, Science World, to the debate on the role of science and technology to the future of the province.

There are, however, several severe technical constraints to such a programme. The first is the need to limit the number of events filmed, for reasons of both cost, and of storage capacity. The number of events can be limited by either constraining the audiences activity, providing only simple choices at a few points in the programme, or by allowing the audience to retrace its path through a series of opportunities. Regardless of the method chosen, the designer of any interactive experience supported by finite technical capacity will always need to accept that the variety an audience can generate may exceed the ability of the system to respond to it. The measure of a designer's skill is the extent to which he or she is able to create the conditions for the maximum amount of coherent visitor-generated variety, while providing support for that variety with a finite number of resources.

The final version of the Hotseat! theatre evolved slowly over the course of a year-long design process. Originally we had been interested in exploring the possibilities of a voting theatre in which the audience was polled electronically, and interacted by means of computer stations around the inner circumference of the theatre. One of the drawbacks to this approach was the difficulty of keeping the process open, even when strategies such as re-voting were employed. In the absence of a human mediator, the questions had to be structured so rigidly that it was difficult, if not impossible, to leave room for the kinds of variety we wanted the audience to generate. Moreover, given the overall message of the exhibition that all technological choices were ultimately social choices, we felt that to ask the audience to use a computer interface in its negotiations was to imply that technology had the answers to human problems. We therefore opted to create an experience in which a live host mediated the audience's responses to the dilemma of the townspeople of Grizzly. A human host had the advantage of underlining the fact that social negotiation lies in human hands, as well as taking advantage of the human host to encourage, shape, and direct the variety generated by the audience. In its final form, the Hotseat! began with a humorous introduction, in which the host creates the fiction of a live, television call-in programme, about to go live to the town of Grizzly.
In order to better illustrate the issues above, let us look at the Hotseat! script in some detail:

[introduction to Hotseat! Beluga Productions 28/08/94]

During the applause, the logo 'HOTSEAT!' spins out in 3-D letters and freezes.

TERRY, the Host, enters with a mike.

TERRY: (really upbeat)
Thank you, thank you, and welcome to Hotseat!, the television programme that puts you at the centre of world events. Each week, your Hotseat! crew will be travelling to one of the hotspots of the world. Washington. Beirut. Johannesburg. And this week – Grizzly, British Columbia. This is a brand new concept in Canadian broadcasting, folks, and I'm delighted that you can join us for our very first show. Our network CNSW, has built a state-of-the-art studio especially for this programme. So let me show you some of the high tech features I have at my command.

TERRY touches his touch screen and an image of Karen Nishi appears on the video wall.

TERRY: This week, Karen Nishi will be reporting live from Grizzly, in northern British Columbia. We have a two-way link with Karen, so I can talk with her via these screens.

Hello, Karen. Are you there?

On the screen, KAREN says: “Hello, Terry?”

TERRY: Goodbye, Karen.

Terry hits his touch screen and Karen is frozen. ...

TERRY: This is Hotseat!, the world’s first television programme dedicated to changing the course of history. Today, Hotseat! is going live to the town of Grizzly, B.C. Grizzly is a town in turmoil. Two years ago the town's lumber company closed down, leaving many residents out of work. Then, a small Canadian mining company, called NorthStar, discovered a rich deposit of copper and gold on the edge of town. Some residents of the town are boosters of the mine. They want the jobs and training that mining offers. Other residents pin their hopes on the tourism industry. They fear that a mine will destroy the valley and its wildlife. We will be asking you to serve as mediators in these discussions. We want you to make suggestions and find compromises. We want you to find a solution that will make both the company and the community happy.
We had originally written the script to allow the greatest number of possible trajectories through the material, in order to encourage the greatest amount of exploration by the audience. However, we wanted the audience to realise that intransigence could mean failure – the collapse of the negotiations altogether, and thus built in several occasions where successive refusal to consider alternatives by the audience lead to the winding up of the show by the host, as noted on the storyline diagram and the following script. Even if the audience successfully avoided ending the show prematurely, there were four possible endings, of which only one allowed a final compromise that would guarantee the support of all four community leaders for the mining company plan – the ‘happy ending’. The challenge of Hotseat! was to give the audience enough information to allow them to make intelligent proposals about how to modify the mining company’s plans (shown on a map) in order meet the different concerns of the community, and to encourage them to debate various positions in order to find a solution.

In the following sequence, after a tumultuous community meeting in which the community leaders storm out in protest after being presented the mining company’s plan (which serves as introduction), the host calls on the audience to help him solve the dilemma.

EVENT #8: THE GROUP ASSEMBLED

Terry turns to the AUDIENCE.

TERRY: Okay, how can we help these people out? The town needs the jobs, but they’ve got some real problems. It’s going to be our job to help, using this map. And if we can, the town can have the mine and all the prosperity that goes with it. But, if we can’t, everyone loses. So, let’s look at the map and see if we can find a way, one solution at a time.

The MAP, as Bob laid it out, appears on the screens.

(refers to the map)
Let’s look here, at the problem areas: we have the tailings pond, and this pile of acidic rock … Karen appears on a screen

KAREN: Terry? Are you there? TERRY: Yes, Karen?

Karen is at the rear of the meeting hall. With her is Dr. MARTY WEINBERG, (mid-forties), the biologist. … [the alternatives for the siting of the tailings pond are outlined]

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Terry leads a debate amongst the audience. The premise of this debate is that there is no alternative place for the tailings pond. It can only be reduced in size.

After a discussion the audience will be asked to vote on the following questions:

1) to save all the elk? which means, no mine.
2) to save none of the elk? which means going with the mine's plan.
3) to save some of the elk, and change the mine's plan.

Terry finally calls for their vote.

The choices are telling the mining company to pack up its bags and go home (a choice that means the end of the town and infuriates the entire community), or giving the mining company a clear go-ahead to their plan (which means sacrificing the salmon stream valued by the Native Indian Band, the historic homestead, dear to older residents and the Grizzly Historical Society, and the plans for other economic growth, such as a ski slope or wilderness trails) or exploring alternative, compromise positions, such as moving the tailings pond.

This was the scenario we pre-tested in front of several classes of bright Canadian grade 10 students (13 – 15 years old), in order to finalise the script before shooting. These classes had been selected because they fitted the profile of the target audience originally specified by the institution – young adolescents and teenagers. These pre-tests worked remarkably well, despite the fact that the pre-tests had been 'performed' by members of Science World staff, rather than shown in the Hotseat! theatre itself (as the film had to be shot long before construction of the exhibition had been completed, the script tests had to be conducted well in advance of the shooting). The students appreciated the difficulty of the problem, and were prepared to engage with the challenges. Notably, they first treated the experience as a problem, to which they had to find the 'right' solution.

In the first test, both classes opted for one of the two either/or solutions right away (predictably for an urban 'green' audience, the 'no mine at all solution'), and were dismayed to find that this resulted in stern disapproval from the entire community – clearly their 'right' answer was the wrong answer for Grizzly. Then, as a consequence, they opted for the opposite solution (the 'pro-mining' option) apparently following the logic that if the first solution didn't succeed, its opposite would. Once again they were faced with an unhappy
community. As the original strategy ended the game if the audience was unwilling
to explore alternatives, we thanked the classes for their participation and suggested
they return to class. Unanimously (and perhaps not surprisingly) they asked – or
more correctly, they demanded – to be allowed to have another chance to explore
the possibilities. As a consequence of this test we revised the Hotseat! structure to
allow exploring new alternatives without ending the game entirely, and noted that
the audience would need to be better prepared to understand the nature of the ex-
perience as a negotiation to reach consensus, not a win/lose game or right/wrong
problem.

On the basis of these test cases, in May 1994, we finalised the script, and shot the
film in July 1994. Once the final editing was completed in August 1994 we were in
a position to test the show with school classes once again in the Hotseat! theatre, in
order to confirm our assumptions, and to ensure that the narrative fiction of the
television call-in show could be sustained. We tested the beginning of the show in
the half-built theatre with several audiences, including those who had assisted us in
May. We were happy to find that notwithstanding several more or less serious tech-
nical setbacks (bad sound, difficult-to-read maps, intrusive mullions) the show
appeared to work well with school classes of advanced Grade 10 students, a finding
confirmed by written comments sent to us by the classes involved, which showed
that Hotseat! worked as it was intended for this age group. As one student wrote
'I think Hotseat! is a great idea because the topic is something you can relate to, I al-
so like it because you can discuss the issue and people like to discuss a lot.' Clearly
the show had caused a great deal of discussion, and some responses showed that
we had touched deeply felt issues. One student, instead of discussing the Hotseat!
experience itself, concerned herself with the fate of the grizzly bears in the valley
threatened by the mine, and wrote 'I think that there should not be a mining com-
pany. If there were to be a compromise that would be a step. I would like to see the
grizzly bears alive and well, and to keep a nice clean environment ...' The Grade
10s were prepared to engage in debate, and thought the Hotseat! was a good place
for everyone to do so. One student wrote that Hotseat! 'allows people to speak their
thoughts and for those who are shy, there is a vote to express their opinions.'**

We were heartened by these comments, and planned to spend the weeks remaining
until the opening of the exhibition attending to technical details.

However, to our surprise and dismay, when we tested the same material with classes
of Grade 8 and Grade 9 students, only one or two years younger, they had great
difficulty with the material, and appeared unable to engage in debate about the

** These quotes transcribed from written evaluations
solicited by the teachers involved in the test screenings
range of options open to the community. They were either mute and uninterested in the material, or they would make suggestions so far from those anticipated by the pre-filmed responses that the host had little room to steer the discussion back to territory covered by the filmed events. With these younger students, the show was a flop.

This finding caused the institution to question its original targeting, and to encourage us to find a way to make the Hotseat! experience exciting for a broader range of audiences than originally planned – younger school classes, and the general public, which could be expected to include a wide variety of age and interest groups. This new requirement forced us to rethink and rewrite the host's script substantially, using the same filmed sequences (which we could not alter by this point), but structuring the show differently to make it more intelligible and accessible to younger audiences. The resulting show differed from the first version in several key respects. First, discussion was structured in a different way. The audience was no longer asked to debate points in full, nor to explore several alternatives, but rather to direct the host in choosing among a limited number of possible options. Sequences were thus used to illustrate the principles of negotiation, not as options in themselves, and audience variety was constrained to the final episode, where they could apply the skills they had learned to help resolve the final conflict that stood in the way of a successful compromise. In this way, the Hotseat! functioned as a group exhibit teaching the three main rules for reaching a compromise – and a happy ending was guaranteed every time.

These changes in approach can be seen in the following script segment.

[same sequence/version 2 – 05/09/94]

EVENT #8: THE IMPORTANCE OF COMPROMISE

Terry comes down the steps and turns to the AUDIENCE.

TERRY: Well! Chaos reigns! The people of Grizzly are deadlocked. This kind of impasse has happened before in British Columbia. Can anyone give me the names of some other areas of the province where these kinds of conflicts have taken place?

(The audience may suggest Clayoquot Sound, Tatshenshini or the Cariboo.)

Right! And sometimes these issues break communities apart.

Turn neighbour against neighbour.
A lot of people who live outside the situation take hardline positions on an issue such as this. For example, some people will say: "Heck, the people who work for NorthStar Mining are professionals. They've done their homework. This mine should go ahead."

Some of you in the studio audience may think that way. How would the people of Grizzly respond to an argument like that? Karen, maybe the people of Grizzly could tell us how they would react?

If the audience accepts the mining company's proposal unquestioningly in the revised scenario, Terry responds to the angry reaction of the townspeople of Grizzly with the following words:

'Well, the community was certainly unhappy about that conclusion! And even though you have adopted the mining company's position, you can see that Bob is really nervous about going ahead with a mine that the community does not support. So no one is happy.'

If the audience chooses instead to send the mining company packing, in this scenario they are chided by Terry as follows:

'Well, Bob has just called that position "unreasonable and fanatical". And the residents are angry too. The problem here is that we often try to solve these issues by taking extreme positions, resulting in no-one being satisfied. We've got to find some middle ground. This requires compromise and new ideas, not hard line positions. Today we want you to act as mediators to find a solution to the problems in Grizzly.

There are two issues here: The first is the tailings pond on the east side of the river. Remember we have Josie's Fort Hope in the North half and Gerry's elk herd in the south. We're going to work together to try to find a solution to these problems then I'm going to turn things over to you to solve the problem on the west side of the river. If you've found a successful compromise everyone will be happy, the townspeople and the mining company.'

The difference between the two scripts is clear. In the first, the audience decides when it needs information, and how to get it. In the second, it is told that information is necessary, and given it. In the first script, debate and exploration are actively encouraged, even at the risk of generating too much variety, variety that could exceed the possibilities of the system to address it. In the second, variety is con-
strained, and the show strictly structured to lead the audience through a learning process.

What can we conclude from the foregoing experiment with creating a social forum?

First, we discovered that the Hotseat! was a very sensitive instrument for detecting the development of social skills, and by means of the Hotseat! we identified a difference in developmental stage between two age groups that rarely comes to light in the museum setting. Hotseat! made the willingness to debate and discuss social issues a central concern, and allowed us to detect the threshold at which young people begin to become concerned about broader social issues, and less about solely personal concerns.

In a more general sense, this finding also underlined one of the central conclusions of this study – that labels that implement the user-languages of problems and games, while conferring the desirable property of actorship, also require far greater attention to the process of ‘addressing’, that is to help users to engage with the label. The greater the demands on the user, the more powerful the properties conferred by the label, the greater the effort required to accept the label. The primary means to overcome this resistance is to create labels in a context relevant to the user, noting, as demonstrated in the example above, that relevance varies critically from group to group.

Second, it highlighted the fact that debate and discussion happen most readily in homogeneous audiences, where the participants know each other and feel comfortable expressing themselves publicly. Hotseat! did not work best when the audience was markedly heterogeneous, as the variety of points of view and suggestions that can be generated by an audience that includes seven and seventy year-olds rapidly exceeds the capacity of even a hosted system to respond to them all – they are just too diverse, and as a consequence, the common focus of the experience is difficult to maintain. In order to allow diverse audiences to debate, it could be argued on the basis of Hotseat! that a neutral, anonymous, interface is better than an amphitheatre. A computer-based interface would allow participants greater discretion to voice divergent opinions without fear of censure. On the other hand, if one of the goals of the experience is to pass on the social skills of negotiation, it could be argued that the Hotseat! experience confronts and explores the difficulties of face-to-face negotiation, rather than avoiding them by the interposition of an electronic mask.
Third, following from the above, Hotseat! highlighted the fact that information may be a necessary condition for debate, but it is not sufficient – visitors need to learn negotiating skills. In this respect, Mine Games in general left the visitor quite unprepared for the Hotseat! experience, something noted by many of the students who participated in the tests. Often this lack of preparation was described as a lack of information, as in the case of the following students comments ‘Everything seemed kind of unclear. I needed more information and details about what went on. I wanted to know more background information.’ Another student blamed herself, not Hotseat! ‘I didn’t find that we were well prepared enough to make decisions [sic].’ This opinion was seconded by a classmate who wrote ‘There was not enough details [sic] about the whole presentation before everyone started to vote, which made the audience difficult to choose a decision.’ Many students charitably looked to the exhibition to fill in the gaps, ‘I’m sure that will be better when the games part of the program is complete.’

Despite the conviction that information was lacking, it was clear, particularly for younger audiences, that the exhibition had failed to provide any opportunities to learn the skills of negotiation before entering the Hotseat!, thus putting the burden on the Hotseat! to teach those skills prior to, or as part of, the overall experience. The fact that the older students resented the constraints to their activity points to the need to include the communicating of social skills into the experience of negotiating solutions to social and technological problems. In other words, Mine Games would have been a substantially better exhibition if it had clarified its already explicit use of the user-language of games, and allowed Hotseat! to concentrate on providing the greatest number of options for audiences eager to explore them. Comments by Grade 10 students consistently emphasise their frustration with the limited field for discussion, and their desire to engage with a full range of options for the future of the Grizzly Valley. This frustration finds voice in nearly every student’s comment. ‘The show really had me thinking about a solution to the dilemma. However, solutions that were not options ... were not quite useful. Maybe the program should add more options to the decisions.’ Another wrote ‘we do not have much options though, but voting for just yes or no.’ Or another ‘I thought the presentation should have involved more complicated answers and votes, instead of just voting yes and no.’ One writer went on at length about the missed opportunities ‘The issue at hand is very emotional for most of the people involved. Everyone wants the things they value preserved. I think there weren’t enough options and compromises discussed. What to do about the old fort for instance. Also I think it
would have been more interesting if Hotseat! invited all the people to be in the studio “live”. Then we could have discussed more possibilities and come up with a compromise more tailored to the problem.

Finally, even given its manifest failings, which are not trivial, Hotseat!, by exploiting the user-language of games which addresses users to deal with the variety other players can contribute, allows us to argue that given a social context that is relevant, sufficient information, and real opportunities opportunity to explore the skills of negotiation, that visitors actively engage with and seek to sustain an experience in which their variety is recognised and encouraged.

From the examples described above in *Mine Games*, even given the complex nature of some of the exhibition experiences, we can see that labels that employ the user-language of games actively confer complex and sophisticated forms of actorship on the visitor, and by necessarily invoking other players, can actively support their willingness and ability to generate new solutions to complex problems involving other players. This would seem to provide grounds to believe that the label has an active role in creating key desirable properties in the museum user.

### 3.3 Using user-languages

Several general conclusions can be drawn from the exhibitions described above.

First, the user must accept the support in order to benefit from the properties it confers. Just as in the analogy of cited in section 2, the gun must be accepted before the property of being dangerous is conferred to the person, and that of being fired, to the gun. The person could equally refuse the gun, and let it drop to the ground.

In the examples above, it is important that the impediments to user acceptance be as few as possible. Particularly in the user-languages of problems and games, where the user has the potential to become an actor, the label must correspondingly be relevant to the potential user – she has to be willing to make the problem her problem, to want to play the game according to the rules. Many factors can contribute to the label’s acceptance – its content, its context, its style, its setting, its language – but most important, it has to matter to the user personally. For the user to accept the gun, she has to have a clear interest in becoming dangerous, and it has to be seen by the user to support that use.
Second, once the user has accepted becoming a user, their behaviour can be observed, and evaluated according to several criteria.

Since the early 1980s, Drew Ann Wake and the author were among a group of sceptics who challenged the notion that hands-on interaction – in itself – provided a better learning experience. As described in the Introduction, 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 – a behaviour already known in the field as the 'pinball effect'. Some researchers, such as Joël de Rosnay of La Cité des Sciences et de l'Industrie in Paris, had gone as far as to declare this behaviour to be a constant feature of the science centre visitor. They 'scan with their eyes and zap with their feet' he claimed. On the other hand, these 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. Unlike De Rosnay, we believed that this unfocused 'pinball' behaviour was a consequence of our labels and our labelling strategies, and that the behaviour would be seen to change if we could find a way to create more effective labels.

It seemed to us that the most telling criticism of most science centre exhibits was just that – 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 show visitors scientific principles, we had to look at them as 'supports' that helped confer new properties on users. In short, 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.

In this we follow the work of the American psychologist of creativity, Mihalyi Csikszentmihalyi, who described in 1990 what he called the 'flow' experience, which he argued characterises most intrinsically rewarding human activities from sport, to music, to art appreciation. 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 which 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’, 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. ‘Flow’ activities are free from ulterior motives, they are, in a fundamental way, entered into freely. 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] 7 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 – in short, to ‘accept’ the label, and engage with it.
As seen from the examples above, labels confer different properties on the user – being knowledgeable, being an observer, agency, other players. These properties are conferred in the way that ‘being dangerous’ was conferred by the gun. The last two properties described, which could be called acceptance and engagement, are those properties which the user confers on the label, just as the person confers the property of being able to be fired on the gun.

This demand for the recognition of and legitimation of the user’s need to accept the label – a ‘bottom-up’ strategy which would address the criticism that the agenda for informal science learning was set from above – can be seen clearly in the two initiatives taken in the late 80s and early 90s described above – the Science Alberta Foundation and its exhibitions *Beyond the Naked Eye* and *The Body in the Library*, and the exhibition *Mine Games* at Science World, in Vancouver, Canada, described in detail above. All three exhibitions looked 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. Each of the exhibitions was deliberately experimental, and designed to test specific hypotheses about informal learning. In terms of user-languages, these exhibitions explored ways in which different labelling strategies could create the conditions for self-generating, self-sustained, prolonged interaction with the exhibition’s content, in particular, ways in which the museum could take advantage of the user-language of problems that characterises the library. As a consequence, these experimental exhibitions encouraged the author in his conviction that the informal learning environment could be improved by using particular user-languages in particular ways.

Finally, from all the above examples, we can begin to identify the ways in which specific user-languages can support specific properties in the user, as well as the reasons for choosing to implement labels on the basis of one user-language or another. Certain of the user-languages clearly seem to confer more desirable properties on the user than others, and the user-language of games, in particular, confers the properties of actorship and of other players, more than other user-languages. Can these observations be tested? Could an entire institution be created based on employing the user-languages of problems and games? Would labels in such an institution consistently confer the properties desired? Would such an institution be a better museum? To answer these questions, it was necessary to
create a new institution – a very unlikely possibility. However, luckily, in 1994, the
author was given the opportunity to do just that.

In 1994, the author was invited to direct the design of Holland’s national science
centre, a project with a general vision, but without a specific exhibition strategy.
This project provided the author with the opportunity to put into practice many of
the ideas that had been developed over the preceding eight years in a single, cohe-
rent, experiment. The challenge was to create a ‘third generation’ science centre
(or even a ‘fourth generation’ science centre, as the institution’s Director often
proclaimed). This experiment, newMetropolis, opened June 4, 1997. From the outset
it was conceived explicitly as a prototype and tool for research, and provided the
author with a means of testing the theories proposed in this study.

newMetropolis is an exceptional project in many respects: it is a national institu-
tion, its development was guided by a clear, explicitly articulated vision, it had a
clear mandate from its backers in the federal government, the municipal govern-
ment, and industry. Most importantly, the author was fully supported in his work by
the Director Joost Douma, the Associate Director dr. Hein Willems, and by the entire
staff of the institution, in creating a new kind of informal learning environment.
Because of these exceptional circumstances – and this exceptional opportunity – it
is important to describe the project in detail below as the experimental proving
ground of the theories developed in this study. It is important to note from the outset
that as in previous exhibitions, the notion of user-languages did not form part of
the explicit discourse within the design teams themselves. The creative staff was
young, inexperienced, and drawn from different backgrounds. None of them had
been involved in exhibition design of this kind or at this scale before. Nevertheless,
the design process was unusual in several regards, particularly in the way in which
it was guided by explicit written documents, and shaped by intense and open internal
discussion. It will be seen in the following section, that while it was not made
explicit, the theory developed in this study explicitly guided the development of all
newMetropolis’s exhibitions – a project in which the author was the final authority
on every aspect of the design of the project and its exhibitions.

The next chapter looks at the development of newMetropolis in Amsterdam, a
science centre opened in 1997 in which the author had the opportunity to put the
theory developed in this study to the test – at the scale of an entire institution.