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## The contribution of museums to scientific literacy: views from audience and museum professionals

Ellen K. Henriksen and Merethe Frøyland

The new goals outlined for museums in recent reports are in line with the efforts to improve the public's civic and practical scientific literacy. We have made a preliminary exploration of the potential of museums to provide information and experiences that the audience finds relevant in the context of science-related issues they encounter in their private or civic lives. We found that for a group of parents faced with the issue of radon in their children's school, two museums in Oslo were not seen as having such a function; neither did the parents expect museums to have such a role. Professionals from the two museums expressed similar attitudes. If this skepticism toward the new goals is widespread, museums face a great challenge concerning how to relate to the new goals. Based on our findings, we suggest some pertinent issues for future research.

### 1. Introduction

#### *The quest for scientific literacy*

In recent years, much attention has been paid to the public's relationship to natural science. Some have bemoaned the lack of interest and outright hostility parts of the public display towards science.<sup>1</sup> Others have demonstrated the public's low level of understanding of scientific concepts and methods.<sup>2</sup> There have been numerous proposals in favor of increasing the public's scientific literacy.<sup>3</sup> Being scientifically literate means not only having an understanding of a range of scientific concepts and processes, but also being able to apply this understanding, together with one's own experience and values, to a range of science-related matters in private or civic life.

Four main arguments are often given for pursuing scientific literacy in the population:<sup>4</sup>

- The practical argument: People need an understanding of science and (even more) technology to handle everyday life in a science- and technology-dominated society;
- The democratic (civic) argument: People need an understanding of science to relate to the many complex science-related issues that confront citizens of modern democracies;
- The cultural argument: Science is part of our cultural heritage and has profoundly influenced our view of the world and of humankind's place in it; thus, one needs a grasp of what science is in order to understand culture. Moreover, knowing something about the objects and phenomena in the world that surrounds us is a source of joy and fulfillment for the individual;
- The economic (professional) argument: A scientifically literate workforce is necessary for a sound and flourishing economy in most countries.

These four arguments may be seen as representing four different aspects of scientific literacy.

The present, low degree of scientific literacy in the population is perceived as a problem by the science education community and by authorities in a number of countries, and if the problem is to be alleviated, a range of institutions must join forces. Through which channels can people get in touch with science and improve their scientific literacy? The school system clearly has a role to play; however, in a world in which science and technology are in rapid change, efforts are needed to put citizens in touch with science throughout their lives. Jenkins stated that the promotion of scientific literacy could no longer be seen as the exclusive responsibility of schools and other agencies of formal education, and he saw museums and science centers as playing an increasing part in this promotion.<sup>5</sup>

### *Museums and scientific literacy*

What is the possible contribution of museums in relation to the four aspects of scientific literacy? We would argue that the traditional role for museums has been suited mainly to improving the cultural aspect of scientific literacy by displaying exhibits illustrating scientific concepts and celebrating scientific advancements, and the economic/professional aspect, through motivating youth for careers within science and technology.<sup>6</sup> In Norway, most museums are still primarily filling these roles. However, during recent years there have been a number of propositions in favor of extending the role of museums in society. In the present situation, it is no longer enough for museums to contribute to the cultural and professional/economic aspects of scientific literacy. Innovative ways of using the museums' collections and expertise need to be conceived to realize museums' potential to contribute also to the civic and practical aspects of scientific literacy.

In their 1992 report, "Excellence and Equity," the American Association of Museums stated that museums should "enrich and empower citizens." Moreover, museums should "foster the ability to live productively in a pluralistic society" and "contribute to the resolution of the challenges we face as global citizens." A recent report issued by the Norwegian Ministry of Cultural Affairs, states that museums should function as "dialogue institutions" and "meeting places" and be "arenas for public debate." Similar aims are outlined for museums in other countries, for instance, in Sweden.<sup>7</sup> From these documents, we have compiled the following list of new goals for museum activity. Museums should be:

- public service institutions
- meeting places
- arenas for public debate
- dialogue institutions
- contributors to the resolution of global challenges

The statements that museums should be meeting places and dialogue institutions may be interpreted at an individual or an institutional level. On the individual level, the phrases may mean that museums should facilitate meetings and dialogues among visitors. We would argue that museums are, to a great extent, already doing this; they are places where families and friends go to spend quality time together, and the exhibits (particularly interactive exhibits) facilitate meaningful dialogues and conversations among visitors.<sup>8</sup> On the institutional level, the above phrases may mean that museums as institutions should provide opportunities for different interest groups to meet and interact, for instance, through arranging public debates or workshops on current science-related issues. Being a dialogue institution may mean responding to current issues in society, using the museum's expertise and collections to throw light on these issues.

We interpret these new goals to be very much in line with the practical and civic aspects of scientific literacy. Can museums fulfill such a function in society? We suggest that if museums are to contribute to these aspects of scientific literacy, the following conditions must be met:

- Perceived need for information: The audience must feel a need for insight to enable them to deal with science-related issues in their private or civic lives;
- Museums as sources of information: The audience must perceive museums as relevant places to seek information and experiences to give them the desired insight;
- Relevant topics: The museums must, in fact, offer information on the relevant topics;
- Form of communication: The museums must offer information, experiences, and interaction in a form that the audience understands and is able to apply to the civic or private science-related issue of interest;
- Accessibility: The museums must be practically accessible; that is: they must be open at times when the audience finds it convenient to visit; they must not be too expensive, they must offer parking space etc.

This paper describes a preliminary exploration of museums' potential to contribute relevant and usable information in a practical, science-related matter to a local community. We interviewed groups of parents whose children went to a school where high concentrations of radon gas had been detected. To find out if parents looked on museums as possible sources of information concerning the radon issue, we invited them to visit two science and natural history museums in the Oslo region: one of them a traditional natural history museum, the other one of the more modern, technical museums in Norway.

#### *The radon problem: a current socio-scientific issue*

The issue of radon in homes and workplaces is an example of a science-related issue that people need to know about in order to make reasoned decisions regarding the buildings they live and work in. Radon is a radioactive gas that escapes from rock and soil rich in uranium and thorium. The gas seeps up from the ground and may enter houses through crevices in the basement. If radon and its radioactive decay products are present in the air, they are taken into the lungs and deposit radiation energy in the lung tissue, giving a radiation dose to the breather. The larger the concentration of radon in indoor air, the larger the radiation dose. Radon concentration in buildings may be reduced by means of some relatively small technical changes.

Where do people turn when they learn that their home or workplace is likely to have a radon problem? Do museums have a role to play in this context? After a study of lay people's dealing with the issue of radon in homes, Alsop and Watts judged it unlikely that citizens would seek out a museum to empower them in dealing with radon issues.<sup>9</sup> We wanted to explore this assumption, using the radon issue as an example of a range of science-related issues that people encounter in their private and civic lives.

#### *Aims of this study*

The main aim of this study was to make a preliminary exploration of the potential of museums in fulfilling the new goals; in other words, museums' potential contribution to increasing the public's practical and civic scientific literacy. More precisely, we wanted to answer the following questions:

- How do people react when confronted with a science-related issue, such as the radon issue? Do they feel a need to get a grip on the scientific aspects of the issue, and, if so, what sources of information do they regard as relevant?

- Do people see museums as institutions that can provide information and experiences empowering them to deal with science-related issues in their own lives?
- How does the audience view the role and aims of museums, and how does this view relate to the new goals stated for museums in official reports?
- How do museum professionals view the role and aims of museums in supporting public scientific literacy?
- Do museum professionals perceive their own museums as fulfilling the functions described in official museum reports? If so, how? If not, what are the major obstacles?

## 2. Methods

### *Focus groups*

In this study, we used focus groups as a qualitative research tool. The focus group method has been described by Stewart and Shamdasani, Krueger and Morgan, and its use in museum research was advocated by Rubenstein.<sup>10</sup> In a focus group session, a group of 4 to 10 volunteers freely discuss their views on a topic, with only limited guidance and interference from the moderator (the researcher or other person appointed to lead the focus group). Greenbaum distinguished between full focus groups (8–10 participants) and mini-groups (4–6 persons).<sup>11</sup> Small groups are particularly suitable when the participants are very knowledgeable about the subject or when they are particularly confident and eager to express their opinion. In the present case, participants had some background knowledge about the issue under discussion, and many of them were in academic or administrative jobs requiring them to formulate and express opinions. Thus, small groups were used in this study (see below). The discussion was taped and then analyzed qualitatively. Focus groups are well suited to exploratory studies like the present one, where the aim is a broad description of participants' thoughts, feelings, and priorities concerning the issue in question.

### *The participants*

Two categories of focus group sessions were conducted in the present study. The first category was groups of parents of children from a school where high radon levels had recently been reported. The second category was a group of museum professionals from two science and natural history museums.

The elementary school with the radon problem is located in a suburban area populated mostly by middle-class families. Participants were recruited with the help of the parents' association at the school. Ten parents (5 women and 5 men) volunteered to participate and were distributed in two focus groups (one with 3 women and 2 men, the other with the opposite gender distribution). Participants were relatively similar in age (38–50 years old), and they were judged to be of similar socio-economic status (middle class). Most of them had higher education, often in science-related areas such as engineering, medicine, or biology. As in all focus group studies, the participants did not constitute a representative sample of a larger population, but rather a *relevant* sample with regard to the actual issue under investigation (responses to the radon problem).

Each parent participated in two focus groups, each lasting 90 minutes, with about two weeks between the two sessions. During this two-week interval, participants were invited to visit one or both of two museums where they might expect to find information about radon and ionizing radiation. The two museums were the Geological Museum and the Norwegian Museum of Science and Technology (NMST). Due to illness and other practical problems, the

last set of focus group sessions (after the museum visits) had to be split into three rather than two groups. Thus, there were three “after-visit” sessions with three participants in each. We were initially worried that three people might be too few to get a meaningful focus group discussion; however, we felt that participants were sufficiently talkative, confident, and thoughtful that the small number did not significantly reduce the quality of the discussion.

When all the focus groups with parents had been conducted and analysis had yielded preliminary results, museum professionals from the two museums were invited to participate in one focus group session. Three employees were recruited from each museum. The group consisted of five men and one woman (this gender distribution reflected the actual gender distribution among museum professionals at the two museums). Participants held various positions at their respective museums, for instance director, curator, and leader of the school service.

An overview of the various focus group sessions conducted is given in Table 1.

**Table 1.** Overview of focus groups and sessions.

Session 1 with parents	Museum visit	Session 2 with parents	Session 1 with museum professionals
2 focus groups with 5 persons each	Parents visit two museums during a two-week interval	3 focus groups with 3 persons each	One focus group with 6 persons

Both researchers were present at all sessions, one acting as a moderator and the other as an assistant moderator and observer. Participants were served light refreshments at the sessions and were given information booklets about radon and ionizing radiation, as well as a small gift item as a sign of appreciation for their cooperation.

Recordings from the focus group sessions were transcribed in their entirety and analyzed with the aid of the program ATLAS.ti 4.1 for Windows. The two authors independently analyzed transcripts, noted prominent themes, and created codes for these. Coding and selection of relevant quotes were compared, and, through discussion, a common set of codes was agreed upon that covered the preliminary findings of both researchers. Analysis was then refined by both researchers according to the new, common set of codes, and the findings of both were merged into a common account of the results.

In the account below, the letters preceding quotes from focus group participants indicate P for “parent,” M for “museum professional,” and Mod. for “moderator.”

### 3. Views on the radon issue and perceived need for information

#### *Attitudes and knowledge concerning the radon problem*

The discussion in the first set of focus groups started with parents’ reactions to the news of the high radon level at their children’s school. None of the parents felt that there was reason to panic, and most were confident that the problem was being solved.

P: I didn’t have time to get worried. I think they started tackling it very quickly.

Many of the respondents had a nuanced, sophisticated view of risks and were able to put the various risks of everyday life into perspective:

P: Take the traffic and all the pollution we have (...) my conscience is worse for letting my children live in the city, with all that pollution.

P: ...depends on what it is. For instance, asbestos, that is typically manmade, whereas radon is more natural (...) has always been there. And then there are other things... other environmental toxins. Dioxins have been serious...

The discussants expressed concern that our modern lifestyle is causing health risks, and most of them saw radon as one such risk:

P: Radon is natural, clearly, but... with air-tight houses... the fact that we spend so much time indoors... makes a substance that might not be dangerous the way it was before, dangerous today, because there is no proper exchange of air, and we spend so much time indoors. It is the life we are living.

Several of the parents displayed knowledge of radon and the effects of ionizing radiation:

P: I seem to remember that it is a noble gas...

P: Whether it is 100,000 becquerels or lux something or other... we say: "Yes, this sounds dangerous!" (laughter), ... I suppose it is, as with other radioactive radiation that there is a cancer risk... If you are exposed to this in large doses. Then you must see... is this more dangerous than cigarettes, for instance?

However, most of the parents were not very confident of their own knowledge of radon and its potential health consequences:

P: We know—or think we know (laughter) that radon comes from the ground, not from the building materials. But I may be wrong. But that's what I thought.

#### *Perceived need for information*

Regarding the parents' perceived need for information about radon and its consequences, it appeared that some of the respondents were reluctant to relate to the problem; they felt that knowing about it was someone else's responsibility (the experts or the school authorities).

P: ...knowing exactly what radon creates... what kind of diseases, what the mechanisms are... I feel it is OK for us to leave it to the experts.

To the extent that the parents did want information, most of them focused on the health consequences of radon and the potential risk to their children.

P: But what are the consequences? Does one get cancer? (...) Does this accumulate in the body?

P: ... how large must the concentrations be to be dangerous, for how long time does this have an effect...?

Some respondents expressed quite clearly how they wanted the information presented:

P: ... information ... should be concrete, and there should be a suggestion or an idea for a solution.

P: I think it is important to consider that if one cannot relate constructively to the information, I actually think it is better to do without it.

Most parents were not willing to spend much time or effort on understanding the cause and nature of the problem. What they wanted was not the scientific background information but rather "some clear conclusions," mainly centered on the consequences of radon exposure (compared to other risk factors, such as chemical pollution, electromagnetic fields, etc.). And

they wanted reassuring information that something was being done to alleviate the problem. However, toward the end of the focus group session, after museums had been suggested as a possible source of information on the radon issue, the parents' information wishes and their expectations about what they could find at museums were more varied and included background information about the geographical distribution of radon-containing rocks, the nature of the radon gas (color, smell, chemical symbol), technical solutions for reducing the radon concentration in buildings, and a historical perspective on the radon issue. Thus, introducing the museum as a possible information source seemed to influence the parents' thoughts of what would constitute relevant information in the radon issue.

We gave the parents a list of institutions that might have competence relevant to the radon problem, and we asked them to assign the numbers 1–10 to the institutions to signify how relevant they judged each one to be as an information source concerning the radon problem at the school.<sup>12</sup> Each participant then explained which institution he or she had placed as number 1 (the institution they would first turn to) and number 10, and why they had made those priorities.

Many participants believed that the Norwegian Radiation Protection Authority would be the right place to turn. Several discussants had the Internet as their number '1' choice, and some of them based this choice on actual experiences searching for radon information on the Net. Most of the respondents placed museums near the bottom of their list (at this point in the discussion, parents were not yet aware that the project was to be centered mainly on museums).

P: But you see—museums have a certain smell that I don't like. I wouldn't have thought of them.

P: I didn't think they belonged there [on the list]

In the subsequent focus group with museum professionals, they were asked to imagine themselves as parents of children at a school with a radon problem and to complete the same task as the parents, rating 10 institutions for their perceived relevance as information sources. It turned out that the museum professionals' choices were very similar to those of the parents: The Norwegian Radiation Protection Authority and the Internet were near the top of the list, whereas museums (with one exception) were placed in the lower half of the list. This was somewhat surprising, since later in the discussion, several of the museum professionals said that they often received questions from the public, both about radon and a range of other matters.

### *Brief summary*

To sum up, most parents were relatively relaxed about the radon problem and did not express a strong wish to understand the scientific details about how the radon problem had arisen and how radon might represent a health risk. They wanted some clear conclusions, mainly centered on the particular risk to their children. However, introducing the museum as a possible information source seemed to influence the parents' thoughts of what would constitute relevant information in the radon issue.

Neither the parents nor the museum professionals saw museums as places to turn for information or solutions to a radon problem. However, since the museum professionals reported receiving frequent requests from the public regarding the radon issue, there must be at least a small segment of the public that finds museums a natural place to turn for help.

#### 4. The image of museums

We wanted to know why the parents had so little faith in museums as providers of relevant information, and we asked them to give the first two associations that came to mind concerning museums. These are some of the words that emerged:

- History (3 respondents)
- Childhood and Sunday
- Formalin smell or something. . . .
- Something in childhood. . . . only look, not touch
- Collections
- Exhibitions
- Professional knowledge

One of the parents remarked after the session had ended:

P: Museum, that's the geriatric department to me!

The parents went on to elaborate on their perception of museums as quite static and old-fashioned places with little relevance to contemporary life.

P: To me, museum is largely synonymous with history and old smell

P: It is the past

These associations were largely negative; however, the image of museums as somewhat quaint institutions also had some positive sides to it.

P: . . . the old-fashioned museums, I think it is quite fascinating, too, the way they are (. . .) walk into a world where nothing has happened.

P: It is quite good to stop the merry-go-round, that's what one does at museums.

Some participants had good memories from childhood museum visits; others had the opposite impression:

P: For me there is only one museum in Norway, and that is XX Museum (. . .) It was like a playground (. . .) it was my lucky place.

Mod.: Yes, what is the point of having museums?

P: Harassing children. . . (laughter)

Whatever the nature of the childhood memories—positive or negative—they seemed to influence strongly the adults' perception of museums. The parents' associations to the word "museum" seemed to be formed chiefly from very personal childhood experiences with museums. On the whole, discussants seemed to think of museums very much in terms of their effects on children—both on themselves as children and on their own children now.

P: I see it as a good source of information for children.

Regarding the role of museums in general as communicators of information, most parents said that museums were places for getting general information, not for getting relevant information about the details of a specific topic or situation like the radon problem at the school.

P: A museum. . . is not the place you go to get more information on a specific topic; you go if you are generally curious and. . . well, it is a bit like leafing through an encyclopedia. . . .

P: It is a good basis for searching for further information

However, it was clear that the parents did not use museums mainly for gaining information:

P: I use the Internet at work (...) but a museum is for having fun.

Some of the participants perceived that museums were currently in a process of change.

P: I would think that there has been a changing trend in museums. Earlier on, museums were... well, stuffed animals, static... now they are much more theme oriented.

P: ...you imagine mostly things that are static in a museum, right, and when we started getting museums with buttons to push, then something happened.

In the subsequent focus group session with museum professionals, some of the parents' views were presented. The museum professionals were not surprised about the parents' associations to museums as static and old-fashioned; on the contrary, they felt that such associations could be expected. Some of the museum professionals commented on the fact that children and childhood were so prominent in the parents' associations and suggested that this was something the museums should consider in their work:

M: We have to stop and consider how we can exploit the fact that children are a very important user group of our museums.

The museum professionals confirmed the impression that the historical side of museums had a strong appeal to visitors:

M: It has to do with the perception of museums—hard to associate museums with contemporary... updated information.

The museum professionals brought up the radon issue as a topic for an exhibition. An employee from the Geological Museum described his museum's exhibit on alum shale (an important source rock of radon):

M: It is a rock formed from clay and silt... that has to be displayed. It has been a raw material used in industry... that has to be shown. It develops substances that break down concrete... that has to be discussed. And fourthly, it contains uranium and is therefore a radioactive source.

This exhibit seems to reflect an encyclopedic view of what a museum exhibit should be: it should treat all sides of a given topic. Thus, the perception that museums and encyclopedias have something in common might also be implicitly assumed among museum professionals.

#### *Brief summary*

Parents associated the word "museum" with childhood and history. They saw museums as old-fashioned and static institutions, and they assessed them very much in terms of their effect on children. Furthermore, parents perceived museums as offering general background information, rather like an encyclopedia. From discussions among the museum professionals, it appeared that they, too, saw museums as important institutions for children. Moreover, the encyclopedic view of museums might also be implicitly assumed by members of this group.

## 5. Museums as sources of information

### *Experiences with two science and natural history museums*

After talking about parents' general associations and impressions of museums, we asked them if they could think of two museums in Oslo that might offer information relevant to the radon problem. Two museums came up in both focus groups: The Geological Museum and the Norwegian Museum of Science and Technology. These were exactly the two museums that the researchers wished to draw into the study. At the end of the first set of focus group sessions, participants were invited to visit one or both of the museums during the 14-day interval before the next sessions. They were provided with free tickets and given practical information concerning the two museums.

The two museums are very different: The Geological Museum belongs to the University of Oslo and is a very traditional museum with tall, wooden showcases displaying rock and mineral samples. Although the museum has made some attempts to improve the educational value of its collections, this effort is restricted by the fact that the building (including the showcases) is of historical interest and may not be changed. The museum features exhibits on alum shale (including radon) and on radioactive minerals, but offers little about the health implications of indoor radon. At the Norwegian Museum of Science and Technology (NMST), efforts have been made to include hands-on exhibits. Even if the level of interactivity is still not particularly high compared to science and technology centers abroad, the museum is at the forefront in Norway in this respect. The museum features an exhibit on radiation and the environment, in which the health effects of ionizing radiation are described, and two exhibits deal specifically with the radon problem.<sup>13</sup>

The second set of focus groups began with our request that parents give their immediate impressions of their museum visits, both the general museum experience and the perceived usefulness of the radon information that they found in each museum. Many of the parents were positive about the way information was communicated through exhibition texts at both museums:

P: If we look at that radon [section at the NMST], it was very nicely illustrated with suitable amounts of text. It is almost as if I remember what was written there! (laughter).

P: It was well designed pedagogically...such as for instance: Some rocks crack easily along one direction as compared to other directions (...) They could show actual examples of that.

A number of the parents had picked up information that they found interesting regarding ionizing radiation in general and radon in particular:

P: I saw the map of where the highest average radiation had been measured (...) Southeastern Norway was among the worst, so it's no wonder that...

P: What surprised me at the NMST was... radon stands for 50% of... all the radiation we get.

P: No, the worst source was granite (...) Alum shale, too, is... there is uranium in both of them.

Mod: Did you get that information at the Geological Museum?

P: Yes, I think it was mentioned... I didn't know that beforehand.

These pieces of information actually seemed to relate to some of the questions the parents had expressed in the first focus group session (for instance, the geographical distribution of radon-containing rocks). However, when parents summed up the radon information they had found after visits to the two museums, most of them (with a few exceptions) judged the information to be very sketchy and not very relevant:

P: Not much relevant information

P: Nothing I didn't know before

P: You could have got the exact same information anywhere else

Thus, we see that although parents seemed to find interesting (general) information at the two museums, they did not regard this information as something they could use to understand and deal with the radon problem at their children's school.

#### *Museums as opposed to other sources of information*

During the parents' discussions of museums as sources of information, museums were frequently compared with other information sources. The mass media came up repeatedly and were viewed less favorably than museums:

P: The first thing that struck me [at the radiation exhibition at the NMST] was: Oh, this should be something shocking, shocking things. But then I thought, look, you are at the Technical Museum, not in the editor's office of the *Dagbladet*. . .<sup>14</sup>

P: [the museums]. . . are more neutral ground to assess [matters] than the press. . .

The parents wished museums to be more active and visible in the media, possibly because they saw museums as serious and reliable:

P: We need someone from the museum who can really throw himself into the debate and have some fresh approaches in the newspaper. . . . I think that they [the museums] are quite silent. . . so for that reason we don't perceive them as a particular source of information.

The museum employees likewise discussed the role of museums in the mass media. They were aware that their institutions were not very visible in such contexts, and they put part of the blame on lack of time for keeping themselves sufficiently up-to-date:

M: . . . if we go out [in the media], we should be confident that we are well informed (. . .) It is good to get engaged and to use one's knowledge, but one has to be aware that in order to contribute with something, one has to spend a great deal of one's time on keeping informed to be able to say anything at all.

The Internet was used as a source of information by many of the parents, and the Internet came up repeatedly during various phases of the discussion. It seemed that the parents saw the Internet as a better source of information than museums; however, it lacked certain qualities that museums possessed:

P: The time I spent to get the same information [at the museum] was considerably longer than what I would spend to get the same information (. . .) on the Internet.

P: . . coming to the Technical Museum and seeing the airplanes and such. . . you cannot do that on the Internet. You don't get the three dimensions, you cannot touch. . . .

The parents were positive about the museums' efforts to make information available on the Internet:

P: [Museums] can make this available on the Internet, can take part in some of these discussion groups on the Internet to get in the neutral, professional contribution. (...)

The question of information at museums as opposed to the masses of information found on the Internet also concerned several of the museum professionals. It was pointed out that many museums have already developed an extensive Internet service. The museum professionals emphasized that museum objects in three dimensions were one of the main things distinguishing museums from other media as sources of information:

M: Museums are three-dimensional. ...so much comes as pictures on a screen today, so seeing it "for real" is terribly important. ...

### *Brief summary*

After a visit to two science and natural history museums, most parents were reasonably positive about the experience. However, the parents did not see the two museums they visited as providing relevant information for current issues like the radon problem at the school. Compared with the mass media, museums were seen by the parents as providing neutral and reliable information, and they wished the museums to be more active in the media. Museums could not compete with the Internet to offer lots of information quickly; however, the parents appreciated the three-dimensional nature of museum exhibits as opposed to graphics on a computer or television screen. Parents were positive about museums offering information on the Internet, and museum professionals joined them in this view.

## **6. Views on the role and aims of museums**

### *What museums are and should be*

The discussion of parents' recent museum experiences led to a more general discussion of what purpose and function museums should serve in society. The parents saw some aspects of museums' current work as very desirable, whereas other aspects of their service could be improved. It emerged from the discussion that parents felt that museums should:

- Preserve history:
  - P: The purpose of a museum, maybe that is to preserve a history that we don't want to disappear.
  - P: Museums should be places where the old and the new meet, where you can see... the continuity, the development from old [times].
- Be a source of expert knowledge and give reliable information:
  - P: It should be pertinent information (...). We expect a museum to be a place where there is expertise and where things are treated scientifically.
  - P: It doesn't have to be boring, but it should be informative and not speculative.
- Be something different from mass media and the Internet
  - P: We have enough media focusing (...). I miss pertinent information. You know you get that at a museum.
  - P: ...important not to compete with the Internet. Museums should have a somewhat different role... concentrate on popularizing and communicating difficult things in a straightforward and comprehensible way.

- Take advantage of their unique objects

P: They have so many terrific things to show (...) unique material (...) simply objects that speak for themselves. It doesn't need to be current or up-to-date. . . .

P: When [my daughter] visited the Paleontological Museum when she was 3 or 4 years old (...) she came home and talked about the skeleton in the pork chops we had for dinner. (...) Then the object has had an influence, right, and the three dimensions.

- Offer visitor activities

P: It is fun to push [buttons] myself, too. I walk around pushing everything myself and try everything to see what happens. . . .

P: . . . something new that is very popular, that is, when it is interactive, when they can push a button and then. . . . they hear sounds and things. It comes more alive that way.

- Have "a human face"

P: Maybe that's the problem with museums. . . you don't meet a face.

P: You can be sure to be quite alone there. . . .

P: One isn't used to meeting people at museums. Wouldn't go there to ask questions. . . .

When presented with these views from the parents on what museums are and should be, many museum professionals expressed agreement. They responded especially to the idea of providing reliable information:

M: I really think we should take seriously this point about reliable information.(...) What we present should be perceived as reliable.

Museum professionals emphasized that museums had to find their own unique position as something different from the news media, based on their special assets: the collections and unique objects.

M: It is the object in three dimensions that is actually our greatest asset, and it is authenticity. I think we should be better at exploiting that. . . .

M: That is what we can present in museums: Factual knowledge with the objects as points of departure.

One museum professional made it clear that even if museum communication must have objects as a point of departure, the objects must at all times be interpreted through the language and the web of associations typical of the current time.

#### *Views on the new goals for museums*

The parents were presented with a few key words from recent documents, saying that museums should be public service institutions, meeting places, arenas for public debate, dialogue institutions, and contributors to the resolution of global challenges.<sup>15</sup> When presented with these goals, most parents displayed a hesitant and somewhat doubtful attitude:

P: . . . Service institutions. . . that is like the television program "TV2 helps you". . . .

P: I reacted to this phrase about meeting places, because we were not able to visit when we wanted to (this participant had planned to visit the NMST with her children after work, but came there only to discover that the museum had closed at 4 p.m.)

P: Dialogue is best when it goes on between people. Not through posters on a wall.

P: To be a museum that is alive, I imagine that there must be people who communicate. . . a living museum, that's what I associate with it.

When asked whether the two museums they had visited were anywhere near achieving the new goals, most parents answered negatively.

P: Well, they have something to work on, to put it that way. . .

P: The NMST as compared with the Geologic Museum has moved in the direction of these goals. . .

P: If they have this as a goal, then maybe they have a couple of things to do. . . (laughter)

The museum professionals were also presented with the new goals for museums and were asked to give their reactions to these. It turned out that the phrase "service institution" puzzled the museum professionals; they expressed uncertainty regarding how to make priorities when offering service to the audience:

M: Some people call and want to know . . . and then they exclaim: "I won the bet!" . . . or they call simply to get answers to crossword puzzles (. . .) So we are back at the issue of quality and deciding for whom we shall provide service. What kind of control questions should we ask those who call us? "What do you want this information for?"

M: When do we do most for the greatest number of people? (. . .) How much time should we spend on some people's obsessions . . . that are quite legitimate and within our mission statement?

M: I want to emphasize that we gladly give these answers, but at the cost of other things.

What is expressed here is the conflict between being of service to the many (through a well-functioning museum with interesting exhibitions) and catering to the needs of the few, but demanding members of the audience with very special interests. As one of the museum professionals put it:

M: We can never satisfy the specialists, and we easily end up with stamp collecting. . .

The museum professionals were quite clear on the point that they saw the traditional tasks of museums—collecting, preserving, and exhibiting—as more important than the new goals, and as a necessary premise for the pursuit of the goals:

M: We have the problem that we are too few and we have other tasks that, at least in our case, are more important, we have to see to it that the museum is reasonably updated, and the exhibitions. (. . .) These points [the new goals] are fine, but (. . .) first and foremost we have to take care of the museum, and these things are secondarily important. . .

M: Many museums have neglected their knowledge base in running after the audience, making shows and marketing efforts. . .

One museum professional remarked that the museum's mission statement, the board, and the process of exhibit development restricted the museum with respect to being a dialogue institution responding to current issues:

M: There is something about our capacity to react quickly [to current issues]. If we look at the time it takes from when we start planning [an exhibition] until we have the opening (...) it is quite long. (...) At the same time, there are our own employees and the board who say: “No, you cannot jump from one project to another. You have to make five-year plans, and you have to stick to them”.

Thus, it seems that the organizational structure of museums may in some cases prevent them from performing the functions that are outlined in the new goals.

We asked the museum professionals whether the new goals for museums were guiding them in their daily work.

M: ... this is on a very high level, which is about completely different goals than what I think of when I get up in the morning and go to work. I am not there to solve global challenges.

### *Brief summary*

Parents felt that museums should preserve history, give reliable information, be different from the Internet and the mass media, take advantage of their unique objects, and offer activities for visitors. They missed “the human touch” at museums. Museum professionals agreed with this view and especially emphasized the aspects of giving reliable information and taking advantage of the museum’s objects. Concerning the new goals for museums, parents were doubtful of their relevance and thought the two museums they had visited had a long way to go to fulfill them.

The museum professionals, likewise, were reluctant to embrace the new goals and were particularly concerned about two aspects of the goals. First, they saw a conflict between being a service institution for a few devoted visitors with special interests and being a service institution for the many. Second, they perceived it as difficult for museums to respond quickly to new issues in society by mounting exhibitions, both because of the time it takes to finish an exhibition and because of administrative difficulties with long-term planning. For the museum professionals, the new goals were not something they related to in their daily work; the professionals regarded their traditional tasks of conservation, research, and exhibition as more important.

## **7. Discussion**

We have argued that museums’ new goals (being dialogue institutions and arenas for public debate, contributing to the resolution of global challenges, etc.) are very much in line with the efforts to increase the public’s scientific literacy, particularly civic and practical scientific literacy. In this study, we set out to explore whether two museums might contribute information that was relevant and practical regarding a science-related problem in a local community, namely radon in a school in Oslo. Five criteria were outlined that had to be met in order for museums to contribute to civic and practical scientific literacy. Let us look at whether these five conditions were fulfilled in the present case.

- Perceived need for information: Did the parents perceive a need for scientific information about radon and its consequences? No, not to any great extent. They felt that acquiring and then acting on such information was the responsibility of someone else (the experts or the school authorities). The radon problem was seen as only one of a range of risks in everyday life, and the parents admitted that even if they knew more about the problem, they might be reluctant to change their lifestyle to do something about it:

P: Even if it was proved that there was less radon in Finnmark [the northernmost part of Norway] than in Oslo, I don't think there would be a wave of emigration to Finnmark for that reason.

P: We have tenants in the basement, so I don't dare to measure there! (laughter)

Thus, it seemed that the parents were of the opinion that in some contexts it was better not to know too much.

- **Museums as sources of information:** Did the parents perceive museums as relevant sources of information concerning the radon problem at their children's school? No, definitely not. Museums were placed near the bottom of the list of possible information sources, and the parents' associations regarded museums as static and old-fashioned institutions with little relevance to contemporary life. Moreover, parents' statements about their actual use of museums revealed that their primary reasons for visiting museums were having fun and giving their children educational experiences. The public's reasons for visiting museums have previously been studied extensively, with results similar to ours.<sup>16</sup> Gaining knowledge empowering them to deal with private or civic science-related issues is not among people's reasons for visiting museums.
- **Relevant topics:** Did the two museums in our study provide information on the relevant topics (radon and the health effects of ionizing radiation)? To a limited extent, they did. Both museums had some information about radon and about ionizing radiation and its effects. The parents acknowledged this; however, they did not perceive the information as very relevant to their problem. The parents perceived museums as offering general rather than specific information (one parent compared museums with encyclopedias), whereas what they wanted for their present purpose was information specifically tied to the radon problem at the school and the health of their children. It seems that many efforts to promote scientific literacy (including traditional museum exhibitions) are built on an assumption that people are able to take general science knowledge and unproblematically apply it to specific, "real-world" problems. However, Jenkins pointed out that scientific knowledge is not very useful as a basis for action unless it is reworked and reconstructed to fit the specific problem.<sup>17</sup>
- **Form of communication:** Was the radon information in the two museums presented in a form that suited the parents? From the discussion among the parents, it appeared that many of them approved of the way the radon information was presented in the two museums; they saw the exhibit texts as pedagogically well written. Parents strongly approved of using visitor activities to make it easier and more enjoyable for the visitors to process the new information.  
Both of the museums in this study presented the radiation topics in traditional exhibition form, and none of them had any discussions, lectures, or other special arrangements elucidating this topic during the two-week interval when parents visited. One of the parents remarked that the problem with museums was that "you don't meet a face." It may be suggested that forms of communication other than the traditional exhibit form might have been more suitable to meet the parents' needs.
- **Accessibility:** Did the two museums appear practically accessible to the parents? Several parents made it clear that the museums were not the most conveniently available source of information; they thought the same information could be acquired more efficiently from other sources such as the Internet. The hours the museums were open were poorly suited to the schedules of most of our respondents, and some of them also saw the entrance fee as too high for the museum to be a preferred source of information.

*The new goals*

From the discussion of the above five points, we may conclude that the two museums in our study were relatively poorly suited to meet the parents' needs for information in the specific case of the radon issue at the school. The parents' and museum professionals' general discussions, and their reactions when presented with the new goals for museums, indicate that their attitude was not limited to the radon issue and the two museums investigated in the present study. Our respondents did not look upon museums in general as relevant sources of information concerning real-world issues.

The parents reacted with skepticism and surprise when presented with the new goals for museums, indicating that they did not see the goals as appropriate or realistic. Could the skepticism be due to the wording in the official documents describing the goals for museums? The documents are not aimed at the museum audience but at museum professionals, and so the audience may not have the same understanding of the document wording as the professionals. The discussion among the museum professionals indicated that this might be the case. One of the professionals, who had also participated in the formulation of a recent report on Norwegian museums, said the following:

M: I wish we had had such a study available when we wrote this. (...) It surprises me a bit that people think of the concept of a service institution in connection with the television program "TV2 helps you"...

Thus, one might guess that if, instead of being presented with the wording from the official documents, the parents had experienced some of these goals in actual museum practice, they might have reacted more favorably. Their skepticism toward the new goals might simply be due to lack of imagination; the respondents might have failed to see the potential museums have to extend their services. A dialogue from the last focus group with parents indicates that this may be the case. The assistant moderator gave some examples of projects that had been launched at museums abroad, for instance, clubs for parents and children on issues like local ecology, and drama sessions in the museum. One parent remarked:

P: The idea of drama... especially the coupling of drama and natural science is very little used, and I think we have a lot to gain there.

It seems that the strong associations of museums as old-fashioned, static, and impersonal institutions prevented the parents from imagining other and more active roles for museums. Once presented with the possibility of extensions of museums' regular services (such as drama), they reacted positively.

From the discussion among museum professionals, it appeared that they, too, were reluctant to embrace the new goals. Their views on the most important functions of museums were more in line with a role for museums in the cultural and professional/economic aspects of scientific literacy, which is the traditional role that museums have had since the nineteenth century.<sup>18</sup>

## **8. Implications**

On the basis of the preliminary findings of the present study, we would like to discuss some critical issues, point to some interesting areas for future research, and suggest some pertinent issues that museums may have to consider with regard to the new goals. The discussion centers on the five criteria, outlined above, that would enable museums to contribute to the practical and civic aspects of scientific literacy.

- Perceived need for information: If people, as exemplified by the respondents in our study, lack interest in understanding the scientific aspects of problems they encounter in their private or civic lives, this may seem to undermine the efforts to improve the public's scientific literacy. Lijnse et al. pointed out that if something problematic shows up in our life or world, our natural attitude makes us ask not for a scientific explanation but only for information that is necessary for us to master pragmatically the situation and to experience it as unproblematic again.<sup>19</sup> If citizens do not want the scientific information that would enable them to consider rationally the various science-related issues they face, then the whole question of whether museums may contribute in this context is rendered meaningless. This is an important dilemma that concerns not only museums but all institutions concerned with the promotion of scientific literacy. Is scientific literacy for large groups of citizens a utopia?<sup>20</sup> The relationship of lay people to science is a complex one, and more research is needed to throw light on how different audiences react when confronted with science-related issues and what kinds of strategies they adopt to deal with such issues.<sup>21</sup>
- Museums as sources of information: If the image of museums found among our respondents reflects a more widespread public image of museums (and there are indications that this may be the case<sup>22</sup>), there are at least two aspects of this image that must be addressed in the context of the new goals for museums.  
 First, an image of museums as old-fashioned, static institutions with little relevance to everyday life would prevent the audience from using the museums in accordance with the new goals. What are the sources of such an image? It appeared from our study that childhood experiences shaped parents' associations to museums. However, the image of museums may also have other sources. Merriman, from a study of the British public's attitudes to museums, concluded that "the attitudes of peers and family are important influential factors (...) as well as the images promoted by the media."<sup>23</sup> Concerning the latter, Louagie analyzed how movies create and enforce museum stereotypes in the public mind and remarked that this image was not in line with the efforts of modern museums to attract more diverse audiences and increase their role as empowering cultural brokers.<sup>24</sup> Merriman similarly hypothesized that a generally diffuse negative image affects museum participation.  
 Second, from the discussions among the parents (and also the museum professionals) in our study, it was clear that museums were assessed mainly in terms of their ability to entertain and provide educational experiences for *children*. If widespread, such a perception would pose a problem for the use of museums to promote civic and practical scientific literacy for *adults* (for instance, in connection with political issues), since adults needing scientific information as a background for political or practical action or decision making would never think of museums as places to turn. It would be interesting to see more research on the sources of the public image of museums and on how this image affects the audience's visiting patterns and their expectations of a museum visit.
- Relevant topics: Since scientific knowledge is not very useful as a basis for action unless it is reworked and reconstructed to fit the specific problem, it is relevant to ask what kinds of topics museums should address if they want to live up to the goals of empowering people to act on science-related issues.<sup>25</sup> More research is needed to throw light on how museums can respond to the audience's needs and what constitutes relevant topics for museums to apply their expertise and collections to in order to be of greatest use to their audience.
- Form of communication: In most museums, the communication between museum and visitors goes on mainly through the exhibits. If museums are to function as dialogue institutions and service institutions, however, exhibitions may not always be the most

suitable medium. Forms of communication in which the audience has a more active role, such as lectures, discussions, and workshops, might be more suitable in this context. The Internet may, in many cases, be a suitable medium for museums to present updated information on specific topics targeted at selected audience subgroups. Schweibenz offered useful insight into various aspects of museums' use of the Internet.<sup>26</sup> Each museum must, within practical and economical constraints and on the basis of audience surveys, consider which communication forms are most suitable for each particular topic it plans to address.

- **Accessibility:** This is a trivial but essential point. If museums are to function as arenas of public debate and information, they have to be open at times when adults with regular working hours can visit, and they must also in other ways facilitate a visit free of practical problems. Each museum needs to perform surveys of its own audience to find out how to become more accessible to the audience.

## **9. Summary and conclusion**

If the new goals for museums are not in accordance with the audience's and museum professionals' expectations, is it the goals that need to be changed or is it people's expectations and museum practice? In view of the arguments given above about museums' role in the pursuit of scientific literacy, we do not think that the new goals should be discarded as guidelines for museum practice. However, if the new goals are still to serve as guidelines, museums may have to reconsider their priorities regarding how they use their human, material, and financial resources in order to achieve these goals.

To sum up, the findings of the present study give rise to a range of questions that might be addressed in future research:

- Are our respondents' perceptions of museums and their reactions to the new goals shared by other audiences and groups of museum professionals?
- If people like the respondents in our sample lack interest in understanding the scientific aspects of problems they encounter in their private or civic lives, what are the scientific community, science communicators, and society at large to do? Is scientific literacy for all an impossible project?
- How does the public image of museums affect the audience's use of museums?
- How can the new goals be successfully converted to museum practice to offer information that is perceived as relevant and useful by visitors in the context of science-related issues? Good examples need to be made available.

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## **Appendix: Interview guides for the focus group sessions**

Below are the interview guides used in the three categories of focus groups conducted in the present study: the first and the second set of focus groups with parents (before and after a museum visit) and the focus group with museum professionals.

It should be noted that questions were not quoted verbatim from this guide by the moderator during focus group sessions, but were adapted to the course of the discussion. For instance, questions were omitted if the moderator deemed them to have been covered already during the preceding discussion. Each focus groups session started with a general introduction and some practical information regarding taping of the discussion, etc., before proceeding to the actual questions to be covered.

*First focus group session with parents*

1. What is your experience with having children at the X school (the school with the radon problem)?
2. Higher than desirable concentrations of radon have been detected in the classrooms at X school. How did you react when you heard this?
3. How do you think the radon problem at X school arose?
4. Now that we have acquainted ourselves with the phenomenon of radon, I would like to ask how you think the problem at X school should be dealt with?
5. Have you been sufficiently well informed about the radon issue at the school? (If you need more information, what kind of information would you like? Where would you turn to get such information?)
6. A list of 10 possible sources of information is circulated. The 10 sources are: the school with the radon problem, friends and acquaintances, the Internet, the school authorities of Oslo, the Norwegian Radiation Protection Authority, technical and natural history museums, libraries, health authorities, the Geological Survey of Norway, the University of Oslo, other (please specify).

Can you please assign the numbers 1 to 10 to these information sources in the order from the first you would turn to (number 1) to the last you would think of (number 10)? (*Participants spend a few minutes doing this.*)

Now I would like each of you in turn to say which source you have placed as number 1 and which one as number 10, and why.

7. We are particularly interested in whether **museums** may be a source of information in such a context as this. Where did you place museums on your list, and why?
8. What are the first two words that come into your mind concerning museums in general?
9. If I ask you to think of a museum in the Oslo region where you might be able to find background information about the radon issue, which museum would that be?
10. In Oslo, there are at least two museums that have some information about radon and radioactivity in rock and soil, namely the NMST and the Geological Museum. What would you expect from a visit to the NMST? What would you expect from a visit to the Geological Museum?

*Second focus group session with parents*

1. Since the last time, you have all visited a museum. We would like to hear something about what you experienced there—not only about what you have seen or learned, but also how it felt, whether it was a positive experience, whether it was nice for the children (if you brought them), and whether there were any practical problems.
2. Here is a list of some of the expectations you had about the Geological Museum last time. (*The list is circulated.*) Did your actual experiences at the museum (positive and negative) correspond to these expectations?

3. Here is a list of some of the expectations you had about the NMST last time. (*The list is circulated.*) Did your actual experiences at the museum (positive and negative) correspond to these expectations?
4. Did you find anything in the exhibitions that was relevant to the radon issue at X school? Was there something you found exciting or surprising?
5. We discussed the radon problem at X school last time because it is a problem you are faced with as parents and citizens and which you may want to do something about. We wonder whether museums might play a role in that context. We will show you a few of the aims of modern museums.

*A list of short excerpts from recent publications on the role of museums is circulated. Excerpts say that museums should be dialogue institutions, service institutions, meeting places, contributors to the resolution of global challenges, etc.*

This is what Norwegian authorities and a large, American museum organization say about what museums should aim to be. What do you think about these aims? Are they good and reasonable aims? Are the museums you visited close to achieving such aims?

6. What can museums do to get closer to the aims?
7. Concerning the radon issue, which was the point of departure for our discussion, what could a museum have done to function according to these aims? Can you imagine issues other than radon for which museums could have such a function?
8. Have any of you visited particularly successful museums in Norway or abroad? Please tell us about it! What was good about these museums? Were they places to seek out for information when having a practical problem?
9. Last time, we asked you to assign the numbers 1 to 10 to a list of institutions/information sources where you might seek information enabling you to deal with the radon issue. Where would you place museums on your list **now**?

#### *Focus group session with museum professionals*

Two prominent themes in our discussion today will be the role of museums in society and museums as sources of information. We have started from an actual issue that is related to both the NMST and the Geological Museum, namely the issue of radon, and we have had discussions with parents of children at X school, where high concentrations of radon have been detected. We have gotten a lot of information about how parents perceive the radon problem, what kind of information they would like, and where they expect to find relevant information. Furthermore, we have discussed whether museums are regarded as relevant sources of information in this context, and we have talked about how the parents view museums and their role in society. Now we would like to hear your opinions, as museum professionals, on some of the same topics. Our main focus will be the role of museums in society and the role of museums as sources of information.

1. Imagine yourself to be an “ordinary” person (not a museum professional). Your children attend X school, and you are informed that a high level of radon has been detected in some classrooms. You are interested in knowing more about this. Which sources of information would you turn to? (*The list of 10 institutions/information sources is handed out, and the museum professionals rank the 10 sources in the same way as the parents did.*) Where did you place museums on your list, and why?
2. Where do you, as museum professionals, think that museums should be on such a list?

3. We gave the parents of children at X school the same list to assign numbers to, and it turned out that most of the parents placed museums near the bottom of the list. Why do you think museums were placed so far down on the parents' list?
4. We asked the parents to say the first two words that came into their minds concerning museums. Here is a list of some of their associations.

*The list is circulated. It contains phrases such as "history," "old smell," "only look not touch," "something from childhood," "professional knowledge," etc.*

What are your reactions to these associations?

5. (*The list of aims for museums is circulated.*) How do you interpret phrases like "dialogue institution," "service institution," "meeting place?" Do you think these are appropriate aims for museums?
6. *A list is circulated of parents' reactions to the aims, illustrating that parents reacted with incomprehension and skepticism to the aims.*  
How do you interpret the parents' statements? How do they accord with your own reactions?
7. *A list is circulated of parents' statements of what museums are and should be, including comments like "preserve history," "give reliable information," "be different from the Internet and mass media," "museums lack a human face."*  
What do **you** feel that museums are and should be? What are your reactions to these statements from parents?
8. How do you see your "own" museum in relation to the new aims? Are you close to fulfilling the aims, or are the aims some way off? Do you wish to pursue these goals, or do you see other roles for museums?
9. To what extent are the aims influencing your daily work at the museum?
10. What should be done to bring museums closer to the new aims?

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