2 Representing Nanotechnology and Its Publics in the Science Museum

Science Museums for Nanotechnology

As nanotechnology became a major science policy topic and a source of public concern, science museums rapidly appeared as sites for the public display of the field. However, there is more at stake in the science museum than the passive representation of nanotechnology. This chapter argues that science museums are sites where nanotechnology is problematized. It describes how European and American science communication experts, museum staffs, scientists, and policymakers debate about and experiment with ways of bringing together the various dimensions of nanotechnology in public representations. In doing so, they question both the nature of nanotechnology and the role of the museum in democratic societies.

This dual focus is not surprising considering the many connections between the science museum and the other sites where nanotechnology is problematized. Science museums are funded by public programs or sponsored by private companies in developing nanotechnology exhibits. They actively intervene in research programs meant to explore the social "implications" or "aspects" of nanotechnology, and are called for to voice the opinions of various publics about nanotechnology. Therefore, these museums are sites where nanotechnology is problematized as a public issue worthy of public engagement, and where, simultaneously, the democratic appraisal of scientific development is put into question.

Science museums—and museums more generally—have always had connections with political institutions. Numerous works have explored the ways in which museums have become places where state power is displayed (Bennett 1995), and where visitors are turned into knowledgeable citizens (Duncan 1995; Macdonald 1996). As they consider the many connections between the public display of science in the museum and the making of the political subject, these works invite us to consider science exhibits and their

accompanying communication tools as agencements. They are instrumented sociotechnical devices that distribute agency to individual visitors and to the museum as a public institution. The agencement perspective suggests examining science exhibits not as more or less exact representations of a stable reality, but as heterogeneous devices granting particular roles for visitors, in the museum space and beyond, and problematizing the objects they display. This approach is even more fruitful when one considers the recent evolutions of science museums, which directly impact the forms of public engagement they organize. A first evolution is that "interactivity" has become a central concern of science museums. Studying science museums in France, the United Kingdom, and the United States, Andrew Barry has described interactivity as a "diagram," making the science museum a crucial site for the formation of a political subject expected not to be disciplined but authorized (Barry 2001; Callon 2004). The examples that I will describe all make interactivity a central component of the nanotechnology exhibit. They do so in different ways and for different purposes. In some cases, interactivity is a means for "informal science education." In others, it is a vehicle for the visitor to be directly part of the representation of nanotechnology, either by contributing to the exhibit, or to the making of nanotechnology public programs themselves. Interactivity, in some of the cases described in this chapter, acts as a vehicle for a new channel of public-opinion measure that is expected to have impact on decision making in public bodies.

A second evolution of the science museum relates to a shift from the representation of science as a black-boxed product toward the representation of science in the making. The former "public understanding of science" objective would now be shifting toward "public understanding of research" (Durant 2004; Lewenstein and Bonney 2004). Just as the science exhibit used to display pictures of already-made science, so it now displays pictures of science in the making. The "Open Laboratory" at the Munich Wissenschaftmuseum, where visitors can look behind glass walls at researchers working in a nanotechnology laboratory (Meyer 2009) is an illustration of this trend, which leads science museums to engage in more complex representations of science, including the display of science as a matter of controversies opening up social and ethical issues (Yaneva et al. 2009; Xperiment! 2007).

Both interactivity and the representation of science in the making are expected by their proponents to contribute to the democratization of science in science museums, no longer under the guise of public instruction but through the active participation of the visitor, who would discover

science in the making rather than science as a repository of given facts and who would possibly be offered opportunities to voice his or her opinion for public bodies to hear. The examples I will discuss in this chapter are all situated within these broader trends. But they also illustrate variations in the use of interactivity, and in their ways of representing nanotechnology as an entity in the making. These variations make comparison an interesting task. They point to differences in articulation among the initiatives undertaken in science museums, the construction of modes of intervention for the visitor, and wider choices about nanotechnology policy. Eventually, these variations relate to the ways in which science museums are expected to act as actors of democratic life—not only in their extending the scope of who has information about science, but also as they force rethinking about the exercise of citizenship and the legitimate channels for producing collective will. Thus, science museums will appear throughout this chapter as crucial sites for understanding ongoing evolutions of contemporary democracies.

Representing Nanotechnology, Turning Science Museum Visitors into Debating Citizens

A French Science Center in the Midst of Nanotechnology Developments

The Grenoble *Centre de Culture Scientifique, Technique et Industrielle* (Center for Scientific, Technical, and Industrial Culture, CCSTI) is a relatively small science center. About twenty people work full time for the CCSTI, and Laurent Chicoineau, its director, is one of the youngest members of the association of the French science centers' heads.[1] Trained in communication science and in regular contact with natural and social scientists, he outlined during an interview a vision of the science center based on interaction and participation: "So many museums are repositories of objects for the visitors to admire. It is not how I imagine the mission of the science center. For me, the science center is a place where people think about, interact with, participate in scientific research."[2]

For Chicoineau, the science center had a "democratic role to play," which could not be limited to a model based on public education. He saw the redefinition of the role of the science museum in conjunction with the intervention of his science center in the public display of nanotechnology. Since the early 2000s the Grenoble CCSTI has proposed several nanotechnology projects to institutional funders (above all, the regional council) and private sponsors. In 2004, it launched a new exhibit devoted

to nanotechnology, which then circulated in the Bordeaux CCSTI and at the Paris *Cité des Sciences et de l'Industrie*.

These initiatives were tightly connected to the policy and industry scenes at local and national levels. They depended on external funding, which were provided by public research bodies and private companies. They included researchers and policy-makers in their design and conduct. In Grenoble, the most visible of these connections was with the Commissariat à l'Energie Atomique (CEA), a national public research institution that had diversified its activities from nuclear energy to the whole range of emerging technologies, and had become a central actor in the French nanotechnology activities, particularly through its Grenoble-based laboratories. Private companies were also included, but their participation was ambiguous. Some of them contributed financially to the exhibit and participated in its design without appearing as sponsors. Others used the opportunity to display their activities in the field of nanotechnology. For instance, a chemical company was a partner of the Bordeaux stop of the nanotechnology exhibit. This company added several panels to the original exhibit, in which it explained why its production of carbon nanotubes was indeed applied nanotechnology, and what its choices were in order to ensure that the production met safety criteria.

The participation in the nanotechnology exhibit was both a financial requirement for the Grenoble science center and a strategic decision for the sponsors. For nanotechnology was a hot topic in Grenoble. Large-scale research nanotechnology projects had been led by the CEA since the end of the 1990s, and had been met by highly visible contestation. Hence, the exhibit was explicitly conceived as an answer to the local anti-nanotechnology activism among other communication initiatives. As it circulated in Bordeaux and Paris, the exhibit was conceived as a basis for public discussions, which took the form of discussion groups involving visitors in Bordeaux, and, in Paris, a two-day public event involving various stakeholders.

New Representations of Science, New Roles for Visitors

A primary concern of the designers of the exhibit was to "connect the representation of the making of nano objects with that of the questions for public debate."[3] The "connection" at stake here was inscribed in some of the devices used in the exhibit, which were meant to display "what nanotechnology does" rather than "what it is." This alternative was regularly mentioned in the preparatory documents. Displaying "what nanotechnology does" related to the epistemological nature of nanotechnology as a

scientific discipline based on instrumented practices. The physicist involved in the preparation of the exhibit defined nanotechnology as a matter of intervention on and control of physical matter at the atomic scale, with the help of tools such as the scanning tunneling microscope (STM). The STM pictures individual atoms by displacing them, and thereby renders obsolete the distinction between observation and intervention. It implies coping with physical forces that have different properties than at the macroscale. Therefore, representing nanotechnology was, for the physicists involved, representing how these forces apply. The exhibit's mottos were "seeing through touch"[4] and "seeing and manipulating the invisible."[5] These phrases, which resembled those used by nanotechnology scientists in policy arenas, related both to the nature of nanotechnology as a scientific field and to the set of its potential applications. They referred to interactive devices introduced in the exhibit, and meant to represent nanotechnology by letting the visitor act and experience the action of physical forces at the atomic scale. Some of these devices were quite simple, others more sophisticated. Examples of the former included a boxing glove to be used by visitors to move Lego-like colored objects. They could thus feel what it was like to manipulate matters while being hindered by physical constraints similar to those researchers faced when working at the nanoscale. A more sophisticated tool was a so-called "nanomanipulator" which consisted of a screen on which users could see the moves of a virtual scanning tunneling microscope, and a joystick that visitors could use to move the tip of the microscope and feel the resistance of the atoms thereby displaced—this resistance being quite different from that of macroscale objects because of quantum effects. As the visitor could use the nanomanipulator, he would "notice that nanotechnology was about building, that it was not (...) about picturing reality but really constructing new ones, new applications."[6] The nanomanipulator had been developed by scientific researchers interested in the control of instruments for use at the nanoscale (Marlière et al. 2004). For its designers, the nanomanipulator was supposed to enact a representation of nanotechnology that was not based on the passive representation of nature, but rather was involved in the actual manipulation of objects.

In the nanotechnology exhibit, interactivity was the necessary condition to represent what the physicists considered one of the characteristics of nanotechnology, namely the actual building of matter rather than the representation of a given reality. The representation of nanotechnology that the nanomanipulator enacted meant both displaying and practicing nanotechnology, in ways that mirrored the intervention on which the

scientific practices of the field are based.[7] It situated the science center in the midst of the development of nanotechnology. The nanomanipulator was not a mere educational tool for exhibit visitors, but it was also expected to be used by students and experimenters. It was the object of numerous scientific publications (e.g.,Marchi et al. 2005; Marlière et al. 2004) and was circulating in laboratories, as a device expected to train students and scientists in the manipulation of scanning probe microscopes.

Interactivity as performed through the nanomanipulor made it possible to connect the representation of nanotechnology as a technological practice with an interrogation about the potential uses of nanotechnology applications. The visitor was thus expected to initiate his or her reflection about nanotechnology's related concerns. The designing team raised these questions early in the preparation of the exhibit. Eventually, several industrial applications of nanotechnology (e.g., electronic chips, high-performance ceramics, provided by the private companies that were partners of the exhibit) were displayed close to the nanomanipulator. The idea of the exhibit planners was, in the continuity of the nanomanipulator, to use applications as entry points to make visitors think about nanotechnology's future technological developments, but also the future they themselves envisioned.

Practicing and Displaying Public Debate

The representation of nanotechnology within the Grenoble science center articulated the epistemological transformation of scientific practices with the evolution of the expected political role of visitors. Interactivity was meant to transform the nature of representation, the position of the science center, and the role of the visitor. Other components of the exhibit were also participating in this redefinition. For instance, spectacular pictures of nanotechnology were displayed within the exhibit as a way of connecting the representation of science as a laboratory practice and that of science policy as an enterprise producing pictures expected to convince policymakers of the value of the field.[8] The nanomanipulator was accompanied by numerous interactive devices intended to make the visitor reflect on his or her attitude toward technology, such as interactive questionnaires about the use of technology. The questionnaires had been prepared by sociologists, and watched closely by the industrial partners of the exhibit, for whom it raised a marketing interest. It aimed to include the opinions of the visitors to the exhibit, who could then participate in yet another interactive activity. Through these questionnaires, the visitors' opinions became a component of the exhibit: representing

nanotechnology was also representing various opinions about technology development. This contributed to one of the main concerns of the exhibit's designers, that the exhibit was supposed to turn visitors into "debating citizens."

Creating these debating citizens is an evolution from a public instruction agencement that the French science museum has long been accustomed to (Bensaude-Vincent 2000; Callon 1998). It is situated within a broader interest in interactivity that national science museums such as the Paris *Cité des Sciences* have been pursuing since the late 1980s. Yet interactivity, in the Grenoble science center, held a specific role. It connected the representation of nanotechnology with that of its debating publics. A technique for the making of debating citizens was a device called *petits papiers (*"little notes") by the organizers. Paper sheets were provided at the end of the exhibit for visitors to leave written notes, which were then displayed as part of the exhibit and examined by sociologists.

The agencement that emerges out of the Grenoble exhibit uses interactivity as a way of integrating the visitor into the representation of nanotechnology. It does not display nanotechnology as a set of given scientific facts, but as an association of objects to be acted upon, imaginaries of future developments, public concerns, and debates. Neither does it attempt to represent "science in the making" or "controversies" as if they could be displayed at a distance.[9] This agencement makes nanotechnology a problem of experimenting with the channels of representation. That the science museum has a "democratic role" to play, as the director of the Grenoble science center believes, does not mean that the visitor could directly contribute to local or national policymaking, but that she is made a debating citizen within the space of the science museum, then better equipped for participating in public discussions.

In later projects conducted by the Grenoble science center, visitors were offered the possibility to design objects meant to be included in public exhibits about nanotechnology, and contests were organized for students to produce films or artifacts about issues related to nanotechnology. I attended the closing session of one of these projects in the spring of 2009. Participants proposed prototypes, films, and scenarios in which they presented what they expected from nanotechnology. Somewhat ironically, the winners were a team of high school students who had displayed in a film an imaginary capsule within which people could live "without nanotechnology." But there is no irony if one situates this intervention within the agencement the Grenoble science center constructed, within which visitors were turned into debating citizens, practicing the debate about

nanotechnology at the same time they participated in its display. It was then entirely consistent that the imaginary "nanotech-free" space was rewarded as a contribution to the nanotechnology debate, and a visual proof that living in a world where nanotechnology had been developed was possible even for people who did not want it.

An Experimental Democratic Agencement and Its Critics

There were real people in Grenoble who did not want nanotechnology, however, and these people were critical of the Grenoble exhibit. They were anti-nanotechnology activists—the very people to whom the nanotechnology exhibit was supposed to respond. Activist groups in Grenoble were opposed to nanotechnology research, and were attentive to the activities directed toward publicizing nanotechnology. They had published online texts that directly targeted the Grenoble science center and the communication policy of CEA. They had criticized other dialogue experiments that Grenoble's local elected bodies had attempted to organize, and had set up demonstrations on the construction site of a research center expected to be a major nanotechnology center in Europe.[10] The director of the CCSTI, who expected potential demonstrations, requested "special protection" for the opening ceremony of the nanotechnology exhibit, as he "feared for the safety of the guests."[11] Numerous policemen were present during the official opening event of the exhibit. The activists reacted by pointing to the material display of the connection between the Grenoble science center and the public bodies that, according to them, were supporting nanotechnology development without democratic control.[12]

The Grenoble science center was directly targeted in the fall of 2009.[13] Red paint was projected on its walls, and leaflets were left in front of the main entrance. Signed by a "collective for citizen debate" (*collectif débat citoyen*), they explained that the museum was targeted since it was "a symbol of the acceptabilization [*acceptabilisation*] campaign orchestrated around nanotechnology," meant to "prevent social mobilization" against a technological domain that caused health risks and was developed for economic or military interests. Laurent Chicoineau, the director of the science center, answered on his blog, and clearly situated the locus of the confrontation. For him, being "anonymous," as the collective was, and using "violence" (albeit without much consequence for anyone), was a "curious way to defend democracy."[14] Democracy was, for him, precisely what his science center was doing. Hence the opposition: for the activists, the French science museums could not pretend in any way their activities were intended to ensure a democratic appraisal of nanotechnology. The democratic model

that the nanotechnology exhibit was constructing, based on the production of representations by visitors themselves, and on the display and practice of debate within the exhibit or in close connection to it, was not accepted by the activists, who considered that their role, as engaged citizens, was to perform a critique of nanotechnology from an exterior position.

The stability of the agencement making interactivity a condition for the formation of debating citizens was also threatened from the inside. At the Paris *Cité des Sciences*, a "totem"—as it was called—was added to the exhibit. It was a tower with large-scale pictures of nanotechnology applications, illuminated from the inside, facing a pool of water where lotus leaves represented "an example of complete natural molecular assemblages."[15] This two-part addition to the original exhibit led the visitor to be puzzled by the beauty of nature, and even more by the mythical power of science, able to transform nature and make it realize its otherwise silent potentialities. The totem situated the exhibit at an objectifying distance from both nature and science. It became a physical place where the passive beauties of the former and the active marvels of the latter were to be displayed. For the museum staff in Grenoble and Bordeaux, this was at odds with how they had attempted to problematize nanotechnology. The totem made the science center an external place where the visitor was not the debating citizen they had hoped to enact, but rather a passive spectator of science and nature conceived as unproblematic sources of admiration.

Facing external criticisms and internal misunderstandings, the Grenoble science center's attempts at redefining the representation of science and transforming visitors into debating citizens are not grounded on stable institutional infrastructures. They are rather experimental forays into a redefinition of the role of the science center in France, based on the problematization of nanotechnology (and more generally, technological development) as a matter of multiple representations, including that of the public debate. This redefinition makes the problematization of nanotechnology in the French science center quite different from other examples, as those of European projects will show.

From the Representation of Nanotechnology to That of Its European Publics

The Grenoble science center was an active partner in European projects devoted to the Ethical, Legal and Social Aspects (ELSA) of nanotechnology. One of them, called Nanodialogue, was a project that Chicoineau, director

of the Grenoble science center, saw as an opportunity to "pursue with European partners the initiatives undertaken in the Grenoble area."[16] Yet he became more and more skeptical as the project evolved, for reasons that will be discussed later. Nanodialogue ended up problematizing nanotechnology in a different way than in Grenoble. As one of the first European ELSA projects and a first step in the development of the European approach toward the communication of nanotechnology, Nanodialogue is a site where the problem of the integration of ELSA into nanotechnology was particularly visible.[17]

The Nanodialogue Project: Interactivity, ELSA, and Public Opinion

Together with the concern for the "ethical issues" that were supposed to be taken care of by dedicated bodies within the European science policy organizations, the stress put on "dialogue" in nanotechnology policy documents makes nanotechnology a case among many others in the European science policy landscape. As a Nanodialogue presentation leaflet of explained: "Engaging citizens in dialogue and discussions about science and technology has been recognized by the European Commission as a fundamental component to create the knowledge economy and the basis of the European Union's Lisbon agenda."[18]

The Lisbon agenda, launched in 2000 by the European Council, had indeed called for the transformation of Europe into a "knowledge-based economy," and of the European public into a "knowledge society." In this approach, "dialogue" among scientists, policymakers, and the European public was an important component. Nanodialogue was situated within these objectives. Early on, the project was meant to be a response to the shortcomings of "traditional modes of government." As opposed to "hierarchical, state-led decision-making processes," Nanodialogue was based on a call for "new forms of governance (...) based on networking among stakeholders, on the integration of interests, and on the involvement of citizens and consumers in the implementation of policies." (ibid, 4). The project was based on the hypothesis that public participation had value, in a context described as that of great public concern for the potential implications of scientific research.

A team of sociologists, led by Simon Joss, participated in Nanodialogue. Joss, an internationally known specialist of public participation,[19] had written on consensus conferences, was participating at that time in another European project called CIPAST to train officials and academics in the practice of public participation in science and technology, and was interested in the "democratic ambition" of the Nanodialogue project. He made that clear

to me when I met him for an interview: "At the time I thought 'well this is really innovative.' (...) It's a knowledge transfer project where educationists, museum specialists, social scientists, and technology experts come together and try to explore the development of new types of interaction. (...) I thought 'it's exciting, you can do something. Maybe you can work on, you know, democratizing nanotechnology."[20]

When the project started, it was evident for everybody (whether partners within the project or program officers in the European Commission's Directorate-General for Research and Innovation) that "democracy on nanotechnology" was to be constructed, and that it had to be done in conjunction with the examination of the ELSA of nanotechnology.

The "democratic component" was an object of discussion among the project members, who considered that the Nanodialogue exhibit was to "make people realize that they were taking part in a democratic process."[21] As in the Grenoble exhibit, interactivity was explicitly linked with a democratic ambition. But whereas the Grenoble science center connected interactivity with the problematization of nanotechnology as a scientific practice blending representation and intervention in the physical as well as in the social world, the problems raised by Nanodialogue revolved around the nature of nanotechnology's ELSA and the way of integrating its aspects within the exhibit.

Within Nanodialogue, the problems of representing nanotechnology in the science museum were related to the appropriate level of content related to nanotechnology's ELSA. Participants in the project argued over the treatment of the original focus on the "societal implications" of nanotechnology.[22] These concerns eventually led the designers of the exhibit to add panels on the "risks" and "ethical" issues of nanotechnology. Some participants in the project considered that this addition was too superficial. But for others, nanotechnology's ELSA was far too visible in the exhibit. The Italian coordinator thus explained during an interview:[23]

> We had contacts with scientists. For instance those we work with here. And many of them thought it was way too much about the risk and ethical issues. (...) Cos', you know, ... all the exhibit would say: "there are biomedical applications," and then "and there are all these ethics questions"; "there are these daily life applications, like energy storage," and then "but technology might have safety risks."... And for many scientists, that was just too much insistence on the "ELSA" part, it was not about nanotechnology at all.

This last quote is revealing. It shows that the discussions about the representation of nanotechnology in the science museum within

Nanodialogue shifted toward discussions about the appropriate ELSA component. Representing nanotechnology in the Europe science museum became representing its ELSA. But while the connection between visitors' opinions and policymaking was never an issue in Grenoble, the focus on ELSA was complemented by devices expected to make the European public speak, and expected to realize the democratic ambition the project had been based on.

From the beginning of Nanodialogue, the production of recommendations meant to be transferred to the European Commission was indeed an objective. These recommendations were eventually produced through focus groups, coordinated by the team of sociologists involved in the project and led by each participating science center. These focus groups were meant to present the "viewpoint of the European citizen on nanotechnology" to the European Commission.[24] The recommendations eventually presented to the EC were mostly general lessons compatible with the Action Plan. They insisted on the necessary "precaution" to adopt in order to develop nanotechnology, and identified more "benefits" than "risks." They were not considered as more than a "snapshot" by the sociologists involved.[25] One could easily identify the ways in which the guidelines of the focus groups distributed to the participating science centers determined the final outcomes.[26] But what matters here is less their unsurprising content than what they say about the problematization of nanotechnology that resulted from Nanodialogue: nanotechnology was both a matter of ELSA and an issue of public opinion.

At the final conference of the project in the European Commission headquarters in Brussels, it became clear that the European public opinion was to be measured in more sophisticated details. Simon Joss argued that it was important "to develop notions of the publics, in plural terms, to recognize that the public comes in different forms and shapes and that therefore developing governance modes needs to recognize there's a plurality of the public."[27] This call was just one manifestation of a more general concern for the connection between the problematization of nanotechnology in the terms of its ELSA, and that of European publics expected to have a say about the development of nanotechnology.

Nanodialogue as an Experiment for the European Nanotechnology Communication Policy

As one of the first European projects in both nanotechnology communication and nanotechnology "societal implications," the Nanodialogue project is of particular interest because it served as a rehearsal of the European

strategy in nanotechnology communication. As with other projects devoted to nanotechnology's ELSA that put an emphasis on dialogue,[28] the Nanodialogue experience circulated widely in the communication of the nanotechnology and converging science and technology unit in charge of the European initiatives in nanotechnology at the Directorate-General for Research and Innovation of the European Commission. Nanodialogue was presented repeatedly at international conferences on science communication, and various European initiatives made use of the project. For instance, CIPAST, the European training program in participatory instruments, had participants discuss Nanodialogue under the supervision of Simon Joss. At this point, the project had become the topic of a typical case that could be used as an example presented to would-be organizers of participatory devices.

The conclusions of Nanodialogue were supposed to feed the further construction of the EU policy on nanotechnology. Immediately after the final conference of the project, a workshop was held in Brussels that gathered project participants, European officials, and experts in science communication. The workshop resulted in a working paper on developing a strategy for communication outreach in technology (Bonazzi 2007). This working paper was later refined and developed into a document written by Matteo Bonnazi, officer at the DG for Research and Innovation of the European Commission.

This report, entitled *Communicating Nanotechnology* (Bonazzi 2010) outlined the "communication roadmap" that was to frame the strategy of the European Commission on the communication of nanotechnology. This strategy was based on a "new mood of communication (...) based on dialogue" and the report stipulated that "instead of the one-way, top-down process of seeking to increase people's understanding of science, a two-way iterating dialogue must be addressed, where those seeking to communicate the wonders of their science, also listen to the perceptions, concerns and expectations of society. (...) This should enable to settle a sound basis for reaching consensus, achieving sustainable governance and social acceptance for nanotechnologies and nanosciences" (Bonazzi 2007, 10).

The report thus pursued some of the issues that had been central in the Nanodialogue project, namely "dialogue" and the evaluation of "perceptions, concerns and expectations of society." It considered science communication "as part of the research process itself."

That nanotechnology communication was "part of the research itself" was rendered possible—at least institutionally—by the fact that the mandate to the European Commission defined a "double role for the Nano and Converging Sciences and Technologies Unit" (the expression was

Bonnazzi's[29]) in the Action Plan. The unit was expected to define calls for scientific research projects, and, at the same time, had to work on communication. Crafting communication coming "from the very core of research," as Bonnazzi said to me, implied that the Nanotechnology and Converging Sciences and Technology Unit at the EC's Directorate-General for Research and Innovation was also in charge of "science and society" topics, as the reorganizations of the DG had just made possible.[30]

The roadmap for nanotechnology communication defined the "goal of communicating" as a "gain in EC image," particularly as far as "transparency, credibility and accountability" were concerned (Bonazzi 2010, 71). The hope was that the "consensus-based support to EU policy-making on responsible nanotechnology within society" could be increased (ibid.). In order to do so, the roadmap proposed extremely simple messages to convey:

Nano is: **not** magic;

Nano is: **a new phase of technology** exploiting nanoscale effects;

It deals with new: **beneficial applications and markets**, impacting on **health, safety, privacy, ethics, and the socioeconomic divide**;

It: **must and can** be controlled and driven conscientiously. (Bonazzi 2010, 106; emphasis in the original)

For all their simplicity, these messages also insisted on some of the main focuses of Nanodialogue, namely ELSA and the fact that nanotechnology was a program open to conscious direction. Eventually, the content of the "main message" was not the most problematic point of the roadmap, which considered nanotechnology as either a set of scientific objects and domains that could be described, or a source of potential uncertainties that raised ELSA aspects. Rather, all the work to be done was to identify potential "targeted audiences" (e.g., "youngsters," "media" or "NGOs"), potential communication techniques (primarily "two-way methods" such as "dialogue" and "participatory" devices), and linked the first with the second. Instead of developing the ways in which nanotechnology could be represented in science museums, the bulk of the "communication roadmap" was about distinguishing between types of audiences (e.g., "children," "youngsters," "scientists," "NGOs"). It could then provide synthetic tables of European initiatives in the communication of nanotechnology, which were classified according to their "targeted audiences." From Nanodialogue to the European roadmap, the main concern had shifted from the representation of science to that of its publics.

This shift was described, in the roadmap, as an evolution "from 'public understanding of science' to 'scientific understanding of the public.'" This move implied that the "public" was to be scientifically known, in ways that also allowed "dialogue" and "exchange of information." Dialogue, in this model, is used as a way of getting knowledge about the public, to be attentive to its "expectations and concerns." It is an instrument in which the "main message" to communicate to the public is not questioned. Hence, the "scientific understanding of the public" tailors the activity of representation no longer toward nanotechnology, but to a European society whose interest in nanotechnology needs to grow. For the head of the Nanotechnology and Converging Technologies Unit at the DG, what was to be constructed through the "scientific understanding of the public" was nothing less than "technical democracy": "These tools will allow a technical democracy platform to be put in place: public opinion will be monitored on a continuous basis through Web-based measures that could be picked up by other media. (...) (They) will make the platform one of the most appropriate means to monitor what people really think about nanotechnologies and promote evidence-based dialogue" (ibid., 152).

Here, the "evidence-based dialogue" is not problematic because of the representation of nanotechnology but because of that of "the public." "Continuous monitoring" can thus appear to solve the "problem of representation" (an expression used by an EU official during an interview) that EU officials have regarding the organizations from civil society they are in contact with. One of them noted: "That's an issue here, it's always the same kind of people, over and over again. We do a meeting open to civil society, we request comments. . . . And we can guess in advance who's gonna show up. They're always the same, Friends of the Earth, maybe Greenpeace, ... And what we want is talking to the European public, to the real European public."[31]

Defining the "real European public" of nanotechnology and the infrastructure able to make it speak to the European institutions is an important issue. It problematizes nanotechnology in ways that define who is entitled to speak to the European institutions, and for what results. For that matter, the European civil servant in charge of nanotechnology who voiced this concern for the "real European public"[32] was skeptical about the value of "dialogue," if it was to be held with established stakeholders. What made the public "really European" was, for him, less the fact that participants in dialogue knew and mobilized on nanotechnology, as many NGOs intervening in the debates about the European regulation of nanomaterials do (see chapter 3), than their being "as diverse as the European society is."

Making (Nano)technology Research European

The ongoing process intended to provide continuous feedback of public opinion on nanotechnology has several objectives. The Directorate-General for Research and Innovation hopes to be able to correct the misrepresentations of the public, but also to develop certain areas of nanotechnology rather than others. Talking about a call for project he was crafting, a EU official at the DG recently explained during an interview:

> If we are not able to give the possibility to the public that is participating in the dialogue to really see that what they are dialoging on is put into concrete policy action, there's no need. So if at the end of the story we have a book, it's a failure. So the condition I'm putting in this call is the following one: that the successful projects (...) will provide evidence that there is a link between what is being discussed and what is going into the changing, or re-addressing, or reinforcement of the current EU policy. That means on current funding lines for nanotechnology. I'm putting this as a condition, it's something quite new that engages not only the public but also ourselves, the regulators. (...) So, for sure, the main input of this will be on funding research. So if the public, or those publics, or different member states, say to us "please don't do research on nanofood," we will not spend any single euro on nanofood.[33]

Nanotechnology forced the DG to refine the representation of nanotechnology: as a science policy program defined by the amount of funding it was granted, as a topic of potential public sensitivity, the issue with how nanotechnology is represented became less that of the representation of science than of the correct representation of public opinion. It is in that sense that nanotechnology is an opportunity to construct a "technical democracy."[34] In this technical democracy, the scientific understanding of the public (rather than the negotiation among stakeholders) is expected to contribute to the making of European nanotechnology policies. In this process (and one can trace it back to the early European project on the "societal implications of nanotechnology"), the scientific representation of the public is built on the exact same theoretical basis as public understanding of science: the problem is to ensure the faithful, at-a-distance representation of an object the existence of which is not problematized. Thus, the initial interrogations about the "democratic ambition" of nanotechnology policy that were made explicit during the Nanodialogue project appear to be solved: the "scientific understanding of the public" is expected to connect the European nanotechnology policy with its publics, and the whole process implies shifting from the representation of nanotechnology to that of the European public. The "democratic ambition" thereby translates into the production of new channels of political legitimacy: the representation

of nanotechnology and its implications need to be ensured, while the scientific representation of the public is expected to ground the formation of a European polity.

Hence, it is now possible to better understand the idea of integrating nanotechnology communication "at the core of scientific research." This integration implies the problematization of nanotechnology in the terms of the examination of its ELSA, and the representation of the "European public." It is based on a well-specified distribution of roles, where the Directorate-General on Research and Innovation of the European Commission needs to gather information about the nature of nanotechnology's ELSA (possibly through social scientific expertise) and public opinion about potential science policy options. This implies an institutional evolution making it possible for science policy offices to deal with "science and society" issues, and also that European nanotechnology policy has the capability to react once a sign of social concern is perceived, either to commission risk studies, or to redirect funding to certain areas rather than others.

An American Expertise in Informal Science Education

In March 2009, I met Margaret Glass, the coordinator of a network of American science museums involved in nanotechnology activities—the NISE (National Informal Science Education) network. When she learned that I was interested in the connections between science museums and nanotechnology policy, she immediately compared the American museums with their European counterparts:

> In Europe, (...) policymakers want to listen to what people say. Science centers have a real grip on nanotechnology governance, you know, and the EU wants them to help them ... you know ... help identify what people's concerns are. We don't have, for instance, Nanodialogue where the EC set that up and asked for recommendations about policy. That's the missing link in the U.S., we have no feedback mechanism to policymakers. I mean we can present (something) to them, but then they'll have to listen. And they're not asking. The difference is that nobody has asked us.[35]

The difference between the NISE network and the European approach to the role of science centers in nanotechnology policy seemed clear for her. Whereas European policymakers were funding science museums to represent nanotechnology for the public, as well as, if not more than to represent public concerns and expectations for policymakers, she felt that the American science centers were isolated from the actual making of American nanotechnology policy. The roles of the American science center and the

problematization of nanotechnology that it enacts are indeed quite different from what we have encountered so far. In American as in European science museums, interactivity is heralded as a necessity, and the representation of nanotechnology as a scientific field is discussed. But the American museums, through the NISE networks, problematize nanotechnology neither as an issue of representation of a heterogeneous entity in the making, nor as a matter of ELSA, but rather as a distinct scientific domain for which "informal science education" is required.

Representing Nanotechnology through the NISE Network

Reflections on the representation of nanotechnology occurred at an early stage in the construction of U.S. nanotechnology policy. In September 2004, a workshop organized by the National Nanotechnology Initiative (NNI) was held in Arlington to explore the "opportunities and challenges of creating an infrastructure for public engagement in nanoscale science and engineering." (Chang and Semper 2004). The workshop gathered about fifteen science museum representatives, and NSF high-level staff, including its director, Mihail Roco. "Public engagement" was indeed considered a "priority" for the federal program, since the "societal issues" make it "critical for NSF" to "engage public audiences" (ibid., 4). Indeed, the whole workshop was structured around the various audiences that needed to be taught about nanoscale science and engineering ("teachers," "K-16 students," "general public," "workforce," "community and public leaders" and "scientists") (ibid., 7). The division according to "audiences" is familiar: we already saw it at play in the case of the European nanotechnology communication roadmap. Yet the perspective was quite different in the 2004 Arlington meeting: the workshop mobilized the various concepts of the so-called "deficit model" that the European actors were keen not to use. The objective was to "reduce irrational fears," foster "nano interest" and "nano literacy," in a context where the American nanotechnology program needed students, workers, and consumers (ibid.).

This definition of the problem of public engagement in nanotechnology was consistent with the objective of a network of museums specialized in "informal science education." In 2003, four museums of science (the Boston Museum of Science, the Exploratorium in San Francisco, the Science Museum of Minnesota, and the Oregon Museum of Science and Industry) gathered within the Network for Informal Science Education (NISE) received $750,000 of funding for the following fiscal year, with the objective to "promote public understanding of nanoscale science and engineering concepts,

scientific processes, and applications to society. The purpose of these efforts is to ensure that the public is kept abreast of advances in the field."[36]

The focus on public understanding of nanoscale science and engineering led program officers at NSF to raise issues about how to represent nanotechnology in the science center. They insisted on the work needed to represent "how size can make a difference in the properties of materials," but also to "appreciate the interdisciplinary nature of nanoscale science and engineering" (ibid.).

Other partners then joined the four initial NISE members. In 2009, about twenty museums were involved in the activities of the NISE network, which had received more than $20 million from the National Science Foundation for five years of funding.[37] Contrary to the projects we have encountered so far, the NISE network was not conceived around the collaborative design and staging of exhibits. NISE is above all a coordination tool that allows American science centers to share exhibit modules about nanotechnology developed by some of the partners, and methods and tools for "public engagement in nanotechnology." The network also distributes ready-made layouts of oral intervention, such as an "Introduction to Nanotechnology" speech, with associated PowerPoint presentations. Each of the components of the NISE production is accompanied by standardized evaluation grids, which, once filled out, are used by the network to refine its offers. The most important common event organized under the NISE umbrella is the annual *Nanodays*, during which activities and exhibits are organized throughout the country in science centers. During this week-long event, which in 2009 involved about two hundred science centers across the United States, highlights include displaying nanotechnology applications, organizing children activities such as building a human-sized model of carbon nanotubes, holding public conferences, and distributing stickers that read "I'm made of atoms."

NISE was funded, within the NNI, through the Nanoscale Science and Engineering Education Program.[38] The NNI emphasizes "informal" alongside "formal" educational activities. This is what a brochure published by NISE argued:

> One benefit of a more scientifically literate public is increased support for funding of research. A substantial majority of Americans support government spending for scientific research, including basic scientific research. The better our research and its implications for society are understood, the better the general public can make responsible decisions about public funding. (...) Another motivating factor is to encourage the next generation of scientists. We need children to consider and pursue careers in science and engineering.[39]

Hence, informal science education too could transform the visitor to a science center into a potential supporter, a future scientist, a citizen participating in her country's political life, or a consumer of nanotechnology products. This implied developing ways to make sure it could happen.

Representing Nanotechnology for a Responsible Citizen

The first task of the members of the NISE network was to identify the "important messages" to convey to the American public. Crafted with the help of a group of scientific advisors, the "messages" were eventually the following:

Nanoscale effects occur in many places. Some are natural, everyday occurrences; others are the result of cutting-edge research.
Many materials exhibit startling properties at the nanoscale.
Nanotechnology means working at small-size scales, manipulating materials to exhibit new properties.
Nanoscale research is a people story.
No one knows what nanoscale research may discover, or how it may be applied.
How will nano affect you?[40]

One can compare these "messages" with the multiple representations of the Grenoble nanotechnology exhibit, and the stress put on the ethical, social, and legal implications of nanotechnology in the European projects. They did not hint at the diversity of nanotechnology (comprising industrial applications, science policy programs, public concerns, or debates) represented through the multiple channels of representations in the Grenoble exhibit. Nor did they focus on the ELSA the European science museums were so concerned about. Indeed, the "messages" developed and supposed to be transmitted through the NISE network partners were all about "what nanotechnology really was" in order for the visitor "to make up his mind and act as a responsible citizen."[41] The reality of nanotechnology, then, was about the "nanoscale": nanotechnology was only characterized by the atomic scale of observation and action. Therefore, it made no sense in this perspective to inquire into the collective construction of objects and concerns (as in Grenoble) or into the direction of science policy programs (as in Europe). The nanoscale was a domain out there explored by scientists (and this is the reason why it was "a people story") who entered a new world where "no one knew what would be discovered."

Accordingly, what was supposed to be provided for the citizen was reliable scientific information, rather than reflections on the potential impacts on nanotechnology.[42] Consequently, the productions of the NISE network

(which are rather those of each separate partner) focused on the correct description of nanotechnology research practice and industrial applications. The collaboration with science laboratories was heralded as a key objective of "informal science education," both for scientists to use expertise about how to communicate to the public, and for museums to make sure the scientific content of their exhibits and activities was consistent.[43] Ready-made exhibition components were proposed to the NISE members, with all the descriptions and instructions provided on the NISE website. They were peer reviewed by external scientific advisors, and evaluated by the partnering museums through the web platform, thereby ensuring that "learning goals" were met. For instance, the NISE website presented an "Introduction to Nanotechnology Exhibition" proposed to instruct visitors that "things at the nanoscale are super small," "super small nanoparticles can have very unexpected properties," and "scientists are figuring out how to create and manipulate materials at the nanoscale through self-assembly."[44] Different media were used (texts, interviews with scientists, animated films) and interactive devices were proposed. For instance, the "Billion Beads" activity proposed: "Visitors inspect tubes that hold quantities of one thousand tiny beads, one million beads, and one billion beads. To the naked eye, the tube containing one thousand beads appears nearly empty. Visitors see that the next tube, partially filled, contains one million beads. Finally, to compare, a four-foot tall container nearly full contains approximately one billion beads."

Hence, the interactivity that the NISE exhibit proposed was quite different from the direct involvement of visitors in the practice and making of Grenoble nanotechnology exhibit. Interactivity was a means to produce an individual citizen knowledgeable enough about nanotechnology, understanding the "basic facts," and who could then act as an enlightened voter or consumer—possibly a supporter of nanotechnology. Hinting at the ethical issues (as in Nanodialogue) or the "nanotechnology debate" (as in the Grenoble nanotechnology exhibit) was never an issue for the NISE partners. The Grenoble exhibit considered various ways to define nanotechnology. Nanodialogue was all about reflecting on nanotechnology's ELSA and considering the domain as a public issue on which the opinion of the European public was to be gathered. The American science centers and their leaders considered that nanotechnology was a science before anything else, and that it was their duty to represent it as such.

The "New Mission" of Science Museums

The idea of "dialogue"—so prominent within their European counterparts—was not foreign to the American museums, however. A NISE publication targeted to scientists stated that the "monologue style of communication" had failed "to win public trust," and that they need to "move from a 'monologue' model of communication, with scientists lecturing the public on what it should know, to a 'dialogue' model, in which scientists meet the public in forums that are evenhanded, giving nonspecialists much more time to air their concerns and share them with the 'experts.'"[45]

Larry Bell, a co-director at the Boston Museum of Science and principal investigator of the NISE network, spoke in 2008 of the "new mission" of the science museum (Bell 2008; see also Reich et al. 2007). For him, the new mission consisted of ensuring that the public of the science museum was engaged in "two-way communications" with experts and scientists. Bell elaborated his idea of this mission accompanied by the development of a mechanism at the Museum of Science called a "forum": a series of presentations by invited speakers in front of a self-selected audience, followed by several rounds of discussions among the participants divided in small groups. In the first series of forums organized in 2006–2007, participants discussed nanomedicine and nanotechnology applications for energy. In 2008, two forums at the Boston Museum of Science aimed to directly contribute to the decisions of the Cambridge City Council. During these forums, participants talked about the potential regulation of nanotechnology research in Cambridge, and the oversight of the risks of nanoparticles. They engaged in discussions about "municipal oversight of consumer products made through nanotechnology," through exchanges on a series of consumer products. They were then invited to vote on predefined options, such as "should citizens/consumers be made more aware of the lack of research on the safety of some nanoparticles in consumer goods?" or "should there be warning signs or labels?"[46] In Cambridge, where active public involvement in local decisions about science and technology has historical precedent,[47] the staff of the Museum of Science considered the forum a way to make public deliberation "relevant" for policymakers. Local city councilors were regularly invited, and the forum conceived as contributing to reflection on the local regulation of nanotechnology research.

Since its early uses in Boston, the forum has circulated across American science centers. As it started to be used in more and more places, its objectives also became less clear, and spurred numerous discussions about their integration within the informal education strategy of the NISE network.

The uncertainty about the role of the forum was visible as NISE members gathered to discuss the organization and standardization of the forum format. I observed one of these meetings, at the Boston Museum of Science in January 2007. This three-day closed meeting was held as the NISE network was already up and running. Forums had been organized in all the museums that were represented at the meeting (Boston, Minnesota, Oregon, and Raleigh, North Carolina). However, there had not been coordinated actions at that time. The difficulties the NISE members encountered with the forum format became clear. Meeting participants wondered about the connections between the forums they organized or wanted to organize, and policymaking. Some of them questioned the ethical basis of using visitors' contributions to provide policymakers with information on public opinion. For others, what mattered was to make participants in forums influence nanotechnology policies. Still others thought that the forum could not, in its actual form, provide any recommendation, but that the transcript of forum discussions could be handed over to social scientists for them to make sense of the exchanges.

These discussions were all about the uncertain introduction of dialogue as an objective of the American science museum, and the ambiguity about its expected purpose. But in the official documentation of the NISE network, nothing remains of this ambiguity. The forum is described as a ready-made device, with explicit organizational methodology, from examples of discussion topics to practical tips about the food and drink to provide, and sophisticated evaluation grids. As a producer and distributor of expertise about informal science education, the NISE network developed the tools and instruments necessary to standardize the forum into a device aimed to contribute to its objective of informal science education. The standardized forum format is based on a representation of nanotechnology that would at least comprise "basics," explaining, for instance, that "nanotechnology has to do with very small things, smaller than you can see with an ordinary microscope," and that "materials can have different characteristics at the nanoscale."[48] As for the objectives of the forum, they are presented as such in the methodological booklet distributed to the NISE members:

Forum goal

To provide experiences where adults and teenagers from a broad range of backgrounds can engage in discussion, dialogue, and deliberation by:

- enhancing the participants' understanding of nanoscale science, technology and engineering and its potential impact on the participants' lives, society and the environment;

- strengthening the public's and scientists' acceptance of, and familiarity with, diverse points of view related to nanoscale science, technology and engineering;
- engaging participants in discussions and dialogues where they consider the positive and negative impacts of existing or potential nanotechnologies;
- increasing the participants' confidence in participating in public discourse about nanotechnologies and/or the value they find in engaging in such activities;
- attracting and engaging adult audiences in in-depth learning experiences;
- increasing informal science educators' knowledge, skills, and interest in developing and conducting programs that engage the public in discussion, dialogue, and deliberation about societal and environmental issues raised by nanotechnology and other new and emerging technologies. (ibid., 7)

As defined in the NISE document standardizing the methodology, the forum is meant to ensure the public understanding of nanotechnology ("learning experience"), which can be used by the network members to convey the "main messages" defined at the onset of NISE (e.g., "how will nanotechnology affect me?"). Participants can then be good citizens, open to true and balanced information; the "positive and negative impacts," the "diverse points of view" are to be considered alongside scientific information, but are not for the participants to decide upon. Accordingly, the evaluation of the NISE forums is based on the measure of the knowledge the participants have acquired. Evaluation reports of the NISE forums provide sophisticated statistical measures of the "impacts" on the "understanding" of nanotechnology.[49]

Hence, the many discussions about what exactly the "impact on policy" of the forum meant did not result in a construction of a European-like, scientific understanding of the public. Nor did it provide ways for the American museums of science to envision other roles for the participant than that of an individual citizen, consumer, and voter-to-be through the "magic of dialogue."[50] The difficulties the participating museums had to face were dealt with through "deliberation" used as an educational device, and for which the representation of nanotechnology was summarized into the "basics," delegated to experts invited to present nanotechnology to the public, or provided through the other components of the NISE project. The forums held at the Boston Museum of Science thus remained an isolated experiment, which conceived the deliberative device as a component of local policymaking. By contrast, the mainstream position of the NISE network made deliberation a way of "engaging" with the newly acquired knowledge, and making individual citizens reflect on how nanotechnology

would affect them. As such, deliberation became a component of "informal science education," and a domain about which the NISE network could then propose expertise on.

The Democracies of Science Museums

In European and American science centers, defining and operating "new" and "more democratic" practices for the museum are shared concerns. But these new missions differ across the sites we examined, and these discussions are directly related to different problematizations of nanotechnology. Indeed, French, European, and American science centers have helped us illustrate three different roles for the science museums. The French case is that of the construction of a representational system, in which visitors actively participate in the display and practice of nanotechnology's various components (including the "public debate"). In the European case, the science museum is expected to represent nanotechnology and its social, ethical, and legal aspects, while paving the way for a "scientific understanding of the public" meant to replace "public understanding of science." Eventually, the American "informal science education" enacts a political model based on deliberation, for the sake of making an individual citizen knowledgeable about a field that will impact him or her, as a consumer, voter, or worker. The representations that are constructed by the science centers are tightly linked to nanotechnology policy, not less because of the funding links among science policy programs, research institutions, private companies, and science centers. They are not at-a-distance representations of a passive domain: they lead to the construction of material objects in the French case, they are connected to the making of science policy programs in the European case, and they produce nanotechnology's publics and concerns in the three examples. This chapter has stressed the importance of the representation of nanotechnology for its expected publics, as (if not more) for science policy officials. It also leads to the conclusion that the science center's position may vary, and in any case needs to be negotiated with many actors. But in all cases, nanotechnology programs involve science museums. In return, the display of nanotechnology in science museums participates in the problematization of nanotechnology as an entity gathering objects, futures, concerns, and publics. It makes it a matter of experiments with "public debate" in France, a problem of ELSA and of science policy options open for direction in Europe, and a question of understanding a stable scientific field in the United States. In this latter case, science museums emerge as a specific source of expertise about informal science

education, expected to be separated from a field it displays. This agencement is based on technologies of representation and dialogue (among them the forum), which can possibly circulate from nanotechnology to other domains. Chapter 3 will discuss further this type of agencement, based on "technologies of democracy" expected to stabilize modes of democratic organization.

Situated within current interests in science communication for interactivity and the representation of science in the making, the examples discussed here also illustrate variations within these trends and the specific issues raised by nanotechnology. The agencements described in this chapter are all interactive, they all challenge the representation of scientific "facts," they are all meant to go beyond public instruction by innovating in the field of science communication. Concerns for "two-way dialogue" and "engagement" are explicit in all three cases, in which the democratic ambitions of science museums are visible. This should not be considered as the end point of the analysis, but as an invitation to look into the types of democracy that the museums produce, the nature of the representations on which they base it, the kind of people they aim to construct in order to fit with it, and their connections with wider institutional constructs. Indeed, the agencements described in this chapter are quite different, and they engage different democratic constructions, as exhibit designers, scientists, and anti-nanotechnology activists argue over the ways to shape public concerns in the science museum, and over the modalities of the involvement of publics in the development of nanotechnology. The French nanotechnology exhibit challenges the very idea of representation at a distance and proposes to integrate the visitor in the display and practice of nanotechnology, in the secluded place of the science museum. It proposes to experiment with the forms of public communication and public/private relationships, in order to make nanotechnology a matter of "public debate." European nanotechnology policy officials made the intervention of science centers a problem of democratic legitimacy by exploring the ways in which the "European public" can be heard. The problematization of nanotechnology as an issue of common values for the diverse European public draws a democratic space that is not characterized by electoral representations and constraining legal interventions, but by the mobilization of the European public through distributed dialogue processes in order to provide upstream elements for policy choices. Eventually, the choice for "informal science education" in the United States makes nanotechnology yet another scientific field for people to understand, possibly through deliberation. Problematizing the role of science museums within the American federal

nanotechnology policy remobilizes well-known figures of the American polity, among which are the "informed" and the "deliberating" citizens (Manin 1997; Schudson 1998), who are expected to participate in the success of the development of the field.

The sites of problematization encountered in this chapter are connected with each other. Connections are drawn by the actors themselves, as they compare the initiatives undertaken elsewhere (as, for instance, the American museum experts do), or as they circulate, like the director of the Grenoble science center, from national to European science communication projects. The sites are not isolated from others outside of the science communication domain. French science museums attempt to answer the contestation voiced by anti-nanotechnology activists, while trying to involve public and private actors in the sponsoring of exhibits. American and European initiatives in nanotechnology communication or informal science education are directly linked with public policy choices about the responsible development of nanotechnology. This suggests pursuing the study of the problematizations of nanotechnology as they develop in other sites.