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Paradise Lost? 'Science' and 'the Public' after Asilomar

Priska Gisler, Monika Kurath

Introduction

In February 1975, the second international conference on recombinant DNA technology took place in *Asilomar*, California. Approximately 150 molecular biologists, several lawyers and a select handful of journalists were invited to discuss the potential biohazards of recombinant DNA research, a voluntary moratorium established by molecular biologists in 1974, and further ways to proceed with research on genetically modified organisms (Weiner, 2001, 211). This historic conference, referred to as *Asilomar II* – or later just *Asilomar* - focused on the safety of newly developed techniques in genetic engineering. Its final report was published in *Science* and *Nature* (Berg et al. 1975) and led to the establishment of guidelines for recombinant DNA research by the National Institutes of Health (NIH) in 1976.

The new technological tools, developed by a Stanford University research group centered on Paul Berg in 1972, enabled the transfer of genetic material between different organisms for the first time. Along with this discovery and its first application in laboratory trials, scientific discussions on the potential biohazards of recombinant DNA research had arisen. Novel risks perceived at this stage were discussed at scientific meetings within the DNA research community. Later, the discussions continued in meetings focusing specifically on potential biohazards, such as the *Asilomar I Conference*, 22-24 January 1973, and the international *Gordon Conference* on nucleic acids in New Hampton, New Hampshire, June 11-15, 1973.

Half a year later, in April 1974, a committee formed by the National Academy of Science (NAS) organized a meeting at the Massachusetts Institute of Technology in Cambridge. The participants decided to write an open letter to the journals *Science* and *Nature* suggesting a voluntary moratorium on certain experiments with recombinant DNA (Berg et al. 1974). The moratorium was lifted after the *Asilomar II Conference*, when the NIH used its final report as a conceptual basis for the first guidelines on recombinant DNA research, released June 23, 1976. Although some scientists participating in the *Asilomar Conference* had been worried about public perception of these novel strands of research (Weiner, 2001, 212), it was only after the *Asilomar II Conference*, and the establishment of the *NIH guidelines*, that public discussions concerning potential risks evolved; a controversy over the safety of certain applications of recombinant DNA technology emerged; and public voices demanded to be heard earlier and taken into consideration.¹ This discussion, however, despite the efforts to improve the transmission of scientific knowledge between university laboratories and the public, continues today.

By the turn of the second millennium, over 30 years after the *Asilomar II Conference*, *Asilomar* as a historic event seems not to have lost much of its attraction as an outstanding moment in scientific engagement. When we spoke to scientific, political and administrative experts in the field of biotechnology about the impact of the *Asilomar Conference* on science policy and science-public relations we found an astonishingly rich variety of accounts about this meeting. *Asilomar* was referred to by many of our interview participants as a potential model for future science policy aimed at bridging the gap between science and the public. *Asilomar* in this context has gained a memorable

status. It is perceived as an exemplary case of scientists taking on social responsibility, and reflecting upon the risks arising from their research.

Thus, the impact of *Asilomar* has not ceased to be debated to this day. While biologists and molecular scientists outside of STS (Science and Technology Studies) judge the moratorium and *Asilomar* as an example of responsible scientific behaviour (Capron and Shapiro 2001), others argue that the hazards had been overestimated within the scientific community itself, and that this contributed to public resistance against biotechnology (Gilbert 1977; Miller 1997; Watson 1979).

Within the field of STS the early scientific debates on recombinant DNA technology are perceived as a unique occurrence in the history of molecular biology (Chadarevian 2005). It is understood that *Asilomar* brought the discussions on the potential biohazards of recombinant DNA technology from the US into the international scientific community (see i.e. Gottweis 1998; Krimsky 1982; Weiner 2001; Wright 1994). Furthermore, there is considerable agreement that it was not so much scientific responsibility that played a major role in 'Asilomar' as it was the aim of keeping the regulation of biotechnology within the professional boundaries of science in order to avoid more severe governmental regulation (Gottweis 1998; Wright 1994). Finally, historians argue that by keeping prominent dissidents out of the *Asilomar* discourse, the molecular biology community aimed to prevent external agenda-setting. Focusing on epidemiological risks and laboratory safety issues, they contributed to the marginalization of further issues, such as the ethical and commercial impacts of recombinant DNA technology (Ratkau 1988, p. 335).

Western governments reacted to the debate that stemmed from early research on DNA structures and their manipulation. In a time of increased government spending on research and development, they established novel policy instruments with the intention of bringing academic knowledge production closer to those to whom it was addressed, members of civil society, and also to those who ultimately paid for it, taxpayers. The policy approach that was later coined as *Public Understanding of Science* (PUS)² aimed to encourage the participation of heterogeneous voices and opinions in the production and assessment of scientific knowledge, to enhance social acceptance of academic research and to settle scientific controversies. However, it also challenged seemingly clear-cut entities such as 'science' and 'the public' and was criticized for its biased conceptualization of the public as deficient in contrast to a knowing and homogeneous scientific community (Irwin and Wynne, 1996). PUS policies became important as a more institutionalized and interactive medium for gaining acceptance for scientific activities undertaken in the name of societal needs, and, as Bensaude-Vincent analyzed, to bridge the perceived gap between science and the public (Bensaude-Vincent, 2001).

Interestingly, general acceptance of agricultural biotechnology and the credibility of science have not increased during times of intense PUS activity (Greenberg, 2001). *Asilomar*, however, remains an exceptional example of how science can demonstrate leadership and responsible behaviour (De Chadarevian, 73, 2005). Whether this behaviour was addressed towards the public or rather focused on inner-scientific laboratory procedures and risks may never be known. Only in hindsight have scientists' concerns been made public, thus informing a broad audience about the potential risks associated with DNA research. Yet, it is remarkable how *Asilomar* has become an exemplar of good and responsible scientific practice.

Looking back on the early 1970s, and taking into account the amount of policy effort undertaken to bridge or dissolve the perceived science-society gap, we would like to consider Asilomar from a slightly different angle. We are interested in learning how actors in the field of biotechnology research have made use of Asilomar as an ideal to remedy some of the fractures perceived between science and the public. On the one hand, it seems remarkable to us that a public, which has been vaguely conceptualized as a kind of ‘free floating media public’ over thirty years ago, has been turned into a kind of heterogeneous and multiplied ‘mediated publics’ that should be continually involved in science policy matters through PUS activities. On the other hand, it seems remarkable to us that science is often thought of as a singular concept, while only certain strands of research – such as genetic engineering, nuclear physics, and stem cell research for example – are widely contested. We are interested in knowing the impact PUS politics may have on ideas surrounding the relationship between science and society or on assumptions of science’s role within society.

During a qualitative case study on risks perception in genetic engineering research,³ we became aware of the iconic status the Asilomar II Conference has acquired for actors involved in biotechnology research and policy: While asked about the role of science in evaluating biotech risks, some interviewees assessed PUS activities in connection to current science policy issues. More importantly, from their answers, it was apparent that the Asilomar Conference was perceived as a memorable event: A remarkable number of the participants in the study contrasted current science policy debates with the exceptional behaviour of the scientists gathered at the Asilomar Conference. Asilomar proved to be a key event in the memory of the interviewees from the US, and this applied equally to individuals who did not participate in the conference.⁴

After a number of research participants contrasted current science policy debates with the exceptional behaviour of the scientists gathered at the Asilomar Conference, we went on to ask the rest of the actors about their recollections of the event.⁵ Struck by their statements, we began to analyze their recollections of the event more carefully. In total, this article drew on the interview statements of 24 people. Eight of these people were active scientists, eight worked in administration or had regulatory roles, and eight worked for non-governmental organisations.

We were interested in how the players from these three different fields (i.e. scientists, administrators or science policy-representatives, and representatives of NGOs) remembered Asilomar. The interviewees were invited to talk about what they thought happened at Asilomar and the impact this historical event had on biotechnology debates. We were keen to learn how they qualified the event with respect to their understandings and expectations towards science-public relations. We analyzed the statements in the context of current discussions on the status of science in society. The broader picture the interview-statements revealed had to do with the paths the history of PUS activities has taken, the analyses it has contributed to, and the concepts it has framed. Tracing the history of some of the emergent concepts in the discourses on PUS, we will bridge and combine the biotech-experts’ readings of the event with the impact politics might have had on them.

Memories of early biosafety discussions vary – not only according to personal experience and the individuals’ history, but also according to the conclusions they draw relative to their position on current debates and their accompanying perceptions of future science

policy. Our argument will be twofold: (1) It is based on the assumption that memories of Asilomar have been shaped by the impact of the PUS-discourse and (2) on how Asilomar is recalled and idealised with respect to the science-society relationship. In the first section of this article, a brief historical overview of PUS activities, and some of the according STS literature, will provide a more detailed account of current notions of public engagement with biotechnology. Following this background, a range of statements stemming from the qualitative interviews with actors in the discourse on biotechnology will be scrutinized in the *second section*. After portraying different recollections of Asilomar and reflecting on them with the history of PUS in mind, we will discuss how a differentiation like ‘science’ and ‘the public’ has been privileged throughout history while Asilomar was transformed into a kind of ideal ‘other’. In the conclusion we will then go on to consider how these conceptions could be revised

Taming the societal beast? A short history of the public understanding of biotechnology research

In the early 2000s, when the interviews for our study were carried out, governmental initiatives to further *Public Understanding of Science* had gained momentum. Concerted actions were adopted on ministerial levels and coordinated amongst Western countries in order to promote the dialogue between ‘science’ and ‘the public’.⁶ They were imposed upon a range of academic bodies in order to enhance the public visibility of science through spectacular events, like European Science Weeks. Moreover, these efforts were accompanied by a stronger level of interaction between public bodies, which meant that universities were organising, state agencies were supporting, and private companies were sponsoring public science events. Their goal was mainly to bring as many people as possible into contact with scientific projects. At this time, biotechnology and biomedicine were recognized as thriving fields and engagement projects offered the interested layperson an opportunity to interact with current research in the life sciences. The degree of engagement in *Public Understanding of Science* was connected to the widespread and controversial debates concerning emerging biotechnologies.

Molecular biology had long since begun moving toward becoming a leading field in science (Kay, 1996, Chadarevian, 2002) before public concern towards biotechnology arose in the US after the discovery of recombinant DNA in 1974 (Weiner, 2001). The *Asilomar controversy* in 1975, the *Cambridge City Moratorium* in 1976 and the *Ice Minus controversy* in 1977 led to debates between scientists, policy-makers and political activists of the time⁷, triggered by a commercial boom in the life sciences that took place during these years (Kenney, 1986). In the late 1970s, public opposition to biotechnology finally hit Europe and demands for stricter regulation and intense debates on the potential risks of agricultural biotechnology emerged (Gottweis, 1998).⁸ Public voices, focusing on environmental issues, pollution and nuclear waste, were increasingly articulated as a consequence of new social movements. Moreover, the expansion of the education system further supported this trend by enabling and motivating people to articulate their concerns (Gerhards, 2001).

Yet, the discourse on public understanding and public support of science can be traced back much earlier than that. It had begun developing in the 1950s, and echoed the concern that funding for scientific research could become politically vulnerable (Miller, 2001). In order to strengthen support for science, the mass media and school education were typically seen as a means of increasing scientific literacy (Turner, 2008). The

importance of such approaches was assessed by the few studies of the time asking for peoples' reactions to the presentation of science in the media (Withey, 1959). Thus, publics were understood as a mass of people that were to be informed through the media and education. Furthermore, and in contrast to later periods, it was considered difficult to tear science away, for evaluatory reasons, "from the rest of society", since it was perceived as being strongly intertwined with society (Withey, 1959).

Hard science and public interactions were more controversially discussed by social scientists (see e.g. Shils, 1974; Nelkin, 1976; Trachtman, 1981; Perlman, 1982) in the 1970s and early 1980s, debating whether protest and public dissent around biotechnology were connected to science illiteracy. Such debates were nurtured by large-scale public attitude studies, reporting a low factual knowledge of science (Gregory and Miller, 1998). A variety of national, American and European surveys, like the NSF studies of science literacy or the Eurobarometer studies evaluating attitudes toward science and technology, helped shape political discourses, eventually framing concepts and understandings of what 'science' meant (i.e. the newest technological trends) and who 'the public' was (i.e. the laypeople – the average person needing education in the natural sciences) (Jasanoff 2005, Lewenstein, 1987, Miller 1987).⁹

Thus, the British Royal Society continued a tradition of similar initiatives when it released its now famous report on "The Public Understanding of Science" in the mid-1980s, addressing the status of scientific knowledge among the British public (1986). An anonymous summary in the journal *Science, Technology and Human Values* stated clearly, that the "Working Group (of the Royal Society Council, led by Walter F. Bodmer) defined 'science' broadly and took 'public' to mean the predominantly non-scientific public" (1986, p. 53). In the report it was argued that a better understanding of the nature of scientific activities, their methods, their limits and finally their social and practical implications would be necessary to increase the "general level of public understanding of science" and to enhance the well-being of the nation (1986, p. 56). In a subsequent article, John Durant et al. measured the cognitive abilities of individuals and highlighted the gap between scientists and the rest of society (Durant et al. 1989). In the wake of this report, and the studies and discussions that followed, many countries launched political programs to enhance the information level and the standard of knowledge of the general public.

In the 1980s and 1990s, particularly in Europe, claims of civil society organizations for a more democratic involvement in science and technology related decision-making emerged. A shift or "democratic turn (Hagendijk and Kallerud, 2003, p. 3) of PUS towards more deliberative, participative and dialogue-oriented forms of public engagement took place. Incremental concern over the implications of biotechnology on food, public health, the environment and developing nations, culminating in the European BSE, foot and mouth, and GMO crises (Hagendijk and Terpstra, 2004), supported a renewed interest in strengthening science and technology communication in terms of PUS during the 1990s.¹⁰

Yet, while participative projects – dialogue exercises between science and the public – and participatory technology assessments had become fashionable in policy circles (Hagendijk and Irwin, 2006), often without measurable outcomes (Abels, 2008, Rowe, 2008), a strong trend edged towards intensifying and professionalizing scientific publicity programs in the late 1990s. In response, a kind of a "backlash" from dialogic participation towards large-scale information took place. Consequently, there was a tendency to integrate as many people as possible into public science activities, mirroring

the information and education activities of the 1970s. From the late 1990s, large-scale science and society-programs were established inside and outside the Anglophone world and continental Europe. The attempts to bring scientific knowledge closer to a wider public were thus transformed into spectacular events such as science festivals, science weeks, public teaching laboratories, and alike.¹¹

However, public skepticism concerning biotechnological research trends remained high in Europe. Polls showed that even in times of intense PUS activities, public acceptance towards these technologies did not increase (Tunrey, 1996, Miller, 2001) and the credibility of scientific research declined over the years (Durant et al., 1998, Bauer/Gaskell, 2002). And another observation could be made: The idea of a significant knowledge gap between experts and laypeople had incrementally been fixed over the years. This happened despite the fact STS scholars had challenged the demarcation ‘quasi’ from the beginning for its preconceived deficit on the side of the public (Irwin&Wynne, 1996) or its incompatibility with the notion of socially distributed knowledge (Nowotny, 1993). Gibbons and colleagues pointed to the fact that science was also re-defining its boundaries concerning differentiations between basic and applied research, or the interactions between science, technology and industry (1994) or between different scientific and political fields (Gisler et al., 2004). From an STS perspective, the notion of one-way communication, in which laypeople acted as passive recipients of information in isolation from other social activities and structures, was seen as indefensible (Whitley, 1985). The underlying normative assumptions, the combination of ‘attitudes’ with ‘understanding’ and the concluded policy actions, raised broad criticism (e.g. Jasanoff, 2005, Collins and Pinch, 1993, Irwin, 1996, Hagendijk, 2006) and the trend to revise the respective concepts, already addressed by STS scholars in the 1980s, continued. To this day, scholars in the field of science and technology studies struggle with the categories that have emerged through PUS policies: Binaries such as ‘science’ and ‘the public’ or ‘experts’ and ‘laypeople, as well as novel constructions such as “citizens of science” (Horst, 2007), either reproduce and reiterate these concepts, or are forced to circumvent these discursively and conceptually marked categories with the fear of losing some central points of discussion.

Drawing on recent literature in STS, it becomes clear that scholars in this field identify and problematize heterogeneous publics addressed by PUS policies in a range of areas and forms. On the one hand, deliberative “mini-publics” turn out to be more cautious of science than the elite sponsors of deliberation exercises, which can afford themselves a Promethean gaze into the future (Dryzek et al., 2009). On the other hand, tensions in these relations are also described as being imminent in lay positions colonized by experts, while lay persons reveal themselves as unable to bring their own more generic understandings into fruition (Kerr, 2007). Durant (2008) gives a note of warning, when he concludes that the understanding gap between experts and the public has merely been replaced by an ontological gap. The ontological gap privileges lay persons’ capabilities for reflexivity over the unreflexivity attributed to expert scientists. From such a perspective, it does not matter whether the gap discriminates between science and *the* public or a range of diverse, but well-defined mini- or sub-publics as long as opposition and differentiation is maintained. However, we cannot free ourselves so simply from considering the impetus that lies behind a politics of participation. If the efforts to be inclusive rather than exclusive are accepted, the differentiations and boundaries at work in public consultation exercises cannot be easily dismissed. In fact, we are reminded of Gieryn’s notion of boundary-work, which is needed to demarcate science from non-

science (1983). Specifically, in our case, we rather apply his approach to questions concerning the achievements inherent in constructing and maintaining the boundaries between science and publics in various forms.

Lezaun and Soneryd highlight that “static images of the public” are produced by the organizers of public engagement exercises. Moreover, they show that these images are sustained, from a governance perspective, by a wish for a malleable public, whose opinions and views can be changed through education or policies (Lezaun and Soneryd, PUS, 2007). Significantly, Lezaun and Soneryd pinpoint the need for a new vocabulary in order to – as they say – evaluate the politics of “listening to the public”.

It is this notion of the public, as a homogeneous and static entity opposed to unified science, that led us to reconsider the relationship between these two entities. As we will see in the next section, the gap between science and the public(s) is applied by scientists as well as by policy makers and NGOs. Each of them favour a constructed opposition, but the way they do this varies considerably. The rather ambiguous assessments of the science-society relationship by our interview participants led us to question the status of current science politics operating on the basis of the previously mentioned distinctions of ‘science’ and ‘the public’ embedded in policies following the British ‘PUS’ report. We were particularly taken by the interviewees’ favourable memories of ‘Asilomar’, an event that happened over thirty years previously. In the eyes of individuals that had been or still were active in the field of biotechnology, Asilomar was highly regarded as a quasi model for good practice in PUS. Being faced with these favourable valuations and being told that the conference had had a positive impact on public perception of science, we decided to have a closer look into what they were referring to when they spoke about ‘science’ facing ‘the public’ during Asilomar.

Remembering the Asilomar Conference: Tales of a ‘world lost’ and new concepts gained

When we discussed their memories of the Asilomar II Conference in 1975, the majority of the 24 actors in the field of biotechnology research evaluated the event positively. While we heard a wide variety of recollections of the happenings some 30 years earlier, we realized that in fact the event was immediately being used as a backdrop for discussing current political trends, as a means of trying to make sense of these trends through dealing with notions of the past.¹²

Goven pointed out the importance of locating public engagement exercises within a structural approach. She referred to the role of social structures that have been neglected in the STS-understandings of technology accounts (Goven, 2006). Accordingly, we decided to enquire as to whether and, if so, how the distinction between ‘science’ and ‘the public’, which has come to be used so widely in science policy, played a role in the recollections of Asilomar by the interview participants. We were curious to know how the three groups of actors perceived the two notions, both in relation to Asilomar and today.

Previously, we described the participants we spoke with as scientists, administrators or science policy-representatives, and representatives of NGOs, knowing that such distinctions are difficult to uphold. In some cases, researchers in the field of molecular biology or genetic engineering, for example, may have become campaigners for NGOs or

regulators may have also studied biotechnology. Categorizing them according to their present position, however, it soon became clear that these were exactly the positions they were speaking from. In the analysis of the respective interview passages, we found that their statements were clearly influenced by the positions the interview participants held, whether they were researchers themselves, or whether they were acting on behalf of intermediary institutions or as spokespersons of independent political organisations, and thus we organised the discussion of the results along these three categories.

We looked at how ‘science’ and ‘the public’ appeared in the memories of the interviewees about Asilomar and how these notions translated to present debates. In what follows, we will show that, when we assessed the interview participants’ elaborations, we found an *Asilomar* that is dynamic; an event that is being constantly constructed and thus transformed. Asilomar, furthermore, was used as a backdrop against which science policy matters were discussed. Moreover, we became aware of a link between the debates over adequate science policy – in some ways echoing our brief PUS discourse analysis – and the ways our interview participants made use of, or moreover struggled with, dominant concepts such as ‘science’ and ‘the public’. We found it helpful to follow the participants’ recollections of the conference in order to find out more about how people articulate their own political concerns and expectations. Asilomar has been idealized because it is linked to significant tensions that have arisen concerning the status of science in society over the last several decades, with which our actors have struggled in their work. The analysis will show that this would not have become visible, in the way that it did, had we only enquired about perceptions of the PUS discourse.

Representatives of civil society organizations/NGOs: A fight for dialogue

During the first interview phase of our study representatives of non-governmental organizations repeatedly referred to Asilomar as constituting a positive example of how science has been able to reflect on its own practices and procedures in the past.

Representatives of civil society organizations are usually highly interested in scientific and science policy debates. They carefully analyse current trends in science and technology and try to comment upon them – usually critically. However, ‘science’ at the time of Asilomar was crowded with diligent actors. Much like the other interviewees, these persons assessed the scientists’ initiative to address the potential biohazards of recombinant DNA technology during the Asilomar Conference favourably and expressed their appreciation of the temporary restraint from certain kinds of experiments.

“The Asilomar Conference was an important event, where scientists themselves were concerned and took responsibility by establishing a moratorium and taking some pause within research.” [biotechnology expert, international environmental organization]

Another NGO pointed to the care with which the researchers were ready to handle their novel practice.

“Gentechnology has gone – interestingly – through a phase where they have considered not to try out everything, to behave cautiously, which proved to be an exemplary behaviour” [biotechnology expert, national environmental organization]

The mere evidence of responsibility, requiring energy being put into considering some kind of control at all, shown by scientists during the Asilomar controversy, was read as a positive behaviour, on which one should try to build. Not only did the NGO representatives reflect upon Asilomar voluntarily, and more frequently than other actors we interviewed, they also tended to link the event more often to a contemporary context.

In stark contrast to Asilomar stood their evaluation of current scientific behaviour, which they assessed as rather weak. Referring to the contemporary context, a representative of a national environmental organization found that commercial interests in scientific developments hinder science from taking on social responsibility. While several representatives we spoke with seemed to share the notion that science acted rather independently in the seventies, they perceived a contemporary loss of scientific autonomy:

“And that was something very impressive for me that science necessarily has the ability to control itself. About 20 years ago, this Asilomar Conference took place, where scientists constrained their work and established guidelines. My opinion is that scientific self-control is no longer possible, as scientists are, to a large extent, involved within commercial interests and no longer independent.”

[Environmental scientist, local environmental organization]

So, what currently obstructs scientists from self-regulation and autonomy is not merely more government regulation, new moral fears, or their lack of time due to intrascientific competition, but it is also – at least in the eyes of the NGOs – a question of the connections between science and industry, and the growing porousness of science towards commercial interests.

Thus, in the case of NGOs, we find an uncertainty about the contours shaping scientific organisations as such, since there are many ties between scientific endeavours and economic incentives. Another quotation from the representative of a consumer organization, who argues that current pressures affect scientific knowledge production, highlights a similar perspective:

“It is interesting that in an early phase of biotechnology – during this Asilomar Conference – scientists decided to constrain their work and to proceed cautiously. For me, this is an exemplary behaviour. In contrast to now, where commercialization, patents and going public is prominent. The increasing pressure on science let cautiousness become less important.” [Program director, national consumer organization]

Such statements reveal the attitude that the current intense commercial ties between universities and industry make it much more difficult for scientists to maintain independent opinions, leaving them unable to reflect on their work as they had during Asilomar. Thus, according to the NGOs, the loss of autonomy is in itself thrusting scientists into more dangerous and risky fields, while their ability to act independently becomes weaker at the same time.

Interestingly, the focus of the NGO's memories of Asilomar scientists blanks out the role of other actors at the time. While they hold a very positive commemoration concerning scientists in contrast to their dependencies later on, they do not clearly remember or explicitly recall the voices of the public in the 1970s.

Concerning their notion of 'the public', in reference to today, NGOs perceive an imperfect relationship between science and society. Thus, they have endeavoured to

speak on behalf of laypeople and have taken upon their shoulders the difficult political task of challenging the ties between science and industry. Society's ability to control, with respect to scientific and technological development, is strongly questioned by the representatives of civil society organisations. In the eyes of a biotechnology expert of a national environmental organization, science as a formerly clear-cut, identifiable entity has given too much away:

"It was a turning point when people like scientists sat down together and talked about it. It is always used as an example of how science can regulate itself. A lot of the problem with control of research now is that this is not happening and that there is not much of that dialogue at all among and between scientists and the public." [biotechnology expert, national environmental organization]

Thus, this biotechnology expert evaluates the public more or less from the negative, from something missing: The talks that took place during the moratorium on rDNA research were held amongst scientists only. Today, as this statement suggests, such talks should be extended into a dialogue between scientists and the public.

However, to have a lively debate – according to an activist biologist – does not come by itself and is not an easy goal to achieve. She does not say who should push for this dialogue and participation, but it may well be seen as one of an NGO's more important goals.

"So, I think if you want to have broad public participation, I think, one really has to fight for that, very hard. I think it can be done, but I think it needs to be pushed all the time." [biotechnology expert, national environmental organization]

In sum, the interviewed representatives of civil society organisations hold on to a very idealistic picture of the Asilomar II Conference. They suggest that contemporary scientific institutions tend to withdraw from responsibility, a trend which they regret. In addition, these actors observe increasing industrial and commercial involvement in science, which makes it all the more difficult for science to define its boundaries. The NGOs equally mirror this prudence, if not cautiousness, towards scientific institutions because of their growing collaboration with industry (Dryzek, 2009), a field they know little about. Somehow these actors seem to be searching for an integrity and autonomy of science which perhaps never existed, but which they aim at helping re-establish. At the same time, they appear to long for a kind of reconciliation with general social needs that they believe science ought to provide. Yet, the role of the public during Asilomar is not explicitly mentioned, and the interviewees do not acknowledge the open dialogue in current political debates over scientific research and its possible risks. Instead, they see it as their task to enable the exchange between science and the public.

It will be revealing to learn whether scientists or central actors in administration and regulation share these views about Asilomar, scientific progress and public concerns. Next we will analyse the interview statements of scientists in the field of biotechnology that discuss how they perceived the public remembering the Asilomar event.

Scientists: The public is more distrustful now

Many scientists in our sample recall Asilomar as a symbol for a new research era, and associate it with an atmosphere of departure. They think of recombinant DNA research as

a far-reaching development, as something unprecedented and unique in science. They mainly praised the prudent stance with which some of their colleagues had approached rDNA research in the 1970s. In contrast to the NGOs, however, the scientists did recollect the role of the public during Asilomar.

Particularly, the fact that members of the scientific community took the time to consider and discuss the potential health impacts of this new technology at the Asilomar Conference was seen as an extraordinarily responsible act. In the eyes of one of our interview participants, a scientist who had been involved in rDNA research since its inception, Asilomar enabled the development of biotechnology by building confidence between the public and the scientific community. The specificity of rDNA technology was thus linked to the specificity of the scientists' respectful and reflexive proceedings.

Some passages specifically highlight the former urgency for action as a kind of prevention against strong restrictions from the outside, i.e. public policy, something that would be unthinkable today. Some of the interviewed scientists assessed the scientific regulation of biotechnology by researchers themselves as an act of self-protection, and as a means of preventing more restrictive government regulation. A professor of law and biomedical ethics recalls the fears of scientists that governmental or public interference might have had an impact on the scientific work itself:

“It is also an example, however, of scientists recognizing that if they did not do this, on their own, the government probably would do it and might well do it in a way that was more restrictive to scientific research than they would like. So it was proactive, and self-protective against public intervention that might have become dominant.” [lawyer and biomedical ethicist]

Although it is often claimed Asilomar contributed to a discussion on moral issues, it nonetheless took place in a kind of ivory tower, and the accounts seemed strangely detached from other social problems of the time. However, a central and unavoidable issue remembered by a professor emeritus of immunology was the question of the commercialization of scientific knowledge and the corresponding conflicts of interest at universities. Similar to NGOs, some scientists were aware of the growing interconnections between science and industry, which began in the 1970s. The interviewee was quite critical about the lack of self-reflection that went beyond technical risks.

“While Asilomar raised some important moral and practical issues concerning the conduct of research, it did little or nothing about the broader issues of the impact of big-business-driven biotechnology on the universities and society in general. [...] I think Asilomar really downplayed the real social problems that had inevitably arisen as part of the emergence of biotechnology and a profit-hungry industry behind it, and it didn't help in that respect.” [Immunologist]

In contrast to historians of science, who have argued against the revolutionary character of genetic engineering (Chadarevian, 2002), another researcher still seems to value the singular importance of rDNA research and for that reason connects it to her perception of Asilomar as an outstanding historical event. Furthermore, she underlines the trustworthiness of scientists in the context of regulatory questions. Asilomar is seen as an example of control being kept amongst scientists, and as evidence of their ability to establish such control.

“I was a scientist in the days of the early recombinant DNA debates and the Asilomar Conference, and it was really an amazing time for scientists actually putting constraints on themselves in a working situation. And it has never happened before and it has never happened since then, and it was very effective. Nobody died from recombinant DNA, and I think scientists are very responsible. I don’t see that the scientific community has really been faced with anything as new, as dramatic, like moving genes between species. And no one ever talked about having any kind of limits on research, like in stem cell research, for instance.” [Molecularbiologist]

Regulatory questions have been dealt with in the meantime in a range of countries with additional laws and guidelines. Different US presidents for example have acted promptly during their administration to modify controversial biotechnology bills, such as President Bush calling for a stem cell ban in his first address to the nation on 9 August 2001 and President Obama lifting it eight years later.¹³ One interview participant compares the Asilomar activities with contemporary scientific practices for example in stem cell research that are much more constrained. This, and similar quotations from the interviews, underline the assumption that the collective character of the agreement, the voluntary character of constraining one’s own work, had to do with the huge intrascientific challenges the scientific community faced in a transforming field (Chadarevian, 2002, 364) and less with contestations from the outside.

By analysing the interviews it becomes clear that for scientists – unlike the NGOs – the public already existed in the 1970s. Yet, the researchers spoke very generally about ‘the people’, the ‘average person’, ‘anybody’ or did not mention the public at all, when they referred to the conference. This seems to mirror our assumption based on the analysis of the history of PUS, that a clear contoured public gained prominence only later.

A biology professor argues that Asilomar is perceived as having led more people to become involved in decision-making, something which, according to some of her colleagues, should have been avoided. According to her, only by identifying the potential biohazards of recombinant DNA technology as a central theme did people – long before they turned into the homogeneous entity of ‘the public’ – become aware of a need to participate in issues concerning technological development.

“Another result of Asilomar was that a number of scientists argued that raising the questions in Asilomar made people suspicious for the sake of needing to become suspicious. Therefore, in sort of public relations, to a certain extent it boomeranged, because some people were listening and drew the consequence, that they should have some say in decision making.” [Biologist]

Some researchers (biologists and bioethicists) argued that the dissemination and scope of knowledge in society has increased only recently. In this sense, time would have worked in favour of the scientists who pushed for the moratorium and the deliberation process. In the meantime a growing number of actors have become knowledgeable. Strong pressure to get involved with public policy work was sometimes perceived as an issue for current scientific practices, following the argumentation by a plant biologist:

“I think scientists can’t avoid getting involved in public policy work now. There was a time when scientists worked in their little ivory towers. But today it is different: everybody instantly knows everything. For science, it has an effect on the way the public reviews science. Therefore, I don’t think scientists can ignore

that anymore, and just do their research. They have to be involved, in government regulation as well as in talking to the media.” [Plant biologist]

While the public, in the scientists’ accounts, did not play a specific role in the Asilomar events, it seems to have gained significance later on. And it needs – again according to the scientists – to definitely be taken into consideration in the present. A scientist, working in the field of biomedical ethics, argues that Asilomar enabled molecular biology to progress the way it has. Yet, the current circumstances would make a similar event less probable, since the public has become much more sceptical in the intervening period.

“An alternative [to the guidelines, finally installed] would have been a very heavy legislation and so, in the long run, I think it was probably the fastest route towards the science we know, we have now. So I am not sure if the same thing would happen now, if scientists would react the same way. But I am neither sure if the public would react the same way. I think the public is more distrustful now, than it was 20 years ago.” [Biomedical ethicist]

Thus, for the scientists, to interact with the public mainly means doing public policy work with regulatory bodies and the media. Furthermore, for these actors, ‘the public’ has become more skeptical, a characteristic which it seems to have acquired only in recent years. While scientists managed to reflect upon their own work and novel findings of the 1970s, they feel a much stronger moral impetus to behave model-like in the face of an increasingly distrustful public. The interactions taking place as a result of PUS policies, however, do not mean that the boundaries that scientists perceive between themselves and others are diminished. Quite to the contrary, one can assume that the impetus to react and respond to outside demands stabilizes the contours of scientific activities.

Administrators, science advisors and policy-makers: You have a strong public

Interview participants from administration and policy-making assess Asilomar as equally positive but again from a somewhat different angle. In their eyes, the public and science were categories that undoubtedly already existed. Moreover, their interpretations take an interesting turn: In their view, Asilomar can be read as proof of scientists’ responsiveness to serious public concerns and the necessity of regulating scientific institutions at the same time. Thus, the vast region between the autonomy of science and the fears of the public opens ample possibilities for administrative and political intermediaries to assist in these interactions and to play a role in shaping public policies.

Several of our interviewees stuck to the view that Asilomar was proof of a respectful, diligent reaction by science to public concerns – although, indeed, this worked the other way round: public concerns had arisen only *after* the scientists in Asilomar had discussed the issues extensively and when it became a controversial topic in the media (Weiner, 2001). In the memory of an administrator of a national scientific academy, scientists reacted and behaved according to needs that were articulated publicly:

“Asilomar is held up sometimes as a model of how science policy can work. You have a very strong public and a high level of public concern. And the scientific community was responding to those concerns and developed standards and processes for handling the research, which will allow the research to go on. I think it was just wonderful, and a very good model for how science can respond to a general public concern.” [Biochemist, national scientific academy]

Again, stem cell research is used as an exemplary contemporary case and is mentioned by several interviewees. This leads to a debate over who – nowadays – should be responsible, who should “govern” science and technology developments. Obviously, policy representatives and administrators see it as the task of the public authorities and the government to step into this void between science and the public, to evaluate scientific work, to assess the risks of technological or scientific approaches and to develop particular regulations. A biotechnology officer in a national agency argues:

“In Asilomar, they paused to consider the profoundness of manipulating genetic material, and I think that may have been wise and fairly impressive, because this is not very usual for a group of people to stop and to do that. But it is not necessarily the responsibility of science – I mean it is the responsibility of the government, that prevents dangerous things from happening that may cause harm to the general good, to the general public.” [Health administrator, US national authorities]

In actual fact, molecular biology had not been the *topic de jour* 30 years ago, and the scientists had gathered in Asilomar without much public attention initially. In contrast to this historical evidence, Asilomar is remembered as having been a fruitful process helping to restore the confidence of a heterogeneous public vis-à-vis controversial research fields, while science as a weaker entity could not be left alone in its actions.

Although the contemporary public may have a strong stance in the eyes of some administrators, earlier political activists were seen as threatening the research at this time:

“I think a lot of bad things would have happened... because there were people in the early seventies, that wanted to shut down the recombinant DNA program in the US immediately” (Director, scientific association).

The public could also be viewed as a threat that somebody had to face, whereas in previous statements we encountered descriptions of a public that was appreciated for voicing their concern. Thus, for the policy-makers and administrators, the public seems to remain a blurry category, a category they have to define themselves. Therefore it is not surprising that although the discussions following Asilomar focus on responsible scientific behaviour, the interviewees are still not quite satisfied with the way current risks and dangers emerging from novel technologies are being addressed. Hence, we come across something new: The role of the government is seen as an intermediary between science and the public, with the task of overseeing scientific trends that could lead in dangerous directions.

Governmental bodies, federal agencies and political advisory boards wanted to play a role, which turns this into a question of the professionalisation and the division of labour in the organization of science. Some of the political and administrative advisory representatives openly refer to their own position when remembering Asilomar. In the following, a university administrator assesses scientific self-regulation favourably because it precisely enabled the government to step in:

“I think it was a great success and a model for self-regulation. We had a technology, which evoked public concern, and the scientific community responded to them. They had meetings, they had a temporary moratorium established, they created some guidelines, and it wasn't just self-regulation. The Asilomar processes actually helped to initiate recombinant DNA advisory

commissions. So they were leaving a role for government to play.”
[Neurobiologist, US university administration]

Presumably it helped, and still does help, policy actors with the consolidation of their position to base their own task on a presumed lack of public confidence, which, from their perspective, Asilomar was able to restore. Yet, the statement also comes close to the adoption of a colonizing position (Kerr, 2007). The policy-makers intend to represent others, including scientists, members of the public and civil-society organisations. Indeed, their picture of ‘science’ and ‘the public’ reflects little change since the 1970s. Science still needs to react to public demands. But, it cannot be done by science alone. In the eyes of these administrative and political actors, they should be relied upon to facilitate responsible behaviour. Support and protection would be enhanced by the formation of public and administrative bodies. They had become necessary in order to navigate the ship of science in the name of a strong public that needed protection. Performing and accepting different roles for different actors contributes to the construction of a common horizon. This is a mechanism which is not uncommon in ongoing institution building processes (Berger and Luckmann 1980).

Analysing the other: Was Asilomar beyond science and the public?

In our brief overview of the development of PUS activities in the field of biotechnology, we demonstrated the emergence of a rhetoric that was increasingly based on fixed notions of ‘science’ and ‘the public’ and thus pointed to the successful drawing of discursive boundaries (Gieryn, 1983). Science politics discursively contributed to the separation of these two entities, particularly since the 1980s. Since this time, it became clear that frictions with respect to the field of biotechnology existed, and they would not prove easy to reduce. Political efforts have long relied on improving the knowledge base of the population through scientific education and later drew on enhancing contacts between scientists and laypeople through the organisation of big public science events. At the same time, STS scholars increased their research on *Public Understanding of Science* activities in an effort to understand the impact of official science policies on science-society relations. Through PUS policies, as in the respective analyses by STS scholars, the public came to be understood as a mediated entity that stood in conflict to science. In this article, we wished to explore this perceived opposition between science and the public and thus reconsider what could be at the root of this potential conflict.

In our analysis we drew on memories of the Asilomar II Conference that took place in 1974. When we talked to a range of key actors in the field of biotechnology, a large number of them remembered Asilomar II as an ideal through which to articulate their ideas and wishes concerning science-society relations. Thus, we began to unveil what made this event so successful and an example of good science-public interactions. It became clear, that Asilomar served well as a kind of screen onto which all sorts of ideas and wishes could be projected. Yet, the contours of the roles distributed later onto ‘science’ or ‘the public’ were not yet as clear and visible. And it was from the memories of Asilomar that our interviewees then projected and extrapolated onto ‘the public’ and ‘science’ what they wanted and wished to see. Thus, we did not find a singular, homogeneous concept of ‘science’ or ‘the public’ within our three groups of respondents, but rather a range of concepts. They fitted unequally into the PUS discourse but were characterized by the various positions these groups stood for.

Representatives of *civil society organizations* share – probably with many members of scientific organizations – an ideal of science as an independent social institution that operates self-reflexively. This was also the picture they recalled of science when they described Asilomar. According to the NGO representatives, the public was not able to play a prominent role during Asilomar. Neither were they pleased with the current dialogue between science and the public, which they assessed as still quasi non-existent. Their demands for more interaction and communication with the institution of science could be understood as a plea to politicians and scientific organizations to re-think the increasing links between science and industry, threatening the autonomy of science and hampering open debate. Although Tuunainen and Knuutila (2009) recently demonstrated that the boundaries between university and commerce have remained relatively stable, the fears of citizens concerning one-sided dependencies can be taken as real and the outcries of the NGOs may be read as a plea for more transparency. The representatives of NGOs, furthermore, were willing to take on a role in this dialogic setting, which they wanted to improve. Ultimately, they judged that over the intervening years since the Asilomar Conference science had turned from strong to weak and dependent, while the public continues to be unable to have a say in the biotechnology policy debate. NGOs, therefore, came to the conclusion that they had to replace the voices of the public in order to oppose the increasing influence of industry on research.

The second group, which included a range of *scientists* from various strands of biotechnology, tended to base their positive memories about Asilomar on an active body of researchers able to anticipate the social significance of their own activities and to act responsibly. Amongst the researchers interviewed, the observation that important moral and practical issues had been addressed during Asilomar was still appreciated. When researchers had discussed the risks of recombinant DNA technology amongst each other during the conference, they had not seen themselves confronted with an intervening public. The voices of civil society organisations, industry, the media and others, accordingly remained strangely mute in their memories. However, with increasing public and industry pressure, interactions with actors outside of science became more urgent. For the scientists, this mainly meant conducting public policy work, reacting to governmental as well as media demands. Despite the increased efforts undertaken by scientists to reach out, the public in general was - in contrast to Asilomar times - regarded as distrustful towards science and thus problematic. Of course, one may ask why PUS-policies have not been more successful and why they have broadened the gap they declared to diminish.

The interviewed *scientific administrators*, finally, came up with an interesting inversion: Several of them were convinced that by organizing Asilomar and discussing the potential biohazards of recombinant DNA technology, scientists were facing up to public concerns. In fact, it had been the other way around: scientists started to discuss the potential hazards *before* a social controversy arose (Berg 2004; Krimsky 1982). In contrast to the other two groups, the scientific administrators did not mention the increasing role of industry in the years following Asilomar. While they welcomed the responsible behaviour of scientists in the early 1970s, they made it clear that they wanted – similar to the NGOs – to give a helping hand. They were pleased with the role history had created for them to play: the governance of science. They supported a picture of a strong but highly imagined public to the weaker, dependent scientists, which were in need of mediation. This made it possible

for the administrators to pronounce and maybe to stabilize their own position within the game. Thus while the civil servants perceived the lack of a public in whose footsteps they stood, the scientific administrators planned to tame the unruly public in order to bring forward fruitful interaction.

To conclude, our analysis revealed how Asilomar was admired by all the interviewees, regardless of their background, as a good example of responsible behaviour regarding novel developments in science and technology. Most of them confirm that the picture of an independent and proactive science in a time of intensive commercialization of biotechnology, and increased pressure to legitimize research activities, has become unrealistic. From their accounts, we see that science is no longer portrayed as the ideal that it was 35 years ago. Interviewees, however, differed in their emphases on how science should be governed and understood with respect to the demands and needs of society. While the public in the 1970s did not exist in the eyes of some interviewees (scientists and NGOs), it served others (policy actors) as rationale for the reactive responses of scientists during Asilomar. Interestingly, for NGOs and scientists, the public only came into being after Asilomar in response to emerging scientific developments and strong science policies. Administrators, science-advisors and policy-makers remained convinced of the enduring importance of mediation between science and the public. For all three groups, the idea of the public was linked to their awareness of the shifting and unstable grounds upon which scientific research is built.

As we have shown, Asilomar was a kind of ‘other’, an ideal screen onto which many ideas and wishes concerning science-society relations could be projected. In contrast to the entities employed in PUS policies, our analysis highlighted the nuanced character of the actors involved in, and the issues at stake during, Asilomar. While NGOs hoped that their concerns regarding contemporary research in biotechnology and science-industry dependencies would be heard, scientists seemed to be aware that they may highlight their own anxieties and considerations concerning research in high risk fields while neglecting potential responsibilities. It also became clear that regulators and administrators were aware of the standards and procedures that needed to be elaborated if science wanted to proceed in novel endeavours whose risks were not yet known.

Conclusion

Our brief history of *Public Understanding of Science* activities, which also took into account STS-literature, showed how difficult it is to agree on common definitions for seemingly clear-cut concepts such as ‘science’ and ‘the public’. These concepts remain open to construction and can be defined to serve various ideas or needs. Nonetheless, they remain useful tools. Beyond our case, an analysis of memories about the iconic Asilomar II Conference, they allow us to ask who is interested in such constructions, what goals do they serve and what is left out of specific arguments. It is not surprising that NGOs suggest that these concepts are poorly understood, and criticize the non-existence of a dialogue, when many parties have stopped taking into account the existence of political groups beyond a very general public. It also makes the role of administrators or regulators more visible when it is clear what kind of threats as well as demands they are to regulate. And if scientists would reflect upon the worries voiced in the media or in deliberation processes or in other forums, they may be able to move away from their picture of a generally distrustful but not clearly recognizable ‘public’.

None of the respondents denied the importance of an increase in a broad debate concerning science and technology issues. They seemed to be well aware of the current worries about the consequences of biotechnology research. However, the analyzed views brought to the fore that there is still considerable controversy about where the points of contention lie and who should address them. The analysis also made visible a longing for times when the roles of actors were not as clearly shaped, when reflections about the consequences of biotechnology began to emerge, and societal concerns began to be considered. To understand PUS policies as ‘politics of listening to the public’ – as Lezaun/Soneryd have suggested – may mean understanding the public as a constellation of actors that are concerned, interested, and want to have a say in the social futures of science and technology, be they members of civil society organizations, regulators, industry and business partners *as well as* researchers from the various fields themselves. The public, in a rather broad but by no means arbitrary sense, thus would be brought back into political debates over the futures of science in society.

According to our view, and against the backdrop of current trends, we suggest that it may be fruitful to ask what scientific matters are of greatest concern, which science policies are to be employed, and who precisely should participate in debating them. However, such a line of enquiry would require giving up the science-public divide, dismissing the assumption of a general public or neatly knit mini-publics that are opposed to science. It will be interest-based stakeholders, groups, individuals from within and outside of science that will have to make decisions regarding current trends and developments in science, technology and society. In this way, any science policy initiative could eventually become a medium through which different voices could be gathered together. In the end, for all the actors involved, it is critical to ask *who* will take part in future decision-making processes and to listen to those who are willing to take up these roles.

Notes

¹ The risk model established by concerned scientists in Asilomar and adopted within the political arena gave priority to epidemiological dangers and workplace safety issues. Further evaluations such as ethical, social, ecological, economic or legal issues were largely ignored (Krimsky, 1982).

² I.e. Third Report on Science and Technology to the House of Lords <http://www.parliament.the-stationery-office.co.uk/pa/ld199900/ldselect/ldsctech/38/3801.htm>, accessed 20.5.09; <http://www.aaas.org/programs/centers/pe/>, accessed 20.5.09.

³ The interview data (69 qualitative interviews: 30 in the US and 39 in Switzerland) were collected by the second author during her PhD fieldwork in 2002 and 2003 (Kurath 2004). The sample contained the views and assessments of actors from science, economics, governmental agencies, and NGOs. The questionnaire explored themes such as: the perception of biotechnology in public discourse; the regulation of biotechnology; the perception of other actors and their debates; the future of biotechnology; Asilomar; engagement in debates; and the image of science in society.

⁴ In fact, just one of the persons interviewed had attended Asilomar II. Two NGOs in Switzerland came up with talking about the event, one Swiss scientist was asked about Asilomar after the interviews in the US had been completed.

⁵ The interviewees were invited to talk about the influence Asilomar had on the debates on biotechnology, what they thought happened during Asilomar, and in which ways the Asilomar discussions influenced the debates on biotechnology.

⁶ I.e. the initiation of the European Science Week, http://cordis.europa.eu/scienceweek/act_sw.htm, 20.5.09, on OECD-level, http://www.oecd.org/document/23/0,3343,en_2649_34293_1962007_1_1_1_1,00.html, 20.5.09.

⁷ On the Moratorium Letter and the Asilomar discussions see e.g. Krimsky (1982), Weiner (2001), Chadarevian (2005). On the *Cambridge City Moratorium* and the *Ice Minus controversy* see Weiner (2001).

⁸ It was particularly the politically introduced science-based risk concept for recombinant DNA in the aftermath of Asilomar which was challenged by various organizations external to science, such as civil society, environmental and peace organizations, for its unilateral perspective (Krimsky, 2005).

⁹ The Eurobarometer survey of 1979, for example, already pointed to strong reservations against research focusing on 'biological identity' and 'genetic experimentation' while fewer concerns were articulated regarding organ-transplantation because it was generally understood that such research could be helpful for disabled persons (http://www.za.uni-koeln.de/data/en/eurobarometer/ec_reports/eb10a_science_and_technology_de.pdf, accessed 5.8.2008).

¹⁰ Experimentation, field tests and the planned introduction of GM plants or foods on European markets evoke intense antagonism, which led to a quasi-moratorium halting the release of GMOs in the European Union in the 1990s.

¹¹ Examples include the German PUSH project (Jasanoff, 2005, p. 252), the Swiss *Science et Cité* activities, and the *European Science Week*.

¹² We use the term memory according to Chadarevian as a reconstruction, reconciling the past with the requirements of the present (Chadarevian 2002, p.56).

¹³ This restriction of the Bush administration was directed towards the sixty existing stem cell lines. For Obama's lift of the stem cell ban, see <http://news.bbc.co.uk/1/hi/world/americas/7929690.stm>, accessed 11.6.2009.

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