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**„The train departed without us“ –  
Public perceptions of biotechnology in ten European countries\***

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## **Introduction**

In recent years it has become clear that biotechnology cannot be commercialised without considering the concerns voiced by the public. While it certainly cannot be assumed that the public has clear and consistent attitudes about ideas they have not previously encountered, it probably is as misleading to assume that they are completely unprepared to evaluate the new achievements they are confronted with. This „empty vessels fallacy“<sup>1</sup> may lead to strong opposition when public sentiment and its major concerns are neglected. For the public, understanding the innovation means giving meaning to it on the basis of everyday experiences. This process of “symbolic coping”<sup>2</sup> is a essentially collective enterprise of information-seeking and processing which cannot be assumed to rely exclusively on sources of scientific risk-assessment. Rather, for the public, it will be conclusive whether the innovation is compatible with their needs, values and experiences or not.<sup>3</sup>

In order to achieve a deeper understanding of such public concerns, we set out to run a number of focus groups<sup>4</sup> with a minimum of four groups and 5-8 discussants per group in each of ten European countries (Austria, Denmark, Finland, France, Germany, the United Kingdom, Italy, Portugal, Sweden and Switzerland). The participants were not selected to be statistically representative but rather the aim was to choose people who were likely to articulate a wide range of concerns. In addition to age, gender and level of education, country-specific selection criteria were used. In order to attempt the ambitious task of drawing comparative conclusions across a number of European countries, key aspects of the research – for example, the content of the moderator’s topic guide, the analysis process and the final interpretation – were a collective enterprise involving researchers of the EUDEB/LSES project in a number of meetings and two workshops.<sup>5</sup>

It was surprising to see, when comparing the national data, that there were far more commonalities than differences among the ten countries. Although often illustrated in the context of national events, there are a number of widely shared concerns across the European publics. When focusing on these common themes in this paper, this necessarily must remain a fragmentary enterprise. We will begin with the general question on the nature of biotechnology and its object, living nature. Polarised views of nature lead to different evaluations on whether biotechnology should be seen as just one technology like many others or as something radically

new and different. Equally, these models of nature relate to the degree to which future consequences of the technology are seen to be predictable. In the second part of the chapter we will deal with the groups' considerations of biotechnology's consequences, advantages and disadvantages for their everyday lives. We investigate this evaluative process in terms of compatibility with needs, values and past experiences. These aspects will help to understand why evaluations of specific applications of biotechnology differ so much. In the third part we address the public's questions on "who is involved?", "who are the addressees of risks and benefits?", and "how are decisions made?", thus tapping into the fields of trust and responsibility.

### **1.) Nature and hubris: what biotechnology is about**

Analysing our focus group data it became apparent that many of the arguments, fears and hopes towards biotechnology are fundamentally based on polarised views of living nature, each giving implicit answers to the question on what the new achievement is about. In the following, three models - a spiritual, a complexity-related, and a utilitarian one - will be described. All address the status of living nature as research object, but while the spiritual model assumes an external force that demands respect and veneration of nature, the two non-spiritual forms focus on a mutual dependency between humans and nature where it is implied that there is a need to protect nature for humankind's benefit.

#### ***1.1.) The spiritual form: Nature taking revenge***

According to this view, nature or God - two terms which are often used interchangeably - are powers which deserve respect and veneration.<sup>6</sup> Living nature in particular is viewed to be most venerable, requiring clear limits to impudent interference. Within this view, biotechnology means tampering with life's fundamentals by enabling humans to create and determine life themselves. In the short run biotechnology might promise to make life easier, but nature will hit back and punish with new diseases or other catastrophes.

#### ***1.2.) Nature and life as complex systems***

A second model of nature takes up elements of science and popular versions of system complexity and chaotic behaviour. Mostly the argument is not presented in a sophisticated way,

but instead refers to general statements about the systemic interrelatedness of living nature: “Yes, because interrupting nature with one thing will affect something else, it’s a knock-on effect, something that isn’t always obvious straightaway” (British).<sup>7</sup> According to this argument, living nature is such a highly complex system that the outcomes of interventions hardly can be anticipated. Effects are expected to be not only invisible and delayed, but also to occur in completely different domains from those intended; uncontrollable chain reactions may be triggered. Any artefacts in the genome of plants, animals and humans will be passed on to future generations and there is no way to reverse it.

### ***1.3.) The mechanistic-utilitarian model***

Another form of the non-spiritual view of nature is a more mechanistic model, where nature and its elements are seen in a utilitarian way, subjected to the needs of humans. “If it helps for medical purposes or something like that, then I have no problem at all, a heart grown in a pig just is a muscle. Because it does the same thing as an electric pump. Now, whether this is titanium, or platinum or something else, if it’s working – why not?” (Austrian). Arguments within this model are more optimistic about whether nature can be used as a means for improving human needs or not. It is just necessary to avoid overtaxing nature’s limits too much since a break-down of nature would mean the end for humankind as well. A certain degree of uncertainty and risk can be accepted as long as we remember that “we just have one world, and that’s it” (Austrian).

The models of nature found in our focus groups resonate with the “myths of nature” described in cultural theory<sup>8</sup> although there is no indication of a “Nature benign” model in our discussions, relying on the assumption that the world is wonderfully forgiving and therefore any form of experimentation can be encouraged. Rather, in most of our focus groups there is strong emphasis on the necessity of caution and foresight since negative effects are well expected.

The models all give an implicit answer to the question what biotechnology is about. Within the mechanistic model, nature is an object of scientific and technological development like many others (though one which is not well-known yet), and is compared to the development of cars, aeroplanes and other achievements we got used to over time. The two other models on the other hand assume a special status of the object “living nature” as something incomparable to other

technological developments, the new development is seen as a “quantum leap”. Within the spiritual model, the perceived difference to conventional research results from the idea of dealing with a venerable, or even sacred object (implying moral obligation), and within the complex systems model it stems from the perception of nature as complex and self-reproducing (implying reduced foreseeability).

The theme of lacking knowledge is a major concern to all three views of nature and virtually all groups wonder how to deal with the unknown. But the models differ with regard to expected predictability and also to the degree to which interference is desirable. The mechanistic model is much more optimistic with regard to technological development in the face of uncertainty than the other models since it assumes that science will slowly but steadily conquer the territory of the unknown. Within this view the main concern is that we do not know enough about possible consequences yet, but the reassuring hope is that we will do so after some time. But certainly we should be patient and not apply innovations before sufficient knowledge is available. Within the spiritual model and the nature as complex system model on the other hand, it is doubted whether predictions are possible at all. How can humans predict the reactions of an upset nature, provoked by human interference? And how can consequences be foreseen when life continuously changes in unpredictable ways? When daring to interfere with nature, it must be assumed that things will get spiralling out of control. Therefore, focus groups referring to the spiritual or the complex model tend to express much more moral outrage against treating life as just another kind of commodity than those perceiving nature in a more utilitarian way. There is a strong moral sentiment against hubris, the striving for knowledge in the face of limited capacities to control the outcome in a responsible way.

## **2.) Biotechnology's applications: what do they mean for our lives?**

Biotechnology is no longer seen as one technology but rather as a bundle of different applications. The Eurobarometer surveys<sup>9</sup> show that GM crops and particularly GM food are the most rejected biotechnological applications. Many medical advances on the other hand are considered as progress and perceived as an example of positive science. It must be noted though, that the public very well acknowledges that the medical domain assembles a number of diverse subapplications and therefore, the evaluations of medical applications differ.

As demonstrated within the psychometric paradigm, the qualities of perceived risk related to a technology have a significant influence on the acceptability of this technology (Slovic, 1987). But what should not be forgotten is that it is not only the risks that matter for the willingness of the public to adopt an innovation, but also its compatibility with the everyday world of those addressed. With regard to the adoption of new technologies, compatibility means that the innovation must be perceived as consistent with existing sociocultural values and beliefs, with past and present experiences, as well as with needs of the groups concerned (Rogers, 1995). In the following we set out to explore in what way different applications of biotechnology vary with regard to their perceived compatibility to everyday life.

### ***2.1.) Compatibility with needs: Utility concerns***

Usefulness may be understood as the "Achilles heel" for new developments, it is a pre-condition for support.<sup>10</sup> Clearly, to consider adopting risky enterprises that do not bring any benefits does not make any sense. Some groups get quite upset that science, industry and regulatory bodies assume usefulness for the public without asking those concerned: "and then this Mister Scientist just wants to decide for me whether I think it to be useful or not" (Austrian). Furthermore, what we found in our focus groups is that perceived usefulness must be understood as relative advantage: the novelty has to be better than the idea it supersedes. Therefore the perceived alternatives to the innovation are of crucial importance.

What concerns GM food, most groups suspect that the so-called "new food" is being tailored only to industry's needs, but not to those of the public: "We all start from an experience that is of food, that until now has not given us any disturbance. Why go and change the taste of food or make the tomato more nutritious? We don't need it" (Italian). At a time of an abundance of food in the West, GM products simply are seen as unnecessary. The promises of help to the developing world are met with skepticism: "You know very well that transgenic corn is not for the developing world, it is for making money" (French).

When confronted by disease, on the contrary, most people see no alternative than to turn to medicine and to welcome advice on what to do. Since a clear benefit is acknowledged, people are willing to weigh utility against social and moral costs. "In medicine, when it is about 'repairing' humans by producing GM medicine, which would not be available otherwise, then I do have a

superordinate goal. That is, I have an enormous problem, which is the ill human being, whom I can hopefully cure. In this situation it is justified to take some risk” (Austrian). But not all medical applications are undisputed. Concerns about transgenic animals for example lead some to discuss alternatives to xenotransplantation. Equally, cloning of animals and genetic testing are not always judged indispensable.

## **2.2.) Risk and dangers**

In contrast to expert discourses, the term “risk” figures infrequently in the public’s vocabulary – and even less so in its probabilistic interpretation. Instead, concerns are often voiced in words such as “hazard”, “danger” and “uncertainty”. In the section on models of nature we showed that the idea of the “unknown” – whether this is the yet unknown or the unknowable - plays a prominent role in discourses on modern biotechnology. Within research on risk perception, it is well known that risks whose consequences are uncertain and which may occur a long way in the future are of far greater concern to people compared to more familiar risks.<sup>11</sup>

GM food is clearly seen as one of these insecure enterprises, leading our focus groups to discuss a wide range of concerns such as environmental, safety and health issues: “Well I am worried... it’s the unknown, and we’ve mentioned cancer, the side-effects; it’s things that we don’t know about” (British). In contrast to medical applications where the suffering individual is concerned and genetic modifications are not assumed to be passed on to future generations, with GM plants people expect that, once released, the manipulated features will spread out in unforeseen ways, thus becoming irreversible realities for future generations. Experimenting with living nature is seen to be different from other domains where the innovation may be experimented with on a limited basis trial. With biotechnology there is no reversability: once the ghost is out of the bottle it cannot be forced back.

In the medical realm, groups all over Europe are concerned with the violation of human and animal dignity, the identity of organisms as separate species, the sanctity of living beings and social justice issues. Furthermore, people stress biotechnology’s potential to be misused: often, it is not so much the technology in itself that makes people worry but rather the way it is used – or misused - by those in charge.

### ***2.3.) Compatibility with values and cultural practice***

Biotechnology's applications concern highly cultural practices like eating or dealing with illness, experiences which are very central to human life. The resistance to GM foods has to be seen as one element of a wider value change that has been triggered by a number of food issues during the last decades. Ironically, with increasing European integration, large segments of the European public discovered local produce as well as organic or biological farming<sup>12</sup> while rejecting the industrialisation and globalisation of food production. The more the preference for "natural" food is a shorthand for identity, the more tensions will arise when food is viewed purely from the perspective of safety and economics, depicted as a "functionally equivalent" commodity lacking any cultural meaning. Equally, a better taste that is promised by some proponents in the GM food industry is a non-issue because a "better" taste would also be a taste that is different from Europeans' present variety of dishes. Taste is not negotiable exactly because local foods and their tastes grew out of a long tradition of cooking that does not need to be bettered by industrial means.

For medical treatment and its research the situation is different. Being provided with drugs or even tissues developed by biotechnology is perfectly compatible with the focus-groups' appreciation of helping humans lead a decent life. Xenotransplants evoke more ambivalent feelings but many groups acknowledge that when in need they might welcome this solution. Moral rejection and incompatibility with norms mainly arise when the applications based on GM have the potential to let humans rise above other human beings by eliminating "unworthy" life or creating new life. "The human reproduction process cannot be substituted by cloning. Instead, childless couples must cope with being childless" (Swedish). Given natural means to procreate, the new artificial methods are perceived to be superfluous and unnecessary on one hand, and socially and morally unacceptable on the other. Cloning animals like Dolly the sheep is seen as just the beginning of a very slippery slope. If humans determine other people's life, "designer babies" and "humans made to measure" will result. According to this view, the human "products" would then be produced for specific purposes, which is considered to be an improper instrumentalisation of man, signifying a threat to human dignity and to universal human rights.

#### ***2.4.) Reference to past experiences***

Past experiences are an important means for people in order to understand and classify an innovation. Therefore, focus groups frequently consider similar or contrasting events and experiences in order to warrant validity to their concerns about biotechnology. Usually posed as a rhetorical question or narrated along a clear storyline, these stories contain a clear moral message. Therefore it is worthwhile to take a look at the analogies being introduced when discussing modern biotechnology in our focus groups.

“How would you feel if, like with BSE, five, ten, fifteen years down the line they’re crippled in the hospital, lying there, horrible death” (British). Applications of green biotechnology frequently are anchored in the 1986 Chernobyl accident as well as in issues of food safety gone wrong, like BSE in beef, salmonella in eggs and chicken, or dioxins in chickens and pork. With medical applications there are comparisons to other medical achievements like blood transfusion, insulin or coma, all things people were horrified about in the beginning but after having profited from the innovation becoming widely accepted remedies. What concerns fears of instrumentalisation and commercialisation of living beings as well as determining of worthy and unworthy life, Frankenstein, Huxley's Brave New World, eugenics and visions of the ‘ideal’ race embodied in Hitler’s Aryan project serve as anchors for this viewpoint.

Besides the positive examples in the medical domain, most of the other analogies refer to technology experiences that point out a lack of responsibility of those in charge, resulting in undesirable long-term effects and in scenarios of science gone mad. In this view, biotechnology is not new at all, but just new wine in old bottles. For the public, the way biotechnology is dealt with resonates with a great number of myths and stories as well as with past experiences that highlight the danger of human hubris. This makes at least some of the applications look incompatible with the way people want to lead their everyday life.

#### **3.) Biotechnology as a “runaway train”: Democracy in a high-speed world**

At this point, it should be clear that concerns about trust, responsibility and regulation cannot be separated from the topics dealt with earlier in this chapter. In line with Wynne’s<sup>13</sup> argument that skeptical public appraisal is essentially a reaction to the perceived behaviour of scientific and political institutions, we found that the questions “what is biotechnology about” and “what does it

mean for us” cannot be seen but in relation to the question: “how are those in charge – the so-called experts – dealing with the new technology?” Confronted with a complex technology like biotechnology, people want to trust but at the same time they believe, as demonstrated in the section above, that there were too many experiences of misplaced trust in the past to easily accept the experts' recommendations. Because of this perceived dependence on scientists and other experts, people feel the dilemma of a need to trust when there is virtually no basis to do so. In this situation many focus groups set out to explore their role as citizens. On the one hand there is a strong wish for in-depth discussion and participation, but on the other hand there are a number of reasons for the appraisal that real discussion is impossible. First, there is the nature of democratic processes that take a lot of time in order to address the many controversial viewpoints on the issue. Confronted with the speed of biotechnology's developments, democratic forms of decision-making are seen to be pressed hard to their limits.

Even more important is the strong sense of being kept away from the discussion. People not only want reassurance about safety issues, but rather they want to participate in a discussion on the usefulness and moral acceptability of different applications. “A real discussion would mean a development which is useful for all” (Austrian). Assuming that those in power are serving their own interests, the focus groups feel like addressees of marketing strategies rather than serious negotiation partners.

In the end, many focus groups come to the conclusion that the train had departed a long time ago, that biotechnology and its manifold applications are on their way, whether they like it or not. “People can't do anything about it... Whenever they say, ‘Now we have started cloning’ or ‘We now produce maize,’ then it will be done. It's definite and we can't do anything about it” (Swiss).

### ***3.1.) Industry and Scientists: “meddling behind closed doors”***

Often, people are reluctant to see biotechnology as just another technology of modern life and, therefore, the experts' doings in the face of the unknown are frequently seen as “tampering”, “meddling” or “fiddling”, a vocabulary expressing strong distrust. The lack of consensus about long-term effects increases the impression “that at the moment there is nobody who really knows the effects of all that, neither a scientist nor anybody else” (Austrian).

The biotechnology industry is seen as primarily lead by financial motives and therefore is judged to be neither independent nor trustworthy. People demand for liabilities, but they expect effects to be not only long term but also complex, rendering it impossible to trace consequences back to their original cause. Scientists are perceived to follow their intrinsic curiosity and intellectual interests without caring too much about the societal implications of their work. They are seen as specialists in narrow domains of knowledge, losing the overview on the whole of interrelated aspects. Although scientists' motivations may be honorable, they also depend on money to conduct their research, and this is why they become dependent on industry. Assuming that much of biotechnology's progress is happening behind closed doors, the focus-groups frequently feel like the guinea pigs in the enormous experiment of those advancing the new technology.

### ***3.2.) Lack of transparency and regulation***

As mentioned above, many focus groups complain about a lack of transparency; they feel like being "kept in the dark" (British). As a consequence, there is a strong demand for regulation of both science and industry but at the same time many focus groups wonder whether regulation can possibly be effective at all. It is not only the speed of the developments, the unknown, invisible and delayed nature of potential consequences, and the wide range of moral issues concerned. Rather, people ask whether there is anyone who they can trust to be competent, independent and trustworthy enough to decide on regulation issues.

Especially with food, people fear that "it's already here, but we don't get any information, we don't know what we are eating and how it might affect the next generation" (Swedish). In virtually all groups, labeling and consumer choice are considered minimal standards where refusal to this demand is interpreted as "conspiracy"<sup>14</sup> of industry, politics and supermarkets to smuggle products in. If they are so reluctant to labeling the new foodstuffs, the reasoning goes, there must be something wrong with the products.

Industry and its scientists are viewed to be the actual decision-makers since they just do what they want to. Legislation is perceived to act in a merely reactive way, like the public running behind the new technology rushing on like a "runaway train". Furthermore, industry is attributed the financial power to control all other actors: "Who could resist the temptation of making money? Not scientists, not politicians, not writers nor Greens, some of them are surely corrupt"

(French). Only consumer or environmental organisations receive high levels of trust arising from their perceived independence. Their role in directing attention to problematic issues is evaluated as highly important, although their opinions are not always shared. However, they are frequently perceived to be a voice of opposition that lacks real power and sometimes even competence to be influential.

### ***3.3.) Living in local, national and global worlds***

It must be noted that trust towards specific actors is not static in the sense that people give or deny an actor a fixed amount of trust, but rather that the felt trust depends on the perspective taken. Looked at from within, national governments often are met with skepticism, but when being compared to other countries this evaluation may change quite significantly. In Austrian groups for example, ministers and others in charge are heavily criticized, while local authorities are seen to be more in line with the public's concerns: "even if those up there endorse releases, at the moment there's no mayor here in Austria who would tolerate that, and that's also a form of working democracy, isn't it?" Indeed there have been initiatives of municipalities declaring themselves as "free of genetic engineering", signs interpreted by the public as in line with their preference for local, organic and "natural" produce. But when taking a European perspective, Austrians are quite happy with the "Austrian way" of their government, a comparatively restrictive one within Europe.

But our focus groups are well aware that biotechnology is not a country's nor Europe's business alone, but that this kind of technology exists on a global scale. As Europeans, people worry about the power of all too liberal states like the USA or the use – and misuse - of the new knowledge in dictatorial states. Many groups conclude that within an economically globalised world, the local and national views are becoming more and more irrelevant since it is on an international level that biotechnology develops and changes at high speed. Therefore, effective regulation should work on an international level as well, a solution which is, however, perceived to be a double-edged sword: harmonization across countries must result in compromise and therefore is just another threat to national identity.

## Conclusions

Biotechnology is an ambiguous development that escapes the broader public's understanding and control. For most of the groups, biotechnology "happens" without their active participation in its process. The image of a "runaway train" captures the idea of this technology as an unstoppable and steady advance to an unknown destination, fuelled by industrial science, without control signals along the tracks, leading to the silent diffusion of genetic applications into everyday life. The public are mere bystanders who cannot participate in the decision-making, consumers who cannot react to this technological innovation by informed choices, politicians who at best struggle to adapt regulation to the present state and handle it with restrictions when the train has already passed the station, and ethicists who ineffectively attempt to set morally defined boundaries. There are a number of issues where the public loses contact with the developments rushing ahead and where discrepancies between the public and expert discourses arise.

First, it has been shown that many focus groups doubt that biotechnology is just one technological development among many others. Living nature is not just an object like other materials, but, because of its very nature, is related to moral questions and special risks, risks that are unknown not only to the public, but to experts as well. Therefore, experimenting with living nature is seen to be dangerous and irresponsible, it is committing hubris. In everyday words, there is called for the application of the precautionary principle in the face of the unknown.

Second, the groups are not willing to run risks connected to developments they do not benefit from. Whether people are ready to accept risks depends on whether they perceive some usefulness for their own lives, and whether the innovations are compatible with their values, cultural practices, and past experiences. In this sense, a "culturally prepared" public<sup>15</sup> evaluates the different applications in relation to personal, sociocultural and national identities. Medical applications with the aim of producing drugs and medicines are perceived to be highly compatible with people's everyday lives, while GM food is seen as superfluous as well as contradicting values and experiences about modern food production. Applications like xenotransplantation, genetic testing and cloning all show a potential for controversy concerning their perceived usefulness, values and anchoring experiences.

Finally, in accordance with the findings of the PABE research group<sup>16</sup>, the public worries about a lack of transparency what concerns the discussions and decisions on biotechnology. Presuming

not to be taken serious by the experts, they oscillate between a demand for in-depth discussion including all parties concerned, and a pessimistic view that those in power just follow their own interests, thereby rendering it impossible to reach democratic solutions. The strong demand for labeling and consumer choice is not only the expression of an individualistic, market-oriented viewpoint, but rather, it is often seen as the last - at least somewhat - realistic resort: if others already decided long ago, the public wants at least to be informed.

It should be noted that the public is not unwilling to accept a future that brings innovation and progress. Often, the topic is not so much the technology per se but the way it is dealt with in society. When James D. Watson, one of biotechnology's founding fathers, remarks that "we biologists ought not be much ahead of society, otherwise it could be that the public cannot catch the train anymore"<sup>17</sup>, he acknowledges a widespread concern of European publics feeling left behind.

## Notes and References

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- <sup>2</sup> Wagner, W, 'Social representations and beyond – brute facts, symbolic coping and domesticated worlds', *Culture and Psychology*, 4 (1998), pp297–329.
- <sup>3</sup> Rogers, E.M. (see note 1)
- <sup>4</sup> Morgan, D L and Krueger, R A, *The Focus Group Kit*, vols 1–6 (Thousand Oaks: Sage, 1998).
- <sup>5</sup> For methodological detail see Wagner, W, Kronberger, N, Gaskell, G, Allum, N, Allansdottir, A, Cheveigné, S, Dahinden, U, Diego, C, Montali, L, Mortensen, A, Pfenning, U, Rusanen, T and Seger, N, 'Nature in disorder: the troubled public on biotechnology', in Gaskell, G and Bauer, M (eds), *Biotechnology 1996 – 2000: The years of controversy* (London: Science Museum, 2001).
- <sup>6</sup> In spite of a frequent use of wordings like 'playing God' or 'tampering with God's creation' in all countries, the explicit reference to religious ideas is more frequent in some Catholic countries, such as Italy, than in other countries, such as in the UK or France, where such frames in fact are rare.
- <sup>7</sup> When in the following a particular phrase or sentence is used for illustration, it is because the quote captures what is typical for a shared concern as a whole.
- <sup>8</sup> Douglas, M, *Risk and Blame. Essays in Cultural Theory* (London: Routledge, 1992); Thompson, M, Ellis, R and Wildavsky, A, *Cultural Theory* (Boulder : Westview Press, 1990); compare Descola, P, 'Constructing natures: symbolic ecology and social practice', in Descola, P and Pálsson, G, *Nature and Society. Anthropological Perspectives* (London: Routledge, 1996), pp82–102.
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- <sup>11</sup> Slovic, P, 'Perception of risk', *Science*, 236 (1987), pp280–285.
- <sup>12</sup> This was the case in countries with the tradition of an elaborate food culture such as France and Italy, as well as in countries with a strong industrialised agricultural sector such as Germany or with an organic agricultural sector such as Austria.
- <sup>13</sup> Wynne, B, 'Misunderstood misunderstandings: social identities and public uptake of science', in Irwin, A and Wynne, B (eds), *Misunderstanding Science. The Public Reconstruction of Science and Technology* (Cambridge: Cambridge University Press, 1996); Wynne, B, 'Expert Discourses of Risk and Ethics on Genetically Manipulated Organisms: the Weaving of Public Alienation', *POLITEIA*, XVII, 62 (2001), pp1128-2401.
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