

Science and Politics in the GM Food Controversy

Abstract

This paper will explore some selected social and political science literature that has considered the relationship between science and politics (in the realm of science and technology policy); as a background and conceptual framework for understanding how – faced with real physical risks; scientific ignorance and uncertainty; a risk-averse public and pressure exerted by environmental groups to make Denmark a GM free zone – the Danish government made biotechnology possible if not happen in Denmark.

For the last few decades, the relationship between knowledge and politics in the realm of science and technology policy has attracted the considerable attention both from social and political scientists. This has involved, among other things, the assessment of science or scientific knowledge and its place in public policies, particularly those of scientific and technological nature. Grossly speaking, we may argue that this literature identifies two main relationships between science and politics (in the realm of science and technology policy). The first is the technocratic relationship that in the last few years stands accused of masking the second, and real relationship that is characterised of a 'politics as usual' scenario that projects, deceptively, a scientific image. We may argue then that it is this awareness and acknowledgement of this scientification of politics that has inflamed mistrust and the call for a third relationship (between science and politics) that is more robust and sensitive to democratic ideals such as public participation and influence in the decision-making process.

Technocratic relationship

The first relationship between science and public policy assumes the old dream; a dream of the eradication of politics to alleviate strife and confusion via an orderly administration of things based upon objective knowledge. To be sure, this view was advanced in the Enlightenment period in the 18th century, and reappeared again with the dawn of Positivism in the 19th century. In accordance with the Canadian policy scientist, Douglas Torgerson, the early positivists heralded "the dawn of a new era based on a smooth, efficient industrial civilisation, established and managed not by the dictates of political interests, but by the dictates of genuine knowledge" (Torgerson, 1986, p. 34). In this view, the industrial society was to address the world objectively. This was by observing facts for determining the lawful order of nature and society. Within this perspective, notions of uncertainty and ambivalence played no part. For everything that was important in social affairs was to be known scientifically, that is, clearly and certainly. Through the establishment of precise and reliable knowledge of lawful regularities, science was to contribute to the progress of human civilisation. In this view then, knowledge was to replace politics. For in a positivist or technocratic policy deliberation, all genuine knowledge is scientific knowledge, that is, knowledge of facts together with logical inferences about the relationships among facts. With this kind of knowledge, the Positivists hoped that all social and political events could be predicted. Clearly, if such knowledge were possible, it would be of crucial importance in the administration of society generally and in the determination of controversial science and technology policy in particular.

The first relationship then between knowledge and politics is the vision of a rational civilisation for which scientific knowledge is the essential pre-requisite for industrial order and social progress, and with this, the perfectibility of humankind and society (Torgerson, 1986).

Thanks to developments in research methods and the revolution in technology particularly information technology – that has made it possible to formulate more precise, and seemingly value-free, empirically driven models – this view continues to enjoy wide currency. For example, in the contested realm of food and agriculture biotechnology policy, proponents of this technology advocate that this area of public policy must be informed only by precise and reliable scientific facts (knowledge). And when the state of the available scientific knowledge does not provide precise or immediate answers, in this view, this only provides a stronger case for more and better scientific research that will, in the long run, generate more certain and precise scientific answers to the GM question (Madison 2000; Frodeman 2000; Funtowicz 2001; Weingart 1999).

Politicised relationship

However, time and again, the imperfect results of policy-making conducted on the Enlightenment model left the technocratic dream taking on the aura of an illusory ideal. In the main, as Brian Wynne and others have argued elsewhere, this is due to the uncertainty of scientific claims to truth, albeit normal and necessary part of scientific endeavour (cf. Levidow 2000, Zehr 1999, Jasanoff 1990, Wynne 1996). The initial reaction to this, amongst a considerable number of science and technology policy scholars was that scientific uncertainty in public science would devalue the authority of scientific knowledge as a legitimating tool for public policy. Because of this, it was argued that scientific experts must be concealing or minimising scientific uncertainty in the public sphere while representing this as certain knowledge claims, indeed, that local scientific uncertainties were represented as universal certainties for public consumption (Zehr 1999, Mulkay and Gilbert, 1982, 1994; Nelkin, 1971). This thesis has however been put to task by more contemporary work that has shown that much scientific uncertainty is in fact exposed in public (science) discourses. With time, this came to gain wide currency and inspired a number of research projects that looked at how scientific uncertainty is carefully exposed, managed and used to achieve particular goals. One of the early sociologists who tested this was the Canadian sociologist Brian Lewis Campbell who, in 1985, published his study on scientific claims in selected public controversies. In this study, Campbell showed how scientific experts in various public controversies exposed scientific uncertainty in support of a given policy position that, on the face of it, appeared objective and trustworthy for informing policy. For example, in one piece of research, Campbell showed how a scientist could claim that a scientific characterisation of a wetland area was not qualified enough due to the scientific uncertainty that was involved. This would revoke restrictions on, let us say, the use of the wetland area. Or in support of, say, the construction of a nuclear reactor, a scientific expert would witness that research results that depicted risks that were posed by a nuclear reactor were inconclusive. On the face of it, these uncertainty claims may seem honest and trustworthy for scientists seem open and willing to acknowledge the limitation and incompleteness of scientific research (Campbell 1985). More recently, Les Levidow has sympathised with this view with reference to the events that followed the controversy surrounding the effects of GM potatoes to human and animal health as

witnessed by the internationally renowned Scottish scientist, Dr. Arpad Pusztai who claimed that, in a research protocol, genetically modified potatoes stunted the growth of rats and their immune system. Biotechnology critics seized this claim as a strong case against GM derived foods. Given the impact that such scientific results would have on a technology that was facing considerable public backlash, proponents of food biotechnology expressed doubts about the reliability of the facts that were the basis of Dr. Pusztai's claim due to, as they argued, its flawed methodology. For example, the UK's Royal Society argued that there was "no convincing evidence of adverse effects from the GM potatoes in question". And the influential European biotechnology industry lobby, EuropaBio, quoted some scientist, Martin Chrispeels, who argued that "this isn't science. It wouldn't be published in a serious plant biology journal. Their conclusion is not correct." (Pusztai 2002; Royal Society 1999; EuropaBio 1999).

Elsewhere, Sheila Jasanof has been inspired by this view in her analysis of the controversy surrounding the question of possible ecological risks that are posed by Bt crops, crops that are modified to express the toxic protein of the naturally occurring soil bacteria, *Bacillus thuringiensis* (Bt). For when in May 1999, in a correspondence article in the authoritative scientific journal, *Science*, John Losey and colleagues of Cornell University claimed that monarch butterfly caterpillars died or had their growth stunted when in an experiment they fed them milkweed leaves dusted with pollen from Bt corn; the mass media, some members of the scientific community, green organisations and EU government seized this finding to argue for probable detrimental effects to the ecology or environment, posed by the Bt crops. This potentially dangerous claim to the biotechnology project attracted broad criticism from the industry and also within the scientific community. The crop biotechnology industry questioned the Cornell team's experimental protocol (cf. Shelton & Roush, 1999). Indeed, it was attacked as preliminary laboratory based research that did not depict real world conditions – even though the studies that these critics referred to in support of their safety claims were also preliminary laboratory based studies (Jasanoff 2000). And on their part, renowned scientists joined the debate, publicly supporting either side of the controversy. For example, Anthony Shelton, a leading entomologist and a scientist who has been working with Bt crops accused regulators for overreacting over results that were "preliminary" while warning that the "policy makers are in danger of making hasty decisions regarding the implications of a lab-based study". On the other hand, the renowned insect geneticist, Fred Gould, who has also for a long time been researching into Bt crops publicly stated that the "study (regarding threats to non-target species) has brought up an important issue that had been ignored by regulatory staff and needs attention." (Renner 1999; see also Levidow and Carr 2000; Hodsgon (1999).

A more recent and no doubt notorious case in point is the Mexican maize scandal that started in November 2001 when the prestigious scientific journal *Nature* published the results of a research work by David Quist and Ignacio Chapela of the University of California Berkeley that claimed that maize in Mexico, the renowned centre of unique maize biodiversity, had been polluted by GM maize "with a range of unpredicted effects" (Pearce 2002). Following this publication, CS Prakash who is a professor of Plant Molecular Genetics at Tuskegee University, Alabama, and the leader of AgBioWorld Foundation attacked this study as "flawed" results that did not "justify the conclusions". Prakash went so far as to accuse Quist and Chapela of being "too

eager to publish their results because it fitted their agenda" as if he himself was not too eager to attack results that he barely knew enough about because this also fitted his agenda. This was a view that was supported by a senior scientist at the University of California Berkeley, Nick Kaplinsky who attacked the paper as "bad science". It was this influence from renowned scientists and biotechnology industry that pressurized *Nature* editorial staff to demand the authors of its own publication to withdraw the paper, who refused to do this, forcing *Nature* to make a historic disavowal of its own publication because it was not "convincing on the basis of the evidence that we have published" even though, the editor of *Nature* "never said that the paper's conclusions are wrong". On the face of it, it is interesting that *Nature* should publish a paper that was unqualified enough to win the credibility of good science without putting its own authority into question. But then again, one could read this as a small step towards its acceptance that, all in all, science is, a "peculiar social institution". That indeed, "the scientific system is not sacred or inhuman"; it is "permeated with folly, incompetence, self-interest, moral myopia, bureaucracy, anarchy and so on" and "even the most high-minded institutions are depressingly alike in some of their less admirable characteristics" as John Ziman has put it elsewhere (2000:4-5). It is little wonder then that critics of modern biotechnology together with other concerned scientists fear that there was a foul play behind *Natures'* decision since the main findings has not been controversial or challenged at all (Pearce, 2002).

Clearly then, we see a second image of the relationship between knowledge and politics that overwhelms the seemingly "objective" ideal, as technocrat would want us to believe. If the first relationship would claim the victory of knowledge over politics, the second view acknowledges the overwhelming scientification of politics. It recognises that conventional policy deliberation conducted along technocratic lines is blind to political reality. In this way, it is acknowledged that scientific knowledge serves political interests, generally, established interests vested in the existing political or commercial order. In the first relationship as we have seen above, policy considerations tend to project a scientific image, asserting the old Positivist belief that somehow science will deliver precise and workable solutions that are required to perpetuate social progress. However, in the second relationship, the reality beneath this appearance is very different. We see that science is used as a political weapon with which to secure particular political positions; indeed, while the rhetoric of policy proponents or makers may seemingly be scientific, the reality is different (Torgerson, 1986, pp. 39-40).

Following this line of thinking, in the following pages, we shall seek to throw some more light on this line of thought by looking at the way the Danish scientific experts, the so-called competent authority (CA) considered the exemption of the application for release and marketing of genetically modified sugar beets and fodder beets by the biggest plant breeding company in Denmark, Danisco, in the wake of a deceptively restrictive and precautionary law on Gene Technology and Environment – as a case study of the scientification of politics in the realm of public policy of scientific and technological nature. The rest of the paper will thus fall into three principle parts: 1) briefly introduce the case in question; 2) look at how the Danish CA scientized politics in its consideration of the applications to release GMOs in Denmark; and 3) draw a conclusion on how the scientification of politics in Denmark made biotechnology happen in the face of uncertain science and an ambivalent public.

Scientification of Politics in the Danish GM Policy

Introduction

In the second half of the 1980s, in the wake of intensive public debates that were initiated by environmental activists on the risks associated with the release of genetically modified organisms (hereafter GMOs), the Danish Parliament passed the Gene Technology and Environment Law (law 288) in 1986. This law banned all field releases of GMOs. However, under § 11, line 3 of the law, the responsible minister was given considerable power of discretion. In individual cases, proposed releases could be exempted from the ban. The grounds for such exemption were not made clear. In 1991, the European Commission adopted the 90/220/EEC Council Directive of 23 April 1990 on the Deliberate Release into the Environment of Genetically Modified Organisms. Following this, Denmark revised the 1986 Gene-technology and Environment law to adopt the stipulations of this Directive. In 1991, the Danish Parliament approved a revision to law 288. Under the terms of the new law (law 356 of 6 June 1991 on Gene Technology and the Environment), GMO releases came to require Ministerial approval on the basis of specific risk assessments (Toft 1996; Jelsøe 1998).

Administrative Procedures

In accordance with Law 356/91 on Gene-technology and Environment, it is forbidden to release transgenic plants or organisms into the environment either for research purpose or for marketing without first notifying the Minister of Environment and Energy. The given applicant was to assess the risks that may accompany such a release. This includes ecological, toxicological, agricultural and environmental risks for the purposes of deliberation and on the basis of this assessment provide a risk assessment report and other necessary information for ministerial deliberation and approval (Toft 1996, Jelsøe 1998).

The Danish Environmental Protection Agency (EPA) was given the overall responsibility for administrating and co-ordinating the risk assessment procedures for the purposes of policy advice to the Minister. The Danish National Forest and Nature Protection Agency (hereafter its Danish abbr. SNS) was to carry out the ecological risk assessments. And while the National Food Agency together with the Danish Institute of Toxicology were to conduct the toxicological risk assessments; the Ministry of Agriculture together with the Danish Plant Directorate were to look at the agricultural impacts. EPA together with the Danish Institute of Environment Research was to oversee the effects of resistance and Round-up use. EPA was to send a summary of the notification to the rest of the EU member states and local interest or affected organizations. It was on the basis of this scientific evaluation carried out by the CA together with hearings from interest organizations or groups that EPA was to draw-up a final recommendation for approval (or rejection) to the Minister of Environment and Energy. The Minister would make a draft approval on the basis of this. But before the Minister could take a final approval, the notification and draft approval were to be submitted to the Parliamentary Environment and Planning Committee for a political orientation (Grundtvig 1999).

Danisco's (DDS) Round up Ready Sugar/Fodder-beet

In accordance with the above legal stipulations, between 1989 and 1997, the Danish plant breeding company, Danisco (hereafter applicant), and later, in a joint venture with a relatively smaller Danish seed company, DLF-Trilifolium made no less than six release applications to the then Minister of Environment and Energy for the approval to release (and in 1997 to market) Round-up ready sugar beets and/ or fodder beets (hereafter RR beets). The RR beets were engineered to resist the weed killer Round-up (produced by Monsanto Company, St. Louis, USA). Most of the releases were carried out on Danisco's (Maribo Frø) research plot in Holeby, Nykøbingⁱ.

According to Danisco, the aim of the research was to 1) assess the possibility of producing RR beets as part of its R&D in plant breeding process; 2) explore the prospects in, or the appropriateness of investing in the field of genetic engineering and adjacent technologies; and 3) produce useful information or knowledge that could be useful for future evaluation of risks that may accompany the release of genetically modified organismsⁱⁱ.

The first few deliberate releases involved RR sugar beets only. However, from January 1993, in a joint venture with DLF-Trolifolium, they started to make parallel releases of RR fodder beetsⁱⁱⁱ. By February 1997, the joint venture had made no less than 6 successful field release and 1-market applications. The latter that was approved by the Danish government in autumn 1997 is still lying in Brussels waiting for the EU approval (Wambui, Kamara, 1999).

A number of factors make these successful applications of considerable interest. For one, from the very beginning, the Danish government expressed its unease on the lack of experience with this technology and the scientific uncertainty that was involved. This was articulated many times and particularly so during the parliamentary deliberation of the (1986) genetechonology and environment law. For example, during one of the parliamentary discussions, the Minister of Environment expressed that:

“Are there hazardous environmental, ecological, bio-diversity, animal or human health risks that might accompany the use of genetically modified organisms? Genetically modified organisms are *alien to our world*. We do not have any history or basic experience that we can build upon ... We have to take into consideration any negative environmental or ecological impacts that may accompany this technology. Otherwise, if the worst comes to worst, we might do irretrievable damage to the environment or eco-system ... It is the government's position that we must put in place a public regulatory mechanism to control this application” (my translation and italics)^{iv}.

On their part, the government's scientific experts acknowledged that the existing scientific knowledge about GMO could not be considered adequate for predicting or evaluating possible impacts to the environment, ecology, human and animal health. For example, in one of EPA's internal letter to other CAs, EPA expressed that:

“We lack experience with deliberate release of genetically modified organisms or cells into the environment. The existing natural scientific knowledge on the effects that would accompany the release of these new (genetically modified) organisms into the environment cannot be considered adequate for predicting environmental consequences that may accompany such a release” (my translation)^v.

In the second place, all the competent authorities acknowledged the scientific uncertainty that was inherent in this field. Take for example SNS that was overseeing the ecological risk assessments. In accordance with the then acting and responsible officers Jan Grundvig Højland and Hans Erik Svart, risk assessment of the effects that may accompany the release of genetically modified plants is a field that is very young

while based on a limited basic experience and knowledge that was yet, still under development. For this reason, in the actual deliberation process, problem formulations of the ecological questions are often very complex and do not necessarily give certain answers, for example, on the actual impacts that may accompany such a release to the Danish environment (Grundtvig 1998; Svart 1998).

Third, a number of risks were identified during the deliberation of all the applications. Fourth, scientific ignorance and uncertainty were identified in the deliberation of most of the applications. Fifth and finally, then as much as now, the Danish government faced the most difficult policy hurdle – that of an ambivalent public together with considerable pressure exerted by environmental groups to make Denmark a GM free zone (Toft 1996).

Given these factors, it is interesting that all Danisco's field release and market applications between 1988 and 1997 were successful. How did the government justify these approvals? To narrow down this otherwise extensive analysis, here, we shall only look at how the Danish Forest and Nature Protection Agency (SNS), the CA (read scientific expert) for ecological risks assessments considered the various applications. We have chosen SNS not least because today it is the responsible authority for considering release applications; but also because in our view, it was the most important actor in the assessment of the applications. For indeed, although the toxicological risk assessments were important, toxicological issues were not considered all that critical for the initial release approvals since the crops were not meant for human consumption but for research purposes. It was because of this that the authority for toxicological risk assessments could get away with limited toxicological considerations. In fact, it was indicated several times that the research was not meant for human consumption. In a similar vein, although the agricultural risks were important, the applications were for R&D purposes rather than agriculture. This was repeatedly mentioned in all the reports, which implied that the authority that made agricultural considerations also got away with limited agricultural considerations such as the effects of the increased use of Round-up or its effect to agriculture in general. Because of this, it would be plausible to claim that SNS carried out the most decisive risk assessments for the purposes of approval (cf. endnote Vii – Viii).

Ecological Risk Assessment

As indicated earlier, in accordance with the legal stipulations, in all the applications, the applicant submitted the release research protocol together with the respective risk assessment documents. And when it was necessary, it provided any other relevant materials that were requested by SNS for analysis. It is on the basis of this material that SNS considered the applications to be supplemented later by other SNS funded research results at some of the Danish universities (Grundtvig and Svart 1998; Svart and Grundtvig 1998).

For both Danisco and SNS, the guiding question for the ecological risk assessment was whether the inserted characteristics would move into and establish themselves in the Danish environment; and if they did move into the wild environment, if there was any need for concern. For both SNS and Danisco, the experience and knowledge of the traditional crops came to provide a useful benchmark for answering these

questions, and understandably so given the lack of experience that they had with the new crop varieties. It was because of this that in understanding the characteristics of the genetically modified plant, they first looked at the available information of the non-modified beets. This is for example their habitat, spreading biology and its interaction with the ecosystem ((Grundtvig and Svart 1998; Svart and Grundtvig 1998; see also Ellstrand 2001).

In the first place then, Danisco and SNS looked at the possibility of undesirable pollen flow from cultivated crops to their wild relatives. Their literature review showed that, in Denmark, within the *Vulgaris* family, *Beta vulgaris* (sugar-beet) had been documented to cross-pollinate with wild *Beta maritima* (sea-beet) that in Denmark grows wildly around the Store-Bælt area^{vi}. It was shown that beets cross-pollinate easily not only with sea-beets but also with other related species such as red-beets, fodder-beets and petal beets among others. Some of these related species; especially the red-beets are available in the food market^{vii}.

Once the literature review showed that cross-pollination was possible, their next question was whether such cross-pollination could cause hybrid formation. Their review showed that hybrids of sugar beet and wild sea beets did not only occur but that these hybrids did survive and reproduce in the Danish nature causing introgression into wild relatives. Together with the introgression pathway, it was also evaluated that the inserted traits could spread through a self-sustaining pathway. For example, though beets have no vegetative organ formation, beets and in particular sugar beets may split and each part comes to form a basis for a new plant. Time-wise, the beets could spread if the planted seeds remain in the planted area and after the end of the season, may germinate constituting the risk of spreading. This of course was to be influenced and thus dependent on the climatic conditions and variety of beets where sometimes, particularly within the first year of the beets' growth, the plant can develop reproductive plants, the so-called bolting plants. As long as the bolting plants may produce pollen, there could occur pollen and/or seed that could spread and survive near or in the cultivated field. This would cause self-sustaining populations that may spread and persist in nature or cultivated areas either as problematic weeds or the like (ibid.)

Given this documented knowledge and experience with the traditional sugar and fodder, it was clear and reported by both Danisco and SNS that the release research was not going to be absolutely safe, indeed, that there was every reason to expect that the inserted traits may spread and persist in the Danish nature or environment (ibid.)

The second consideration was the risk that was posed by the inserted RR characteristics. Both Danisco and SNS evaluated that there is every reason to expect that if the round-up tolerance traits were to spread to the surrounding wild or cultivated plants, there was every reason to expect that this would give a fitness boost, that of round up tolerance. However, they acknowledged their scientific ignorance and uncertainty of other possible unknown risks that may result if the inserted trait expressed itself in other ways than expected (ibid.)

Here then, we see Danisco and SNS acknowledging the risks that were posed by the release research. But on the same lines, they sought ways of taming the seriousness of these risks by claiming that 1) the risks were not unusual, but common place, known

and accepted in conventional agricultural practices; and 2) with sufficient mitigation and control measures, these risks could be managed, for example, with ordinary mitigation measures. What is more? We again see Danisco and SNS acknowledging scientific ignorance and uncertainty. However, instead of using this against the application, scientific uncertainty and ignorance is considered and used as a reason for justifying and hence approving the release research. This was by arguing that it was only through this kind of release research that knowledge could be produced for use in future risk assessments^{viii}. It was this conclusion and thus recommendation for approval that was given to EPA to be considered together with comments from environmental and other interested groups. The various interested or concerned groups were very critical about the release of RR beets, pointing, as it were, to the potential risks together with the scientific ignorance and uncertainty that accompanied this technology. However, the interested and concerned groups' comments came to be considered more normative than scientific^{ix}. And since they could not prove their claims scientifically, their comments came to weigh less as compared to the CA evaluations in the final concluding report for ministerial advice and approval. Needless to say, the initial release applications were approved on this basis^x.

However, the results of the first generation of the field trials (1989-90) showed that pollen leaked from the research area crossing with control non-RR plants. For example, in 1991, approx. 0.5% of the seeds that germinated from the sterile control plants, even those that were placed outside the buffer zone, crossed with RR plants, developing a fitness boost, that of round-up tolerance^{xi}. It was clear from this and acknowledged by Danisco and SNS that it would be extremely difficult to obtain 100% pollen isolation, particularly in normal field practices, meaning that the inserted RR traits could spread and persist in the Danish environment^{xii,xiii}. Again, this risk was considered not unusual, but commonplace, known and accepted in conventional agricultural practices. It was argued that this could be managed with sufficient mitigation and control measures. This was for example increasing the distance between RR plants and non-modified related plants or use of a better buffer zone^{xiv}. This was considered enough to mitigate the risk of the spread and perseverance of round-up tolerance traits into the surrounding environment. However, if this did not work and worse came to worst, round-up tolerance could be combated with the use of other weed killers^{xv}.

Here then, we see Danisco and SNS acknowledging risks but immediately reducing them to nothing. These risks were considered as acceptable because they were sufficiently well known and manageable (via use of a buffer zones, space distancing or use of other weed killers). We also see Danisco and SNS acknowledging uncertainties and ignorance about their knowledge about other unknown risks that may accompany these releases. However, this ignorance and uncertainty is used as a good ground for the need of this research, both in principal and an opportunity for carrying out research that may produce scientific information that would be useful (also for the CA) in the evaluation of future release applications. Scientific ignorance and uncertainty is used as a valid ground for legitimating release approvals, instead of, for example, using this scientific ignorance and uncertainty to reject the application. It was this assessment that came to form the basis for ministerial and governmental deliberation for approval^{xvi}.

What was interesting was how later, at the political level, the government and a number of other politicians came to claim that the government has considered these issues closely, and that there was every "scientific evidence" that these releases were safe to the Danish environment and ecology. Many a times during the various political deliberations, the government argued that the CA had evaluated the notifications as safe on the basis of the latest scientific evidence. It was through this scientific rhetoric together with the deceptively restrictive and precautionary law that the government could tame public unease so as to support biotechnology development in Denmark. Surely, the government was wholly aware that public perceptions were to be accommodated. But they were also surely aware that it had a responsibility to encourage biotechnology investments and development in Denmark that was crucial for international competitiveness. For although the latter was important during the whole regulatory process, the government was clearly aware that this was only possible if they could first and foremost contain public unease. For indeed, despite the rhetoric of risks or scientific uncertainty and ignorance, latently, the industrial interests held sway:

“We hear so many times that the environmental demands are blocking industrial development due to the slow and tedious process of undertaking environmental risk assessments; ...we often hear the complaints that the law is very restrictive. It should be, ... but I think we should annihilate the myth that the Ministry of Environment delays industrial activities. It does not. We are willing to co-operate with the industries” (my translation)^{xvii}.

The Minister of Environment expressed this during the parliamentary deliberation of Danisco's initial application. And again, during the deliberation of the 1992 release notification, in one of its internal letter, the government articulated that:

“Danisco controls approximately 10-15% of the world sugar beet and fodder beet market. The doubling of the market would involve a 3-4 times increase of the current profit. A decisive factor for this will be the development of transgenic sugar beet and fodder beet with tolerance to Round-up and rhizomania virus. Danisco estimated back in 1989 that the new transgenic variety would bring home a revenue of hundreds of millions; ... The gene technology and environment law is aimed at protecting the environment and thus it's stipulation is restrictive; but this should be relaxed” (my translation)^{xviii}.

Concluding summary

In the foregoing pages, we started by looking at some selected literature that has considered the relationship between science and politics in the realm of science and technology policy. The first was the technocratic relationship that has been put task for masking the actual relationship that is characterised, as it were, of scientification of politics, an awareness that, we may argue, has inflamed the recent calls for a more broad-based decision-making process that is more benign to democratic ideals. We also looked at some social and political science literature that have looked at how this scientification of politics manifests itself by 1) minimising or managing scientific uncertainty and ignorance and more recently; 2) exposing if not magnifying scientific uncertainty and ignorance to support particular policy positions. We showed how this is done during public controversies that may affect policy decisions. And finally, in

our case study of the Danish regulation of the release of GMOs, we see how this scientific uncertainty and ignorance is carefully exposed, managed but also used to make biotechnology happen in Denmark. First, we see the Danish government using this scientific uncertainty and ignorance to argue for the need to put in place public regulatory mechanisms. Second, on the same token, the government argues that it would be difficult to regulate this area because of scientific uncertainty and ignorance that is crucial for an informed regulating mechanism. Third, the government's CA acknowledges this scientific uncertainty and ignorance. However, later and fourthly, this scientific ignorance and uncertainty is used as a good ground for approving the release as a principal step towards more knowledge. Fifth, the release research exposes risks and more scientific uncertainty and ignorance. But the CA tames this as normal and manageable. Sixth and finally, during the political deliberation, the government minimises risks, scientific uncertainty and ignorance, arguing that its CA has shown that there was "scientific evidence" that these crops were safe. It was this scientification of politics that helped to contain public unease and encourage agriculture biotechnology in Denmark.

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ⁱDDS Ansøgning om dispensation fra lov nr. 288 om miljø og geneteknologi; 27.12.1988; see also A letter with Annexes from Monsanto to the Danish EPA on: Directive 90/220/CEE: Notification to Place on the Market Genetically Modified Higher Plants: Roundup Ready™ Fodder Beet derived from A5/15 by DLF-Trifolium, Monsanto Company and Danisco Seed - dated 4 April 1997).

ⁱⁱ ibid.

ⁱⁱⁱLetter to Miljøministeriet from Skov- og Naturstyrelsen (05-02-93). Vedr. Ansøgning fra Maribo Frø om Tilladelse til Udsætning af Genetisk Modificerede Sukkerroer i 1993 samt tillægsansøgning til forannævnte ansøgning.

^{iv}Forespørgsels vedr. bioteknologi, den 04-02-1986. pp. 6364-6365.

^v Levnesmiddelstyrelsen brev til det på vedlagte liste anførte adressater vedr. udsætning af genteknologisk fremstillede organismer og celler, den 1987-04-01.

^{vi}DDS Ansøgning om dispensation fra lov nr. 288 om miljø og geneteknologi; 27.12.1988. see also Godkendelse in henhold til §11 og 16 i lov nr. 288 af 4.juni 1986 om miljø og geneteknologi til forsøgsudsætning i 1990 af gensplejsede sukkerroer - dated 30 juni 1989. See also the Miljøstyrelsen Landbrugs- og bioteknologikontoret Rammenotat: Ansøgning om

markedsføring af genetisk modificeret herbicidtolerant foderroe i henhold til Rådets direktiv 90/220/EØF - 22.July 1997),

^{vii}Maribo Seed. Meeting Report (18-12-89) " Undersøgelser over spredning af pollen af bederoe (Beta Vulgaris); see also Skov og Naturstyrelsen. Notat om Økologisk konsekvenser ved udsætning af gensplejsede sukkerroer. 7-04-1989; Miljøstyrelsens redegørelse om vurderingen af resultaterne og forløbet af de i 1989 gennemførte forsøg vedrørende forsøgsudsætningen af gensplejsede sukkerroer (den 08-03-1990); Skov- og Naturstyrelsen letter to Miljøministeriet dated the 18-01-91. Vedr.: Udsætning af gensplejsede bederoer på Maribo Frø's arealer ved Holeby i sommeren 1991, see also SNS letter dated the 31.01.1991; see also Miljøministeriet Godkendelse i henhold til 11 og 16 i lov nr. 288 af 4. Juni 1986 om miljø og genteknologi til forsøgsudsætning i 1991 af genetisk modificerede sukkerroer.

^{viii}Cf. Godkendelse i henhold til 11 og 16 i lov nr. 288 af 4.juni 1986 om miljø og genteknologi til forsøgsudsætning i 1990 af gensplejsede sukkerroer - dated 30 juni 1989; A letter and a draft permit for the release from the Minister of Environment to the Folketingets Miljø- og Planlægningsudvalg (26-02-93);

Miljøstyrelsen Landbrugs- og bioteknologiskkontoret: Notat om ansøgning om godkendelse til markedsføring i EU af genetisk modificeret herbicidtolerant foderroe i henhold til Rådets direktiv 90/220/EF.

^{ix} Cf. Naturfredningsrådet blev to SNS vedr: principielle overvejelser ved udsætning af genteknologisk ændre planter , den 4-04-1989.

^x Maribo Seed. Meeting Report (18-12-89) " Undersøgelser over spredning af pollen af bederoe (Beta Vulgaris); see also : Skov- og Naturstyrelsen letter to Miljøministeriet dated the 18-01-91. Vedr.: Udsætning af gensplejsede bederoer på Maribo Frø's arealer ved Holeby i sommeren 1991, see also SNS 1 letter dated the 31.01.1991; SNS økologisk risikovurdering af anmeldelsen fra DLF-Trifolium A/S, Danisco Seed og Monsanto Europe S.A. vedr. markedsføring af genetisk modificeret herbicidtolerant bederoe (Beta vulgaris L.ssp.vulgaris) i henhold til del C, artikel 12 (3) i Direktiv 90/220/EF. See also here Miljøministeriet til Folketingets Miljø- og Planlægningsudvalg: Vedrørende miljøministeriets redegørelse til Folketinget om forsøgsudsætning af gensplejsede sukkerroer efter lov om miljø og genteknologi (spørgsmål 14) den 20th juni 1989

^{xi} See Skov og Naturstyrelsen brev til Miljøstyrelsen: Svar til Miljøstyrelsen fra skov- og Naturstyrelsen dated the 27-02-90; see also Skov- og Naturstyrelsen brev til Miljøministeriet, 18-01-91. Vedr.: Udsætning af gensplejsede bederoer på Maribo Frø's arealer ved Holeby i sommeren 1991, see also SNS letter dated the 31.01.1991)

^{xii}Skov- og Naturstyrelsen to Miljøstyrelsen dated 14.02.95. Vedr.: ansøgning fra Maribo Frø om tilladelse til udsætning af genetisk modificerede bederoer i 1995 med indsat herbicide resistance. See also letter from Skov- og Naturstyrelsen to Miljøstyrelsen dated the 11.01.95 Vedr. Supplerede ansøgning fra Maribo Frø om tilladelse til udsætning af genetisk modificerede sukkerroer i 1995.)

^{xiii}Cf. See Miljøstyrelsen bioteknologikontoret, den 31-januar 1992: Notat vedrørende krav til undersøgelse med udsætning af frit blomstrende genetisk modificerede sukkerroer; Skov og Naturstyrelsen brev til Miljøstyrelsen: Svar til Miljøstyrelsen fra skov- og Naturstyrelsen dated the 27-02-90; eller Skov- og Naturstyrelsen to Miljøstyrelsen dated 14.02.95. Vedr.: ansøgning fra Maribo Frø om tilladelse til udsætning af genetisk modificerede bederoer i 1995 med indsat herbicide resistance

^{xiv} Miljøministeriet Departmentet 4. Kontor letter to Maribo Frø, dated the 5 April 1991 - Godkendelse i henhold til 11 og 16 i lov nr. 288 af 4. Juni 1986 om miljø og genteknologi til forsøgsudsætning i 1991 af genetisk modificerede sukkerroer; SNS økologisk risikovurdering af anmeldelsen fra DLF-Trifolium A/S, Danisco Seed og Monsanto Europe S.A. vedr. markedsføring af genetisk modificeret herbicidtolerant bederoe (*Beta vulgaris* L.ssp.vulgaris) i henhold til del C, artikel 12 (3) i Ditektiv 90/220/EF.

^{xv} (source: Ansøgning i henhold til lov nr. 356 af 6. Juni 1991 om tilladelse til forsøg med udstning af genetisk modificerede sukkerroer i 1993. Maribo Frø November 1992).

^{xvi} Godkendelse i henhold til 9, stk. 1 og 16 i Lov nr. 356 af 6. Juni om miljø og genteknologi af udsætningsforsøg med genetisk modificerede bederoer, dated the 2nd May 1994.

^{xvii}Folketinget forhandling nr. R22: Miljøministeriet redegørelse af 24. Maj 1989 om forsøgsudsætning af gensplejsede sukkerroer efter lov om miljø og geneknologi, p. 10675-10676.

^{xviii}Folketinget forhandling (nr. R22: Miljøministeriet redegørelse af 17. Maj 1989 om forsøgsudsætning af gensplejsede sukkerroer efter lov om miljø og geneknologi. Miljøstyrelsen Bioteknologikontoret). Notits om bioteknologi frøforædling og andre bioteknologiske forskningsområder, den 13-10-1992 pp. 1-2.

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