

THE PUBLIC PERCEPTION OF RISK

Rosaleen Love

There is growing debate about the release of genetically modified organisms to the Australian environment, and current concern about the lack of a national approach to biotechnology regulation. The House of Representatives Standing Committee on Industry, Science and Technology set up an inquiry into genetically modified organisms in October 1990, and called for public submissions. The submissions are a valuable resource for research into the public perception of risk with respect to a new technology which has developed very rapidly, and in advance of an adequate regulatory framework.

Keywords: Genetic engineering, environment, science policy, public perception of risk.

INTRODUCTION

In July 1990 the House of Representatives Standing Committee on Industry, Science and Technology set up an inquiry into the release of genetically modified organisms to the Australian environment. The terms of reference of the inquiry were:

- to identify and report on any national issues unique to the contained development and use of genetically manipulated organisms and their release into the environment; and
- to inquire into and report upon the adequacy of the current arrangements, and advise on future desirable legislative frameworks for the regulation of the contained development and use of genetically manipulated organisms, and their release into the environment, including imported material.

The inquiry followed from concern expressed by the Australian Conservation Foundation (ACF) that the public should be invited to participate in debate on a technology which, as most respondents agreed, had developed very rapidly, and in advance of adequate national legislation.

The submissions and the subsequent public meetings of the committee are a valuable resource for research into the public perception of risk, and the process of science communication from both public and scientists to policy-makers. They also provide a valuable source of commentary by scientists on the wider meaning of the new techno-science.

* I am grateful to Bob Phelps, Genetic Engineering Campaign Officer for the Australian Conservation Foundation for his help. The anonymous referees for *Prometheus* made very useful comments on an earlier draft. Part of this paper was read at the *Ecopolitics V* conference, University of New South Wales, April 1991.

Submissions were invited in July 1990 by means of newspaper advertisements placed nationally. Members of the ACF who had registered an interest in the topic were also separately invited to reply. By the end of October 1990 there were some 140 responses, from scientists and peace activists, from government departments and consumer groups, from biotechnology companies and church groups, from individuals and from university researchers.

The term 'policy actor' applies to both individuals and institutions making submissions. Policy actors want their words to count in the world. They see a need for rational thought (their own) in the development of public policies, and they want to do their best to avoid an outcome which seems to them to be the wrong one. Policy actors gather the facts, do the research, develop their understanding; then find it far from simple to take effective action about what ought to be done, what legislation should be drafted, how research should inform rational decision-making. More research seems to introduce more complexity, does not seem to make the decisions any easier, and frequently makes the outcome less certain. According to Martin Rein, three things interfere with the attempt to sustain systematic thinking about social action. First is the problem of interests, since different policy actors want different things; the second is the problem posed by the complexity of the natural and social worlds, 'reality is so complex'; and the third, that knowledge which emerges from research requires a framework to interpret it, and often, there are only competing frameworks.¹ The three problems posed by Rein help clarify some of the issues in the debate about the release of genetically engineered organisms into the Australian environment.

The public responding to the call for submissions gave their information freely, as a gift to the committee. The committee, however, had already determined the agenda; it had framed the terms of reference in terms of risk; it was set up in an industry context, as a sub-committee of a standing committee of Industry, Science and Technology; it knew what it wanted to hear, the promise of economic growth for Australia.² Information was central to the committee activity, but information is never value free, as Ralph J.K. Chapman pointed out in a previous issue of this journal.³ Information is frequently a commodity to be manipulated in ways which serve the interests of those who want to control the outcome.

THE SUBMISSIONS

The submissions provide a record of who is currently saying what, and why, to whom, on the topic of the release of genetically modified organisms to the environment. They also provide insight into the ways in which opposing factions in the policy community perceive each other: e.g., either for science, or anti-science; either making a rational approach to the issue, or reacting emotionally to it; either for the environment, or for industry, (though biotechnologists also may present the

commercial interest as the environmental interest). There is also a split between those who perceive science as the disinterested search for truth, and those who see science as the producer of marketable products.

What constitutes the particular public who respond to the call for submissions? What use are concepts like the 'mass public', those persons with no special knowledge of science, and the 'attentive public', those persons prone to discuss and debate science and society issues actively?⁴

Most responses from scientific institutions, e.g., CSIRO or various university departments, if they brought up the topic of the public perception of science, made the point that the public, i.e., the mass public, is ignorant of science. Hence, the submission might continue, the public may be indifferent⁵ or hostile⁶ or fearful⁷ or unduly trusting⁸ of the new technology. Or there may also be the perception that the public is supportive, e.g., from the Waite Institute submission⁹ and The Murdoch Institute for Research into Birth Defects.¹⁰

A number of the scientists who responded as individuals could be grouped with members of the 'attentive public'. Many identified themselves as scientists in fields other than biotechnology — e.g., ecology, and their principal concern was about the risk to the environment.¹¹

Those who identified themselves as members of 'the public' in their submissions did not perceive themselves as misinformed. They expressed concerns on a variety of grounds, including risk to the environment,¹² risk to purity of food,¹³ risk of military use,¹⁴ and ethical objections on animal rights grounds.¹⁵

There seems to be a contradiction here between some of the scientists' perceptions of the public, e.g., as ignorant and misinformed and the view of the 'attentive public' including other concerned scientists, which has a perception of itself as reasonably well-informed. Differing perceptions indicate divergent definitions of the problem, where risk for the non-professional will mean more what Brian Wynne terms "social risk", and include perceptions of the risk management capacity of present social institutions,¹⁶ (social institutions which, as a number of submissions remarked, have in the past made the disastrous decision to introduce the cane toad). The recent growth of pressure groups having a wider range of environmental interests is indicative of some increase in scientific literacy in the Australian community, and successful protest against the Franklin Dam and mining on Fraser Island has also contributed to a growing public confidence in public action.

The CSIRO submission characterises the mass public as ignorant, citing a recently commissioned CSIRO Public Awareness Survey on issues related to genetic engineering:

Those consulted knew very little. Their concept of genetic engineering was almost entirely related to its use in humans, with ideas of Nazi experimentation and eugenics. . .they were uncertain scientists could be trusted.¹⁷

Statements about the ignorance of the mass public, and their claims for validation from survey data have certain consequences in suggestions for changes to government policy. If the public is held to be ignorant, then there is obviously no point in having public representation on bodies such as Institutional Biosafety Committees or the Genetic Manipulation Advisory Committee (GMAC). Only scientists, it was strongly argued by some submissions, should participate. Comments along these lines included "the likelihood of uninformed comment",¹⁸ or "broaden representation on Institutional Biosafety Committee, but only to include an external scientist".¹⁹ One submission (from Alcoa) particularly wanted to reject the notion of any representation from the ACF.²⁰ (I shall say more later, about the role of the ACF as chief villain in some scenarios).

CSIRO presented a proposal for the correction of public ignorance: "Scientific organisations like CSIRO have an important role in informing the public . . . so that public participation in setting of standards for regulation can occur on a rational basis." There does lurk there an assumption, that once the CSIRO has explained things we, the public, will understand and see it their way, where communication is a one-way process, them to us, with us, the grateful and enlightened recipients. The public are here perceived to be the ignorant mass public with the recipe for fixing it, (and here, curiously, a common thread ran through many submissions from scientific institutions) to give those making the submission the funds for printing more leaflets, giving more public lectures.

The question of conflict of interests in CSIRO's public communication role, given its commitment to funds from commercial sources was raised in the public sitting of the committee. The CSIRO response was: "Rather than a conflict of interests, CSIRO is in a very powerful position to balance these different viewpoints and to actually come out with a balanced look at what might go on".²¹ It is precisely this kind of institutional attempt at reassurance that Brian Wynne sees as presenting a problem in terms of public credibility. CSIRO might intend to inform dispassionately, but it may also convey, unintentionally, a tacit message of institutional interest in the appropriation of science by industry as a private resource rather than a public good.²²

The science-centred notion of science communication present in the CSIRO and some other submissions fits what Brian Wynne has termed the "cognitive deficit" model of science communication, science packaged by the expert for the passive consumer, knowledge transmitted as a one-way path.²³ The "cognitive deficit" is in the recipient, if the message is not received. Wynne is critical of this notion. He argues that the public uptake of science is not based on intellectual capacity, but more on whether knowledge is judged to be useful.²⁴ The "cognitive deficit" model ignores the institutional context of science communication. For example, claims about the ignorance of the mass public seem to represent an attempt to seek the removal of those who

have different interests (and possibly different theoretical frameworks for interpreting the data from the those held by biotechnology professionals) from the policy development process.

The clear difference of interests and theoretical framework can be seen if the CSIRO submission is compared with the submission from the Women's Environmental Education Centre. Research programmes within a scientific speciality normally mutually reinforce each other and their shared presuppositions without needing to subject them to direct examination. It takes an outsider group, in this case a women's group, to challenge as assumptions what the professionals accept as self-evident truths. For example, the notion that genetic manipulation is a technology vital to the future of Australia, one which promises maximum economic and environmental benefits, as stated in the CSIRO submission, is accepted as a self-evident truth, while, with the women's group, "the use of expressions such as 'existing and potential benefits', and 'existing guidelines' presume that the technologies only need fine-tuning before they go into mass production", an assumption which the group queried as part of their aim of broadening the terms of reference of the committee to include a more searching analysis of the notion of potential benefits.²⁵ Benefits, they ask, but the question is, for whom?

Both groups are trying to come to grips with the complexity of the world, and both make different assumptions about the interaction between what is known, what is assumed, and social and scientific needs. Both groups are making guesses about where genetic engineering and the releases of genetically modified organisms to the environment are going.

REPRESENTING THE INTERESTS OF TECHNOSCIENCE: THE ROLE OF THE MEDIA

If the public is being misled, a number of submissions argued, then the blame lies firmly with the media and its scaremongering tactics. There were several accusations of emotional over-reaction inspired by media over-simplification in the submissions.²⁶ This perception of media bias does not, however, seem to fit the evidence, at least as far as the print media representation of two events is concerned, the 'transgenic pigs to the Adelaide market' story of 1990, and the 'NoGall release' (both the experimental release in 1987 and the later commercial release in 1989). In both these stories, it seems that the print media is serving the interests of the biotechnology researchers extremely well, in presenting a largely science-centred version of events.

NoGall, a genetically engineered strain of *Agrobacterium tumefaciens* that controls crown gall disease in stone fruit, was the first recombinant product to be approved for release in Australia. The commercial release was controversial in that the release occurred in New South Wales with the approval of the NSW authorities (the NSW Department of Agriculture and Fisheries), but without being cleared by the Agricultural

and Veterinary Chemicals Council for national release. For that reason alone, the 1990 press might have been expected to be hostile, but this was not the case. Only one article out of the nine sampled, an article by Peter Quiddington in the *Sydney Morning Herald* (11 April 1990), mentioned the unofficial release implications and the lack of public debate on the issue. All the other articles emphasised the benefits of the new technology. Soon after the commercial release, the first *Australia Prize* was awarded to the three men who developed the technology, and articles reporting their win told the story favourably, making full use of the scientists' own accounts of their work.²⁷

If the articles from 1987 are included in the total sample of 17, the overall impression is one of strong print media emphasis on the benefits of the new technology. The images of benefit fall into the categories: (1) broad images, "no specific danger",²⁸ "zero likelihood of it becoming dangerous",²⁹ "fantastic potential",³⁰ "export dollars",³¹ "a safer, cleaner planet",³²; and (2) specific scenarios, "plants resistant to disease, herbicides",³³ "plants resilient to drought, waterlogging, salinity, and acid soils",³⁴ "successful biological control of Crown Gall disease".³⁵

Much less was written on risk, with two environmental groups, the Friends of the Earth in Adelaide and the Australian Conservation Foundation cited. The risk themes included the broad images of "unknown hazards. . . possibility of sabotage",³⁶ "Russian roulette with bacteria",³⁷ "an ecological disaster",³⁸ "South Australia a testing ground . . . in the tradition of Maralinga",³⁹ while specific scenarios envisaged "the creation of pathogens",⁴⁰ and "the development of resistance".⁴¹ The environmental groups were cited in raising the issue of risk, while scientists, e.g., Professor Allan Kerr, the designer of NoGall, and Professor Nancy Millis, then (1987) head of the recombinant DNA committee, the Genetic Manipulation Advisory Committee, took on the task of specifying "no risk".⁴² The scientists received a sympathetic press, and were often allowed the last word in criticising the critics. In Graeme O'Neill's article "The battle to disarm the plant pirates", subtitled "one of Australia's greatest scientific detective stories", Kerr's reply was given boxed prominence: "I see genetic engineering as an aid to the environment, and yet a lot of the opposition is coming from bodies who would benefit from it if they were really interested in the environment".⁴³

In short, I found nothing to suggest media bias against genetic engineering. Rather, I found a tendency to take the stories told by scientists, and report them straight, without comment. Kerr, in the Waite Agricultural Research Institute submission to the Parliamentary Inquiry (Submission 26) stated that most of the publicity he has received had been favourable, and he could see no evidence of any strong public concern about his work.⁴⁴

Similar conclusions can be drawn from the pig story. In Adelaide in 1988 over 50 transgenic pigs were taken from facilities run by Metrotec,

a joint venture between Metro Meats and the University of Adelaide. They were taken to an abattoir, slaughtered and sold for human consumption. The release did not become public knowledge until media comment in April 1990. The pigs were transgenic in that they possessed an extra copy of the gene responsible for the production of porcine growth hormone.⁴⁵ (Overseas experiments were more controversial, as there the added gene was human in origin and produced various defects in the pigs.)

The pig story was given a more critical press treatment than the NoGall affair, but hardly reached the heights of misrepresentation and bias alleged by some of the inquiry submissions. There was only one headline reference to "mutant pigs" and that appeared above an *Age* story by Graeme O'Neill, probably much to his horror.⁴⁶ Rather it was the apologists for the incident who used emotional over-statement in their attacks on the critics, e.g., "a hostile climate of public opinion towards genetic engineering [is] endangering the future of agriculture"⁴⁷; "ACF has blown case out of all proportion"⁴⁸; "Brave New World",⁴⁹ "sinister Franksteins"⁵⁰ (in caricaturing community misapprehension); and "Luddite distortion of the technology".⁵¹ The scientists at Metrotec were quoted extensively, and where the ACF was mentioned it was certainly not given equal space. Press comments stressed the future benefits of the new technology, including more efficient use of land, and the reduction of environmental degradation. Press criticism concentrated on the public's right to know, and on the issue of regulation.

Once again the ACF took on the role of bearer of risk information, while scientists were quoted as declaring "no risk".⁵² One memorable image is of Metrotec Director, Dr John Smeaton, after mention of "a media beat-up on the part of the ACF" saying "I've eaten meat from these pigs myself and its pretty good".⁵³ Ah, if only he had accompanied his pork dinner with a glass of NoGall, for yes, Gary Bullard, a director of Biocare Technology, the company that manufactures NoGall offered to mix up a solution of NoGall and drink it himself.⁵⁴ One has a vision here of a brave new Australian pork-and-pesticide cuisine.

THE SOCIAL AND POLITICAL CONTEXT OF RISK

Scientists as a professional group are expected to value evidence, the facts, and the keeping of an open mind, at least according to the canons of scientific rationality. Yet some of the submissions castigate the media as if statements constituted evidence. Touchiness about criticism from other scientists and the public, and its casual dismissal as emotional are curious features of the genetic engineering debate in Australia. There seems to be a kernel of truth in the stereotype of the scientist-inventor, cocooned in the world of his own brilliance, unable to imagine the broad social consequences of his work. Groups co-operating in the new research

share unexamined common presuppositions. What the bio-critics challenge as assumptions, the genetic engineers see as self-evident truth, for example that the technology is inherently good; that most of their activities are low risk; that the public is ignorant, and misled by the mass media. The interests that are served by the persistence of these assumptions are those of the biotechnology companies, the government agencies caught in the implementation of economic rationalist management policy, and biotechnology researchers. In this context, it is not surprising to find that the explanation for criticism is that the critics are emotional, biased, and ignorant.

The issue can be seen as one of problem identification. The word risk itself conjures up for the environmentalist the notion of risk to the environment, above all else. However, in an industry context, risk can also mean commercial risk, and in identifying the problem of risk, biotechnology researchers, at several key moments in the debate, move into defining risk in terms of commercial risk.⁵⁵ Not only are there different perceptions of environmental risks, there are different meanings given to the notion in different contexts.⁵⁶ Different institutions respond to risk differently, in terms of their different interests, their different frameworks, and because the way to cope with the complexity of the real world is to gloss over ignorance with assumptions. The desire to limit the debate to technical risks (putting to one side the question of social risk) is again another way of coping with complexity through the attempt at simplification. It also means, as Sheldon Krimsky points out, that the expertise to resolve the problems remains with those who have the most to gain from the technology's development. Those with self-interests will find themselves in a compromising position.⁵⁷

Problem identification occurs at the level of identification of risk as a scientific issue. Who will speak for science? Biotechnologists acknowledge that the examination of environmental risks in broad ecological terms is outside their area of expertise. Yet it is to the representatives of industry that the committee is turning for advice on risk. What was notable about the Hansard report of the public hearings was strong support for industry expressed by members of the committee, in contexts where a more impartial hearing might have been expected.⁵⁸

J.R. Ravetz once commented, with respect to the social responsibility of the scientist, that a common misconception is that "Science takes the credit for penicillin; society takes the blame for the bomb".⁵⁹ The belief that the new genetic science can be divorced from its application is expressed most explicitly in the following comment from one submission:

Some of the genetic and medical techniques that have been available for 10 or 15 years have been open to abuse but have been abused only rarely. For instance, prenatal determination of gender has been possible for this long, but has rarely been used for trivial social reasons in our society. (The different attitude to this matter reported in other societies needs to be seen

in their different cultural settings and not judged by our values or seen as a threat to our values).⁶⁰

What this scientific researcher sees as unimportant, Ravetz sees as the central problem, that credit and blame for discoveries cannot be so neatly apportioned.

If the genetic researchers stress the economic importance of their work, it is also because they perceive, accurately, that this is the favoured rhetoric of government-funded bodies at the moment. Against this, competing views which talk about quality of life are judged vague and unrealistic.

The submission from the Women's Environmental Education Group took a media release from the chairman of the Standing Committee, Michael Lee, MP, and teased out some of the assumptions in the document. Where the statement cited "Tremendous potential benefits to humanity", the critique zeroed in on one of the real problems, that environmental safety has to be understood in its social context. Hence, the women's group felt the need to remind the Committee, "Like any other technology, biotechnology is inextricably linked to the society in which it is created and used. It is not neutral, and will be as socially just or unjust as the society in which it is developed".⁶¹

This is the problem with the opening up of the debate, to make explicit the underlying competing frameworks and value issues. The complexity of reality makes it necessary for a broad approach, as suggested in a most comprehensive submission from a group from Griffith University. To come to terms with the full complexity of the many issues, environmental safety needs to be viewed more broadly in a social policy framework.⁶² For this reason, the CSIRO submission attempted the impossible, when it sought an "articulation of the issues: scientific or social?".⁶³

These insights on science and society have long been part of the academic discipline of the sociology of science. The problem still is, how to bring this knowledge to the attention of scientists so that it can inform their understanding of technical issues. Martin Rein wants to achieve some integration or accommodation of the different frames. Rather than try to restrict the terms of the debate, as the Inquiry has chosen to do, solely to the analysis of environmental risk, Rein would call for an elaboration of the debate, in recognition that the real world is very complex, and that no one framework provides the whole answer.⁶⁴ Ian Barns has adapted Rein's insights to the sustainable development debate. He argues that this process of "elucidation of frames enables us to appreciate the underlying differences of practice, strategic purpose, ideology and values and thus (possibly) to achieve some level of integration or accommodation of different frames."⁶⁵ Ralph J. K. Chapman calls for scientists to recognise that they are now a part of a political process, and for changes in the institutional processes by which decisions are made in society.⁶⁶ Brian Wynne calls for new

institutional relationships between experts and non-experts, with “the need for greater introspection into the non-technical values and preferences that affect both the selection of evidence and its interpretation.”⁶⁷ Nobody imagines this will be an easy task.

SOME CONCLUSIONS

Briefly, here are some conclusions which can be drawn from the submissions.

1. The placing of science in a wider social context is happening, but not with the scientists who contributed to many of the institutional responses. The genetic manipulators see their science in limited ways. They cite the importance of increasing the yield of plants and animals, but they do not go that step further, of inquiring what this increased yield might mean, socially, philosophically, or historically. It is the rural sociologist, the church groups, consumer organisations and individuals and groups concerned with animal rights who ask what the new technology might mean for disadvantaged groups, plants, and animals. In short the biotechnologists exhibit a technocratic optimism in which social interest is equated with economic interest.

2. Non-scientists tended to make use of arguments by analogy, e.g., comparisons of problems of biological pesticides with chemical pesticides, when grappling with scientific issues. The biotechnologists (as might be expected) use the language of science with great authority. The conceptual moves the professionals are using are very assured, compared with the kinds of conceptual moves the non-professionals are using. Yet, while accusing their critics of the use of emotive language, the biotechnology professionals tended to use hidden analogies, hidden metaphors, e.g., metaphors of progress and economic prosperity.

3. An important distinction between the submissions was the extent to which respondents were content to remain within the assumptions of the terms of reference of the inquiry, and the extent to which they questioned them, and wanted to broaden them. Placing science in a social context is happening, but by the outsiders to genetic engineering, by people who have to learn the language of science, at least enough to see what the possible problems are. The push is coming from the wider society towards science, from members of the attentive public.

4. Who says what, to whom, and why? Here ‘to whom’ is clear enough, the committee of inquiry. ‘Why’ is clear, too. People responding to the call for submissions are seeking to influence government policy. They want their words, their effort in writing a submission, and perhaps also appearing before the Committee, to be effective. They want to translate public knowledge into action. How are they doing it? Here there were a number of factors operating. The ACF was very active in providing the Committee with their mailing list, and also provided a two page summary of the issues, “Genetic Engineering: Time for Action”, a kind of master narrative from which a number of the

responses drew inspiration. The ACF thus provided the means by which otherwise marginalised and isolated policy actors could gain authority through aligning themselves with an organised conservation advocate.

The ACF master narrative had the power to call individuals to action. Its approach to risk was, in Sheldon Krimsky's term, "expansive". It posed questions which the biotechnology professionals regarded as outside their sphere of technical competence, but which many respondents clearly saw as within the legitimate domain of public concern. It provided a means through which public frustration at narrow definitions of economic benefit could be channelled. It explained technical issues while at the same time legitimating an emotional (I do not use the word pejoratively) affection for the Australian environment. It articulated issues in a way which promised to provide a possible remedy for past *laissez-faire* attitudes to environmental impact.

What the submissions also indicate is that a broad range of people are concerned about the release issue. It is not just the ACF which is making the running on the issue, as, for example, is claimed by the science journalist of *The Age*, Graeme O'Neill. In a recent article, "Keeping fantasy out of the biotech debate", published in the business section of the paper, O'Neill accused the ACF of "playing fast and loose with the truth", with "Luddite undercurrents" permeating its campaign.⁶⁸ Yet the voices of concerned scientists are also being raised in the debate, and the reasons they give for their concern are properly the domain of science.

What the documents illustrated, for this author, was what Krimsky calls "differences between technical and cultural rationality with respect to risk and risk communication" in the Australian context. Alternative conceptions and expectations of what "risk" means are held by different parties that are participating in shaping the political discourse of deliberate release. Whether the public perception of risk, broadly constituted, will feed into proposed changes of legislation remains to be seen. The impression of some environmentalist respondents is that in this case all it will do is contribute to the broad consensus that a national approach to biotechnology regulation is required, and this no doubt will be forthcoming. The Parliamentary Committee was itself set up by the Department of Science, Environment and Technology, with the environment viewed in an industry context. The prospects for further public participation, at the moment, do not seem to be very promising.

Overseas findings, as reported by William R. Freudenburg, suggest that the dichotomy between real and perceived risk is less real than might be assumed, and that scientist's errors in risk assessment are most problematic in areas involving human and social factors and those requiring judgment in the face of limited or non-existent evidence.⁶⁹ To which Freudenburg added, in words which accurately reflect the terms of the release to the environment debate in Australia, "Monetary or political pressures can create additional problems and distortions". In the Australian context, the opening of the risk issue to public debate marks only the beginning of the story.

NOTES AND REFERENCES

1. Martin Rein, *Social Science and Public Policy*, Penguin, Harmondsworth, 1976, p. 98. The three points are also developed by Professor A. Brownlea of Griffith University in his appearance as witness before the parliamentary committee, Brisbane, 8 February 1991 (Hansard, pp. 934-5).
2. Australia, House of Representatives Standing Committee on Industry, Science and Technology, *Inquiry into Genetically Modified Organisms*, p. 347.
3. Ralph J.K. Chapman, 'Information diffusion: reconciling scientific knowledge and public policy', *Prometheus*, 8, 2, December 1990, p. 241.
4. Ole R. Holsti, *Content Analysis for the Social Sciences and Humanities*, Addison-Wesley, Reading, Mass., 1969, p. 38 and James N. Rosenau, *Public Opinion and Foreign Policy*, Random House, New York, 1961, pp. 35-41.
5. House of Representatives Standing Committee on Industry, Science and Technology, *Inquiry into Genetically Modified Organisms*, Submissions 3, 26 and 104.
6. Submissions 60, 62 and 69.
7. Submissions 3, 54 and 106.
8. Submission 18.
9. Submission 26.
10. Australia, House of Representatives Standing Committee on Industry, Science and Technology, *op. cit.*, p. 550.
11. Submissions 2, 8, 11, 41, 111, 119 and others.
12. Submissions 2, 20, 29, 92, 107, 113.
13. Submissions 125, 129, 137.
14. Submissions 84, 95, 96, etc.
15. Submissions 5, 20, 56, 85, etc.
16. Brian Wynne, *Risk Management and Hazardous Waste: Implementation and the Dialectics of Credibility*, Springer-Verlag, Berlin, 1988, p. 11.
17. Submission 107.
18. Submission 68.
19. Submission 115.
20. Submission 70.
21. Australia, House of Representatives Standing Committee on Industry, Science and Technology, *op. cit.*, p. 1082.
22. Brian Wynne, 'Knowledge in Context', *Science, Technology, and Human Values*, 6, 1991, p. 113.
23. *Ibid.*, p. 116.
24. *Ibid.*, p. 114.
25. Submission 35.
26. Submissions 50, 54, 62, 69, 138. The Waite Institute, Submission 26, stated that "invalid emotive arguments are used to antagonise the population" but this is still to a very limited extent in Australia, but more so overseas." CSIRO, Submission 107, stated that "media reports have tended to focus on one side of the debate or the other . . . [some] arguing total opposition to genetic manipulation". Richard Hindmarsh has analysed 70 items in the Australian print media on the theme of genetic engineering 1987-1990. Of these 70 items, 51 were positive, two were critical, and 17 explored both sides. Hindmarsh also includes the electronic media in his analysis, and suggests that the coverage there is fairer, and more balanced (personal communication). A good example of media polarisation of the debate occurred in the ABC TV Monday Conference, **October 23, 1988**, where the participants simply did not listen to each other. See Rosaleen Love, 'Talking past each other', *Australian Society*, 7/8, December/January 1988/89, pp. 14-15.
27. *Age*, 14 April 1990; *Australian*, 17 April 1990.
28. *Canberra Times*, 28 July 1987. In this analysis I am following Sheldon Krimsky and Alonzo Plough, *Environmental Hazards: Communicating Risks as a Social Process*, Auburn House, Dover, Mass., 1988, p. 92.
29. *Times on Sunday*, 14 June 1987, p. 5.
30. *The Age*, 20 June 1987, p. 2.
31. *Sydney Morning Herald*, 11 April 1990.
32. *The Australian*, 17 April 1990.
33. *The Australian*, 14 April 1990.

34. *The Age*, 14 April 1990.
35. *The Age*, 12 April 1990.
36. *The Sydney Morning Herald*, 6 May 1987.
37. *The Australian*, 24 July 1987, letter to the editor.
38. *Adelaide Advertiser*, 30 September 1987. This was a letter to the editor from Ian Grayson, Friends of the Earth, South Australia.
39. *Ibid.*
40. *Ibid.* and *The Times on Sunday*, 14 June 1987.
41. *The Australian*, letter to editor, 24 July 1987.
42. *The Times on Sunday*, 14 June 1987, p. 5.
43. *The Age*, 12 April 1990.
44. Submission 26.
45. Ian Anderson, 'Genetically altered meat slips through the net', *New Scientist*, 12 May 1990, p. 3.
46. *The Age*, 28 April 1990.
47. *The Australian Rural Times*, 3 May 1990.
48. *Adelaide Advertiser*, 28 April 1990.
49. *The Age*, 2 May 1990, p. 13.
50. *The Age*, 2 May 1990, p. 13.
51. *The Age*, 8 May 1990.
52. *The Age*, 28 April 1990.
53. *The Adelaide Advertiser*, 28 April 1990.
54. Brett Wright, 'Gene spliced pesticide uncorked in Australia', *New Scientist*, 4 March 1989, p. 23.
55. Australia, House of Representatives Standing Committee on Industry, Science and Technology, *op. cit.*, p. 422, 456 and 1113.
56. Langdon Winner, *The Whale and the Reactor*, University of Chicago Press, Chicago, 1986, p. 146.
57. Sheldon Krimsky, *Genetic Alchemy: The Social History of the Recombinant DNA Controversy*, MIT Press, Cambridge, Mass., 1983, p. 1.
58. Australia, House of Representatives Standing Committee on Industry, Science and Technology, *op. cit.*, p. 571, 996 and 1118.
59. J. Ravetz, somewhere.
60. Submission 54.
61. Submission 35.
62. Submission 106.
63. Submission 107.
64. Martin Rein, *op. cit.*, p. 98.
65. Ian Barns, Conference Abstracts, *Ecopolitics V*, Sydney, 1990.
66. Ralph J.K. Chapman, *loc. cit.*, p. 254.
67. Brian Wynne, *Risk Management and Hazardous Waste*, p. 15.
68. Graeme O'Neill, 'Keeping fantasy out of biotech debate', *The Age*, 1 March 1991, p. 20.
69. William R. Freudenburg, 'Perceived risk, real risk: social science and the art of probabilistic risk assessment', *Science*, 242, 1988, pp. 44-9 at 48. Another paper which deals with risk perception with some reference to Australia is S. Martin Taylor, 'Environmental contaminants as public health risks with particular reference to electric transmission lines', briefing paper submitted to the Brunswick-Richmond Transmission Line Review Panel, Office of the Commissioner for the Environment, Melbourne, Victoria. Other useful references include Dorothy Nelkin, *Controversy: Politics of Technical Decisions*, 2nd ed., Sage Publications, Beverly Hills, California, 1984, p. 15; J. Cramer, R. Eyerman and A. Jamison, 'The knowledge interests of the environment movement and its potential for influencing the development of science', in S. Blume *et al.*, *The Social Direction of the Public Sciences*, Reidel, Dordrecht, 1987, pp. 89-115; J. Boyle *et al.*, *The Politics of Technology*, Longman, London, 1977; Susan Wright, 'Molecular biology or molecular politics? The production of scientific consensus on the hazards of recombinant DNA technology', *Social Studies of Science*, 16, 1986, pp. 593-620.