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Book Section

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1. Introduction

Expert knowledge is centrally important in modern industrialised societies. Nowhere is this more evident than in science and technology. The technological products of modernity have produced innumerable benefits as well as unforeseen risks. People are living longer, healthier lives, but there is also a pervasive sense of threat. In the United Kingdom, this dynamic is apparent in food safety. Since the 1980s, there have been a number of 'food scares' including those linked to salmonella, listeria, *E Coli*, and 'mad cow disease'. In recent years, anxiety has centred on genetically modified (GM) foods and crops.[1] Government responses have generally focused on food quality, safety and hygiene[2] with the expressed aim of restoring public confidence.[3] Studies have suggested, however, that in the wake of the 'mad cow' and other crises, publics[4] are increasingly unconvinced by such governmental assurances.[5] Moreover, with GM technology, the increasingly heated debate over food has addressed scientific concerns with safety and calculation of risk, in light of contextual issues including ethics, politics, and economic power. Correspondingly, the language and rhetoric of the debate has increasingly drawn upon styles and techniques beyond those of the factual report and evaluation of evidence.

At least three relevant perspectives have emerged in the continuing public debate: (1) Government officials and GM scientists argue that GM crop technology is based on 'sound science' and consequently safe for both human health and the environment. (2) Environmental pressure groups and some members of the public contest these scientific judgements, raise ethical concerns about the relation between human activity and nature, and express political concerns about commercially-motivated research and government decision making. And (3) meanwhile, the media characterise both scientific reassurances and public anxiety in extreme terms.

2. The Great GM Food Debate

In early 1999, a period of intense media interest in GM took place, which came to be known as 'The Great GM Food Debate'. It was sparked by a letter in *The Guardian* signed by 22 scientists in support of Arpad Pusztai, a researcher who had found that rats developed cell damage in their stomachs, immune system defects and stunted growth after having eaten GM potatoes for a time period corresponding to ten years of human life.[6] In February, *The Guardian* ran a series entitled "What's Wrong with our Food?" and phrases such as "Frankenstein Foods" and "Mutant Crops" became commonplace in describing GM food products.[7] Some of the factors contributing to the heated nature of the exchanges included:

- the erosion of public confidence in the British food industry following the crisis over 'mad cow disease' in 1996,
- the importation of unsegregated soya and maize in 1999, and
- the establishment of a coalition of GM critics including Friends of the Earth, the Soil Association, the Vegetarian Society, and public figures such as the Prince of Wales.[8]

The debate remained in the news in subsequent years following a successful campaign spearheaded by the group Five Year Freeze advocating a moratorium on commercialisation of GM crops and further safety testing.

3. University GM Crop Scientists

It was in the context of the ongoing dispute over GM technology that we set out to investigate the debate within one representative social institution: the university. The project aimed to uncover how GM crop scientists at a British university[9] presented their research to non-specialists, and how their linguistic and rhetorical choice varied with the purpose of the communication and with their perceptions of audience knowledge and views, and how these choices persuaded or antagonised receivers. The research took place between November 2001 and November 2002. In it, we completed nineteen in-depth interviews with scientists, thirteen with non-experts, and seven with outside commentators.

The study relates ways of conceptualising risk to the different strategies used to represent it. Risk analysis in the social sciences has long viewed risk perception as a subjective and social process.[10] It argues that risks are socially constructed; their collective meanings are shaped by the various storylines disseminated by competing institutional actors,[11] and food scares have been specifically invoked as examples of this process.[12] People's responses to the risk statements of scientists and government officials are seen as reflexive and embedded in social practices, for example lifestyle choices that preclude eating certain types of food.[13] This highlights the difference between scientific calculations of risk in objective terms as probabilities, and actual human perception of risk as a factor in daily life.

4. Framework and Methodology

The research strategy combined a sociological approach to the content and context of the scientific arguments, with a discourse and linguistic analysis of the wording. On the sociological side, the method employed provides for the examination of discourse using frame analysis.[14] This combines an analysis of the semantics of texts with an analysis of the contextual factors, such as the discursive strategies of scientists. The duality of this type of discourse analysis allows the research to relate oral and textual representation of social reality to the social processes generating them.[15] This is enhanced by the use of rhetorical analysis, which has a long tradition of examining persuasion in scientific discourses, including specialist and non-specialist genres.[16] The transcripts of interviews were analysed using a version of the constant comparative method.[17] In this approach, coding paradigms developed before data collection begins are enhanced or rejected through a process of comparing analytical 'dimensions' that emerge through the process of integrated data collection and analysis. This forms the basis for the outcome of the research, which is an empirically grounded theory.[18]

On the linguistics side, the project draws upon three approaches, applied linguistics discourse analysis,[19] critical discourse analysis,[20] and corpus analysis of texts.[21] The central tenet of applied linguistics discourse analysis and critical discourse analysis is that the coherence and meaning of a text cannot be analysed or accounted for separately from the situational and cultural context of its production and reading and its paralinguistic features. Our aim was, in using techniques developed in corpus analysis of text, to relate linguistic choices in our data to these factors. These linguistic based approaches, therefore, fit well with, and indeed already make use of, the sociological methodology outlined above. From critical discourse analysis, we borrowed techniques for relating textual choice to overt ideology, using our sociological data to assess the effects of such choices.

5. The Politics of the Risk Society

Ulrich Beck's theory of the risk society informs our analysis of the ways in which GM as a controversial technology comes to be contested by experts and non-experts in the public sphere. Beck's thesis is that life in western, industrialised societies has taken a radical shift since the 1980s, which has profoundly altered the ways in which people relate to one another. The shift is the constant threat of environmental catastrophes and health problems that ironically arise out of technological progress, such as global warming, the thinning of the ozone layer and genetically modified foods.[22]

An important feature of the risk society is the way in which the past monopoly of the sciences on rationality has been broken. Paradoxically, science becomes "more and more necessary, but at the same time less and less sufficient for the socially binding definition of truth".[23] Beck contrasts the rigid "scientific rationality", which is rooted in a critique of backwardness with a new "social rationality", which is rooted in a critique of progress. Under pressure from an increasingly edgy public, new forms of "alternative" and "advocacy" science come into being and force an internal critique. This "scientisation of protest against science" produces a fresh variety of new public oriented scientific experts who pioneer new fields of activity and application, such as conservation biology.[24]

In similar fashion, monopolies on political action are said to be coming apart, thus opening up political decision-making to the process of collective action. One example of this is the entry of the Greens into parliamentary politics in Germany in the late 1980s. The dynamic of reflexive modernization leads to greater individualisation. Unbound from the structures of traditional, pre-modern societies, the new urban citizens of the industrial revolution were supposed to reach new levels of creativity and self-actualisation. However, this did not happen, largely because a new constraint, the culture of scientism, invaded every part of the lives of its citizens, from risk construction to sexual behaviour. Now, Beck argues, there is a chance for the individual to break free once again and choose lifestyles, subcultures, social ties and identities. Yet, ironically, just as this individualised private existence finally becomes possible, people are confronted with risk conflicts, which by their origin and design resist individual treatment.[25] Examples of this are the genetic manipulation of plants and animals, the greenhouse effect and the thinning of the ozone layer. Thus, "reflexive scientisation" in which scientific decision-making, especially that related to risk, is opened up to social rationality becomes important to reclaim individual autonomy. According to Beck,

> Only when medicine opposes medicine, nuclear physics opposes nuclear physics, human genetics opposes human genetics, or information technology opposes

> information technology can the future that is being brewed up in the test-tube become intelligible and evaluable for the outside world. Enabling self-criticism in all its forms is not some sort of danger but probably the *only way* that the mistakes that would sooner or later destroy our world be detected in advance.[26]

As Lidskog points out in his review of *Risk Society*,[27] Beck contradicts himself by arguing that the planet is in increasing peril due to an escalation of objectively certifiable global risks, and at the same time, insisting that risks are entirely socially constructed and therefore do not exist beyond our perception of them. This reflects a longstanding tension in environmental sociology between the environmental activist and the sociological analyst.[28] Beck also tends to overemphasise the need for alternative forms of scientific knowledge, however we agree that on its own, science is an insecure base upon which to explain how risks can be understood and confronted.[29] In this analysis, the main points we draw from Beck are the conflicts that occur when scientific rationality is opened up to social rationality, and the ways in which this has the potential to engender new forms of democratic decision making.

6. Corporate Drivers and Biotechnology

An additional factor to consider, which Beck does not examine in any great detail, is the role that commercial drivers play in mediating and contesting biotechnological risks.[30] Of the six major companies that now dominate the biotechnology sector, three are United States (US) owned: Monsanto, DuPont and Dow, and three are European: Bayer, BASF (German) and Syngenta (Swiss). These companies specialise either entirely in agricultural biotechnology, pesticides and seeds (Monsanto and Syngenta), or have developed specialist businesses to cover these areas (Dow AgroSciences, DuPont Agriculture and Nutrition, BASF Plant Science, Bayer Crop Science). Monsanto is the world leader in GM crop sales. In 1998, it had 88 per cent of the total market. The companies have varied histories, DuPont, Dow, BASF and Bayer are traditional, well established chemical companies, with long involvement in agrochemicals, while Monsanto had focused on discovery of herbicides, but became a leader in GM technology and grew by acquisitions. There has been a concentration of power in US agriculture concomitant with the introduction of GM. In the first five years that GM was commercially available, during the mid to late 1990s, suppliers of inputs, and numbers of seed companies went from over 400 to just five major players.[31]

In the United States, more than 70 per cent of processed food contains genetically modified ingredients. Around 80 per cent of soy and one-third of maize became GM within five years of commercialisation. In an average US supermarket, 2000 products contain maize and soy, thus most of these contain GM ingredients.[32]

In the United Kingdom, the biotechnology sector has been in decline for the last twenty years. Since 1980, the number of research and development posts in the agrochemical and biotechnology sector has decreased by over sixty per cent. The largest annual decrease was between 1999 and 2000, in the period following the Great GM Food Debate. No agrochemical company has its headquarters in the United Kingdom (UK), and there is only one major commercial centre, Syngenta in Berkshire. There has been a moratorium on commercial production of GM crops in the United Kingdom since 1999.[33] A national debate was held between June 2002 and July 2003 to aid the UK government in making a decision on commercialisation. The debate was comprised of three strands, a scientific review, an economic review and a public consultation. In early 2003, the UK Government decided to process nineteen applications for growing and importing GM crops and forward them to relevant member states and eventually the European Commission for authorisation. Critics claimed this action effectively by-passed the national debate. Margaret Beckett, the Environment Secretary asserted that many of the applications were "not new" and "already in the pipeline".[34] Sue Mayer of Genewatch UK argued "It is premature not to say outrageous, to carry on the licensing of GM crops before either the scientific evidence has been gathered or the public consulted. It makes the whole exercise seem pointless". Other members of the steering committee of the debate echoed this sentiment.[35] The government response was that it had not taken any decision about commercialisation, and that in any event, it would not know whether the applications that were submitted were successful until after the public debate had concluded. This may suggest that the government was confident that the conclusions from the debate would advocate commercialisation.

7. Public Understanding of Science

Many scientists believe that public concerns over GM food could be addressed if scientists engaged more directly with laypeople, such as through a national debate. Within the last fifteen years, scientists in the US and UK have been required by funding bodies to deal with non-expert members of the public. Scientists in the recent past had looked at the popularisation of science as something that could damage their career, which is consistent with a culture that sees the hallmark of good science as that which is unintelligible to all but a small group of elites.

Underpinning much of the public understanding of science movement is the idea that greater public knowledge of science will lead to greater public support of the scientific endeavour as well as scientific and technological achievements. A corollary of this view is the 'deficit model' of the public understanding of science, which sees the public as blank slates or empty vessels, laypeople whose minds are in need of scientific information to be replete.[36] For example, EuroBarometer reports, which are based on the deficit model, define knowledge purely in terms of GM technicalities, and correlate lack of knowledge with negative attitudes to GMOs.[37] Other research suggests, however, that greater knowledge does not necessarily lead to greater acceptance of controversial technologies. The 1996 British Social Attitudes Survey found that, while knowledge of science had increased significantly since 1988, overall attitudes toward science had hardly changed at all.

There is some evidence that people who are more knowledgeable about science do have more positive attitudes towards it. However, there is also much empirical support for the view that greater understanding of technologies and their social implications can lead to criticism and hostility. This has been the case with nuclear energy and its associations with planned or accidental mass destruction, as well as new advances in fertility and their ethical implications. It has also been the case with genetic modification. Notably, Bucchi and Neresini[38] found that increased knowledge of techniques did not bring about acceptance of genetically modified organisms. Environmentalists often make use of science and are in conflict with the scientific establishment, which is commensurate with Beck's observations about the "scientisation of protest against science".

According to the deficit model, the scientific community is the source – and by and large the censor – of the information that is transmitted in a one-way stream to the public. The contextual approach on the other hand tries to take into account the particular circumstances of the recipients, as well as the purveyors, of the scientific information.

Our research suggests that GM scientists view lay members of the public through the lens of the deficit model, while members of the public take a more contextual approach. In the former view, scientific information is seen as distinct from politics, economics, history, and ethics. In the latter, scientists' statements are cross checked against issues such as the safety history of the British food industry, people who will benefit from GM food technology, and those who are funding the science.[39] Taken together, they become an example of the struggle Beck identified between scientific and social rationality.

8. Scientists Frame Publics

We found that many of the GM scientists interviewed framed non-experts, normally referred to as "the public", in four ways, as ignorant, irrational, gullible and intellectually vacuous.[40] While all scientists did not hold these views, they were certainly the main ways in which non-experts were portrayed. We argue that this is significant for understanding the wider GM debate, since the framings allow scientists to resist lay participation in debates and decision-making on science and technology, and to propound the view that GM can only be viewed through the scientific perspective.

Scientists frequently characterise the public as uniformly ignorant, of GM science rather than other relevant dimensions of the debate, and attribute opposition to GM to this ignorance. Their views suggest that further scientific education would mollify or eradicate opposition to GM:

> "There are relatively few people that are absolutely against [GM], no matter what. Those that are tend to be less well informed, in general, than those that have taken a more measured view." (Paul)

A key theme that emerges in scientists' narratives of the public is a dichotomy that opposes rational scientific knowledge with emotional public responses. This division is articulated using words and phrases such as "blind", "blindly", "religiously hostile", "real risks (versus) phantoms", "gut feelings", "inchoate feeling of something wrong". Decisions about the introduction of GM technology are perceived as almost entirely safety oriented, based on a rational choice model.[41] In other words, if people have enough information, they can make a 'rational choice' for GM. There is an almost exclusive focus on a cost benefit analysis based on assessable safety issues relating to health and the environment. There is no reference to unforeseen risks, bounded rationality and the need to make the best judgement in situations of imperfect knowledge,[42] although this has recently featured prominently in expressions of doubt about GM technology.[43]

> "So the more that you know, and the more information you have in particular areas, then the more rational and more quantifiable the risk becomes…so that people become more able to be rational in the areas that they are worried about, and become more relaxed in the areas

that are really, frankly, nothing to worry about." (Paul)

The view that laypeople are intellectually weak is suggested by discussions of whether they can handle the complexity of the issues at stake.

> "You can talk in general terms about it and about the ethical implications and about whether…for instance a particular GM crop will be useful in terms of food production on a world scale. Those kinds of things you can perfectly talk to people about at length. They're perfectly capable of contributing usefully to that. But I think issues for instance about gene flow out of transgenic crops into the environment, I mean that's… quite…complicated." (John)

Scientists' view that non-experts are intellectually weak is often parodied in anecdotes relating a farcical encounter with a particularly uninformed member of the public:

> "I had a lady from a magazine ring me up about genetic manipulation and [she] said their readers were worried about this fact that they were eating DNA, and I said 'Well look, you know, OK, but we're eating DNA all the time you know'. [And she said] 'Are we? Really? We're eating DNA?' And, I mean – I can understand – I'm not criticising her at all or belittling her, but she had no idea that everything was full of DNA." (Simon)

Scientists also discredit non-experts' sources of information, and claim that people derive their opinions on GM from tabloid newspapers and other "sensationalist" press. The representation of members of the public as intellectually weak is reinforced through the idea that they are gullible and vulnerable to scaremongering by the press and NGOs:

> "A lot of this has been driven by the green pressure groups and I think they have been playing on fears of the unknown. I think that a lot of the rather sensationalist press has got a lot to do with the very anti feelings about GM in this country at the moment, because scare stories sell papers, good news doesn't." (Brian)

Discrediting publics in these ways makes it possible for many

GM scientists to ignore their concerns, or to engage with them only in a one-way process of information transfer. It also allows scientists to characterise those lacking in scientific knowledge, or who have doubts that surpass scientistic constructs, as inappropriate participants in decision-making processes about the technology.

9. Lay Publics and Agency

Many laypeople also feel a lack of agency, sensing that decisions about the technology have already been made and are beyond their control. Their views about the GM debate, again not universal, but dominant in our dataset, are focused upon actors in the debate and their trustworthiness, which is linked with the specific information they purvey. Assurances of safety, or cautions about danger, are cross checked against knowledge of those who fund the scientific research, and those who champion the scientific findings. Public views constellate around key institutional players, including the government, corporations, and NGOs.

Regarding trust, several themes emerged. Non-experts felt that an impartial group was needed to mediate between dominant institutions, scientists and the public. Driven by the memory of past food crises, government and corporations were seen as untrustworthy as well as biased sources of information about GM. This sense of mistrust was not always reduced by legislative controls:

> "Maybe the Government or somebody could give out booklets on what GM food actually is. But they probably can't do that…But yea, just – maybe not the Government – somebody – a completely non-biased group… [Interviewer: 'Does the assurance that work is conducted in accordance with the relevant legislation make you feel safe?'] No, not at all. Because, I've sort of been brought up not to trust the Government…and you imagine it's just…Tony Blair and the Americans… making the legislation." (Mick)

> "I think it's very difficult if you've got businesses sponsoring research that deliberately aim to get a specific result out of that research. I think there are some ethical issues about big companies like Monsanto, or whatever, sponsoring research on genetically modified foods…and…from a personal point of view, if I was to look at any research, I would always find out who paid

for it." (Rachel)

Some believed that research funded by corporations and disseminated by them was acceptable, as long as it was clear who was providing the information, so that they could be held accountable:

> "I personally would rather [information] come from the company. If, touch wood, something does go wrong – you hope it doesn't go wrong – you can fall back and you can say 'right, if so and so said that a food blah, blah, blah.' At least you can go to the company, and if you have to go down the lines of going to court, you can go down there and take them to court." (Tom)

Laypeople's perceptions were that an independent authority, outside politico-economic interests, was needed to make GM safety assurances. NGOs were seen as having the potential to fill that role because the need for profit did not influence them as much:

> "I suspect it comes down to providing understandable science tests that are done in this immaculate vision of an environment where no damage can be done. I think having the Monsantos of this world beating the drum is total backfire land. You need to find that independent and believable authority – and it's not our Government either. It may be Friends of the Earth or some organisation that's different … So your method of testing and your science has got to be totally clear and transparent and above board and your arbiters and testers have got to be totally believable." (Ian)

> "With NGOs, I imagine that the big ones have PR people working for them. But again, there aren't quite the same commercial concerns there, so that I would expect them to put out the information in a clear way. I would expect it not to have been spun for commercial gain." (Elizabeth)

The non-experts were not necessarily anti-GM, but most expressed concerns that the process by which GM was entering the food chain in the UK was already a *fait accompli*, and essentially undemocratic:

> "So I can see [GM] coming. I just would be desperate that it happens in a way that we all understand what we're doing, and are at ease with what's going on, and welcome it – rather than have it forced on us." (Ian)

What is clear from views of non-experts is that there is a sense of the failure of the political process to address adequately and transparently all of the contextual factors surrounding GM, and which inform the scientific question of whether it is safe. Among the scientists interviewed, there is a vague awareness that there are ethical and social objections to GM technology, but these are often portrayed as being religious or irrational in nature.[44] In private or in informal conversation, some scientists acknowledged other dimensions to the technology, but expressed an inability to address these within the realms of science. Those who say they can be addressed, if obliquely, through studies of GM safety, for example, are well aware that there are limited resources to pursue this kind of research.

10. Ways Forward: Democratising Science and Technology

Contextual factors relating to new technologies in society do not have to be left to experts; they can be addressed through a deliberative democratic process that draws legitimacy from free and open debate within the public sphere.[45] There are a number of possible ways forward. Many have called on governments to re-examine decision making on controversial technology, and consider whether there should be "a broad cultural change about relationships between technology and society". This would build democratic participation based upon a relationship between experts and non-experts, rather than an approach rooted in the top down transmission of information.[46]

There is a wide range of examples where relationships between science, technology and society have been successfully democratised. Citizens' juries of laypeople have been used fruitfully in Cambridge, Massachusetts to make decisions about new gene splicing laboratories at Harvard University. The Danish Board of Technology's consensus conferences are driven by interested lay citizens making use of scientific evidence to compile a final report, which is then cross-checked by expert panels.[47] Similarly, the GM public debate in Britain in 2002-2003 was a first step toward democratising the lay/expert divide, but the way it unfolded suggests there is still much work to be done.

11. Conclusion

The GM debate is a paradigmatic example of the struggles between scientific and social rationality that occur in societies defined by risk. Trust in institutions that traditionally ensured safety has deteriorated, and there is the sense that democratic decision making occurs only in name. Those who hold power, government officials, scientists and corporate executives, portray themselves as embattled and under siege. Powerful actors often set the rules, directly and indirectly, by which others participate. At the same time, there is a contest over meaning that occurs within the public sphere between those for and against that provides tremendous prospects for democratic decision making. New science and technologies offer vast opportunities to high modern societies, and to a certain extent define them. The answer is not to return to an idyllic past or retreat into Ludditism. Nor is it possible to leave important decisions to 'experts'. The solution is to transform participatory politics, and to encourage new ways of debating, contesting, and shaping our common future.

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Notes

1. Wynne, 2002a.
2. UK Government, 1990; 1998.
3. Shaw, 1999.
4. The use of *publics* in the plural denotes our position that the lay public is not a homogeneous and clearly defined community (Mayer, 2002; cf. Mills, 1956, 298).
5. Grove-White et al., 1997.
6. Ewen and Pusztai, 1999.
7. See the *Daily Mail* 28 January 1999 and the *Express* 18 February 1999.
8. Durant and Lindsey, 2000.
9. The name of the university and those of the scientists have been masked to protect their confidentiality.
10. Douglas and Wildavsky, 1982, 6; see also the related literature on the psychology of risk, e.g. Frewer et al., 1998 and Slovic, 2001.

11. Gabe, 1995.
12. Beck, 1992; 1995.
13. Beck et al., 1994; Macnaghten and Urry, 1998.
14. Gamson and Modigliani, 1989.
15. Eder, 1996.
16. Fahnestock, 1986.
17. Glaser and Strauss, 1967; Strauss and Corbin, 1990.
18. Kelle, 2000.
19. E.g. Brown and Yule, 1983.
20. E.g. Fairclough, 1992.
21. Stubbs, 1996.
22. Beck, 1992.
23. Beck, 1992, 156.
24. Beck, 1992, 160-163
25. Goldblatt, 1996.
26. Emphasis in original, Beck, 1992, 234.
27. Lidskog, 1993.
28. Hannigan, 1995.
29. Cf. Macnaghten and Urry, 1998.
30. See Robbins (2001) where this is examined in greater detail.
31. Prime Minister's Strategy Unit, 2003.
32. Hollingham, 2003.
33. Prime Minister's Strategy Unit, 2002.
34. The UK government confirmed that their actions conformed to EC Directive 2001/18, which introduces new requirements including a more rigorous risk assessment, post-market monitoring, mandatory public consultation and mandatory traceability and marketing (Secretary of State for Environment, Food and Rural Affairs, 2003).
35. Brown, 2003.
36. Gregory and Miller, 1998, 89-90.
37. BEPCAG, 1997; INRA, 2002.
38. Bucchi and Neresini, 2002.
39. Wynne, 2002b.
40. Cook and Pieri, 2002; Cook, Robbins and Pieri, 2003; Cook, Pieri and Robbins, forthcoming.
41. Coleman and Fararo, 1992.
42. Simon, 1957.
43. Scientists often see members of the public as demanding inappropriate assurances of 'zero risk'. Research suggests that people are willing to accept risks, as long as assessments are expressed transparently and accurately (Wynne, 2002a, 466).
44. Cf. Deane-Drummond et al., 2001.

45. Habermas, 1996.
46. Marris et al., 2001.
47. Kleinman, 2000; Gregory and Miller, 1998.

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