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# Market Orientations and Mediation of Public Opinions in Finnish Biotechnology

National Report for COMPASS -
Changing Contexts for Mediating Public Concern in the Assessment of Biotechnoscience

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# BIOTECHNOLOGY AS A NATIONAL COMPETITIVENESS FACTOR

Since the late 1980s Finland has followed the strategy of the OECD by paying more attention to "new promising technologies" (OECD 1988; Science and Technology Policy Council 1987). A corporatist decision has been made concerning the responsibility of the state to finance specific high-tech fields, such as information and material technologies, and biotechnology. The increasing interest of the government in new technologies has been related to the rise of market-orientation and commercial ethos and to a change in the political ideology from the welfare state to the neo-liberal state (Alestalo 1997). The membership of the European Union in 1995 has made the neo-liberal preferences even stronger. Due to a new corporatist agreement the transformation from the politics of equal opportunities and community ethos to market competition, market governance and market democracy has been rapid (Häyrinen-Alestalo 2001; 2002). As market orientation has been seen as a collective aspiration of all policies to foster the international competitiveness of the economy, technology policy has become highly selective with the primary focus on information and telecommunication technologies (ICT). The rise of Nokia as a world market leader in mobile phones has strengthened this orientation.

The chosen strategy has been a mixture of the ideas of the knowledge-based society, new growth theory and the new economy (Stehr 1994; Grossman & Helpman 1991; Castells 2001; European Commission 1998; OECD 2001; Tekes 2001; Science and Technology Policy Council 2003). In the strategy human capital and competencies are significant determinants of economic growth. There is also a tendency to see new-tech products as having wide potential markets and the most effective cost/benefit ratio.

In the current Finnish political vocabulary the national innovation system stands for economic expansion, collective representation and information mediation (Science and Technology Policy Council 2003; Miettinen 2002). This system is composed of networks between various producers of knowledge and the criteria of their performance are similar for all of them. The criteria are derived from the international markets and emphasise competition and effectiveness (Allardt 1998; Häyrinen-Alestalo 1999). The citizens are invisible actors in the national innovation system. They are mostly consumers and customers who have local importance in front of the pressure for globalisation (Cabinet programme 1995; Ministry of Finance 1996; Sitra 1998; Snell 2002).

Due to the success story of the Finnish ICT sector biotechnology has been for a long time "an area of high potential benefit" (OECD 2001; European Commission 2001). The ICT-driven international competitiveness has also strengthened the tendency to see the generic importance of biotechnology through the lenses of ICT and to regard the issues of social, ethical and moral responsibilities as only secondary.

In the following we outline and analyse the changing context of Finnish biotechnology and the main issues and actors present in the field. We use here for the most part the term biotechnology, even though the term covers a large range of scientific fields, industrial sectors and applications. This choice has been made because in much of the basic material used in this report no differentiation is made between gene technology and biotechnology. Aside from the documents and results of earlier research we also draw on personal interviews among science and technology policy makers and biotechnology experts that we have made in 2000-2003.

## The New Hope of Technology Policy

In 2000 the global economic environment became turbulent due to ICT-driven economic uncertainty. Although Finnish policy makers have been unanimous in their predictions of the short length of the economic instability, they have had to revise the estimations of economic growth several times. Today they agree that the ICT sector has not fulfilled all political promises.

With the falling validity of the new economy thesis, more and more weight has been given to the market expectations of biotechnology. These hopes follow the prospects of the European Commission (2002: 3) seeing "life sciences and biotechnology to be, after information technology, the next wave of the knowledge-based economy, creating new opportunities for our societies and economies". Our interviews indicate, however, that in the view of the Finnish technology policy makers, biotechnology has been called a promising field for too long. They have started to ask what is the new new-tech after ICT and biotechnology. Still there is a strong trust on the commercial potential of biotechnology. *The National Technology Agency (Tekes)* mentions the field as one of the key technologies (Tekes 2001). There are also hopes that a new biotech Nokia can be established. Still the idea of the generic nature of biotechnology is unclear.

The Biotechnology 2000 Working Group (2000) and the Evaluation Panel of Biotechnology in Finland (Academy of Finland 2002) that were set up by the Ministry of Education to consider the promotion of academic biotechnology research and industrial applications have paid attention to the science-based peculiarity of biotechnology and to the need to be patient when waiting for scientific and commercial breakthroughs. In fact, in the shadow of ICT, biotechnology has received political understanding of its long-term application process. When the new economy thesis has shown its fragility, the questions of the economic value of this field have become louder. Strong market orientation has prevented, however, the discussion of the rights and responsibilities of the state, industry and academic researchers. Today the European Commission (2002: 4) speaks at the same time of the need "to examine measures required to utilise the full potential of biotechnology and to strengthen the European biotechnology sector's competitiveness in order to match leading competitors" and of the need "to ensure that those developments occur in a manner which is healthy and safe for consumers and the environment, and consistent with common fundamental values and ethical principles". Even though the Finnish policy makers are aware of the latter demands, they are primarily keen to know how national competitiveness can be maintained by investing in biotechnology production.

The hardening attitude was also visible in the speech of the former Prime Minister Lipponen at the opening of Helsinki Biocentre 3 (Lipponen 2002). Aside from pointing to the complex characteristics of biotechnology and to the need to have an open discussion of these complexities and ethical problems, he presented normative expectations of the future commercial success. In his view the state has supported research and technology programmes of biosciences and biotechnology for over 20 years and it has the right to expect real evidence of the effects of this funding. It is now time for this research to show its capability to compete for new markets, knowledge-based innovations and for highly competent labour force. Our interviews indicate that this view is shared among many technology policy makers.

By following the OECD strategy, the Finnish policy makers have identified growth clusters for the development of the national economy. According to Tekes, the strong clusters are ICT, forestry and metal industries, the rising key clusters being bio-industry and knowledge-intensive services (Tekes 2002b: 2). As a response to the growing demands for globalisation, the national focus is also on the most "change-activating technologies". Aside from ICT and material technology biotechnology is mentioned as being capable of responding to this challenge. The identification of the key clusters is one way of searching for a more stabile economic environment and of pursuing a selective policy. According to Tekes (2002a: 11) a cluster is composed of highly competent producers, customers and competitors. An effective, specialised and competitive cluster tends also to develop into a centre of competence. The value of the centre of competence can in turn be estimated on the basis of its international market share and of the growth of productivity, surplus value, and employment.

By regarding biotechnology as a "change-activating new-tech" Tekes has made references to its rapidly expanding applications but has also started to pay attention to the ethical issues. Accordingly, an increasing understanding of the living organisms has created new conditions for the development of new medicines, diagnostic methods, vaccines, chemistry, forestry and foodstuffs. The generic characteristics of biotechnology have improved the quality and effectiveness of various materials and production processes in respect to sustainable development. Due to high potential expansion of biotechnology and difficult issues of ethics and values, wider applications should be based on jointly made agreements of the future uses (Tekes 2002a: 6). Tekes provides, however, no plan of the ways the common choices will be made and no proposal

of the type of actors who are going to take part in this process. When asked about the possible forums where the discussion of the effects of new technologies can take place, the technology policy makers mostly refer to the formal groups of representation even though they scrutinise the closed circles and normative structures of decision-making. They also wonder who has the responsibility to make the political choices and who could be the responsible partners.

In recent years biotechnology has been integrated as a sub-theme into several technology programmes of Tekes, such as Innovation in Foods, Diagnostics programmes, Drug programmes, Polymers for the Future and the Finnish Forest Cluster Research Programme. The New Biotechnology Programme was initiated in 2002. Even though Tekes has good experiences of the programme-based activities, their overestimated surplus value and diffuse policy relevance has been criticised (Tuomaala 2001). The Evaluation Panel of Biotechnology in Finland has also been troubled of the limited in-house expertise of Tekes in making the grant decisions (Academy of Finland 2002: 55). Moreover, our notions indicate that the issues of responsibility are mostly left open or they refer to the intellectual property rights or to the right to publish the results freely. Among the evaluation criteria of performance there are questions about the actual or expected economic impact of the results or products. Due to the complexity of the surplus value and market governance in biotechnology, it is often impossible to identify real or latent markets. The sensitivity to moral and ethical issues makes the customer choices also labile. Sometimes the products cannot provide clear benefits for the producers or customers (Häyrinen-Alestalo 2001; 2002; also Academy of Finland 2002).

The technology programmes of Tekes are based on the efforts to establish networks to form centres of competence, a model taken from the EU. In the case of biotechnology, academic producers of knowledge have been integrated into the system by establishing biocentres. These centres are a combination of the centres of excellence strategy of the Ministry of Education and the Academy of Finland as well as of the centres of competence strategy of the Ministry of Trade and Industry, Tekes and the relevant cities and industries. In comparison to the centres of competence in ICT, the biocentres are more science-oriented. Therefore it has been difficult to judge their commercial value and to link high-level science to top rated market value (Pelkonen 2001; Häyrinen-Alestalo & Peltola 2003).

Recently Finnish technology policy makers have redefined the welfare cluster and have started to discuss the conditions of its development. In the Tekes terminology the development of welfare and the growth of the markets are based on the choices of the citizens, on the changes in the living style and structure of population, and on the social development of society (Tekes 2002a: 10). The revised view of welfare services is dependent both on market functioning and on customers' choices, where the chemical and biotech cluster provide new possibilities for the life-science industry. These industries are expected to serve both the goals of welfare and the demands for globalisation and sustainable development (Tekes 2002a: 21). In this way the collective and individual responsibilities move towards market orientation and private competitive action.

## Biotechnology in the Scientific Excellence Policy

Due to the strong commercial ethos Finnish technology policy has become a super-policy with impacts on the goals of science, university and education policies (Häyrinen-Alestalo 1999). Still there have been a few attempts to integrate the activities between various policies, although there have been discussions of the need to have horizontal means for information and interest mediation. Inflexible forms of communication have also prevented the development of horizontal structures to include public concern and participation. Accordingly, *the Ministry of Education* draws the guidelines for science, university and education policy and *the Academy of Finland* is responsible for the financing of academic research and doctoral education. The *Ministry of Trade and Industry* is the primary technology policy maker and Tekes takes the responsibility for allocating public funding to technology development programmes and industrial research.

Due to a rapid concentration of public expenditure to Tekes there has been tensions between the science and technology systems, the representatives of the former having accused the government of a systematic

favouring of technology projects and industries (Allardt 1987). The governments additional funding program for 1997-1999 also raised criticism from the side of the Academy and the universities accusing the goals as aimed ”at making the national R&D system to work more effectively for the national economy, business, industry and employment” (Academy of Finland 2000), i.e. for the knowledge-based economy. Today the technology policy makers tend to speak of a harmonised innovation system indicating a balanced funding for science and technology.

Even though the Academy of Finland has spoken of “scientific research and universities in the national innovation system” (Academy of Finland 2000: 12-14), its view of the knowledge-based society has been more science-driven than that of Tekes. Mostly the Academy has stressed the long-term effects of scientific activities on societal development and the need of “making the importance of basic research known in the entire society and among policy makers in particular” (Academy of Finland 1993: 6).

During the last ten years, the promotion of biotechnology has been linked to the general strategy of the Academy of Finland in five integrated actions:

*First*, the Academy has made an effort to strengthen the scientific quality of Finnish academic research and its international recognition and visibility. In this respect new international partnerships and agreements have been made. In biotechnology, important agreements were made in the late 1980s with the European Science Foundation, the European Molecular Biology Laboratory and the European Molecular Biology Conferences. The membership in the EU in 1995 provided Finnish researchers with the possibility to apply for funding from the EU's framework programmes. There have been 446 Finnish participants and 106 coordinators in the EU biotechnology projects between 1996-2001 (Academy of Finland 2002).

*Second*, to guarantee the high quality of the Academy funded research the Academy has identified and funded centres of excellence. The first ten centres of excellence in research were selected in 1994 and three big biotech units, i.e. Biocentrum Helsinki, Biocenter Oulu and Biocity Turku, belonged to this group. According to the National Strategy for the Centres of Excellence (1997: 22-27) the aim is to identify the highest national top having the capacity to reach the highest international top. The centres of excellence are expected to attract other top quality groups and networks as well as to do research in nationally important research fields and to be capable of estimating future socio-economic needs.

*Third*, the Academy of Finland has financed large research programmes that are supposed to be capable of solving new socio-political problems. A growing number of these programmes are joint projects with Tekes. One of the first big research programmes of the Academy was the Development Programme for Biotechnology and Molecular Biology in 1988-1992. One of the latest joint programmes of the Academy and Tekes is related to the intellectual property rights in new-tech research applications. This issue has been considered to need special attention due to the growing market expectations of biotechnology industries. It is characteristic of the Academy of Finland that it has been interested in the issues of the intellectual property rights and ethics as a general problem of the science system. In its reports no specific attention is paid to the risks and uncertainties that are related to biotechnology or to public concern in this respect. So the Academy has seen citizen participation and public concern as needing no extra efforts.

*Fourth*, in order to promote the state and quality of Finnish science, the Ministry of Education and the Academy of Finland have requested peer reviews of specific scientific fields. In this respect the European Molecular Biology Organisation (EMBO) Review Group made evaluation of Molecular Biology and Biotechnology Research in Finland in 1996. The main purpose of the judgement was to identify the successful and emerging research teams on the basis of past performance and to present future plans in order to recognise future needs and risks. The issues of commercial and industrial involvement were also mentioned (EMBO 1996). The Evaluation Panel of Biotechnology in Finland (2002) has also paid attention to the Academy’s activities in the promotion of biotechnology research.

Both review groups have referred to the rapid advancements of academic biotechnology research in Finland. They have also found more success in the respective industry than is being recognised. In the view of the groups the biotech centres in the key universities are of top international quality, even though the evaluators

have also noticed some weak groups in a couple of more peripheral universities. In the view of the EMBO Group there are two contrasting trends in the organisation of molecular biology and biotechnology in Finland: one is to build up expertise in peripheral universities and the other is to develop centres of excellence in some of the larger universities (EMBO 1996: 21). Between the two evaluations a concentration process has been going in Finland the Helsinki region predominating now both in ICT and biotechnology research.

*Fifth*, the Academy of Finland has on the initiative of the Ministry of Education set up Graduate Schools aiming at improving the quality of postgraduate training. From the very beginning these schools have been integrated to the centres of excellence. According to the chosen strategy, top quality research groups are innovative and good educators by the definition. A notable part of the government additional funding has been allocated to this purpose. The aim has been to dedicate new places to fields that are important to the development of technology, the natural sciences and knowledge-intensive business (Academy of Finland 2000). Even though ICT and biotechnology have been favoured already in the first selections of the doctoral schools, a kind of balance was earlier maintained between these fields and other disciplines. The decisions from 2001 and 2002 indicate, however, a notable concentration in biotechnology. When the humanities and social sciences have lost their share of the total school places, biotechnology has been the winner in this respect.

The recent strategic approach of the Academy of Finland has been a mixture of a growing but still relatively weak commercial ethos and a strong concentration programme of the scientific excellence. This approach has also concentrated the issues of new responsibilities and risks of biotechnology into the hands of the scientific elite. A search for new rankings of competence tends, however, also to favour individual choices and to weaken a collective scrutiny of the rights and responsibilities. This makes the elite vulnerable to growing public concern.

## From a Concentrated Effort to Dispersed Research and Biobusiness

New biotechnology is a diffuse field and its roots in Finland can be traced to various sources and industrial sectors. The Finnish biochemistry research and industry got started in the 1920s. The development of biochemistry is much credited to A. I. Virtanen, the only Finnish scientist to receive the Nobel price (Alestalo 1979). Another important branch of industry that has long traditions in Finland and has ties to biotechnology is industrial enzyme productions. There are also strong links to the medical sector and pharmaceuticals as well as dormant connections the former number one industry of Finland, the forest industry.

When trying to define some kind of starting point for Finnish *gene technology research* the year 1980 would be a good candidate. That year a group for DNA-combination technology was established in Finland. The initiator and one of the major financiers for the group was *Sitra*, the Finnish National Fund for Research and Development, which is a public foundation that functions under the parliament. The aim was to introduce the new technology to Finland and create a knowledge base for the research. It was a state lead effort that was hoped to be of utility to many fields. The research group had members from universities, VTT (Technical Research Centre of Finland) and the National Public Health Institute (Kuusi 1991, 22). The research that centred on the bacteria *bacillus* resulted also in the establishment of the first Finnish biotechnology company, *Genesit*. Seven large Finnish state corporations, representing a wide range of fields (forest industry, pharmaceuticals, chemical industry, food industry) held shares in the company, but it did not succeed. The closedown of the company in 1991 has been put down to number of factors: the bacteria's disappointing performance to produce enzymes, rapidly ageing work processes, over-emphasis on applicable results instead of basic research and emerged contradictions between commercial and scientific interests (Kettunen 2002, 22; Kuusi 1991, 22-23).

Even though developing biotechnology R&D is still in many ways a state-lead project, the private sector is increasing its share as a financier and as a researcher. The public sector used € 24 million for biotechnology

research in 2000. This was 4,8% of the total research and development financing directed to the public sector. The universities spent € 91 million on biotechnology research which was 11,5% of the total research expenditure. Industry's investments in biotechnology research in 2000 were estimated to be € 223 million. Altogether € 338 million was spent on biotechnology research in 2000 (Source: Statistics Finland. Half of the resources for the research and development of biotechnology come from the state funding.

## *Universities and Research Institutes in the Innovation Framework*

As biotechnology is a research intensive branch of technology, universities play an important role in the research and development of the field. In the field of gene technology the importance of universities as research institutions can be seen for example in the notifications made to the Board for Gene Technology. Between 1995 – March 2002, the Board approved 204 different notifications concerning the use and release of genetically modified organisms. University units have made over half of these notifications.[1]

Biotechnology research is concentrated in five university cities: Helsinki, Turku, Oulu, Kuopio and Tampere. The state has invested heavily to develop biotechnology centres especially through the scientific excellence policy in these five regions and the universities have been making the most of the biotechnology boom. This is apparent in the utilisation of funding as well as in the strategies of the universities and as a result several new institutes and research and education programmes in biotechnology have been created. Biotechnology, along with ICT, is seen as a means for the universities to introduce market orientation into their activities (University of Helsinki 2003). Many different mediating organisations have been established to aid the commercialisation process but the universities are struggling with this new market-oriented role (Pelkonen 2001).

The *University of Helsinki* has two biocentres with different profiles. *Helsinki Science Park* hosts departments from three faculties and the separate Institute of Biotechnology. In addition a new Faculty of Biosciences will be created in the area in the beginning of 2004. The motivation for this is stated to be the growing importance of biosciences and preparation for the potential growth of the field. Although creating a specific faculty for biosciences is seen as a tool for promoting the field, its effects on interdisciplinary research and education and thus creating possible new technologies and applications has been criticised. The other concentration, *Biomedicum Helsinki* is the centre for biomedical research and teaching and is also a host to the *Finnish Genome Center*. The *National Public Health Institute* is also a partner in Biomedicum. The National Public Health Institute in itself has a number of projects in gene and biotechnology dealing for example with multifactoral nationally common diseases and vaccinations. *The Helsinki University of Technology* has also laboratories dealing with biotechnology. These laboratories work in co-operation with closely located *VTT* (Technical Research Centre of Finland) that has a large biotechnology research unit.

Even though large part of the biotechnology research is concentrated in the capital area, the "bio boom" started in Turku. *BioCity Turku* was the first biocentre to be established in Finland. It is a joint organisation of *the University of Turku* and *the Åbo Akademi University*, with the Turku University Hospital and National Public Health Institute also taking part (See Kivinen & Varelius 2003). *The University of Kuopio* has profiled itself in animal biotechnology, neuroscience and health related biotechnology. Biotechnology research is concentrated in A.I. Virtanen Institute. It is located in the Kuopio Science Park. Research and education in biotechnology is also done at the *University of Tampere*. Fields of specialisation in Tampere include medical biotechnology and health informatics. *The Medipolis Science Park* was founded in Oulu alongside its successful ITC science park. It hosts the Biocenter where biotechnology research is concentrated. Biotechnology is one of the three fields of emphasis in the university. The areas of expertise in the Biocenter include collagen research and developmental biology.

[1]Every institution, research group or company that uses gene technology has to file an application with the Board of Gene Technology which then processes these notifications. The figures here are calculated from data received from the Board of Gene Technology.

The innovation storyline is repeated at universities also through the creation of biotechnology business programmes. The University of Oulu together with its biocentre, the city of Oulu, Tekes, European Science Foundation and other partners has also created a BioBusiness Programme, which is marketed as a research-based new business development programme. The aim is to "develop the business know-how of scientists and other key specialists and train them to work successfully in a business environment" (BioBusiness Oulu 2002). The *Helsinki School of Economics* joined the game by launching a Biotechnology Management Program in 2002. The programme can be taken as an individual module or it can be chosen as part of the university's International MBA degree. It is mainly targeted at people working in biotechnology with core courses in venture capital in biotechnology, high-technology marketing and IPR management.

Lately, the universities have started to pay more attention to ethical and societal issues related to biotechnology and research in general. Ethics and social responsibility appear more often in the latest strategies. One notable reason for this is the so-called third mission of universities that will be set in the new university law. In addition to research and education the universities are supposed to fulfil their societal function. In many cases this is interpreted as closer connections with industry and more efficient utilisation of research results. However, ethical and social issues are also incorporated in the third mission. Education of the general public and active communication are emphasised, but there are no references to bottom up communication – hearing the public in the issues of science.

## *Old Industry and New Business*

Most of the biotechnology companies have their origins in university research projects and half of them are located at biocentres or science parks (Hermans & Luukkonen 2002). Depending on the source and definition, there are 90-120 companies in Finland that deal with biotechnology. *Finnish Bioindustries* – the industrial association of biotechnology industry – has in its registers about one hundred companies. The association was formed in 1997 by the initiative of large already well-established companies who work in many fields, biotechnology being only one of them. Small companies and university research units also played a part, however, in the discussions concerning the role and formation of the association. According to the association, out of the 90 companies in 2001 40 % are micro companies (under ten employees); 32 % are small enterprises (10-50 employees); and middle sized (51-250) and large companies (over 250) have a 14% share (Source: Finnish Bioindustries). As these figures show, the biotechnology sector is still so small that it has no capacity to contribute to the much talked about change of industrial structure.

The most common field of biotechnology among the companies belonging to the association is diagnostics (one fourth of the companies), followed by services (just under one fourth) and pharmaceuticals (one sixth). However, the pharmaceutical companies are in general older and much bigger both in terms of annual turnover and in number of personnel. The older companies operate in many fields and only parts of their functions are related to biotechnology. In the interviews with various experts, the fields mentioned above and industrial enzyme production were seen to be the core competencies of Finnish biotechnology. Biomaterials and biotechnology related to the environment were regarded to be the rising fields in Finland. Most of the Tekes funding is however directed to R&D in the fields of medicine and health. One reason is that there are hardly any applications for funding R&D in the agricultural sector as industry sees it as too risky. In general customer demand and concerns are taken seriously and they direct the operations of companies. On the other hand the industry would like to have state support in the sector for the "transition period", meaning the opposition of GMO-foods. There is a strong belief that this kind of an attitude is just a passing phenomenon.

Another potential field of application of biotechnology is the forest industry. New enzyme biotechnology is relatively common in the forest industry compared to other countries. The application of biotechnology in forestry, however, is still very limited (Laestadius 2000). From the three important Finnish paper and pulp producers Stora-Enso has announced that it refrains from commercial use of genetic engineering. However, it takes part in basic research in the field. M-Real has stated that it is not using GMOs or transgenic technologies in its products and is not doing research in the field. This is not because of lack of interest, but because of the customers' demand (Gädda 2002). In the statement of UPM-Kymmene on the use of

genetically modified organisms it is written that "UPM-Kymmene will not use genetically modified wood raw material in its products until the safety of both the production and use of such material has been established by the authorities" (UPM-Kymmene 2000). The forest industry is however encouraging universities to do research on gene technology, but without getting their own hands dirty. The industry is pushing the responsibility for developing this new technology to research institutes and universities. While the industry seems to be responding to customer demands and concerns the research side is not expected to do so.

In addition to purely market-driven customer orientation, many large and international Finnish companies are following the global trend and developing strategies of corporate social responsibility and ethical guidelines. For example *Teollisuus ja työnantajat* (2002), the association of industry and employers, has published guidelines for corporate societal responsibility that are said to include tools for "self-evaluation and development of activities". The three pillars of societal responsibility are the economy, the environment and humans. The human side – social responsibility – consists of four major elements: the well being of personnel; product safety and consumer protection; good methods of action and co-operation in the network of enterprises; relationships with surrounding communities and supporting activities of public utility.

The Finnish Bioindustries has developed ethical guidelines that all the member companies and organisations have to agree to follow. The guidelines emphasise open discussion, improving the quality of life, human dignity and biological diversity. Providing information and participating in public discussion are listed as objectives but there are no references to developing bottom-up communication. Usually only big international companies have developed strategies of social or corporate responsibility and ethical guidelines. The small companies are new and still in the process of trying to find suitable markets and have not made similar attempts. Whether these strategies are only rhetorical or have some consequences for the working patterns of the companies and their surrounding environment remains to be seen.

From the small, new "pure" biotech companies only two have gone public and are listed at the Helsinki Exchanges (HEX). These companies have been regarded as prime examples of success in Finnish biotechnology. *BioTie Therapies* (listed at HEX on 29.6.2000) is one of the first biotech companies in Finland, situated in Turku's BioCity. It focuses on cell receptor research and its products targeted to specific areas of inflammation, thrombosis and cancer. BioTie underwent a merger in 2002 with *Contral Pharma*, another pharmaceutical company and *Carbion* Oy. Contral Pharma specialised in research and developing treatment for alcoholism and dependency problems, and its competence areas stretch beyond biotechnology. BioTie Therapies has been in the headlines also because of a patent dispute it had and won against *Orion*, a large Finnish pharmaceutical company. The CEO of BioTie believes that the year 2004 will produce a zero-result, meaning that it would be the first year without loss. This demonstrates the difficulties that small companies have in finding market segments to function in.

The operating area of *Biohit* (listed at HEX on 18.6.1999) is diagnostics. Biohit develops, manufactures and markets liquid handling products and accessories as well as diagnostic test systems for use in research, health care and industrial laboratories. Biohit has mainly international markets. In 2001, 96% of the annual turnover came from abroad. Like BioTie, Biohit's finances are still on the negative side. Another so called success story is *Bionx Implants*, a company that produces surgical implants. It got started from the work of two Finnish researchers. Today the manufacturing plant is still in Tampere, Finland, but the company headquarters are in the USA and it has been listed on the Nasdaq. All of the people interviewed emphasised the fact that there is no use in forming a biotechnology company for only Finnish markets. Finland is too small and companies have to think global in order to succeed.

The founding of new companies and their strategic development is aided by number of public and private financial sources. An important venture capital investor in biotechnology is Sitra. In 2001, biotechnology was the fifth most funded field by Sitra (9,9 million €) (Sitra 2002). In the private sector there are some venture capital firms that have profiled in new technologies. For example *BioFund* (founded in 1997) is wholly dedicated to financing biotechnology and life sciences. It has an investment portfolio of € 185 million from which half has been directed to Finnish companies. BioFund's primary investors are domestic

insurance companies, pension funds and foundations. Risk financing has been one of the problems identified in the commercialisation of biotechnology research. But it is said that recently the situation has improved.

While ethical and social issues are being incorporated in the strategies of large companies as a result of customer orientation and internationalisation, small companies face ethical issues in these processes of funding. Both public and private financiers go through strict evaluation of applications and they state that all ethically dubious projects and companies will be automatically dismissed. The evaluation processes are done by the experts in the field which means that social implications and ethics of research and development are assessed by "enlightened experts" without the help of for example bioethical experts or lay opinions.

# REGULATORY AND STRATEGIC MEASURES FOR BIOTECHNOLOGY

Regulation and control of biotechnology is attributed to a large number of different organs mainly functioning under various ministries and even though the Parliament is the main legislative authority the politics of biotechnology are played to a great degree inside the ministries and their boards and committees. The Parliament has had to deal with the introduction of new laws concerning gene technology, and along with expert opinions heard, various reports to aid the decision-making have been commissioned and produced. These also include aspects of public concern and opinions (for example Salo *et al.* 1998). Issues in gene technology have been dealt in various standing committees and in open discussion in the Parliament. However, there has been a political consensus about the importance of investing in biotechnology, and gene technology has not become a sensitive or controversial political issue. Only some members of the Green party have been active in promoting discussion about the risks and benefits of gene technology.

## Regulation and Legislation Mediated from the EU

Finnish biotechnology regulation is very EU-dependent and the EU is the origin of most activities in regulation. All major laws and regulating boards are the result of EU directives. The most important law concerning biotechnology in Finland is the Law on Gene Technology (377/95) which is based on the first two directives (90/219 and 90/220) about gene technology. The law is applied in use, production and sales of genetically modified organisms. Issues concerning human genetics are embedded in laws that concern medicine in more general. One of the most recent laws dealing with medical biotechnology is the law concerning the usage of human and animal tissues (101/2001). Another important law related to biotechnology is the Act on Medical Research (488/1999) and the respective statute (986/1999). When becoming a member of the EU in 1995 Finland had to incorporate these directives into its own legislation and this resulted in the new law. In the beginning of 1995, Finland was the only EU country together with Greece that had not legislation about gene technology (von Troil 1995: 44).

The preparation of the law on gene technology, however, did not start from scratch when the membership to EU was confirmed. Finnish researchers and authorities started to discuss regulation of gene technology much earlier. Already in 1979 the Ministry of Social Affairs and Health established an expert group to discuss DNA technology and prepare statements about it. The ministry got the idea for this from researchers in the field. So, before the mid 1990s, controlling and regulating gene technology was not yet institutionalised. Instead it functioned on more or less volunteer basis inside the professions who were using the technology. The established expert group was transformed into the more permanent and institutionalised Advisory Committee on Biotechnology in 1991. It aided the preparation of the law on gene technology that had started in 1989.

The process of introducing new regulations and legislation has not changed much from this. Most of the new additions and needs for renewal emanate from the EU. Researchers and other experts are however very aware of the developments in their field and are involved in many international committees and boards, but the final push for implementing changes comes from the EU and other international organisations not from national activities.

Researchers and decision-makers interviewed recognised that Finland by itself is a small player and does not really have any possibilities of changing the direction of development in biotechnology. However, they still had somewhat nationalistic views about technology and its control. National authorities and researchers are regarded to be trustworthy and competent while the same cannot be said about all the other countries. Biotechnology is seen as a national project (see Väliverronen 2002) that "we" have to participate in, and we are good at it despite the field being mostly controlled by international legislation and market forces. Transnational frameworks and national factors are constantly and simultaneously being introduced as competing and supplementing sides in biotechnology.

A common view among state officials and members of different boards is that legislation of gene technology and biotechnology has gone almost too far. The laws include flaws that are seen to hinder research and development and they are regarded to impose unnecessary changes on activities that have been regulated successfully previously by for example the medical community.

> "This has been in my opinion a little contradictory. In for example the European Union it has been very clear that the Commission has, when drawing up these directives, aimed at diminishing regulation. Because today we know better than twenty years ago what the consequences can be. The end result, it is different. The regulation has, in spite of this, increased because the people have been worried about the fact that one can do so many things, and what are all of their consequences" (Member of the Advisory Committee on Biotechnology).

Also the process of regulation in Finland and Europe is seen among the informants to be complicated and bureaucratic. On the other hand clearer rules of conduct are being asked for especially from the side of university researchers aiming at commercialising their research and from the side of the private sector. There is uncertainty about the limits and possibilities of the existing regulatory framework.

## State Regulation and Official Bodies

Biotechnology belongs as a field under the control of number of ministries. The general division of labour and responsibilities in the issues of biotechnology between different ministries is as follows: *The Ministry of Social Affairs and Health* directs and controls generally, and especially in health issues, the compliment with law on genetics. *The Ministry of Environment* controls and advises in legislation concerning the environmental effects of genetically modified organisms. When it comes to bringing new products to the market, *the Ministry of Trade and Industry* and *the Ministry of Agriculture and Forestry* are in charge of the issues. This structure of control has resulted in a set of dispersed strategies and visions. Since the beginning of 2002 the ministries have been working together to construct a common ground in biotechnology issues and to enhance co-operation between different bodies. Currently however, there is no common biotechnology policy in Finland that would overlap the division of labour between the different ministries and this co-operation of the ministries is not aiming at creating one. The goal of the co-operation group is to share information between the ministries and ensuring that statements (for example to EU) are congruent.

Instead of one policy, there are a number of different strategies and memos from the various ministries and their working groups that deal with specific aspects of the technology. However, only the Ministry of Agriculture and Forestry has been actively developing a coherent strategy for gene and biotechnology for the whole ministry (Ministry of Agriculture and Forestry 2003). As a pilot project, a strategy was first developed just for the department of agriculture (Ministry of Agriculture and Forestry 2000). The strategy development also included separate reports on ethics, legislation, research, environmental effects and economic effects on the food chain. The ethics report (Launis 2000) was made by a philosopher from the University of Turku. He is also member of the Board for Gene Technology and the Advisory Committee on Biotechnology, and seems to have the role of an official bioethical expert in Finland.

In addition to the ministries, two specific bodies have been set up that are dedicated to gene and biotechnology: *the Board for Gene Technology* and *the Advisory Committee on Biotechnology*. The establishment and institutionalisation of both of these is largely the result of EU legislation and the Law on Gene Technology. The Board for Gene Technology functions under the Ministry of Social Affairs and Health and its responsibilities include processing applications and notifications of the use of genetic technologies; giving rules of procedure in complying laws on genetics and making decisions for specific cases. It is the highest national authority in gene technology. The Board was founded to fulfil the controlling functions defined in the Law on Gene Technology in 1995. Its members are representatives of four ministries named above. In addition ethical expertise is required to be represented on the Board. The reputation of the Board has suffered, because it was accused of not working openly enough. This issue got as far as to the Finnish Supreme Court and the Board has had to open its files to the public. This case shows that although number of new boards have been established to work along with already existing ones, it cannot be said that they would have created new and more open forms of functioning or mediating public opinions. Characteristic for the Finnish model of governance is to incorporate new questions and their problem solving inside the existing system (see Bergman 1998).

The biggest effort to incorporate public views into decision-making has been made by the Advisory Committee on Biotechnology. The Committee became statutory through the introduction of the Statute on Gene Technology (821/1995). Its mission is to promote co-operation between officials, researchers and others working in the field, to follow discussion on biotechnology and to develop education and distribution of information in biotechnology. The Advisory Committee publishes also an informative journal called "Geenitekniikka tänään" (Gene technology today). Members of the Committee are composed of state officials, as well as representatives of the academia and industry. There are also representatives from the consumer organisation and environment and animal rights organisations. Because of the relatively broad bases of representation and the goals of the Advisory Committee, it functions as a mediating organisation more clearly than any other board or organ devoted to biotechnology. Other organisations do not include lay members.

The Advisory Committee on Biotechnology concentrates on gene technology that is not directly related to human health. Ethical issues concerning human genetics and health care are the responsibility of *the National Advisory Board on Health Care and Ethics (ETENE)*. It deals with ethical issues related to health care and the status and rights of patients. It can also take initiatives and make advisory opinions and recommendations on ethical health care issues and foster discussion on them. ETENE has a *Sub-Committee on Medical Research Ethics (TUKIJA)*. Research ethics are more generally discussed also in *the National Advisory Board on Research Ethics*. Established in 1991, the council is nominated by the Ministry of Education. The task of the council is to promote discussion and inform the public about research ethics. It also prepares statements about research ethics in general and can comment on actual cases. In 2002 the advisory board published its guidelines for good scientific practice (National Advisory Board on Research Ethics 2002). The board is very active in raising discussions about research ethics inside the academia and decision-makers, but the discussions do not necessarily reach the public.

Working under the Ministry of Environment, the *Finnish Environment Institute* is one of the five expert authorities defined to have a special function in the Law on gene technology. The task of the Institute is to evaluate the environmental risks of GMOs. *The National Food Agency* processes applications for novel foods and controls, together with the communal authorities, the marketing of food products. *The Board for Novel Foods*, was established (as a result of the directive on novel foods in 1997) to evaluate the safety of proposed novel foods, including products made with the help of gene technology. There are also other institutions that have activities in relation to biotechnology for example the *National Agency for Medicines* and *the National Veterinary and Food Research Institute.*

## NGO'S AND PUBLIC PARTICIPATION

When the policies, strategies and memos of Finnish officials concerning biotechnology's different aspects are compared to those of the European Union a strong difference in how the publics are being framed is detectable. In the documents of the European Union there is a great emphasis on citizen participation while Finnish documents contain a more passive idea of citizens. Instead of being active and participating citizens, they are perceived more as a population-like object of action, that can be studied and controlled, or as human beings that are worthy as such and thus need to be cherished and respected (Snell 2002). The lack of the citizen aspect in the biotechnology documents has to be put however in a wider context. There has been active discussion about civil society and citizen participation in Finland in more general environmental issues. Indeed, there are many NGOs and citizens movements, but they seem to be targeted towards other areas like environmental protection and animal rights. Biotechnology has not become a big issue among the public.

There have been some attempts both from the side of NGOs and the state to create forums for discussion about gene technology. However the meetings and hearings arranged have been sporadic events with little results. Public attitudes are therefore more often mediated to the decision-makers through surveys and consultations of NGOs. Citizen and consumer barometers are used in constructing a public opinion that is then used as bases for policies (Rask 2002).

Another shift that is detectable is the trend to replace citizens by consumers. Actually, consumers are given more active roles than citizens, even though they have clear limits for their action. Consumers make decisions concerning only themselves by buying or choosing not to consume and act in the market, not in the society. From their choices, the industry and decision-makers can make their conclusions. Public concern is therefore mediated through markets and consuming habits instead of public forums of discussion (Snell 2002).

Another reason for lack of open resistance towards gene technology can be explained by the positive attitude of Finns when it comes to technological development. According to various surveys science and technology are highly valued among the public (Tiedebarometri 2001, Eurobarometer 1997, 2000). Public attitudes towards science and technology are in general more positive in Finland than in many other European countries (Miettinen & Väliverronen 1999, Salo *et al.* 1998). This can be seen in the results of surveys that have been conducted about public attitudes and knowledge about biotechnology in the countries of the European Union. In the first Eurobarometer survey on biotechnology (Eurobarometer 1997) Finnish citizens were the most optimistic about biotechnology.

Even in Finland, however, concern about research and the applications of biotechnology are growing. The follow-up survey showed that the Finns were no longer the most optimistic, but still were the ones who believed the most, that biotechnology's applications are not risky (Eurobarometer 2000, 31). When asked, who do people trust in the issues of biotechnology the most common answer in Europe were consumer organisations. Finns on the other hand trusted most the medical profession. Also universities were trusted and they received much higher scores from Finns than from the average European (Ibid. 76-77). Thus scientists and experts were regarded to be trustworthy. Finns see that Finnish science and scientists are reliable, because science is not commercialised. Commercialisation is regarded to be a problem that is occurring elsewhere in the world (Snell & Laurén 2002). Another important aspect to note is that even though Finns are generally optimistic about genetic technologies it does not mean that they are not critical (Jallinoja & Aro 2000). Options are pondered, but the conclusions reached are often positive towards new technology and products.

## The NGOs Representing the Public

The NGO sector in Finland has long been very active for example in the issues of environmental protection (Järvikoski 1991). Genetic technologies, however, have not caused wide activism. There is currently only one NGO that is dedicated solely to resisting gene technology. The association is called *Kansalaisten bioturvayhdistys* (Citizens Biosafety Association). An examination of the main environmental and consumer associations in Finland in spring 2002 revealed that Kansalaisten bioturvayhdistys actually is the only NGO that has ongoing activity around genetic technologies. Other NGOs have had campaigns dealing with gene technology previously but do not have permanent information mediation or campaigns about it. In 2000 there was a joint campaign involving a number of associations dealing with GMO foods, which included actions in supermarkets, handing leaflets etc. This was not a national effort, however, but part of an international action campaign. Patient organisations have also been rather silent in public discussion about genetics.

According to all of the experts interviewed public discussion about genetics and biotechnology is generally weak. It was also thought that the discussion from the citizen side is mainly conducted by Kansalaisten bioturvayhdistys, which is often regarded to be more of a nuisance than a constructive party of discussion. Kansalaisten bioturvayhdistys is a small group whose two leading figures write actively to Finland's leading newspaper Helsingin Sanomat's opinion pages. The statements of the group are strongly negative towards genetic manipulation, including food products, plant manipulation and vaccinations. This gives the public discussion a narrow and one-sided label and the experts feel that public discussion does not bring any constructive points of view to their own knowledge.

Despite lacking an active and public role, the NGOs play an important role as the mediators of public opinion in the issues of biotechnology. A small number of NGOs are involved in the Advisory Committee on Biotechnology. The Advisory Committee has currently 30 members (15 members and their deputy members). From these 30 two are from *Suomen Luonnonsuojeluliitto ry*. (The Finnish Association for Nature Conservation), one from *Animalia ry*. (Federation for the protection of animals), one from *Juliana von Wendtin säätiö* (a foundation promoting scientific progress without animal testing), and two from *Suomen Kuluttajaliitto ry*. (Finnish Consumer Association). Even though this kind of NGO involvement as representatives of the public in advisory organs is not new, it is taken perhaps more seriously than before. The chairman of the Advisory Committee on Biotechnology stated that these groups have been very active and constructive parties in discussions. These NGOs work in a corporatist manner that is a well-established working model in Finnish governance. Kansalaisten bioturvayhdistys on the other hand is an antagonistic movement that is grouped together with "fox girls", activists who released animals from fox farms in the late 1990s.

When the law on genetics was revised in 2000, one new addition to the law was a passage concerning the hearing of the public (36a §). It is stated, that if the Board of Gene Technology sees it appropriate, in certain cases, the Board can make a decision to hear the opinions of some groups or the public. This passage concerned the usage of GMOs in closed spaces. There is no mention about taking public opinion into consideration in any other form in the law. This passage is very descriptive of the Finnish situation despite the fact there have been a couple of attempts to start "public discussion". One of the most notable efforts was the seminar on genetic technologies in the beginning of 2002 hosted by the Ministry of Health and Social Affairs. The seminar was not regarded as a success, because of relatively weak participation. It is questionable, however, to judge people for a lack of interest because the seminar was arranged by invitation only.

Another public hearing was organised by Kansalaisten bioturvayhdistys in 2001. The impetus for the event was the case of "Transgenic cattle in Lapinlahti" (more of this case later). The representatives of company Pharming and the researchers from the University of Kuopio, who were the major players in the transgenic cattle -project, were invited, but they boycotted the event. The hearing received also rather negative publicity as Helsingin Sanomat (14.1.2001) wrote about "an atmosphere of brain washing" in the discussion.

The law on genetics is currently undergoing yet another revision. The directive (2001/18) that has caused the revision emphasises public hearing in the decision-making. When asked about the influence of current trend in EU to involve citizens more in the decision-making and evaluation process, and whether this will bring changes to Finnish procedures, a Member of the Board of Gene Technology answered:

> "Well, it [citizen participation] is clearly emphasised more in these new directives, so in some way it has to be followed through. Yes, it has to be increased for sure, but in what form? These public hearings, if there is no public it will not succeed very far. But maybe it will increase a little now. We have to act on it as far as it will be in the law."

How statutory public hearings would take place was still unsure during the interview. As organised public events were seen unsuccessful, the chairman of Advisory Committee on Biotechnology felt that consulting NGOs might be the only possible way to proceed. Seeing the NGOs as representatives of the public is regarded not only to be an easy and economic means but it is also seen to offer more structured opinions and views than consulting citizens some other way. Other viable alternatives have not been presented. Whether the NGOs represent the people accurately, however, is often questioned.

Researchers and biotechnology authorities systematically say that public discussion is needed. Many are, however, sceptical about the willingness of people to participate in discussion and the "blame" is put on citizens. There seem to be some expectations of a bottom-up model emerging in public discussion about biotechnology. Top-down models like consultation and surveys still prevail in practise. The biotechnology experts also think that discussion is not always worthy as such, if there are no proper reasons for the discussion. Discussions have also a bad reputation among some of the interviewed. Participating in a discussion or being an active promoter of discussion is thus not tempting. This means that it is not necessarily the lay people but the experts who are not interested in changing opinions.

Even though the engagement-side is relatively weak, there have been numerous occasions and forums for informing the public about biotechnology and its research. The Academy of Finland hosted a series of events in 1999 where biotechnology research was presented to the public. The Days of Science gather people biannually to public presentations about developments in science. In 2003 the area of emphasis was biotechnology. Also Studia generalia lecture series have been arranged dealing with biotechnology at the University of Helsinki. The latest platform for informing the public was launched in September 2002. The site www.bioteknologia.info has been established as part of the NeoBio research programme funded by Tekes. Originally, there was supposed to be notable resources also for ethical, legal and social research in the programme, but that diminished to financing a consulting company to do a survey concerning information needs of the public. On the basis of that work the internet site was constructed. Though very little can be said about the success and impact of the site, it is clear that Tekes has taken the more progressive steps in informing the public compared to the Academy of Finland.

## THE MEDIA AND ISSUES OF DISCUSSION

Helsingin Sanomat is the biggest daily newspaper in Finland. The opinion pages of Helsingin Sanomat are widely read and are a kind of a national institution. Many nationally and locally (the capital area) important discussions are started in these opinion pages. The topics and viewpoints of the writings vary, as does their capacity to create a discussion. The most active discussions have been about GMO-products and their safety, but there have been also discussions about GMOs and developing countries, human cloning and stem cell research. A concerned member of a NGO or a researcher in the field often starts the discussions.

Helsingin Sanomat has also weekly environment and science pages. New developments in gene technology and possible controversies are covered in these pages. Bigger articles are written by science journalists but most little news articles are quotations from science journals or from other international sources. News about gene technology are also now and then published in the international news and economic pages. International issues like GMOs and the developing countries also penetrate the discussions of national branches of

international NGOs. In the media these issues are labelled “external”, and not really affecting Finland. For example the claims that human embryos have been successfully cloned and are waiting to be born were widely published. Many of the news articles or stories in television include the line “This can not happen in Finland because…”. Even though these issues can create discussion in a national level, they are mostly treated as news from the outside world. New findings by Finnish scientists are also reported (Laurén 1998). These findings have also the status of news. They differ from the international news in the sense that findings of Finnish scientists are reported in a very nationalistic tone. One could conclude from the news articles that in Finland, researchers are doing good work and are in the international front-line. The foreign scientists on the other hand do questionable research and together with the politicians from their countries let bad things happen.

A research about the news on human genetics on the pages of Helsingin Sanomat between 1994-1997 shows that the articles have mostly covered findings of new links between genes and diseases or other scientific discoveries. The articles were mostly neutral or positively oriented towards gene technology (Laurén 1998). During the last few years the more critical articles have gained ground, but in general Helsingin Sanomat is still neutral or optimistic (Väliverronen 2002). Along with a positive tendency towards technology, Helsingin Sanomat reflects the attitudes of the Finns in the respect that the sources used in the articles were mostly researchers and experts from universities or representatives of the medical profession (Laurén 1998). In the economy section and other financial newspapers, attention has been directed to the new and promising biotechnology companies and the stories follow the innovation storyline and lately also ruptures in it.

Television coverage of biotechnology on the national TV-channels happens mostly through the news and through science programmes. The national channel YLE1 broadcasts a science programme every week and there have been several episodes focusing on gene and biotechnology. The material is usually internationally produced. YLE hosted also an evening of interactive discussion about gene technology in 1998 where the audience could send e-mails and SMS to experts in the studio. The two commercial channels MTV3 and Nelonen have a more scandal-seeking approach to biotechnology. Especially Nelonen has aired documents that deal with gene technology and the possible future horror scenarios. These programmes are, however, made without exception abroad. The science magazines *Tiede* and *Tieteen kuvalehti* have covered gene and biotechnology extensively. But like TV programmes much of the material is written by international journalists and edited by international publication houses.

## Controversial issues

A variety of issues have been covered in different forms of public discussion and the media. Here are listed some of the most visible national controversies of the last few years. These are controversial issues in the sense that they have received a great deal of attention in various forms of media and the coverage has had implications on the underlying issues or the issues in themselves have caused changes in practises.

1. *Conflict of interest.* A conflict of interest was reported and discussed in the case of one the members of the Board for Gene Technology (Tuula Pehu). Her validity to work as an unbiased state official was challenged because of her being involved in a patent application for a virus resistant potato together with her sister (Eija Pehu). As a result Tuula Pehu resigned from the Board. The case was covered regularly for example in Helsingin Sanomat. This case demonstrates the two interrelated aspects that are important to both the Finnish public, as well as to the experts: trust and financial profit. As described, experts and the public generally trust the researchers as well as regulatory and controlling authorities. The trust is, however, weakened in the eyes of the public if search for financial profit becomes integrated in the issue. The decision-makers and policies on the other hand emphasise the role of biotechnology in creating profit and ensuring national competitiveness, which is seen to create dilemmas for both public and private organisations.

2. *Openness of the Board of Gene Technology.* Representative of the Green Party and MEP, Heidi Hautala asked for information from the Board of Gene Technology in 1997 about a GMO-product, but was

refused any information. She took the issue to Supreme Administrative Court where she accused the Board of violating the openness principle of public institutions. The court ruled the case in her favour. Since then the documents and applications to the Board have been made more easily available to the public, but the reputation of the Board has suffered. This was not, however, a case of creating new more open ways of functioning, but ensuring that the Board follows already established practices. There are still opposing views about what information should be made available to the public. There are fears that providing too much information can be a hindrance to companies and their business operations, as well as a security risk for experimental crops.

3. *Misuses of research funding and unethical research conduct* in medicine and biotechnology. There have been two very thoroughly followed cases of misconduct in research. Even though they are not directly linked to gene technology, these cases are relevant, because very often when biotechnology research and its financing is discussed the potential for misuse and misconduct is brought up. These suspicions are presented largely because of the two cases. This also prompted the development of ethical rules for research (National Advisory Board on Research Ethics 2002). One of the cases was the embezzlement of research funds by a professor of neurology, Paavo Riekkinen, from the University of Kuopio. After using grants from medical companies and other research funds to his and his family's personal expenses, Riekkinen received a two-year sentence. Also his son, a neurology researcher himself, was accused of embezzling funds. The other case concerns the financial, ethical and professional misconduct by a Parkinson's disease researcher, professor Urpo Rinne at the University of Turku. The investigations about Rinne not informing his patients enough and even neglecting their care are still going on.

4. *Transgenic cattle in Lapinlahti.* Dutch company Pharming started to produce hLF (human Lactoferrin) with transgenic cattle in a farm in Lapinlahti, in eastern Finland. The project started with about 50 cows, but there were plans to increase the number as high as 2000. The hLF-high milk produced was used only for testing purposes for the company's laboratories. Two potential applications of the milk were researched. The first application planned was a medicine used to help blood clotting in operations. The other target was to create a novel food preparation for people with diseases such as cancer and AIDS. The transgenic cattle project received much attention in the media and also activated public discussion. The hearing arranged by the NGO, Kansalaisten bioturvayhdistys, was held around this issue. In 2001, the Dutch mother company Pharming filed for legal moratorium and the Finnish part of Pharming filed for bankruptcy. The cows were slaughtered except for a few that were left for laboratory purposes. The ending of the hLF-production in Lapinlahti was due to the financial problems of the Dutch company.

5. *Transgenic "golden calf" Huomen.* The case above is closely connected to this fifth one, the case of one transgenic cow called Huomen ("Morrow"). Huomen was born in 1993 at a research farm of the University of Kuopio. It was the first transgenic calf in the world. It had a human gene that produced erythropoietin (EPO), a hormone that increases growth of red blood cells. The birth of Huomen got Pharming interested in Finnish research and enabled the project in Lapinlahti. The life of Huomen did not go as planned. The goal was that Huomen would produce 60-80 kg of EPO in her milk. The annual demand of EPO for medical purposes globally was estimated however to be only 20 kg. During the 1990s the demand of EPO grew, but this was because it was used among athletes as a performance enhancer. This created an ethical dilemma. Huomen was slaughtered in 2001 because it was overweight and had joint disease and the EPO-cow project ended (see Väliverronen 2002).

In addition to the concerns about searching for financial profit at the cost of public good present in the cases, the last three issues deal also with animal rights and ethical aspects. The issues presented here have been brought to public discussion and kept there by relatively few actors. The association Kansalaisten bioturvayhdistys was involved in the both cases of transgenic cattle and some members of the green party have been actively promoting discussion about genetic manipulation and the openness of decision making. The National Advisory Board on Research Ethics has been an active and critical voice in the cases of research misconduct and prompted by situations like in the conflict of interest case it has also published a memo concerning the relationship between researchers and the private sector and problems arising from it (National Advisory Board on Research Ethics 2001).

# CONCLUSIONS

In Finland the growth of biotechnology research and development has been rapid during the last decade. There have also been growing politico-economic expectations of the capability of the biotechnology cluster to transform the structure of the industry. The advancements in biotechnology are related to a variety of major changes reflecting a radical change in the political ideology from the welfare state to the neo-liberal state. New international market openings for new technologies, emphasis on commercial ethos instead of community ethos, as well as a general trust of the Finns on the benefits of new technologies all have contributed to the issue. It is characteristic of the country that the political system has been able to agree both on the welfare state programme and thereafter on the goals of the neo-liberal state. Lately, however, citizens have been demonstrating against the competitive model.

Even though the legitimate basis of ICT has been shaken in the beginning of the new millennium, the political pressure on new technologies has not lessened in Finland. On the contrary expectations of biotechnology to be the next global market winner after ICT are high. Concomitantly a multilevel programme aiming at securing the development of biotechnology has been accomplished by the government. The measures comprise a generous public funding to biotechnology research, attempts to change the infrastructure of university research by establishing biocentres and other centres of competence, an integration of doctoral schools to centres of excellence in research, financing of research and technology programmes between universities and industries as well as subsidies to biotech industry. Aside from the attempts to promote biotechnology for its own sake all these efforts indicate a tendency to strengthen market orientation in the biotechnology sector. Still there are more evidences of the high quality of Finnish biotechnology research than of the high market competitiveness of its industrial applications.

As in the other European countries there is an increasing international/EU pressure to control the development of biotechnology in Finland. All necessary laws have been passed by the Parliament and new official bodies have been established to fulfil the controlling and regulating functions. The interest representation is, however, traditional. The respective ministries function in a discretionary way having only few efforts to develop more horizontal ways of action and information change. Therefore attempts to develop a coherent biotechnology policy have been rare. Sector-based responsibilities make it also difficult to solve the growing tension between the common and private good.

Traditional forms of action also predominate in regarding the public concern and action. The government has launched the national innovation system as a modern model of societal cooperation and responsibility. The primary goal in this frame is to advance the coherence between the activities of universities and industries. The citizens are invisible actors in the national innovation system. When they come to the scene, they are customers who are needed to stabilise the markets, and through their choices to make estimations of the appeal of the products. It seems that here are the roots for new citizen mistrust. A strongly market oriented political system has not managed to advance the components of the common good.

As regards public concern, there is a national peculiarity to see a difference between international and national ways of scientific action. The citizens and the academic researchers in the biosciences tend to have a strong trust on the neutrality and purity of Finnish science. Ethical and moral problems come from abroad. At the same time both the decision-makers and the public are increasingly concerned of ethical issues and of the role and responsibilities of various actors in solving these issues. Still they are not sure how ethical and moral problems can be solved. They wonder what kinds of forums should be favoured to promote the discussion of shared responsibilities and who are the relevant partners. The Finnish system for tackling emerging problems and risks is still very expert-led. As the authorities are trusted to do a good job, it seems to many that it is not necessary to construct new forms of action because the old system still functions well. Therefore the pressures from the EU to integrate the public into the decision-making system pose difficulties. These kinds of uncertainties also become visible in the role of the media in biotechnology issues. Even though there are attempts to mediate neutral information, the publicity is mostly on ethically or morally suspect issues and the attempts by the public to influence biotechnology issues are downplayed.

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