ETHICS OF SCIENCE NOW MATURING: EXPERIENCES SO FAR AND OUTLOOKS AHEAD

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There is a common misunderstanding among practising scientists. The misunderstanding is that science is one thing, ethics is another, and that is why those that talk about the ethics of science at best deliver a more fashionable outfit to a body that remains essentially unchanged by the new appearances. At worst, it is the emperor's new cloths! To many scientists the call for ethics in science is something that is best answered by adding something on to the usual practices of science, for instance an ethics committee that provides opinions on what science does. Hopefully these opinions then increase the public acceptability of science in areas where there is dispute, like e.g. in genetic engineering. Occasionally these opinions may even say 'no' or 'stop' to scientific developments that have or may have consequences too extreme for public moral sentiment, or developments that put society to unacceptable large risk. Questions of human cloning or biological warfare may be examples here. This misunderstanding is sometimes also shared by the critics of science from within the anti-science movement. To them, ethics of science is mere window-dressing, designed to cover up what they often perceive as the deeply inhuman nature of the scientific enterprise.

I think both miss the point. Ethics is not an add-on to science, it is not the emperor's new cloths, and it need not be window-dressing. Ethics is already deeply baked into the practice of science, and ethics of science is an activity that elucidates the underlying value assumptions, lays them bare for public discussion, and tries to formulate visions for what socially responsible science could mean in terms of actual practice. Ethics of science is a platform for the new governance of science, a platform where new dialogues are created both within science and between science, society, industry and government. Thus it is much more than the perceived "yes – acceptable" or "no – unacceptable"- judgement by some committees. In fact, one of the first axioms of ethics of science should be, I believe, that there is no high court of ethics, in spite of occasional governmental efforts to establish one. Perhaps the German Ethikrat would be well advised to spend some time on reflection of its own status and basis for work. Ethics of science is more process-oriented than outcome-interested.

In the following I shall elaborate on these points and illustrate them by examples. I shall then try to point to those areas where I see the main challenges to the present discussion, and I shall sketch what I see coming.

But let me first illustrate why I hold that ethics is already baked into the practice of science. My point is not that all of science is continuously under pressure from the point of view of ethics. Rather, my point is that many of those judgements that we normally are prepared to accept as scientific judgements, are frequently infected by value judgements without stating this explicitly.

Ethics infects scientific judgements

In Norway we recently had two government appointed expert commission reports within one year where the Precautionary Principle played a crucial role. One such report was on the health consequences of genetically modified food products (NOU, 2000:29; Walløe-report), and the other one was on xenotransplantation (NOU, 2001:18, Gjørv-report). While both are unusual in their explicit and lengthy discussion of the Precautionary Principle, they come roughly to opposite results with regard to its application.

The Walløe-report considers a number of potential health risks of gm-food, and nearly each time all but one member conclude that existing evidence so far provides no reason to apply the Precautionary Principle. For instance, concerning the question whether the new gene can be transferred from the food plant to mammalian cells, the group is unanimous that this is normally not the case. However, the group also mentions that a number of new studies seem to suggest that there are significant exceptions to this rule. The group mentions that the very few animal studies based on long term feeding with gm-food have not considered the question of gene-transferral to the body cells. The majority then concludes from this that there is no reason to apply the Precautionary Principle, and that the few possible exceptions that we know of would apply to traditional food as well. Only one member warns that we do not know the mechanisms behind the exceptions, that gm-food might well stimulate these exceptions, and that the potential health risks are too significant to be neglected. He alone therefore opts for applying the Precautionary Principle.

The philosophy behind the majority in the Walløe report is apparently that we need specific scientific studies that establish by proven methods that the risks are real. Then we may consider whether the risks are too great, and whether we should apply the Precautionary Principle. It is noteworthy that the report repeatedly complains about the lack of independent studies, but this has apparently no effect on their judgement that risks are non-existent or too small to justify applying the Precautionary Principle.

The Gjørv-report has to tackle uncertainties that by and large may be of the same kind as those in the Walløe report. The main risks of xenotransplantation derive from the possibility of xenosis, i.e. the transferral of infectious diseases from animals to humans via xenotransplantation. The so-called porcine endogene retrovirus (PERV) is of particular importance in this connection. Again, there are to date no studies that show transferral of PERV from primary (i.e. not grown in the laboratory) pig cells to primary human cells. But the study also identifies a number of (7) steps necessary for PERV-infections becoming a health risk to humans. The fact that 4 of the 7 steps were already shown in laboratory studies, even though some of them only under very different and idealised circumstances, was taken as evidence that the risk is real. Furthermore, the report refers to the development of HIV-infections as a relevant model for potential xenosis. It is thus assumed that this constitutes a scientifically based scenario of possible harm, though there is no indication about its likelihood. On the basis of this the report is unanimous about the need to apply the Precautionary Principle to xenotransplantation.

Those that argue for a restricted use of the Precautionary Principle, like the Walløe-group, typically base their arguments on what "sound science" has shown or what kind of "facts" have been proven by scientific studies. Those that argue against this typically find it paradoxical that the very core of the Precautionary Principle, i.e. the existence of scientific uncertainty, need to be described by "hard scientific facts". Arguments from analogy and from model scenarios seem for them often sufficient ground to apply the principle.

The existence of unavoidable scientific uncertainties and the existence of scientifically reasonable harm scenarios are two of the crucial conditions for applying the Precautionary Principle

It was on the basis of these criteria that the report on xenotransplantation concluded that the Precautionary Principle had to be applied in this case. It was on the basis of the very same conditions, specifically the existence of scientifically reasonable scenarios of harm, that the majority in the Walløe-report rejected applying the principle. The difference lies in the fact that the xeno-group was willing to accept reasoning by analogy (the HIV experience, basic research in laboratories under idealised circumstances etc.), while the group on gm-food wanted these scenarios or models to be based on feeding experiments directly relevant to the issue of gm-food (and thus disregarding exceptions to the rule etc.). The reason why the first group was including research results not directly related to xeno, was that they deemed the risks to be too great for the general public to overlook or disregard evidence that signals caution. When the Walløe group felt differently, they obviously made a value judgement of significant importance, even though it was presented as the result of "sound science".

A science that is not very self-conscious about its own potential pitfalls and shortcomings, a science that assigns to itself a better track-record than is justified by history, a science that forgets the many idealisations and abstractions that are prerequisites for its model-building and testing procedures, and finally a science that portrays itself as unaffected by large commercial (or even political) interests, such a science stands in grave danger of becoming a socially irresponsible actor.

One need certainly not be anti-science to realise that much talk about sound science and hard scientific facts in these debates are more grounded in old-fashioned ideology than in a sober appreciation of how science works and what it can produce. Science, and in particular the scientific expertise that we might utilise in policy making, is much more pluralistic, uncertain, divided, interest- and value-based than often appears in these debates. Failing to concede this much, may be seen as ethically defective.

Ethics of science so far

In Norway we have three national committees for research ethics, established since 1991, one for medicine, one for social science and the humanities, and one for science and technology. It is perhaps noteworthy to point out that these committees have operated with a wider notion of research ethics than is usually the case in the anglo-american countries. First of all, research ethics is not limited to research with human subjects, but includes other entities like the environment. Secondly, research ethics is not even limited to individual scientists' behaviour in a research setting (like scientific misconduct etc.). It includes reflections on the behaviour and policies of macro entities like scientific institutions. Thirdly, it is not restricted to the process of doing research, but it includes also the responsible handling, interpretation, and information of the results of research. In fact, for science and technology it is the last area that was the most dominant in the Norwegian discussions about ethics of science.

The rationale for this wide use of ethics is twofold:

The belief that science is not an important actor in translating scientific results into social / technological reality is based on an illusion.

While in matters of policy all involved parties have some responsibility, those that have the best insight into possibilities and dangers have a special responsibility to utilise that insight. Knowledge implies moral co-responsibility.

It was during the 1980's and 90's that research ethics and ethics of science became a focal point of public interest. In many countries, and I believe Germany is among them, this interest was often dramatically triggered by some academic scandal of scientific misconduct. For instance, it was revealed that some well-respected scientist took a short-cut and simply faked some results. This, of course, catches on newspaper headlines and public interest. Science is asked: is this common, and what do you do to prevent it?

In 1996 we conducted an empirical study among Norwegian scientists (excluding medicine). We asked them (cf. Elgesem, Jåsund & Kaiser 1997; 1203 questionnaires, 456 received answers ☐38,7%): do you know of any incidence of scientific misconduct in your research environment? Many did. But the most disturbing results were the answers to our following question: have you yourself ever committed any of the following actions, where a long list of minor and major examples of scientific misconduct was provided. Surprisingly many (35 committed serious misconduct, 41 less serious misconduct) admitted they had done so.

It is not easy to know who is more disturbed by these findings, the public or the scientists. I believe many people simply take these findings as an indication that scientists are, after all, human, not better, not worse. But scientists, by and large, tend to react more strongly. (At least in Norway they did!) For them scientific misconduct apparently hits a nerve. This is largely understandable, given that science builds on mutual trust in the information that has slipped through the system of scientific peer review. But there may be more to this reaction than just this, especially when one considers that the total numbers of serious misconduct are supposedly rather small.

Firstly, scientists may rightly worry what news stories like this can do to the public image of science. Apparently many scientists experience a loss of authority and status in the eyes of the public. More serious may be that this is then reflected in public policies where science in many countries has to fight for basic funds, and where traditional academic institutions (like universities or academies) are put under tremendous pressure to implement significant institutional changes. This again has consequences for capacity building and recruiting young people to science. As we know, many countries face acute difficulties in this area. Therefore, many scientists feel that acknowledging cases of serious scientific misconduct (instead of downplaying them) means pouring water on the mill of those who want to limit scientific freedom as they understand it.

Secondly, there is the worry that if we openly acknowledge that science has a problem with scientific misconduct, then one should do something about it. But what? The production of scientific knowledge cannot be policed or controlled effectively. And very few scientists would want it thoroughly controlled anyway.

There is always the element of some individual creativity, of experimental skills, of tacit knowledge, of knowledge disparities and other mechanisms that are essential to new insights, but that also make any mechanical control procedure elusive. We end up with ethical guidelines and codes of good practice. There has been a near inflation of ethical guidelines over the last years. Most self-respecting scientific institutions have them. But how effective are they in steering scientists away from those short-cuts that seem so tempting? The honest answer is: We do not know. We have hope, though.

I believe there is a third underlying worry. Many scientists are acutely aware that science is no longer what it once was. We often connect the image of science we present in public to the heroes of science. But the days of an Albert Einstein, a Max Planck, a Kurt Gödel, or an Alfred Wegener are over. Already Crick and Watson's race for the Nobel price already indicated some significant elements of change.

Science functions differently nowadays. It is the days of Big Science as Derek De Solla Price termed it in the 1960's. Some of the traditional distinctions, for instance between basic science and applied science, do not make sense any longer when confronted with genetic research. There are important structural changes in the production of new scientific knowledge. Disciplines and individuals and traditional institutions become less important, it is problem-focus and multi-disciplinary research teams and new research units (science parks etc) that seems to be the cutting edge. Gibbons et al (1994) coined this new production of knowledge "mode II science". One does not need to agree fully to the analysis of Gibbons et al to recognise that there certainly are important structural and institutional changes in science.

And the biggest change of all is money. Large parts of science have become commercialised. With the recognition that technological innovation is the key to the competitive edge in a globalised economy, science has become an important actor in a nation's struggle to secure wealth and work for its people. And scientists know that this development has not remained external to science. Scientists are crossing borders between research and commerce more and more, and quite routinely. Cutting edge research is deeply infected with large commercial interests.

Discussions about patenting and setting up new institutional links between universities and industry highlight this development. It was an eye-opener for me when I on one occasion realised that certain published articles on xenotransplantation in highly respected medical journals were not primarily written for the scientific community, but first of all for the shareholders of the pharmaceutical company that invested in this research. The whole point was to convince the shareholders that their investments were well placed and that steady progress is being made. Given this background it is hardly surprising to learn what emerged later, namely that the publications were not very rigorous in terms of method (they made short-cuts by selective reporting) and that they broke various rules for good animal experimentation.

I believe, though I admit I am speculating on this point, that it is the more or less conscious recognition of these deep structural changes in science that makes many scientists worry about the phenomenon of scientific misconduct. The extreme cases may not so much reveal what was once thought to be merely an individual moral defect, but they may point to what lies at the end of the road science has started to take. Understood in this manner, scientific misconduct is an all-pervasive threat to the present day practice of scientific knowledge production. That is also why it is legitimate to ask of science "who pays the piper?", a question that seemed out of place just a few decades ago.

The Walløe-report notes the virtual absence of independent studies of health effects of gm-food, all available studies were paid and conducted by the industry, but it does not draw any conclusions from this. When we arranged a lay-people consensus conference on this same topic, the lay people were much more direct: if there are no independent studies, then there is good reason to doubt the conclusions. With the increased commercialisation of science, the ethics of science is interwoven with the practice of science itself and the ongoing evaluation of the value of the knowledge that is produced.

Science and social co-responsibilities

In the above discussion I tried to show that already those ethical themes that at first glance appear purely internal to science, like scientific misconduct, tend to point to much larger problem areas of the interface of science, society, industry and government.

This is even more obvious when we look at some of those fields of science where the public attaches high moral value to the question of what kind of knowledge one actually produces. Sometimes the question is raised whether there are any ethically founded absolute limits to technological development or even scientific knowledge itself. Quite naturally this issue occurs in some parts of modern medicine. Xenotransplantation or stem-cell research may be a case in point. This is also the case for modern genetics.

But in more general terms, it is the management of risks and uncertainties that has captured our attention, and that seems to cry out for a better integration of ethical viewpoints.

Risk and uncertainty have become the most central parameters when discussing social responsibilities of modern science. This is in itself an interesting fact, given that it is not so long ago since people, including many scientists, believed that the main business of science was to produce certainty, or at least something that came very close. This has left traces in the legal system of many countries, where environmental law and other legal domains may include phrases like "science has to prove with absolute certainty / or: establish beyond reasonable doubt…". The law often requires that causal links be established between certain effects and their supposed causes. Most practising scientists are ready to admit that this is seldom the case. At best science can provide statistical data that demonstrate correlations that again may indicate causal agency. But typically one deals with a multiplicity of possible causes that are expressed in a multiplicity of possible effects. The typical state of real systems of the world is complexity (May 2000).

And as we learn more about the complexities of nature, we also learn more about the limits of scientific knowledge. Very often we have to express the regularities that we find in terms of non-linear equations. Some systems are chaotic. This has consequences for our ability to predict future states of these systems (Fenstad 1995). We learn that increased scientific knowledge not necessarily implies increased controllability. Manipulating nature by means of science and technology then acquires some of the characteristics of a gamble. We routinely deal with possible benefits and possible harms, and all the time we are uncertain or even ignorant about all the possible intervening parameters that may redefine the gamble. I believe this holds true for most genetic research, for environmental science, for medical technology and treatment, for nuclear power, for information technology, for applied chemistry, and even for most traditional engineering tasks, given a certain complexity of the systems that are developed. When these systems are put in a social context, the uncertainties and complexities manifold.

I am told by engineers that the term "risk" was not even a part of their scientific curriculum before sometimes during the 1960's. Even though philosophers, like e.g. Karl Popper, argued vehemently that science can never be understood as producing final "truths", i.e. certainties (because of human fallibility and logical under-determination), many, including Popper himself, conceived of science as a rigorous process that approached certainty as a matter of degree. The world picture that emerges from our current conceptions of science may be a far cry from this. We have somehow to accommodate for the fact that even the best science only gets an imperfect handle on the world, creates with every new discovery new white spots of ignorance on the map of nature (cf. Cartwright 1999). This is nowhere more apparent than when we want to apply scientific knowledge to real systems of nature.

The most prominent example of this new reality of risk and uncertainty is perhaps climate change. Even after many years of intensive, co-ordinated and international research, the reality of its most crucial phenomenon, the process of climate change due to human agency, is not beyond all significant dispute. And once one assumes this phenomenon, the scientific problems only increase when we ask about possible effective remedies to counteract this change. The problem is that every possible counter-measure opens up new complexities, most notably complexities of the socio-economic system. At the same time many people have realised that behind this scientific problem there are important social values at stake, indeed even life and death for some communities of the world. Silvio Funtowicz and Jerry Ravetz (1993, 1999) have coined this combination of high system uncertainties with high social values "post-normal science".

We have just begun to learn our first lessons from these new realities of science. The very first lesson is that post-normal science demands a new form of governance. Our reliance on an established expert culture needs rethinking. The International Panel on Climate Change (IPCC) is perhaps one of the first expressions of this need for new forms of governance (cf. Andresen et al 2000; in particular Underdal's ans Skodvin's contribution to the volume). Similar bodies, like the International Whaling Commission, experienced strong pressure to adapt to new social realities and e.g. to allow for larger transparency and have NGO's accepted as observers.

There are perhaps two questions one would like to ask here. The first is, what is really new about this alleged new forms of governance? The second is, what has all this to do with the ethics of science? Let me try to formulate tentative answers in turn.

I believe the main innovation lies in the fact that these new institutional arrangements are explicitly build around the recognition that there necessarily will be scientific dispute and major uncertainties at the same time as one needs to plan for action. Therefore, a major task of these arrangements lies in the sorting out of different degrees of uncertainty (notabene the difference to the Popperian version where one sorted degrees of certainty). Degrees of uncertainty are not quantifiable risk parameters, but they are qualitative information from and about science. Assessing or evaluating the relevance of this qualitative information is only partially a matter of scientific expertise. How this information is evaluated will to a large degree depend on one's values. The interplay of assessing the state of knowledge with the consideration of suggested modes of action then becomes a process where science, public interest groups (NGOs) and decision-makers need to interact. This constitutes, at least in principle, a significant innovation in relation to older models where science first delivered the facts, decision-makers then decided on the actions, and the public had to wait for the next election to influence policy. The new governance of science and technology is explicitly built around the recognition that participation from different parties is absolutely crucial for successful outcomes. This, of course, also implies transparency and openness.

And what has all this to do with the ethics of science? I have already indicated that values play an important role in assessing scientific knowledge, once we concede the existence of major uncertainties in our knowledge. But more basically I believe that it is the universe of values, the multiplicity of them and the possible conflicts between them that defines the common platform where science meets the public, industry and governmental authorities. The dialogue between science and its publics has values as its focal point. This is already apparent in the challenge that many interest group put to science e.g. in relation to gm-food. It is not so much the question whether genetic modification in itself is good or bad (which assumedly would be impossible to answer), but rather the question whether the scientists really have promoted those values that they often allude to in their public discourse. Have they contributed to better social equity between the North and the South, have they contributed to feeding the world? Is this a positive contribution to sustainability? It is with regard to the values expressed through the direction of scientific research that science is challenged by a critical public. And I believe science is still badly prepared to enter this dialogue. Science needs to reflect on its own values, as scientists need to reflect on their values individually. Hitherto, too many scientists have regarded ethics as purely external to science. Now, with the new role of science as partner in the new participatory fora for governance of science and technology, science needs to become much more sophisticated, self-critical, and reflective about its own value basis and inherent value assumptions. In some sense, the ethics of science becomes an instrument for entering the dialogue with the public as a full partner. This is what I see as the major task of a socially responsible science.

Given these prerequisites it is also clear how I view the question about some ethically founded ‘absolute’ limits to science and technology. I do not believe there are some ready-made normative answers available that are binding to all, or acceptable from all points of view. There is no theoretical framework from which we could infer or deduce ‘sound’ solutions to pressing issues like stem-cell research or xenotransplantation. It does not help us to refer to human rights or other universally accepted moral principles, since it is too long a step from general principles to specific problems where these principles might or might not play a role. Ethical theory is needed for an enlightened discussion of the pressing issues, but to the extent that they actually indicate possible answers, these have to be checked be a detailed public discussion of the case at hand. Ethics of science can clarify basic uncertainties, lift up underlying values, and muster a variety of relevant arguments. This then can feed back into the new fora for governance of science and technology that I mentioned above. In the end it is the public discussion, which may result in consensus or other robust strategies to meet the new challenges. All of this requires an extensive learning process from all parties involved – there is no instant ethics. Ethics thus develops at a slower pace as science and technology.

Challenges ahead

So far I have argued that ethical values are already inherent in science, that discussions about internal ethical aspects of science tend to touch upon larger external problems of science, and that the social responsibilities of science and their critical reflection define the prerequisite for science entering the new governance of science and technology as a full partner. It may have sounded as if all this is already widely established among large circles of science, or at least among those with an active interest in the ethics of science. Far from it! Much of it is a very personal statement, based on idiosyncratic experiences. There obviously are those that remain deeply sceptical of the project of an ethics of science; Lewis Wolpert and John Maddox may be two prominent examples here (cf. e.g. their contributions and discussions in Balabam & Sambuc 2000.). Yet it is not just a manifesto or a personal credo. There are very clear indications that ethics of science is indeed by and large developing along these lines. Research centres on the ethics of science are formed. Scientific institutions and academies establish bodies that deal with these issues. Governments appoint advisory committees on these issues. Many of their mandates reflect some of the major points made here. Codes of ethics are issued that cover not only the traditional internal issues of ethics, but explicitly address the social responsibilities of science. Transparency and participation form cornerstones of policy documents like those issued from the World Science Conference in Budapest (1999; UNESCO & ICSU; see WSC 1999), or those recently issued from the EU (White Paper on democracy, especially report from working group on Democratising scientific and technological expertise; cf: EU 2001a , 2001 b). Ethics figures explicitly in many of them, and in the recent discussion about a new social contract for science, ethics is an essential element. Similarly, in the preparations of the Rio+10 summit, and the Earth Charter. UNESCO has made the ethics of science a major activity (COMEST; CIB). Both from within science and from outside there is a call for integrating ethics in the education of scientists.

When seen from the perspective of someone who works in this field this is certainly good news. The more critical question is whether ethics of science really can deliver all the goods that are expected from it. I believe that the honest answer is that this can only happen if practitioners in the field and the bodies appointed to this purpose acknowledge the need of developing more rigorous professional standards. In Norway we have ten years of experience with institutionalised ethics of science. So far we have dealt with cases on an individual ad hoc basis. We have experimented with different mechanisms of creating public debate about values in science; we have had expert and committee reports, scenario workshops, consensus conferences (citizen panels), ethical matrices, parliamentary hearings and other means of putting ethics on the agenda. Because of the need of a new governance of science, and because of the realisation that plurality of values in democratic societies calls for participatory measures, we have refrained from the temptation of becoming an ethical high court. There is already enough experience available to systematically start to inquire whether we can establish a system of quality assurance for ethical advise. We need to know what it takes for ethical assessments to ensure high quality of the result. Normally the key to this challenge is to develop specific methods that answer specific needs. Ethics of science has not yet developed such an ethical toolbox. It is still very much in the experimenting phase. This has to change soon, if we want to avoid undermining the positive dynamics that is currently taking place. Otherwise we risk the credibility of the whole enterprise. We need to work systematically on the methods that we can utilise in order to come up with robust ethical assessments and advise. We need a toolbox that answers the needs of the new governance of science and technology. I for one would be more than happy to invite the German Ethikrat to join this discussion.

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