OPEN MEETING AT THE ROYAL SOCIETY OF EDINURGH ON

'GM GENE FLOW: SCALE AND CONSEQUENCES FOR AGRICULTURE AND THE ENVIRONMENT'.

27 JANUARY 2003.

INTRODUCTION

Professor Andrew Miller,
Chairman.

This meeting is part of a Consultation organised by the UK Government to examine the possibility of Genetically Modified (GM) crops being grown in the UK and used to produce food. There is a moratorium on the cultivation of GM crops for food at present in the UK but this is due for review in 2003. Some Field Trial Evaluations of GM plants have been approved in the UK and are due to produce their first reports in mid-2003. There are strongly expressed views both for and against using GM crops for food. The Consultation aims at airing as many of the relevant facts and views as possible.

There are three sections to the Consultation – one is a Public Debate overseen by a Steering Board chaired by Professor Malcom Grant of the AEBC, the second a study by the Prime Minister's Strategy Unit into the overall costs and benefits which GM could have on the UK economy and the third part a review of the science which underpins the production of GM crops. The Science Review is chaired by the Government's Chief Scientific Adviser, Sir David King, and by the Chief Scientific Adviser to the Secretary of State for the Environment, Food and Rural Affairs, Professor Howard Dalton with independent advice from the Food Standards Agency. Output from the second and third reviews will feed into the Public Debate.

The Royal Society of Edinburgh was invited by the Scottish Executive to organise this meeting as part of the 'Public Meetings' activity of the GM Consultation (see DIAGRAM 1) and it is special first because it is regional (Scottish) and secondly that it is devoted to the science underlying a specific aspect of GM crop production namely, Gene Flow: scale and consequences for agriculture and the environment. The RSE is not a lobbying body. The aim of the RSE is to facilitate the dissemination of sound scientific information on GM.

This is therefore a scientific meeting for discussion of the biology relevant to Gene Flow and the majority of participants are scientists. It is expected that contributions will be aimed at clarifying issues surrounding the science of gene flow. We want to know what relevant facts about gene flow are well established, the precision to which they are established, where there is uncertainty and in what areas further research is still required.

We should compare the uncertainties surrounding products from GM with the uncertainties surrounding products from more conventional methods. We aim at this meeting to come up with objective information that must be addressed by all. Scientific evidence should be determined by how the physical and biological world is rather than how we might like it to be. Of course we can then use our knowledge of the physical or biological world to try to mould society to our liking.

The scientific picture is essential as a basis for the assessment of the effects of gene flow on human health and on the environment (matters of keen interest by the public and to which we hope scientists may relate their scientific comments at this meeting) and for the establishment of public policy and practice (which we will leave to the other components of the Consultation). This is not to suggest that science is insulated from the other issues. It is simply that we are focussing on the science here and it will be related to the important wider aspects at the level of the Steering Committee. The Public Debate is aimed at obtaining an awareness of public concerns about GM and at this meeting of scientists, who are, of course, members of the public, we must feed in the concerns of scientists about GM.

GM projects can have two aspects. First, ‘Can it actually be done safely with present knowledge and technology?’ and secondly ‘Do we want to do it?’ Even if the answer is ‘Yes’ to the first question, we may still decide on social, moral, aesthetic, environmental, financial, or cultural grounds that we do not wish to do it. It is important that we do not confuse these two questions. In this meeting we address the first question.

At present it is widely claimed that around one billion people have been eating GM foods in several countries for 5-10 years and no instances of harm to human health have been observed. This is despite the fact that in some of these countries there is an aggressive system of monitoring public health. This does not mean that it is certain that no harmful effects of GM will ever be picked up, but ‘no evidence of harm’ over that scale must reasonably be said to auger well for GM. There is an oft-quoted ‘No evidence of harm is not evidence of no harm’. This is misleading. It is not possible to prove a negative, and we should not accept an invitation to try. ‘All swans are white’ is a reasonable generalisation until you visit Australia when the sight of one black swan will refute the theory. But it still remains a very good generalisation in the UK (except in zoos!). We should not expect from empirical science the kind of ‘proof’ that is available in logic or mathematics. Empirical science can, however, offer evidence of high (or low) probability that a statement is true and these statements can be an excellent guide for action. No evidence of harm might mean that there is evidence of a very high probability of no harm. It is important to specify the ‘harm’ we are talking about. A pragmatic approach is appropriate with a careful case-by-case consideration of the safety of each new GM product before it is released.

The effects of GM on agriculture and the environment are less well known though there has been a vast amount of research over the last decade or so. At this meeting we will survey what some of the latest scientific findings show about gene flow of modified genes in GM crops to other parts of the environment. You will hear from our speakers that very interesting information is now available and research continues apace. This information can then be used as a basis for inferring the impact of GM on agriculture and the environment and hence how safe or dangerous it is to eat food from GM crops. Since GM is relatively new, it is important to compare the evidence for its safety with evidence for the safety of other things we normally eat or other things we normally do. GM products and processes must be submitted to at least the same degree of scrutiny as products and processes from other sources.

The output from this meeting will be fed in to the main UK Science Panel and it will be posted on the GM website. The UK Science Panel output will be considered by a Steering Committee which will conflate it with the output from the other two consultations.

It only takes a moment 's reflection to realise that absolute certainty is not a common feature of life. The success of science and technology has sometimes led to unrealistic expectations about what can reasonably be delivered. On the one hand some think that the promise of benefits for humanity from GM is obvious; others think that it is obvious that GM is dangerous and should be avoided. Scientists are familiar with uncertainty and are frequently very cautious about applications of their basic research results and very critical about proposed applications which they see as premature and potentially hazardous. As of this moment, Ian Wilmut, whose team produced Dolly the sheep, warns strongly against applying cloning techniques to humans, given our present state of knowledge, and working geneticists are highly critical of commercial offers to predict, for a fee, what people will die of by determining some of their gene sequence. Some leading scientists have suggested that scientists should perhaps sign a Hippocratic-type oath undertaking to 'do no harm'.

It is helpful to think of three different modes of scientific research - in the context of discovery, in the context of verification and in the context of application. At this meeting we are mainly interested in verification and application.

Discovery is heavily dependent on the psychology of the researcher and on the social, political, economic and cultural environment. Discovery can be the creation of new ideas or interpretive frameworks or the report of new observations or experimental findings. There is no infallible recipe for discovery and it can result from several sources - chance, guesses, deep insight or brilliant creative originality. Sociologists of science have estimated that only about 5% of researchers are creative leaders who seriously develop their subject with new ideas or discoveries. Creators of new ideas do not need to explain how they got their ideas, but they must submit them to the process of verification (or refutation).

Verification assesses the validity of the proposed discoveries and usually follows the accepted protocol deemed necessary by the relevant scientific community, so-called peer review. Inevitably verification involves critical questioning. It is less dependent than discovery on the psychology of the individual researcher but personal qualities such as honesty, diligence, openness to new ideas and subservience to the facts are essential. Verification should yield new knowledge which must be accepted by all, it should be 'objective' which means commanding intersubjective agreement. In the verification process the accuracy of measurement and the use of statistics are central in determining the precision with which scientific data and conclusions can be adopted. The majority of researchers operate at the level of verification though in so doing they may also create new knowledge, for example, new molecular structures, gene sequences or details of the cell cycle and they can certainly produce key materials in the establishment or the rejection of proposed discoveries. Proposers of new discoveries usually offer arguments or data as verification when they submit their work for publication. The peer review of articles submitted for publications in scientific journals is a key early step in the verification process.

An interesting point about research is that verification leads to what is accepted as 'sound science' which is widely accepted by the scientific community and by educationalists and yet, all knowledge remains corrigible. Experimental findings are all subject to confirmation or disconfirmation, to improvements in accuracy or to reinterpretation in a new theoretical framework. All theories are vulnerable to replacement by more comprehensive or productive competitors or as new experimental findings emerge.

It is a mistake to conclude that susceptibility to correction means that science is therefore of no value as a guide to decision making or to safe action. It is true that errors can be made by trying to extrapolate science outside the range within which it has been verified. However, many scientific observations have proved a sound guide to action even if they have later been subject to theoretical reinterpretation. It is important to ensure however, that scientific statements are only made in the domain within which they have been verified.

There are other influences too. In common with other professions, the scientific community is vulnerable to fraud. Fraud can result when individual scientists decide to sacrifice scientific codes of practice in the interests of achieving other goals such as professional ambition, wealth or power. Fraud by scientists is almost exclusively detected by fellow scientists.

All scientific subjects are in the process of growth and development. Sometimes the rate of growth can be affected by the extent of funding available for a subject and this means that the predilections funding bodies such as governments, industry or charities can influence specific research programs. However, in the long run, the internal logic of a subject determines how it can develop. Scientific views may originate in individual whim or in social fashion but to become established, they are constrained by the way the world is rather than by how we might like it to be.

If science is to be applied, it must result in predictability. Astronomy provided the predictability of the movements of the stars which was central to successful navigation. Systems containing a small number of variables can become well understood and lead to high predictability. The predictability of a billiard ball after being struck by the cue ball will be predictable to a certain accuracy. After one bounce from another ball or the side of the billiard table, the degree of unpredictability increases until, after a few rebounds, the degree of unpredictability is larger than the length of the table and so not useful at all in the game. Skilled experimentalists strive to devise experiments in which the number of variables is reduced to a level which allows predictability and hence testing. We now know that most natural systems are so complex that, while they may be determinate, they are only predictable to a degree which is not actually helpful in situations where we might like it to be. Weather forecasting is an example in which the precision of predictability may be adequate to assist fishermen at sea, or farmers reaping their harvest but often not adequate to answer the question 'Will it rain on me tomorrow?' Experiments or observations on natural systems are therefore carefully designed to yield firm conclusions or predictability.

Even if our knowledge is good enough to predict accurately how to do something, for example to construct a nuclear bomb, we can still ask ‘Do we wish to develop such an application?’ Application is heavily dependent on society and its aspirations, morality and sensitivities. Application can also be heavily dependent on the ambitions – commercial, political or ideological- of the individuals seeking to develop the applications. If the question is only one of safety to human health or to the environment as we have in this meeting on GM crops, the general issue is risk/benefit analysis. Risks attract more public interest than benefits but the European Commission regulatory framework correctly recognises the need for risks to be assessed and compared with assessed benefits. If a new technology with promising applications but possible risks is being considered, then risk/benefits may have to be expressed in probabilities. There is no point in saying that, ideally, we want the probability of harm to be zero since that would rule out most of everyday actions at present. But experimental explorations with materials that have risk should be done cautiously, moving little by little into unknown territory, to minimise the likelihood of harm.

The benefits of some discoveries in basic medical science cannot be converted in to treatments available in the clinic without huge investments in research and in safety assessments. But this certification must be done before drugs are used. Hundreds of millions of pounds are sometimes needed to develop one new cancer drug and these sums can only realistically come from industry (which then, reasonably, expects profit from its’ investment) or governments. It is important when commenting on science not to confuse the distinct activities of discovery, verification and application.

SPEAKERS

I am a scientist (now emeritus but still active!), a biophysicist interested in biomolecular structure and function. I have spent two thirds of my working life in universities and one third in research institutes. Now I hold an honorary post as General Secretary of the Royal Society of Edinburgh. I am not an expert in GM – my knowledge of it comes from following the literature as an interested scientific layman. I am keen to see the results of research applied to the benefit of humanity and would give first priority to ensuring the health of humanity and the environment. Our speakers however are experts with experience in the science underlying GM.

Tonight, we will first hear from our speakers on different aspects of Gene Flow. The speakers have been chosen to cover different areas of the science and to represent different views of how the safety aspects of GM should be dealt with. Then there will be a discussion amongst the speakers and three members of the UK GM Science Panel.

In the second half of the meeting the discussion will be open to all participants to put comments or questions. I know that some of you have come to this meeting as interested members of the public or as non-scientist observers, but most of you are here because you are scientists working on GM or who are competent scientifically to judge the matter. All comments will be recorded and used to produce both an edited report from this meeting and a transcript.

It is of crucial importance that you, as scientists, make sure that your views are expressed. Public policy must be based on the best scientific knowledge at our disposal and you are best able to provide that. What society does with science is up to society, but scientists can help to ensure that public policy is not founded on wrong views of the science.

I ask two things of contributors (who should identify themselves and their provenance) to the discussion:-

- that all contributions address the science underlying GM and where possible refer to peer reviewed (this does not mean infallible, but at least it has passed one sieve) evidence.

- that contributions are concise so as to allow opportunities to all who wish to contribute in the limited time available.