WAAR MOET DAT HEEN? HOE ZAL DAT GAAN

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ENVIRONMENTAL RESEARCH IN THE NEW EUROPE

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Dames en Heren,

In het losgeslagen zusje van onze wetenschappelijke vakliteratuur, de science fiction wordt nogal eens gebruik gemaakt van de zogenaamde "kantelmomenten" in de geschiedenis. Dat wil zeggen dat er in de historie een aantal momenten is waarop de beslissing die toen werd genomen maatgevend was voor het verdere verloop van de geschiedenis. Hoe zou het de wereld bijvoorbeeld zijn vergaan wanneer Eva niet van de appel had gegeten? En, hoe zou Europa er nu uitzien wanneer Napoleon Bonaparte als overwinnaar uit de slag bij Waterloo tevoorschijn zou zijn gekomen? Intrigerende vragen waarop we helaas nooit een antwoord zullen weten.

De Landbouwuniversiteit staat op dit moment aan de vooravond van zo'n kantelmoment. In het komende academisch jaar zullen er beslissingen genomen moeten worden die hun sporen tot ver in de toekomst van onze universiteit zullen nalaten. Afgezien van de vele tientallen kleinere beslissingen die hun invloed zullen doen gelden doel ik nu op een aantal grotere operaties; namelijk het vaststellen van een nieuw strategisch plan en - daarmee samenhangend - het opstellen van een leerstoelenplan, het voeren van een zogenaamde "brede onderwijsdiscussie", de vaststelling van een lange-termijn huisvestingsbeleid en het formuleren van een aangepast public relations beleid.

De basisvraag die daarbij beantwoord moet worden is de vraag wat de missie, wat de raison d'être van onze universiteit is. Het beantwoorden van die vraag is geen eenvoudige opgave, zeker niet wanneer we er vanuitgaan dat de missiedefinitie niet alleen in inhoudelijke zin deugdelijk moet zijn, maar ook een integrerende, katalyserende en mobiliserende werking moet hebben. Dat neemt niet weg dat, als er voor één van de Nederlandse universiteiten een aansprekelijke missie formuleerbaar moet zijn, dat de Landbouw-universiteit is.
Mijn mening is dat we moeten vasthouden aan het begrip landbouw. We moeten niet vluchten voor de problemen van verdeling en indeling van schaarse ruimte, van de milieuschade ten gevolge van voedsel-produktie, van zorg voor de kwaliteit van produkten en van de financiële perikelen van de boeren, onze voedselproducenten. Ons begrip landbouw omvat namelijk ook al datgene wat samenhangt met de integrale voedselketen. Dat wil zeggen het hele proces dat loopt vanaf het systeem bodem-water-lucht, via planten en dieren, via de bewerking van produkten tot aan het voedsel zelve. Dat hele proces moet zijn plaats hebben binnen de randvoorwaarden die de maatschappelijke en fysische ruimte ons dicteren. Vandaar onze bemoeienis met de maatschappelijke en milieuhygiënische problemen van de landbouw.

In de discussie over de missie van de Landbouw-universiteit zal als uitgangspunt gelden het wettelijk verankerde drieluik onderwijs, onderzoek en maatschappelijke dienstverlening. Hoewel de onderlinge zwaarte van die drie elementen niet is vastgelegd moeten wij onszelf naar mijn smaak blijven voorhouden dat de opleiding van studenten primair is;

om die student zal uiteindelijk alles moeten draaien. Natuurlijk is het zo dat goed wetenschappelijk onderwijs alleen mogelijk is wanneer dit verankerd is in goed onderzoek en wanneer dit geplaatst is in de maatschappelijke context. Maar toch, ik bespeur zo af en toe in onze universiteit dat het uitvoeren van onderzoek wordt beschouwd als het hoogste goed en het geven van onderwijs als een corvee. Ik vind dat een afkeurenswaardige houding. In een periode als deze, waarin onze verantwoordelijkheid voor goed onderwijs als gevolg van de bedreigingen voor studenten vanwege verkorting van studieduur en –financiering, alleen maar toeneemt kunnen wij ons zo'n houding niet permitteren.

De ontwikkeling van ons taakgebied gaat steeds duidelijker twee, ogenschijnlijk tegengestelde, richtingen uit. Enerzijds is er de behoefte om de aanwezige kennis meer en meer te integreren. Deze integratie moet de Landbouwuniversiteit niet te moeilijk afgaan omdat dit immers een traditioneel sterk punt van de LU is. Een conditio sine qua non voor deze integratie is echter dat wij goed zijn in de te integreren kennis. Het in de planvorming bewaren van een goed evenwicht in aandacht voor integratie en specialisatie is één van de grote uitdagingen van het komende jaar.

De tweede, al genoemde, manifeste richting is die van het steeds dieper duiken in het wezen van de materie door middel van onder andere biotechnologie en genetische manipulatie.

Dit ingrijpen wakkert een ethische discussie aan over de vraag wat wel en wat niet acceptabel wordt geacht.

Opvallend daarbij is dat de discussie anders verloopt wanneer het om planten dan wanneer het om dieren gaat. De discussie ten aanzien van planten beperkt zich vooral tot een risicodiscussie, met andere woorden tot de vraag welk risico ingrijpen heeft voor het milieu c.q. ons nageslacht. Daarbij bestaat er ten aanzien van planten ook kennelijk het gevoel dat er een groot risico is van ongewenste verspreiding van gemanipuleerde planten. Waar het om dieren gaat blijkt een dergelijke angst veel minder, behalve wellicht bij onze eigen muizen.

Bij dieren speelt heel nadrukkelijk ook een rol het element van de intrinsieke waarde van het dier, waarbij het dier zelf een morele status heeft gekregen welke aan een plant kennelijk niet wordt toegekend. Mij bekruipt overigens nogal eens het gevoel dat we in onze benadrukking van de intrinsieke waarde van het dier niet altijd even consequent zijn; zelden of nooit hoor ik immers stemmen opgaan tegen bijvoorbeeld de castratie van jonge katers of tegen de domesticatie van meer en meer dieren.

Bij het voeren van de ethische discussie is een belangrijke taak voor de Landbouwuniversiteit weggelegd. Waar het zo is dat duidelijke normen over wat acceptabel en wat niet acceptabel is ontbreken en waar deze disscussie nog bezig is of moet beginnen rust de verantwoordelijkheid in alle zwaarte op de individuele onderzoekers. Het behoort tot onze taak om binnen onze instelling de discussie hierover te genereren en te stimuleren en om buiten onze instelling de maatschappij c.q. de verontrusten daarin te informeren over de uitgangspunten, doelen en feiten van "ethisch gevoelig" onderzoek.

De strategische discussie over de missie van de Landbouwuniversiteit is deze zomer opgestart door middel van een enquête onder een aantal personeelsleden en studenten alsmede een tweetal werkconferenties. De eerste resultaten leveren een rijk geschakeerd beeld op van kansen en bedreigingen, als gekeken wordt naar de omgeving van de universiteit, en sterke en zwakke punten in het functioneren van de universiteit zelf.
De Landbouwuniversiteit wordt gezien als een sterke organisatie met een internationaal gezien goede naam.
De grote kracht ligt in de toch wel unieke combinatie van fundamentele en toegepaste wetenschappen, en het feit dat zoveel mensen met verschillende wetenschapsgebieden als achtergrond elkaar binnen Wageningen ontmoeten en stimuleren.
De wetenschap staat vooral ten dienste van de praktijk. Er is een grote diversiteit van gebieden die bestudeerd kunnen worden. Het brede scala aan keuzemogelijkheden die het onderwijs biedt stelt de student in staat zich volledig in overeenstemming met zijn of haar capaciteiten en belangstelling te ontplooien, en blijkt een soepele instroom op de arbeidsmarkt te bevorderen.
Buitenstaanders merken wel eens op dat de Landbouwuniversiteit teveel aan zelfkritiek doet, en dat de dagelijkse interne problematiek nogal breed wordt uitgemeten, hetgeen weleens ten koste zou kunnen gaan van de ontwikkeling van een bredere, grootschalige visie.
Het is een tijd van grote onzekerheden. Bij kansen en bedreigingen valt te denken aan demografische ontwikkelingen, politieke besluitvorming over bekostiging van het hoger onderwijs en de specifieke

plaats die de Landbouwuniversiteit in het politieke krachtenveld inneemt, en bestuurlijke schaal-vergroting die op Europees niveau ook de landbouw-politiek en de Landbouwuniversiteit niet ongemoeid zal laten.
Er overheerst echter, gelukkig, optimisme over de toekomst. De Landbouwuniversiteit heeft de kennis in huis om oplossingen te vinden voor nationale en internationale problemen op het gebied van landbouw en milieu.
Velen zowel binnen als buiten onze instelling zien een voortrekkersrol voor de Landbouwuniversiteit weggelegd. Dit moet gebeuren in nauwere samenwerking met andere Nederlandse en Europese universiteiten, met DLO en met het HAO.

De laatste tien minuten heb ik u enige van de vele onderwerpen voorgeschoteld waarover de Landbouw-universiteit binnenkort een beslissing moet nemen. Daarmee keer ik even terug naar de eerder genoemde kantelmomenten; nu om dit begrip wat te nuanceren. Zelden zal het immers voorkomen dat een kantelmoment zich zo voordoet dat het om één enkele beslissing met vèrstrekkende gevolgen gaat. Meestal zal het gaan om een reeks van dagelijkse, soms heel banale, beslis-singen die in hun onderlinge verband de toekomst bepalen. Dat zal bij ons niet anders zijn.

Eén modieus sleutelwoord hebt u van mij vanmiddag nog niet gehoord, namelijk het woord internationali-sering. Ik heb eigenlijk ook wat moeite om dat woord te gebruiken in de contekst van de Landbouwuniver-siteit omdat het suggereert dat een actie – interna-tionale ontplooiing – ondernomen zou moeten worden. Bij de Landbouwuniversiteit weten we echter al

tientallen jaren niet beter; de internationale oriëntatie is voor ons bijna spreekwoordelijk.
De Europeanisering, een onderdeel daarvan, wordt – wanneer we kijken naar het toenemende aantal projecten in dat verband – steeds belangrijker.
Het is mij ook daarom een genoegen u een spreker aan te kondigen die een exponent vormt van onze internationale oriëntatie namelijk prof.dr. Lake, directeur van het EERO.
EERO, which stands for: European Environmental Research Organisation, was established in 1987 by a number of outstanding environmental scientists with the goal to initiate transnational, interdisciplinary and innovating environmental research and to accomplish a highly effective transfer of knowledge.
In 1990 EERO found his logical headquarters in Wageningen.
Prof.dr. John Lake, who's origin is plant physiology, acted until 1990 as Head Sciences of the Agricultural and Food Council of Great Britain. Since last year he is director of the EERO office at Wageningen.
He also acts as visiting professor at the University of Wales located at Cardiff.

Ladies and gentlemen, I kindly ask your attention for John Lake.

ENVIRONMENTAL RESEARCH IN THE NEW EUROPE

INTRODUCTION

The main purpose of environmental research must be to protect human health; other objectives such as the conservation of natural resources or the creation of wealth serve essentially the same purpose in the long term.

Rapid growth in public awareness of the need for research on the processes of environmental pollution and change, the ecological impacts and the possible remedial measures, has been matched by an equally rapid growth in the scientific opportunities to resolve these problems. No one country can fund all the worthwhile activities and so international co-operation seems essential if gaps and overlaps are to be avoided and costly facilities fully utilised.

The new Europe includes countries that have inherited large environmental problems, as well as intellectual resources that could in principle be harnessed to solve them. The scale of this Europe is appropriate for some of the main problems, yet remains small enough for research coordination and cooperation to be feasible.

The economic scale of Europe is large enough for a good diversity of research to be funded; with rigorous assessment of success as a selection pressure, an evolutionary development of science then becomes possible.

Assessment of international research requires access to a body of internationally respected scientists. Such a body can provide also a foundation for making sound scientific assessments of internationally significant environmental problems and institutions.

Environmental research needs scientists from single disciplines to be ready and able to work in multi-disciplinary teams. This requirement and the rapid pace of development of science demand continuing training and education.

The present pace of development also requires institutional flexibility; research networks and interdisciplinary host laboratories provide two ways of achieving this.

The governments, companies and institutions most likely to participate in international research and to apply its results will be those involved in its funding. Thus a European research organisation should seek a wide and diverse funding base. The Netherlands has been particularly active in the early funding and scientific membership of the EERO and in this connection the Agricultural University of Wageningen has played a leading role.

THE PURPOSE OF ENVIRONMENTAL RESEARCH

Health

The fundamental purpose of environmental research must be to protect human health. This principle was enunciated by the Secretary of the Council of Europe, Madame Catherine Lalumiere, when she opened the CNRS conference on environmental research in Strasburg

last year. She was not alone in this conviction; closer to home, the Ciba Foundation and the, EERO, are jointly planning an international conference on Environmental Change and Human Health, to be held here in Wageningen in September 1992. It will be followed by a larger one-day meeting organised by the University and the EERO.

Twenty five years ago, the American ballad singer, Tom Lehrer, told his audience that New York was a healthy place, but "don`t drink the water and don't breath the air". Or if you must breath, try not to inhale. The danger of environmental pollution, a popular joke then, has become one of the largest political issues of our time.

In the affluent West, the protection of health is associated with protection against pollution and disease, but worldwide the first objective is more often protection against starvation. So agriculture is intensified. Chemicals for plant and animal nutrition and protection are applied to the point where the marginal cost of a heavier dose exceeds the marginal increase in value of the product. At this point, the concentrations, in the food chain or released into the environment, of chemicals originally applied to alleviate starvation, are often great enough to endanger human health. That only one tenth of the nitrogen used in Western European agriculture is ingested as food in the year of application has been known for more than a decade, but only in the past year has evidence appeared of significant corrective action being taken.

Environmental change is likely to alter the distribution and activity of vectors of human pathogens and the epidemiology of disease. If global warming fails to bring malaria to North Western Europe, it may be because the abundance of water is offset by its level of pollution.

The release and disposal of radionuclides by the energy and defence industries are subjects of close public scrutiny and an abundance of research funding is availabe to anyone who can think of a genuine scientific opportunity arising from the Chernobyl accident. Yet the fundamental processes of DNA disorder and repair associated with irradiation remain poorly understood. At a time of rapid environmental change an increased pace of genetic mutation might even be valuable in hastening the rates of evolutionary adaptation of organisms.

Environmental pollution and change can influence social and mental health, for example through causing populations to move across land bridges to more congenial habitats. These are topics not easily accessible to the scientific method, yet they are in great need of research.

Conservation

A different perception of the purpose of environmental research is that it is to conserve what is there. Change has always been a fundamental attribute of natural ecosystems, but the pace has been slow enough for the concept of a steady state climax vegetation to remain a useful working hypothesis for the geologically brief period during which science has developed. Suddenly, the pace has quickened, con-

spicuously in regions such as those of tropical rain forests. That three million front doors made of Brazilian mahogany have been installed in Britain is distressing enough aesthetically; environmentally it seems to spell disaster. Yet if they are to eat food, the people of tropical regions must clear land to grow it, burn timber to cook it and sell what they can to give them purchasing power. Once again, the protection of human health becomes the key issue.

To preserve biodiversity can be seen as another aspect of conserving what is there. Who knows what genetic resources may be needed by man in the future, yet may be irretrievably lost through man's activities now? But we do not know what is there; the number of species of organisms is variously estimated as between five and one hundred million, but of these fewer than three million have been described. Even before the industrial revolution, the pace of change possibly exceeded the pace of discovery and description. Why should man wish to preserve the existing portfolio of species? Again, presumably to safeguard human nutrition and health.

Wealth Creation

To create or conserve wealth is perhaps the most controversial objective, yet without it what government or company would fund environmental research? And without it what are the prospects for human health?

In economic terms, the growth in the output of industry over the past two decades in the United States and other developed countries has been offset or even reversed by the cost of the pollution that

industry has created. But pollution has also stimulated new business opportunities. Biotechnology offers scope for less polluting production methods; biological or integrated control of pests and diseases in agriculture, genetic manipulation to provide durable resistance to pests and diseases, biological replacing synthetic production systems for industrial and pharmaceutical chemicals, biological nitrogen fixation replacing chemical fertilizers. It also offers ways of transforming existing pollutants in water or soil into harmless products, for example through microbial degradation.

Legislation for pollution abatement brings its own business benefits, particularly to lawyers and to those developing new instruments for monitoring the often small potentials of toxic chemicals in soil, air, water and food.

In energetic terms, using new processes that avoid environmental pollution can lead to more efficient production, so that in the long term industry can benefit economically rather than having to count the cost. To that extent, governments are better advised to spend money on basic research underlying environmental problems than on subsidies to industry to meet the cost of short term expedients to alleviate pollution from existing processes.

NEEDS AND OPPORTUNITIES

Research needs

The problems in environmental pollution that might be solved by research can be classified under processes, impacts and remedial measures.

Processes include the production and fate of pollutants. Energy production and the manufacturing industries often have the potential to produce pollutants without themselves suffering significantly from it. By contrast, the agriculture, fisheries and food industries can all generate pollution, but may also be strongly influenced by it. The water industry produces minimal pollution but suffers increasingly from it, as evidenced by the rising sales of bottled mineral water. The research need is for new and cleaner processes. The transport and transformation of pollutants in soils, atmosphere and water and their secondary consequences for example in global climatic change, remain poorly understood and predictions often have wide margins of error in space and time. Scientists capable of doing innovative basic research in the various relevant disciplines need to be made aware that environmental research requires the highest scientific rigour as well as requiring multidisciplinary cooperation, typically between mathematicians, physicists, chemists and microbiologists.

The impacts of environmental pollution on natural and agricultural ecosystems are often interactive. In the short-term, the harnessing of solar energy by vegetation enables ecosystems to become sources and sinks of energy and chemicals and this process is complicated by the addition of large quantities of a complex range of chemicals by man in managing agriculture. In the longer term interaction arises through changes in land use where again part of the change is natural and part man-induced. Man is part of the natural ecosystem and a significant medium term consequence of environmental change is likely to

be population movement, caused partly by economic pressures and partly by health impacts.

Remedial measures include not only cleaner production processes, but also the development of new techniques for waste disposal and for making less harmful the legacy of environmental pollution already existing in the natural environment. The need for these remedial measures and for developing a public attitude that is ready to implement them is particularly acute in central and eastern Europe and can best be resolved by hastening cooperation between East and West.

Opportunities for new solutions

Both the nature and the perception of environmental research are changing rapidly. The perception is fast disappearing of a hiarchy of prestige from pure mathematics through the physical sciences to ecology as a subject of last resort. The opportunities from basic research and from interdisciplinary collaboration are now widely perceived. The results of research in molecular biology, co-ordination chemistry, enzymology, protein engineering and biotechnology all find immediate application in new and cleaner production processes and in remedial measures for transforming existing pollution into relatively harmless products. Research on processes at interfaces can be applied to environmental problems at all levels from molecular to global and a particular need exists to encourage physicists and physical chemists to do research in these areas. The whole subject is characterized by a need to face its inherent complexity rather than seeking falsely simple solutions. Mathematical modelling has been central to environmental research and to projecting the con-

sequences of pollution, but even here the need to accept complexity has not always been faced. The application of advances in mathematics, such as the theories of chaos and patch dynamics seems to provide many new opportunities.

COORDINATION AND COOPERATION IN THE NEW EUROPE

Selectivity and cooperation

The growth of discovery in the environmental sciences has been so fast that no one European country is likely to be able to fund all the worthwhile research opportunities. From an economic point of view, a national priority must be to encourage industry to fund strategic and applied research at the com–petitive level, although the growth of multinational companies has blurred the national boundaries of even this activity. The national funds remaining available for basic and pre–competitive research are such that selectivity is essential if a uniform spread of misery is to be avoided. International coordination and cooperation can then avoid gaps and overlaps and can allow the shared use of costly facilities. Environmental research often requires costly equipment whether at the molecular level, for example nuclear magnetic resonance spectroscopy, or at the global level, for example remote sensing satellites. Cooperation is required also in training the required number of people to enter environmental research in government and industry.

The scale of the problems in the new Europe

Central and eastern Europe is characterized by a legacy of chemical pollution resulting from

inefficient industrial processes and careless waste disposal. The problems range from the deposition of acids, heavy metals and radio-nuclides, to the loss of soil fertility through agricultural exploitation. Fortunately, the same area has inherited a valuable but hitherto stifled intellectual resource and this can be rapidly mobilised by interaction with the West. The scale of the new Europe seems appropriate and convenient both economically and geographically for a coordinated research effort in the environmental sciences.

The scales of problems arising from chemical pollution can be global, for example carbon dioxide increase, continental e.g. ozone depletion, transferable e.g. oxides of sulphur and nitrogen, shared e.g. waste in oceans, national but common e.g. eutrophication, national but unusual e.g. from tin and lead mines. The scale also varies in time and the recent concern with the delayed release of toxic chemicals from soils, or "chemical time bombs" brings a new perception of the potential severity of the problems.

Evolutionary development of science

The development of basic environmental research to exploit new scientific opportunties can be seen as an essentially evolutionary process, based on diversity, selection pressure and survival of the fittest. The first need is to encourage sufficient diversity including the development of entirely new ideas that question the received wisdom. This calls for an economic base strong enough for some funds to remain available to support research on new ideas, and the European economy may be large enough for this. A

second and more difficult requirement is for the peer review system to be ready to accept imaginative new ideas. Sadly, one of the consequences of recession has been that the British Petroleum has disbanded its Venture Research Unit which had precisely this objective. One of its methods was to try to find out about research grant applications that had been rejected by the ordinary peer review system in the expectation that some of them would contain new ideas so bright as to be unacceptable.

The next requirement for evolutionary development is a selection pressure. The new concern for developing the methodology of research assessment is seen by many scientists as a threat, yet it must be a much more acceptable procedure than the creation of committees to distribute funds on the basis of political and economic need. Assessment criteria can be seen to fall into two categories. The internal criteria treat the intrinsic scientific quality of the research and include timeliness, pervasiveness and excellence or originality. External criteria address the question of the usefulness of the research results and include applicability, exploitability and relevance to training. Fortunately, the methodology of assessment has advanced rapidly and good methods are now available for bibliometric analysis and for computer assisted peer review. An international research agency must accept assessment as one of the costs of research and be prepared to use it with rigour and implement the results.

Having used assessment to identify the fittest research leaders, the task remains of ensuring their survival. This can come partly through continuing or

increased funding, partly through recognition, and perhaps most importantly through providing them with continuing freedom to pursue their research, for example by sparing them the task of sitting on committees.

But they cannot be spared the task of participating in peer review of their colleagues. They are precisely the people required to form a body of internationally respected scientists who can review interdisciplinary research proposals and who may be ready to take risks in funding new ideas. The same group of people can also be drawn upon to form working parties that provide sound scientific assessments of topically important environmental problems, making critical judgements of the scientific evidence rather than giving priority to political, social or economic expediency. They can also provide the members of teams to assess major European institutions for research and training, where a team of national experts might be seen to have too narrow a view and too strong a vested interest. The EERO as a European organisation elects its membership precisely on the basis of individual scientific excellence and intends to harness it for all these purposes.

MULTIDISCIPLINARY RESEARCH AND TRAINING

Multi disciplinary teams

Environmental research typically requires the formation of teams from several disciplines to exploit a particular scientific opportunity. For example, research on the interaction of vegetation and the environment in the context of global carbon dioxide change requires cooperation between experimental phy-

cisists, plant physiologists and applied mathematicians; research on the degradation of pollutants in soil or water requires chemists, enzymologists and microbiologists; the development of new industrial processes and products requires cooperation between microbiologists and process engineers, and the modification of microorganisms, plants and animals to cope with new environmental problems requires cooperation between molecular biologists, biochemists and physiologists. Such teams are not normally found in one laboratory and a cost effective method used by the EERO to bring them together is the award of international fellowships. These can be for a short term of up to three months to enable scientists of any level to develop a cooperation or exploit new techniques, or they can be held for a year or more to enable post doctoral scientists to complete major pieces of interdisciplinary research in a foreign laboratory with the prospect that they may seed a new research group when they return to their own country. Workshops and symposia enable scientists from different disciplines to take stock of the latest advances in their area of environmental research and to avoid gaps and overlaps.

Flexible research structures

The rapid pace of change of research requires a flexibility often lacking in large laboratories with tenured staff. Part of the solution can lie in increasing the proportion of posts held on a temporary basis, but at a time of static for research this can be achieved only with difficulty. More immediately, flexibility can be created through the development of research networks. Such a network might typically consist of up to ten laboratories from dif-

ferent disciplines and different countries that can together address a particular interdisciplinary opportunity in environmental research. The laboratories are best identified on the basis of the current scientific strength of the research leaders concerned rather than on the basis of the longer term status of the institution as a whole. A network should last only for as long as regular peer review assessment judges that there is a continuing strong scientific opportunity. A network should provide synergism, but for the output of the whole to exceed that of its component parts requires recognition that the cost is not negligible. A coordinator must be identified from amongst the research leaders and he must be provided with funds to relieve him of administrative loads. Funding is also required for travel between laboratories and for seminars and workshops. The creation of a network may also justify the purchase of expensive equipment not otherwise reconcilable with the budgets of individual laboratories.

A natural outcome of the creation of a network may be the emergence of a lead laboratory, which with additional funding for new building could become the host laboratory for interdisciplinary teams. Given the appropriate funding, the EERO plans to develop a small number of such multidisciplinary laboratories, based on existing sites, but detailed plans have yet to be worked out. In principle, such a laboratory is likely to have a small nucleus of tenured staff and of relatively costly equipment maintained by expert technicians, and it would host temporary teams of visiting workers, including the holders of fellowships.

Training

None of these ambitions can be realised without proper training both of scientists and of managers in science and in the industries that will make use of the results. Some training is provided through fellowships and workshops, but a strong demand exists also for formal training courses and the EERO has now created a Training Centre for this purpose in Wageningen. Initially it will run about ten international training courses per year, each lasting for a few days, and some of these are already becoming heavily oversubscribed. The addition of Central and Eastern European countries is likely greatly to increase the load.

FUNDING, PARTICIPATION AND TECHNOLOGY TRANSFER

Governments

An international research organisation needs to be supported by the governments of the countries concerned. This commitment is likely not only to ensure that scientists in those countries participate in the research programmes but also that the results of the research are used by governments in setting environmental policies. The EERO is creating a Standing Conference of science ministers and senior officials who will meet annualy to decide on the level of government funding for the organisation and to regulate its use at its strategic level. Governments from Central and Eastern Europe have expressed a wish to participate, but this wish is complicated by the current surge of nationalism and by the economic weakness. The EERO is only one of several European research organisations in the various areas of

science and in the longer term a case can be made for creating a single intergovernmental European Science Conference that oversees the government funding and strategy of all of them.

Companies, foundations and institutions

Without technology transfer the results of research fall on stony ground. Companies will be eager to participate in a research organisation and use its results if they have contributed to its funding. The EERO has been fortunate in getting initial funding from a consortium of companies, foundations and institutions in The Netherlands, including the Agricultural University, as well as from the Volkswagen Foundation in Germany, in addition to contributions from Governments. It thus has a measure of involvement with the real world, combined with an independence to pursue scientific excellence. To secure this position for the longer term, a Capital Fund is being created by seeking relatively large, once and for all, donations from major companies who would thereby become permanently linked with the organisation. Only the income from the fund would be used for annual current expenditure. Without such a fund, it will be hard to embark on major new activities such as the creation of networks, assessment and advisory groups, and interdisciplinary laboratories.

One of the benefits that the EERO has enjoyed from the outset is its location in the Ship of Blaauw in Wageningen on the campus of the Agricultural University and it is most grateful for all that this offers both physically and intellectually.

CONCLUSION

The development of agriculture has long been a fundamental need for the wellbeing of mankind and the Wageningen Agricultural University can be proud of its leading contribution to this endeavour. But only second in importance is the protection and conservation of the environment and that is a concern that has developed relatively recently. The invitation for the central office of the EERO to be located on the Wageningen Campus is one of many initiatives that the University is now taking to develop the environmental sciences alongside agriculture, recognising their strong interdependence. We look forward to a fruitful and growing cooperation.