

Forestry research in the future

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Dames en Heren,

Neemt u mij mijn onwetendheid van de Hollandse taal niet kwalijk, maar ik zou willen beginnen met te zeggen dat ik het als een grote eer beschouw om u bij deze viering toe te mogen spreken.

Ik ben ervan overtuigd dat ik namens alle houtvesters en bosbouwonderzoekers over de gehele wereld spreek, wanneer ik u hartelijke groeten en felicitaties aanbied bij het jubileum van uw beroemd Research Station. U kunt trots zijn op uw vele prestaties op bosbouwgebied gedurende de laatste vijftientig jaar - moge uw succes in de toekomst bestendigd blijven!

It is a great pleasure to be with so many friends and distinguished colleagues at the jubilee of your famous Research Station. I am also aware of the great challenge in being invited to speak to such an expert audience on the future of forestry research, - particularly as some of the main developments in Europe will be in social forestry and land use planning, - fields in which your country leads the world.

What qualifications have I to speak on this subject here in Holland?

One may be the similarities between our two countries so far as forestry and forestry research is concerned. We both have less than 8 per cent of our land area under forest, - and a very small area of forest per head of population, i.e. less than .03 hectares per head which is one-tenth of the European average.

A second feature which might be regarded as a qualification is that we both established our main Forest Research Stations almost exactly 25 years ago; - and there have always been very close links between our Station at Alice Holt and De Dorschkamp. In fact, our research contacts began some 40 years ago in the mid-1930s with the close friendship between your late first director, Dr Van Vloten and our late Tom Peace when they were both working on *Armillaria mellea* and they were beginning to become actively interested in poplar diseases. We have had a close association with your Station ever since, and I want now to pay tribute to the high quality and relevance of the work you do. It is outstanding amongst the forest research stations of the world and I believe that one of the reasons for this is that the Station has never lost the "personal touch" and atmosphere of informality which are

so vital to a creative climate in a research organisation. Also, there are important lessons for us in the way your programme had been adjusted to meet the changing needs of forestry in Holland. We are looking forward to seeing more of this at close quarters in the next few days.

My aim today is to consider where our research is going in the future and in particular to indicate what I think are the most important problems requiring research over the next 10 years or so. Before I can do this I have to look at the changing purpose of forestry itself throughout the world, and particularly in Europe.

Forecasting is now more difficult than ever because of the rapid and accelerating rate of change in the technology of wood and competing materials, in social attitudes to forestry and the environment, and in the financial climate in various regions of the world. We have all seen the huge changes affecting forestry in western Europe in the last 20 years; - a period in which it can truthfully be said that objectives change more rapidly than the trees mature; - a factor sometimes forgotten in public criticism of forestry practices.

Changes have been very great in the more affluent countries of the world, including western Europe, and the revolution in public attitudes to the environment has focussed popular attention on forests as never before. Also in these countries people have become increasingly frightened by the speed and apparent ruthlessness of technological development, with the result that words like "conservation", "environment", "ecology", and "pollution" have become charged with emotion in the popular media. In Europe the evolution of thinking about the role of the forest has followed a pattern; - first, - that its main function is to supply industry and people with wood; - later came awareness of the importance of forests to the environment, notably in soil and wildlife conservation; and most recently realisation of the popular recreational values associated with forests. The emphasis likely to be given to each of these roles will vary greatly between countries and regions. However, all these countries need wood.

Since the middle of this century world consumption of industrial wood has increased at an unprecedented rate, and virtually all published forecasts indicate major increases in future demand linked to increased population and higher living standards. This applies particularly to the industrially developed countries which will account for

some 70 per cent of the world increase in demand over the next 10 years. The most recent figures published by FAO (Provisional indicative world plan for agricultural development 1970), forecasts a world consumption of industrial wood rising to 1,500 million m³ WRME by 1975, and again to 2,000 million m³ by 1985; a figure double that of actual consumption for 1962. Most of this increased demand for wood will be for reconstituted wood rather than for wood used in solid form; - that is the demand will be for pulp, paper, and wood-based panel products. It could be that the importance of substitution by plastics and other materials is under-estimated in these forecasts but I think not. When considering the prospects for plastic substitution for paper and board products it is as well to remember that plastics will need to drop by one-third to one-half their present price level if they are to replace wood products on a large scale; - and in any case they are derived from oil and coal which are themselves limited resources. The view propounded by Dawkins in 1969 to the effect that wood will be replaced by plastics synthesised from earth minerals depends on an assumption that there will be abundant cheap energy from nuclear sources which is a somewhat doubtful prospect in the foreseeable future. Furthermore, as fossil fuel reserves dwindle then living plant conversion of solar energy could become the main source for efficient carbon fixation for numerous purposes including manufacture of plastics and liquid fuels. However, I am becoming rather speculative, my main purpose is to stress the rapidly increasing future demand for wood for industrial purposes.

The world's forests amount to something over 4,000 million hectares (or nearly one-third of the world's land area), of which only about 1,500 million ha. are in use for wood production. Most estimates show that the anticipated demand represents only a small part of the productive potential of these forests. So that the crucial question is how much of this potential is available at acceptable cost and in a way that is acceptable in environmental terms? Major increases in production in the short run are possible in three ways. - Firstly, by extending forestry operations into existing unused forest areas (notably in Siberia, Northern Canada, and tropical regions of Africa and America). Secondly, by increasing the productivity of areas now in use, and thirdly by making more effective (that is less wasteful) use of wood now harvested. In the longer run a substantial addition to supply is possible by creating new plantations, particularly in sub-tropical regions, some of which have good growing conditions for softwood species.

Europe as a whole is a timber deficient region with a deficit which will have to be imported from non-European sources estimated at 66 million cubic metres of industrial wood for 1980 (- or 15 per cent of annual consumption). The pattern in individual countries of course varies enormously from the major timber exporting countries of Scandinavia to the EEG countries which together import some 40 per cent of their timber needs with the prospect that in the enlarged community more than half their wood

will have to be imported from abroad.

The case for expanding wood production in any individual country has to be seen in the context of the economics of wood supply as set by international trade. Labour costs are high and rising, and in general there seems little doubt that sustained efforts to increase productivity from existing forests continue to be justified so long as there is no serious collision with the environmental values of forests. In Europe, long term investment to increase wood production by new planting may now be hard to justify on purely economic grounds as the opportunity cost of capital is so much higher than the expected rate of return. In practice of course investment in new planting will be determined by political judgement on the combined benefits of employment and recreation, and prudence in making a contribution to future home grown supplies for expanding wood-using industries, (and considerations such as those that went into the Mansholt plan for EEC countries for redeployment of unwanted agricultural land.)

Some European countries will have to continue importing wood on a large scale, and in the medium term this will come mainly as softwoods from the forests fringing the Arctic, that is from Russia, North America and Scandinavia), together with tropical hardwoods (from Africa and South America). In the longer term, it is almost certain that these sources will be supplemented by softwood supplies arising from afforestation programmes in sub-tropical countries, in Latin America, Africa and Asia. In brief, the supply potential exists in the world's forests to meet anticipated demands, - a major part of which will be met through international trade. It is also certain that wood exporting nations will wish to develop their own industries and export processed products rather than raw material. This will add substantially to the import bills of some countries.

At the same time, there are changes taking place in the role of forests which have very little to do with wood production.

The environmental significance of forests on a world scale has become widely recognised for protection and regulation of the environment on which man depends - providing shelter, absorbing heat and wind, regulating water supply, taking up CO₂ and releasing oxygen, preventing erosion. There is now concern with conservation of some of the vast areas of indigenous forests, particularly tropical rain forests and preventing their destruction, notably through agricultural clearances.

There is also widespread recognition of the value of forests to society for landscape, for wildlife protection and for recreational activities of all kinds. These values rise with population, and income levels, and with increasing personal mobility and leisure. The supreme example of awareness of these values is perhaps to be seen here in Holland.

I think I am right that in Holland management giving first priority to social benefits of forests goes back to 1957, so that you are pioneers and showing the way that

many of us will follow.

These changes of emphasis in forest management aims have been sudden and dramatic and can cause conflicts to arise. Forests designed and managed for one purpose, e.g. timber production, may not be well suited to another use, for example recreation. Intensive forestry is similar to agriculture as an example of human exploitation of an ecosystem and both involve decreasing the natural diversity of species if the sole aim is maximum efficiency and economy in production of a particular product, whether it be wheat or wood.

Putting the conflict in its starkest terms, efficient wood production requires simplicity and uniformity while the needs of amenity and recreation are best met by diversity of conditions. Today, there is mounting pressure from conservationists against forest operations of many kinds, but especially those concerned with mechanised harvesting. The constraints now appearing on felling, including countries like Sweden, Finland and Canada, countries heavily dependent on their forest industries, are only equalled by the pressures against changing the environment by planting in some countries such as Britain. One of the main problems before us today as research foresters is to help reconcile these conflicts and demands on the forest so that policies can be worked out that provide the best advantage to society as a whole.

At one extreme, it may be necessary to subordinate wood production almost completely to the environmental roles of the forest. However, I believe that in the great majority of circumstances wood production and the social benefits can be combined. The essential point is that a rational evaluation has to be presented to the decision-makers on what is technically possible, what is likely to be socially acceptable, and what is economically sound.

I think there is much we can learn from Holland on how to harmonise the social, conservation, and wood production benefits. In particular, the evident close co-operation of several departments of State working through the Forest Service on all aspects of the management of forest land.

In some ways, I wish I were speaking two weeks from now after Professor Ivar Samset, as President of IUFRO has delivered his address to the World Forestry Congress in Buenos Aires on the future of forestry research. Our purpose is the same.

My starting point is that future research must be closely related to problems of forest management, - which is easier said than done because to remain relevant research must not only respond to changes but actually anticipate them. We are now faced with quite fundamental changes in human attitudes and values, - particularly attitudes to the environment, the quality of life. The pressures arising from these changes are most marked in the affluent countries and exert an increasing influence on industry, on land use, on technology and on the use of research resources. In these countries the public are not going to tolerate technical innovation without regard to its

social and ecological results. This will demand more resources being given over to study the consequences and side effects of new projects. Research can no longer be concerned almost exclusively with the needs of timber management, but must also turn to ecology and social problems.

I propose to speak on what I believe to be the most important fields in which research needs to be developed in the next 10 to 20 years with particular reference to European countries.

Firstly, the rising demand for wood, the rising cost of labour, and the high opportunity cost of money will add urgency to research aimed at improving productivity both in terms of wood output and in terms of cost efficiency.

Secondly, there will be a broadening of the research approach to take account more fully of possible environmental effects of existing and new technology.

Thirdly, research must take account of the increasing values associated with visual amenity, wildlife conservation, and recreation.

Fourthly, the mounting pressure of demand on available land will require more research to work out methods of assessing the optimum forms of land use through better means of expressing the economic, social and amenity benefits of forests and other land uses.

In the timber management field, an important point to keep in mind is that most of the timber required up to the year 2000 will come from existing forests, - which highlights the importance of research and development work aimed at improving growth and production in the forests we already possess. In many situations throughout the world, actual growth and production of wood is well below the potential within the prevailing climate and there is huge scope for improving yields by better management and more intensive methods of silviculture at various stages in the life of a crop. An important challenge to research lies in the development of better methods of forecasting site capability and the probable response to site upgrading treatments. Ad hoc experimentation can provide answers to some of these questions, but there is an increasing need for more fundamental research aimed at better understanding of the environmental factors particularly soil and climate determining growth. Such work will assist in more reliable assessment of site potentiality; - a development of immense value in land use planning, investment appraisal and choice of the best system of management.

In plantation forestry intensive silvicultural measures are now possible to increase production of wood per hectare but there are obviously economic and biological limits to take into account and careful research is necessary to determine what these limits are. We are dismally ignorant of the physiology and mechanism of growth in trees and there are important practical gains to be achieved by expanding physiological research especially if it is directed to means of selecting trees and designing stand structures in order to make the most efficient use of solar energy. There is also an urgent need to know more about

the physiological basis for differences in vigour, form and adaptability to site conditions between individual trees. The modern trend in plantation forestry towards increasing growth rate through selection and site treatment has profound effects on wood properties and research is necessary on the significance of these changes in terms of the value of the final product. At present, in most regions of the world the roundwood product specification remains fairly unsophisticated, mainly because of uncertainty about the wood properties that industry will require in 25 to 50 years time. The result tends to be an assumption that we should be aiming for "general purpose" timber, i.e. wood properties that are uniform and versatile in relation to end use, and a form of tree that minimises handling costs and wastes on conversion; - a specification that in general points to whitewoods as a group, with a special premium on straightness and minimum taper.

Tree improvement by selection and breeding offers important gains in the future. If only we could break through the "time barrier" presented by the slow process of selection, propagation, and progeny testing involved in most conventional tree improvement programmes. Research into the physiology of flowering and seed production will help accelerate the process as will development of rapid methods of testing progenies for vigour and growth habit under controlled environmental conditions. One possible way of breaking through this time barrier might be to propagate vegetatively as has been done for years for poplars and willows and more recently for *Pinus radiata*. Development of mass production methods possibly involving meristem culture hold important possibilities for the future. More speculative are the prospects for major and rapid advances in disease prevention through hybridisation and resistance breeding. However, the evidence is clear of heritable resistance to many pests, - some of it exemplified by the work here in Holland on elm and poplar, - and efforts must certainly continue to seek out more resistant individual trees in epidemic areas.

Turning to problems of pest control, it has been realised that continued damage to our habitat through use of certain pesticides is intolerable. Some 15 years ago research into insects in some parts of the world fell into decline as DDT and other organochlorines seem to provide almost a complete answer to so many problems. There is no need to repeat here what we now know about that subject, but certainly the sudden and widespread realisation of possible dangers has led to what amounts to a crash international programme of search for new philosophies and methods of pest control. It has also stimulated a search for more fundamental information on insect biology. Countries with organisations and scientists experienced in these fields are now reaping the reward of their long sight. I am particularly interested but not surprised to hear of the pioneering work now in progress at Wageningen under Professor De Wilde's experienced direction and the practical use of insect hormones as pest control materials, and also into the application of sterile

male techniques. Similarly, there is a large new market for knowledge of the epidemiology of pests and diseases, and Professor Klomp's work at your new Institute of Nature Management must count among the few studies of this kind in the world and can form a basis for more enlightened thinking on pest control problems. Pointers to the future also include the use of microbiological agents, notably insect viruses, such as those presently in use on a limited scale for control of Pine sawfly. This approach holds out the possibility of highly specific control of individual pests and this is now the subject of active international co-operation through the agency of EPPO and IUFRO in order to develop safety procedures and methods for large scale production.

I want to turn now to another aspect of productivity. In many situations, it is often true that improved returns are obtainable more effectively by developing means to lower costs, and particularly labour input, rather than by raising wood yield. Forestry operations are still highly labour intensive and manpower costs continue to rise, so research into new methods and systems of increasing manpower productivity becomes essential if unit costs and the competitive position of wood versus other materials is to be held.

In the last 10 years in Europe, labour costs have risen by 10-15 per cent per annum and this commands study of all labour intensive operations, notably in silviculture, timber harvesting and timber transport.

Technical developments, particularly the advent of light-weight motors, high pressure hydraulics, pneumatics, radio control and other devices applied to harvesting have already revolutionised work. Present developments in mechanisation are mainly concerned with replacing muscle-power by machines, - the machines being manually controlled. Future developments will certainly enable replacement of manual control by an increasing number of mechanical and electronic control devices.

Economics dictate that research be intensified in this field aimed at three ends, - to rationalise, to simplify, and if possible to mechanise work. In the future, systems of work are likely to change to enable tasks to be completed with reduced labour input; current examples being semi-automated production of containerised plants, modified plant spacing and thinning regimes, mechanised weed control and so on. In timber harvesting, semi-mechanised work is now practised and is likely in some areas to give way to full mechanisation. This picture of mechanised "push bottom" forestry is correct only if technological changes evolve solely on the basis of operational efficiency and economics. Obviously in practice there are major constraints on this process.

Firstly, silvicultural and land management constraints to avoid mechanical damage to the soil capital, and secondly to the need to preserve and enhance amenity and recreation values, which require diversity and complexity rather than uniformity. We are back again to the conflict between maximum productivity versus environmental considerations and in practice compromises have to be

reached on the objectives and systems of management appropriate and acceptable in each region.

In some regions it is significant that for the first time serious suggestions are being made that in the future labour intensive skilled manual work has special value in provision of employment as a social benefit, - and should not be mechanised. The extent to which this idea constrains productivity development remains to be seen.

To make efficient use of management and supervisory staff is equally if not more important than advancing productivity of forest workers. Thus, research into new planning and operational procedures to help management decisions and above all to provide means of freeing managers of trivial detail to allow them to manage in a positive way is vital. This embraces work in cybernetics, operation research and can only be done in the closest liaison with management itself.

So far in discussing productivity I have said nothing about timber products research. There are many important possibilities here, not least being to make fuller use of the world's forest resources through better utilisation of the wood that is harvested. At present many species and log sizes are left in the forest or not fully utilised. Similarly at the sawmill, bark is discarded and the actual sawing process yields only 50 to 60 per cent of the round log, the residues often being left to waste. In some pulping processes, waste liquor containing a high proportion of lignin is wasted and can give rise to pollution problems. Research into systems designed to reduce the present massive waste and make more efficient use of the wood harvested is of immediate importance and will include sawmilling technology, integration of sawing, chipping and pulping processes, and improved methods of recycling waste fibre material.

A special aspect of this is the possible development of new products based on waste material, for example the prospect of chemical utilisation of lignin which comprises some 40 per cent of the wood substance; - and the chemical engineering possibilities of wood including manufacture of sugars and hydrocarbon fuels. Less speculative is the research needed to enable timber to compete more effectively in its more traditional markets, notably for constructional purposes. Here the greatest single obstacle to more efficient use of solid timber has been its variability. Research, especially in the further development of mechanical stress grading is likely to enable precise rating of the strength characteristics of wood and will ensure that it can be prepared economically in order to meet determined performance standards as now needed for building and other construction purposes. Similarly, development of improved designs, finishes and combinations of wood with other materials must go on and it is increasingly important that work in these fields be done with materials scientists from other industries to ensure that wood is combined with other materials, notably plastics, steel, aluminium and pre-stressed concrete in order to provide the best of all worlds in terms of rigidity, strength and durability at the most

reasonable costs.

I have said as much as time will allow about research trends in timber management and I must consider research relating to the environmental values including recreation, landscaping and conservation of soil and wildlife. As we all know, these aspects of forest management have increased greatly in importance in the last 10 years, although the benefits that are identified often cannot be measured or valued in money terms. We need more data on values. Without such attempts to measure and quantify, management priorities and decisions are very liable to prejudice. High among the social benefits are the special values of forests in providing an environment well suited to human recreation. Research in this area can be most complex and becomes involved in the basic interaction between human being and their environment, including landscape analysis and the establishment of criteria of what constitutes good and bad scenic or environmental features. It is highly subjective and in some respects it is more of an art form than a science, and for this reason demands value judgements from investigators with a wide range of skills and background including sociologists, planners, economists, landscape architects and others as well as foresters. Research into human preferences and the behavioural pattern of visitors is necessary and coupled with the need to identify and describe the potential for recreation offered by various types of forest, including those managed primarily for timber production. The potentialities are often diverse; - forests providing unique opportunities for specialised leisure activities notably countryside-type pastimes including riding, shooting and fishing. Research can enhance these benefits by, for example, providing improved methods of wildlife management. Conflicts do of course between various recreation uses, and research into management systems that might resolve or minimise these conflicts are necessary. Also, where visitor numbers are high there may be problems in avoiding habitat degradation. The future in this field is difficult to predict merely by extending past trends of recreation use. We really need to know why people want what they do on visiting the countryside and this needs intensive research if forest managers are to plan ahead to meet recreation needs rather than lag behind public demand.

The visual values of trees in the landscape are well recognised yet landscape architecture is still in its infancy. As a subject it combines art, science and technology and in the past has suffered from a lack of biological know-how. There are now many regions in which trees are of much greater value than the timber they contain, a situation well illustrated in many parts of your country and also by our recent experiences in Britain of the attitude of the public to the threatened loss of elm trees in the countryside as a result of Dutch elm disease.

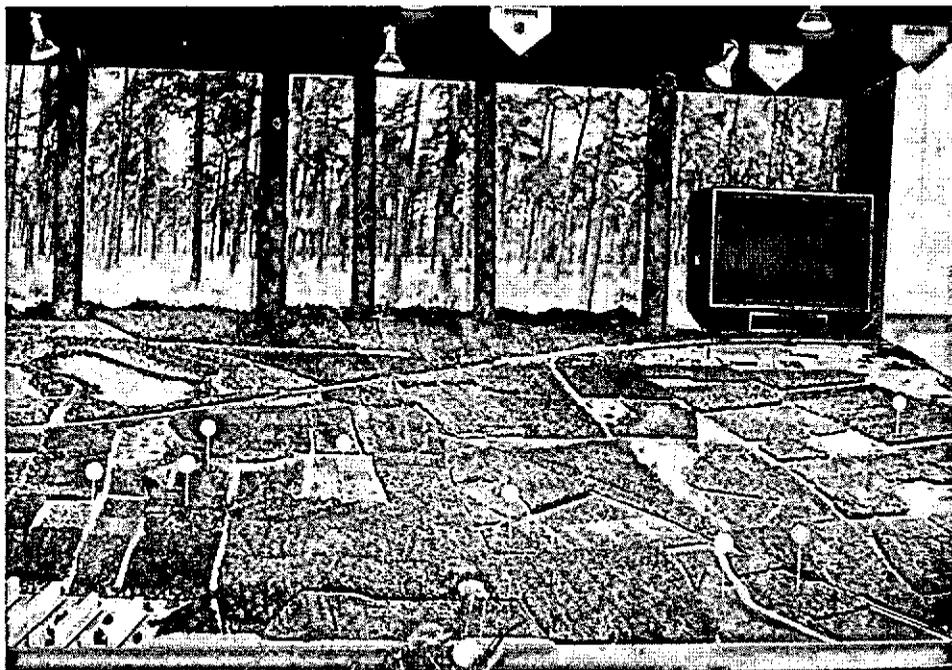
The whole subject of trees in the landscape is enormous, - trees as screens to hide unsightly buildings and derelict land, trees to beautify motorways and

parkland; trees for street planting etc. These immensely important roles of trees in predominantly urban surroundings are often far removed from the forest situation and underline the wide scope for research in arboriculture, including special breeding programmes, and development of improved methods for individual tree culture and protection. I shall confine my comments to landscaping aspects of forest and forestry operations. The first need is for silviculturists and landscape architects to draw up quality criteria for the guidance of forest managers. One of the most sensitive problems in landscaping forest areas relates to the condition of edges and margins created by planting and felling operations. Here research is necessary in order to examine means of making these more pleasing to the eye. There is a renewed interest in the planting and management of deciduous broadleaved species and choice of silvicultural system for their establishment and management, including "free growth" systems, which might provide a means of limiting costs whilst still achieving a large part of the timber and landscape values of broadleaved species.

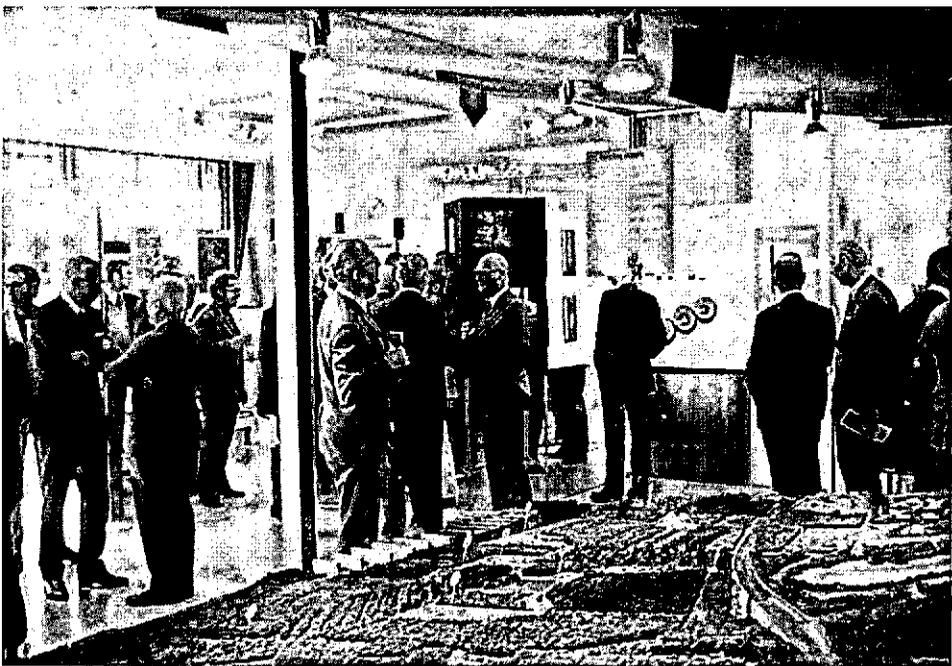
I tremble to mention research into conservation in the forestry context as I am running into the usual problems of definition. I think it was the late President Taft who said that although conservation is difficult to define you can be quite sure of one thing and that is that everyone is in favour of it! The problem is one of identifying priority objectives. Project No. 2 of UNESCO's Programme on Man in the Biosphere recognises some of the environmental problems requiring study on an international scale. The topics highlighted there identify some of the major long term problems for the future. For example, the effects of forest management practices on wildlife, the effects of forests and particularly of monocultures on the soil and on the water balance and the effects on recreation use on site and wildlife. Most of these questions concern relationships which are so complex that they are incapable of "solution" in the ordinary sense. Nevertheless, research should lead to an improvement in the scientific basis for some of our forest management decisions. Each of us has the problem of deciding how much resource and how much research effort to commit to such work. We certainly need to know a good deal more of the implications for wildlife both fauna and flora of alternative systems of forest management, - and this must provide for careful study of the side effects of

particular techniques including pesticides and fertilisers for forest use. Research on pesticides problems is particularly difficult and demanding of the research workers concerned partly because the issues are often emotively charged in the public mind and partly because of the impossibility of proving a negative when trying to assess a wide spectrum of possible side effects. Constant alertness is necessary to foresee threats to our environment. It is perhaps in this function of early warning of environmental hazards that research personnel with their scientific awareness have a special responsibility in the future.

The manner in which forestry research is organised within a country and the institutional framework controlling and directing its financing have profound effects on the aims and approach to research. There can be much discussion on which particular systems and institutions provide the best blend of skills and attitudes and which are the most effective in solving practical problems. This in itself deserves study, and I would not venture an opinion now. However it is quite clear that our research problems are becoming more complex and demanding. Progress in solving our problems depends more and more on deployment of a wide variety of scientific and technical skills to attack particular problems. Much hinges on encouragement and good facilities for communication between scientists and technologists and this applies to the international scene as well as what happens within one country. IUFRO, which celebrates its 80th anniversary this year, is still the most effective international agency for contact between scientists in forestry. It has the great advantage that it is exclusively scientific and technological, and following its major reorganisation in 1971 it provides for a greatly enlarged membership from some 70 countries. I am sure that IUFRO will continue as an excellent forum in future, providing it maintains its atmosphere of informality which is so stimulating and productive of new ideas. Nevertheless, I believe the time has come when countries should get together in regional groups to discuss more positive planning and integration of their research programmes. This could have immense advantages in concentration of skills and I wonder whether progress can be made in this direction within the next decade?



Overzicht van de centrale maquette met rechts de diaprojector.



De tentoonstelling had veel belangstelling van de gasten op de officiële dag.