REDE'S

uitgesproken door

PROF. DR. A. QUERIDO

en

PROF. DR. B. REXED

op 18 september 1967 ter gelegenheid van de opening van het Academisch Jaar van de Medische Faculteit Rotterdam en de Nederlandse Economische Hogeschool

Zeer gewaardeerde toehoorders,

De werkzaamheden van een academische instelling zijn bij uitstek gericht op de toekomst. Jonge mensen wordt de gelegenheid gegeven zich voor te bereiden op hun toekomstige taak, die meestal gekenmerkt zal zijn door het werken op basis van een zelfstandig oordeel en een eigen verantwoordelijkheid en daarnaast is er het wetenschappelijk onderzoek dat nieuwe ontwikkelingen voorbereidt. De rector - en voor de Medische Faculteit Rotterdam is mij voorlopig deze functie toegedacht - moet op deze dag verslag uitbrengen over het afgelopen jaar. Dit stelt hem tevens in de gelegenheid zijn berichten te toetsen aan de vraag in hoeverre zij hebben bijgedragen tot het bereiken van de wezenlijke doelstellingen van de instelling. Zoals ik reeds naar voren bracht zijn deze doelstellingen vooral op de toekomst gericht. De meeste rectoren volgen bij hun toespraak dit recept. Zo schreef de historicus Huizinga - nu al meer dan 40 jaar geleden - in zijn rectorale rede: „Er bestaat bij ons te lande, ook in ontwikkelde kringen, gering begrip voor de betekenis der wetenschap en het wezen der Universiteit. Deze geldt voor de meesten als een onderwijsinrichting, dat zich enkel door wat meer uiterlijk aanzien en wat hoger tractementen boven de overige verheft. Men kan in de Tweede Kamer lang en breed over universiteitsbelangen horen spreken, alsof zij met wetenschap niets te maken hadden, enkel met onderwijs".
Men zal het met mij eens zijn, dat er sindsdien wel iets veranderd is maar ook dat de gedachte aan de Universiteit als 'centre of learning' nog steeds in brede kringen weinig aanzien geniet. Volgens Huizinga is de grond van dit euvel diep te zoeken, en reikt o.a. terug tot de wetgeving van 1815. Ik kan een ieder die belang stelt in de universiteit het lezen van zijn rede aanbevelen !
De belangrijkste gebeurtenis van het afgelopen cursusjaar is vanzelfsprekend dat de „Commissie voorbereiding van de medische faculteit Rotterdam" onder voorzitterschap van mr. Van Walsum, erin is geslaagd inderdaad, na slechts één jaar voorbereiding, aan 160 studenten in de geneeskunde vernieuwd onderwijs te verschaffen. Dit is gelukt dank zij een grote inspanning van velen, in de eerste plaats van **iedereen** die betrokken is bij het werk van de Medische Faculteit Rotterdam, maar zeker ook door hulp van zusterfaculteiten en niet in het minst door

steun van de Technische Hogeschool te Delft. De resultaten bereikt met dit onderwijs waren zeer gunstig. Het is voor 134 studenten dus bijna 85% mogelijk het volgende studiejaar te volgen. De uitkomst van het experiment met ons eerste studiejaar maakt het in Nederland nog onopgeloste vraagstuk: wèl of niet de numerus fixus voor medische faculteiten opnieuw actueel.
Tot dit positieve resultaat, dat bereikt werd met 160 ongeselecteerde studenten, hebben ongetwijfeld vele factoren bijgedragen. De technische uitrusting en ruimte waren berekend voor het aantal studenten, de docenten hebben met enthousiasme hun nieuwe curriculum willen waar maken, en de studenten hebben hard gewerkt. Het is mijns inziens ook overduidelijk dat deze drie factoren onderling afhankelijk zijn, en dat zij terug te voeren zijn tot het nauwkeurig vooraf vastgestelde aantal studenten, tot de numerus fixus - en voor buitenlandse begrippen moet het aantal 160 nog **hoog** worden genoemd. Want stel nu eens dat men het aantal studenten ongelimiteerd had gelaten. In dat geval waren er onvoldoende (kostbare) onderwijsmiddelen en ruimtelijke voorzieningen per student beschikbaar geweest, het zou de docenten aan enthousiasme en het plezier ontbroken hebben zich in te zetten voor het onderwijs, wat ongetwijfeld er weer toe geleid zou hebben dat de studenten hunnerzijds zich minder inspanning hadden getroost. Het is vanzelfsprekend noodzakelijk veel onderzoek te verrichten over de **methodiek van onderwijs.** Maar centraal blijft de bereidheid van de docenten zich in te zetten, en dat zal alleen gebeuren wanneer hun taak overzichtelijk is.
De beantwoording van de vraag wèl of niet een numerus fixus, is duidelijk complex. Wanneer bij een vraagstuk vele factoren hun invloed doen gelden, kan de oplossing nooit zo zijn dat elk aspect volledig kan worden gehonoreerd. Men zoekt in dat geval naar de optimale oplossing. Zonder het aspect van selectie in het geding te brengen meen ik, dat de Rotterdamse ervaring tot nog toe duidelijk de volgende vraag naar voren brengt. Dient de voorkeur te worden gegeven aan een systeem met een beperkt aantal toegelatenen, maar met een duidelijk studieschema dat een hoog numeriek rendement doet verwachten, of moet de voorkeur uitgaan naar een onbeperkt aantal toegelatenen en dientengevolge onderwijs met onbekend rendement en studieduur ? Dit is een onderwerp, dat mij wel zeer ter harte gaat ... maar het mag mij nu niet te ver doen afdwalen.
Het opbouwen van een nieuwe medische faculteit in een grote actieve stad als Rotterdam, ondervinden wij allen als een boeiende bezigheid, die vaak **bijzonder moeilijk** is omdat een medische faculteit vele activiteiten ontplooit die verweven zijn met de Rotterdamse gemeenschap. Niets is moeilijker dan bestaande, in maatschappelijk verband gegroeide structuren, te beïnvloeden of om te buigen, indien dit noodzakelijk wordt geacht voor een gezonde academische ontwikkeling. Indien men zulke moeilijkheden ontmoet dringt zich - ten onrechte - de vraag op of 'Rotterdam' de medische faculteit wenst. Van de zijde van het Stadsbestuur wordt ons dienaangaande in woord en daad geen twijfel gelaten. Kan men echter verwachten dat een veel ruimere kring er net zo tegenover staat ? In

dit verband denkt men onwillekeurig aan wat verteld wordt over de stichting van de Leidse Universiteit. Leiden zou destijds voor de keuze zijn gesteld tussen: 10 jaar vrijdom van belasting of een Hogeschool. Het moet voor vele Rotterdammers geruststellend zijn te weten dat dit verhaal door een Nederlands historicus naar het rijk der fabelen werd verwezen. De keuze werd noch gesteld, noch gemaakt. Men mag niet verwachten dat werkelijk velen in een stad zonder Universiteit naar zo'n instelling zouden verlangen. Want hoe kunnen zij de verstrekkende betekenis daarvan voor de toekomst herkennen ? Daarvoor is, zoals ik reeds eerder stelde, het beeld dat men in Nederland van het wetenschappelijk onderwijs en onderzoek heeft, te onduidelijk.
Maar laat ons eerlijk zijn, ook de academische gemeenschap ziet het beeld, maar dan vooral wat de organisatievorm van faculteiten en de totale Universiteit betreft, in dit tijdperk niet helder. Daarin staan wij niet alleen, hiervan getuigen de vele buitenlandse studies die over dit onderwerp verschijnen. Een president van een Amerikaanse universiteit stelt dit vraagstuk in extreme vorm door het te vergelijken met dat van de voorwereldlijke brontosaurus. Dit kolossale dier zou uitgestorven zijn omdat het lichaam steeds in omvang toenam maar de hersenen daarbij achterbleven, d.w.z. het organisatie-centrum functioneerde onvoldoende ! Ook de Medische Faculteit Rotterdam werd reeds in het afgelopen jaar scherp geconfronteerd met de problematiek van zijn organisatie, zodat deze tijdig in studie kon worden genomen.
Van vele zijden in Nederland wordt een „betere organisatie en meer efficiëntie" van het hoger onderwijs verlangd. Wanneer woorden als organisatie en efficiëntie tezamen worden gebruikt denkt men klaarblijkelijk aan een bedrijf. Weliswaar heeft het woord bedrijf meer dan één betekenis maar in dit verband gaan de gedachten uit naar de uitoefening van een tak van de industrie waarvan de resultaten in kwantiteit of kwaliteit kunnen worden gemeten. Men is het er algemeen over eens dat een faculteit of universiteit zeker geen industrie is.
Hiermee is echter de discussie niet afgelopen want het begrip effectieve organisatie heeft een veel ruimere betekenis. Men wil bereiken dat de doelstelling van een organisatie zo goed mogelijk kan worden verwezenlijkt. Hieruit volgt dat, vóórdat over organisatie kan worden gesproken, de doelstellingen duidelijk moeten zijn geformuleerd. Ik kan mij nooit aan de indruk onttrekken, dat, ondanks de formulering in de Wet op het wetenschappelijk onderwijs, toch vaak onvoldoende gedifferentieerd over dit onderwerp wordt gesproken en gedacht. Daarom zijn wij zo blij, dat vandaag Professor Rexed voor u in het bijzonder zal spreken over deze doelstellingen.
Hoewel onderwijs en onderzoek nauw gekoppeld zijn beogen zij geheel verschillende doelen en verlangen dus verschillende accenten in hun organisatie. Maar het is bovendien duidelijk dat ook het onderwijs voor alle studenten niet hetzelfde nastreeft. Sinds de recente wetenschappelijke revolutie heeft de universiteit niet slechts tot taak het opleiden van theologen, docenten, doktoren,

juristen en bestuurders (en enkele beoefenaren der wetenschappen) maar de maatschappij vraagt nu ook naar een grote groep van academisch gevomden die actief zullen deelnemen aan het produktie-proces en aan het bepalen van het algemeen beleid. Voor deze groep is van belang dat zij aan de universiteit geoefend is in de wetenschappelijke denkwijze en deze kan toepassen op de problemen waarvoor zij later gesteld wordt. Het gaat hier om de grootste groep van de studenten die een universiteire studie zoeken. Men dreigt echter te vergeten dat daarnaast het wetenschappelijk onderwijs de taak heeft, liefst zo vroeg mogelijk, speciaal begaafden te herkennen en deze op te leiden tot wetenschappelijke onderzoekers ten behoeve van o.a. de industrie, maar óók ter vervulling van toekomstige universitaire posities. Dat herkennen en zo veel mogelijk ontwikkelen van creatief talent, is een andere doelstelling dan de eerste, één die vroeger voor de 'centres of learning' vanzelfsprekend was, maar die nu vaak door de massaficatie van het wetenschappelijk onderwijs in het gedrang is gekomen. De vormende functie van het hoger onderwijs alleen al heeft dus meer dan één doelstelling en de organisatie ervan zal noch efficient, noch effectief zijn, wanneer deze tweede taak, het ontdekken en ontwikkelen van talent, in verdrukking komt.

Voor de faculteiten en daarmee van de Universiteit zijn nu reeds drie taken genoemd, die uiteraard verweven zijn, maar toch specifieke voorzieningen vereisen: de snelle opleiding van een groot aantal academici die later 'in toegepaste vorm' hun taken zullen vervullen, het vormen van een wetenschappelijke 'elite', en het doen van wetenschappelijk onderzoek. Voor de medische faculteiten komt daar nog bij het ontwikkelen van de geneeskunde die verbonden is met de behandeling van patiënten. Een medische faculteit is dus een 'multipurpose organization', met alle vóór- en nadelen ervan.

Nauw gelieerd met het vraagstuk van de doelstellingen is, naar mijn mening, het volgende. Het Nederlandse woord 'besturen' heeft een onduidelijke inhoud. Ik heb mij laten vertellen dat in iedere organisatie duidelijk onderscheid moet worden gemaakt tussen beleid en uitvoering en dat men dient te vermijden dat deze taken worden vermengd. Van Dale's woordenboek omschrijft besturen als regelen, beheren, gezag uitoefenen. Voor organisaties die onder een centraal overheidsapparaat vallen, wordt besturen vooral regelen: handelen in overeenstemming met bestaande regels. Dit laatste is uiteraard te statisch en dus funest voor een academische instelling. Deze dient immers vóór te gaan, en bij de toepassing van de regels dient te worden uitgegaan van datgene wat steeds opnieuw nodig blijkt om de doelstellingen te verwezenlijken.

Mag ik u een eenvoudig voorbeeld van dit laatste geven: vernieuwing van dat deel der universitaire organisatie dat de bedrijfsvoering in engere zin van de Universiteit, de faculteiten en de wetenschappelijke werkplaatsen zoals laboratoria, bibliotheek, enz. verzorgt, kan alleen worden verbeterd wanneer een geheel ander personeelsbeleid dan voorheen kan worden gevolgd. Elk bedrijf ervaart dat het streven naar verbetering van zijn resultaten voert tot meer hoger en middelbaar personeel en minder lager personeel. Wil men bepaalde processen automatiseren, dan leidt dit bijv. ook in een laboratorium tot minder analysten, maar meer academici en medewerkers met middelbare opleiding. Vernieuwing in deze tijd betekent meer topfunctionarissen, gesteund door een kleinere groep hulpkrachten.

Het realiseren van de doelstellingen in een faculteit of Universiteit vereist **'beleid'**, dat uiteraard slechts gevoerd kan worden in intensieve samenspraak met de uitvoerende sector, maar dat tevens van het beleidsorgaan diepgaande kennis der algehele problematiek vergt. Helaas is er Nederland een tekort aan figuren die deze kennis bezitten. Ook hier manifesteert zich de 'managerial gap' waarover zo veel gediscussieerd wordt. We zullen daartoe bij deskundigen in binnen- en buitenland in de leer moeten gaan. Dit is dringend noodzakelijk willen wij in Nederland de Universiteit maken tot wat Perkins zo treffend noemde: de dynamo van de moderne maatschappij.

En bij deze verklaar ik het nieuwe academische jaar van de Medische Faculteit te Rotterdam geopend.

Prof. Dr. A. Querido

Honourable rectors of the Netherlands School of Economics and the Medical Faculty of Rotterdam, Ladies and Gentlemen:

I am very much honoured by the invitation you have extended to me to come here and speak to you on this occasion which I understand is a unique one, the first time when teachers and students of the two learned schools in Rotterdam meet together. It is with some trepidation I appear in this moment, but I feel that at least for me this will be an occasion to develop a new academic community. I must before I start tell you that some twenty years ago I visited this town and also Holland for the first time. I came here to see a very great man, professor Jan Boeke - he is now dead - he was the last of his generation of scholars in neuroanatomy, and I wanted to meet him before it would be too late. I stayed for one month in Utrecht and studied with him. He was at that time already emeritus and had suffered great hardships during the second world-war and also had severe personal losses in his family. I came to appreciate him as a very great scientist, as a fine and outstanding personality and as a very friendly man. He has come for me to be the symbol of the Dutch scholar, with his integrity and his intellectual sincerity. I remember also well what this place, the centre of Rotterdam, looked at that time. It was just when the scars of the war had healed into a green grassplain, and now I come back and witness this remarkable expansion in economics, culture and science, and it is possible for me to appear in this building in that very area. This is a deeply impressive situation and I think one that reflects on the great competence and effectiveness of the Dutch people who have been able to perform this change in such a short time. To begin with I remind you that the word 'university' comes from the medieval latin term 'universitas magistrorum et scholarum', signifying a free unity of teachers and students. At that time this unity could really think of itself as someting free and independent, a group which had as its ideal to give learning to its students without any practical intention. The university was permitted to live its very free life, because the medieval society had little interest in what it did and almost no use for the results of its activity. There is little doubt that the university now is much more important to the society in which it works. Today everybody seems to understand that for good or bad the scientists - and the technology which they create - transform the world and give the citizens a steadily

increasing economic standard but also the threat from stronger and stronger terror weapons. Society cannot function today without the high level training, based on scientific principles, given by the university. Thus this organization has come to be very important but also it has been forced to take on responsibility for central social functions and it has grown into a costy apparatus, bound to be influenced by governments. The comparison with the medieval university might be turned into a kind of paradox. One could say that the medieval university certainly was free but it had to pay the price by being without influence. Now and in the future the university is important but it has to collaborate to achieve the aims of the society.

If one tries to talk about the modern society and what its aims and functions are, it is therefore necessary to try to understand what kind of world this university will have to work in. Even if it is very difficult to speak about the future world - and you should really perhaps be a prophet to do it - still the changes in the development of the society show themselves gradually and quite a few institutions and material things have a lifetime which is considerable. It is possible already now to see something of the forces which are transforming them. It is therefore possible to make something like an informed guess about the world of the year 2000 or a little further. And I think it is very interesting to know that the institutions which you are now building here will function in the year 2000, and the young men sitting here in the auditorium at this moment will graduate in 1970 and will then be around their 50th year. The very great majority of them will live in the year 2000, and they will then be among the rather small part of the community which really is of the determining level of it. The future is already with us !

One strong trend in the future development is of course the impact of science and technology. Even if learning is very old, still this change coming from experimental science and technology is rather young. It is something of the nineteenth century, because earlier the world changed mainly through other mechanisms. Science and technology now are transforming especially the production apparatus, transforming us into a mass production society. In the future we will see technically very sophisticated enterprises functioning in a largely automatic way. The mass production will ask for big markets, and the enterprises will grow to very large companies. Such large companies will be able to pay for costly research and development activities to keep on top in business. The intensive and large scale production will steadily increase the economic standard of the society, and we will see the affluent society grow and prosper. High economic standard among all citizens will mean high consumption of all kinds of everyday goods and also of more expensive capital products for the home or for the free time of individual. This high standard will also mean that people want to consume very much of medical care and of preventive health measures.

The men and women of the future society will be used to an advanced technology and also in medicine, they will ask for the most modern developments, which means specialist care and very specialized technics.

But the high standard of this future society will not only cause consumption of material goods. It is my belief that it will also foster a will to consume culture of all kinds and for these cultural persuits, education is a necessary basis. In the welfare society education will be broad and intensive. All citizens will have the possibility to educate themselves to degrees which we cannot quite believe today. But this will not only - and may be not in the main - be because the citizens of the future society like to be cultured. They will also educate themselves, because they have to be trained and educated for the very complicated society in which they are living. And it is quite probable that in this world everybody will have at least two careers, wanting to change the place and situation in his life as he goes on. It even seems that the whole progress of the developed society depends on a steadily better education of its citizens and a steadily higher quality of the work, which they can perform because of their better education. The problem of the educators in this future society will therefore not be to select an elite for a small number of professions, but to develop an educational technology to upgrade also people of mediocre and low intellectual capacity to fulfil complicated tasks. Thus education will dominate the future society.

This society will also be a very international society - geographically the distances will disappear and the globe will be rather small with the new transportation facilities. Commercially the nations, as we now know them, will have diminished in importance because the large scale production will ask for big markets joining much greater populations than most of the nations contain today. Also culturally the world will be small, because the broadened education will mean better knowledge of foreign languages and may be a world language, which can be understood everywhere. The intellectual appetite will increase, and it will be common for people to move from one country to another, not only in education but also professionally. The need for high quality in training for many jobs will give rise to an international market for such qualified personnel. We will move around much more between countries, just as we see people moving today in U.S.A., where, may be you will be surprised to know, already today something like one quarter to one third of the population moves every year.

The description which I have given may be said to be rather optimistic. I do believe in it, not just because I am an optimist but because I believe that continued progress economically and culturally is not possible without this type of development.

Now in this future world, what will education and research and the whole activity of the university mean more specifically ? Here I may remind you of the new feeling economists and scientists have, that if you look at the development of a modern society it is not enough to know what were the classical production

factors. One was to increase the man-power, and to invest more in capital goods, in buildings and in machines, which then leads to increased production. Scientists who have studied these things found that they could never explain the development, the increased national income in a modern society, only because of these two factors. There was always something more that happened, another factor that they could not grasp. It has come to be called 'the technical factor'.

'The technical factor' means the new knowledge and the new inventions, which are introduced by research, and also the raised educational level which follows from these developments. And it is believed nowadays that as a production factor 'the technical factor' means something like 35-75% of the whole increase of the gross national product (GNP). Probably something like half the increase in economic standard comes just through research and the scientific effort.

I now want to examine the different ways in which the university takes part in the 'technical' production factor in the future world. By 'university' I mean every kind of college and university institution, and by science I mean every kind of intellectual persuit on a high level, something like what the Germans mean when they say 'Wissenschaft'. There are two ways in which the mechanism of the technical production factor can express itself.

One of these is through the educational increase of the quality man-power. Of course professional training and high level education have always been and will always be the main functions of the university in a future society. It will be a very heavy task just because the future world will ask for much larger numbers of academically educated people. I can give you an example in telling about the development in Sweden which I know best though this country is not, I think, exceptional. Between the years 1950 and 1970 the number of all people going to schools of lower and higherstanding including universities, in Sweden has increased from 850.000 to 1.3 million people. This means that in 1970 something like 15% of the whole population will be in schools at various levels. The population between 16-18 years has increased their school attendance from 25 to 62% of the whole age-group, and in the years 19-25 from 10-24% of the whole age-group. It must be noticed that most of this increase in numbers up to 1.3 millions lies on the higher levels of education, because already earlier we had a fairly extensive general schooling in the lower parts of the school system. In fact between 1960 and 1970 university institutions of all kind in Sweden have more than doubled their number of students. The costs have increased even more because with higher quality cost increase is much more rapid than increase in number of students.

In future most universities will be bigger than we now like to think of, and some will be very big. One might ask why this is necessary, and the answer is that a well arranged curriculum is a quite complicated and costly affair, which must operate on a certain scale to be rational. When the society has to take responsibility for a comprehensive education, it will therefore set up units of an economic and effective size. This puts the university in front of a certain problem, namely at the same time to keep its quality and may be to increase it, and yet to go into a more rationalized and quantitatively much bigger business.

I also think that here we have to develop a new kind of technology, which we might call an 'educational technology'. We must use that modern technique to produce means for the educational process which can be used on a larger scale and more intensively than before. I think of such things as we already witness is teaching laboratories, programmed instruction courses and the possibility to use such means in combination with television etc. This will be the place for new industries which are already now growing up, producing educational equipment, accomplishing the technical development which is necesary.

Education in this new society will show a number of types of training which will grow in the borderland between present day university education and the more vocational practical courses. This growth of a transitional field will be necessary because on one hand the vocational courses will need more theoretical content than before, and on the other hand many purely academic career lines of today will need a practical component in the future. This content of a theoretical component in the on-the-job training is something which I think is typical of the intimate contact and integration of every phase of the future society. It will not be possible in any area of life to be isolated from the rest of society. Universities will have to change and open themselves to participation in new kinds of training.

Possibly not all of this education will be the kind of professional training that should be given in the university itself. It may well be that parts of it can be given in other institutions and in other places under the active collaboration of people from the university. It is even possible, that we will see affiliated institutions, giving a sort of medium level academic training but without research, grow outside and below the university. They will function then in a loose contact and collaboration with the university. This would be something like the colleges in U.S.A. and the new university extensions which we are just creating in Sweden - to increase the educational effort.

The necessity for change in the modern society will, I feel, force another development inside the university curriculum itself. If the society changes rapidly it is clear that you cannot produce professional people who are ready to go out and work all their lives whithout additional training.. The situation is therefore that one must make it possible for them to acquire the continued training and education that they will need later on in their lifes. This will mean, I think, that we will have to find a new balance between what is now called undergraduate and postgraduate training.

The undergraduate part will be inside the university. In the future it will probably be shorter, and it will be more given to principles and to scientific training in a

general way. Broader blocks of undergraduate education may be constructed to serve several professional postgraduate lines. The postgraduate education will partly move outside of the university and often be given parallel to the practical work. It will be much more specialized than nowadays, so that one has a sort of basic common graduate training, and from that a large number of specialized professional postgraduate lines are growing out. I think this will be a rather common development. You can already see it beginning in the medical profession, where there is a tendency everywhere in the world to shorten and to concentrate and to make the undergraduate training more scientific.

At the same time the training of specialists, that is the postgraduate training, is given in parallel with the practical work but is mainly directed from the university and its medical faculty, even if it is not all given there. The same situation, I think, will appear in the teachers'profession, in the engineers' profession, and in fact everywhere, just because society in which these professional people will function, is changing. The professions must change with the society. The scientific body from which they have to work is also changing and developing very rapidly. All this will also ask for continued refresher training, meaning that after you have finished training as a specialist, you will have to come back at regular intervals to the university or to special courses lead by scientific people to make you know the modern developments and the new techniques you will have to apply.

This whole picture of an education with great specialization, and great weight on making the professions understand the scientific principles on which they have to work, this in my opinion is part of the raised quality of the future society.

Without such a specialized and intensified and long term, even lifelong, education, it will not be possible to apply the new knowledge which is necessary to develop the world. It otherwise is not possible to produce the leaders you will need in the university and in the various sectors of the society, so that development can be applied also in the country where the university is working.

The second way in which the technical factor as a production factor comes to be evident in the society is of course through scientific research, and through all the new apparatus, machinery and production methods and process which follow from these activities. On the one hand the research activity in the university is necessary to keep up a high standard in the education. There must be active research in the university so that these institutions can send the results of research into the educational process all the time. But the research is necessary also because there must be a production in every country - of research. The aim of the research in the university in the future will I think also mainly be basic and fundamental research as it is now. Even if I am going later to stress strongly the contact with application and the participation of the university in this process, I believe that there is a good case for a large sector of fundamental research in the

university. Just because what we want is the unexpected, we must plan an institution which can develop what we don't know about. The completely new knowledge which will be the most important thing in the development in the long run! And although one cannot always foresee the results of fundamental research, it is quite certain that in the long run these activities, if they are scientifically original, will lead to practical applications of value. The only way to plan this future is to trust in the original, the best scientists, and to give them the money they need to go on with their work. If anybody has a hunch about the right way of development it is an original scientist. This function of the basic fundamental research is the first link in what has come to be called 'the innovation chain', the chain leading from new facts into general applications and from there into purely industrial, agricultural, technological development and production. There is a continuous flow of facts from the extreme of very fundamental research to the other extreme or very applied development work.

The need to apply modern ways of research and to introduce modern apparatus in the university, will lead to what I think will be rather drastic changes in organization. Just because a scientist in a modern university and in a future society will have to apply very costly and complicated instrumentation, and just because the science in itself develops so rapidly, it is necessary to have several specialists working together in the scientific group. This means that more of the work in the future will be done in groups or teams of scientists.

It is not necessary any more, I believe, to keep to the one-professor-institution, the small unit, working independently. We will witness the growth of departments in the American sense, or big institutions, or centres, or whatever you would like to call them. There, many scientists in top positions and a large number of service personnel and quite a lot of modern costly equipment will be concentrated and kept effectively busy. This is necessary for reasons of quality and also because the government which must pay, wants to know that the big money spent is used in an effective and rational way. This probably cannot be guaranteed unless you have a group of a certain size. Also in education such big departments will function as units.

In the construction of a university there must be departments or big institutions of this kind complementary to each other. They will specialize in various directions, and I think it is necessary in an active, intellectual milieu of a modern university to have many such groups working side by side, so that the vast methodology of modern science can be covered in many sectors. One strong tendency in modern scientific work is the interdisciplinary type of work where people who are working in one institution, in one subject, have to collaborate with people from other disciplines, commanding other methods. This stimulating process is possible in an environment where many and differentiated institutions of this type work side by side. Therefore when building a university it is extremely important to give a wide range to the research work performed there.

It is not possible when you plan research to know which are the interactions which will be most fruitful. They will be part of the unexpected. But to make this possible you will have to create new and as varied contacts as possible.
This development will have effects on the organization and administration of the university. In my opinion the present situation with faculties built on age-old disciplines and fields of disciplines would be less important in the future. In many countries people who discuss the formation of new universities, discuss a new arrangement where faculties disappear and their place is taken by administrative and council boards. Below this level work the groups, the centres, and the big departments I have spoken of. The faculty machinery will be reserved for more general educational discussions of principle but not function as governing bodies, in the sense we mean now. This may seem a dangerous development because one might think that the scientists would lose control of the whole business and come under the lead of administrators. I don't think that development in those countries which have started using these types of administration show that - rather it is my belief that strong institutional groups will give more responsibility and therefore a more important role in the planning and administration to the scientists than is possible under the present arrangement.
One aspect of the work in the future university will certainly be the part it takes in application. This, perhaps in most European universities, has not been the usual thing for university institutions to do; to develop applied work or even take part in technical development work is not usual here.
There are several factors favouring such an arrangement. The cost of scientific instruments and the high degree of methodological specialization give added value to the active scientific university groups also for applied work. In many instances it will be too expensive or may be impossible for the society to build up the necessary equipment in laboratories outside universities, when the technical problem must be attacked. It is more effective to use the knowledge and instrumentation of the university group for the work on an applied problem, for instance in industry. This can be done by placing a contract with the specialized group in the university, or by using its scientists as consultants, or by placing groups of engineers and technicians paid by the contracting company under the scientific leadership of the university. A third possibility is to exchange scientists between university and industry or other applied areas, for shorter or longer periods, so that it will be possible for them to work on the one or the other place side by side with each other.
Why I stress so much the necessity of creating this close collaboration between industry and the practical application field and the university, is because in most European countries the whole scale of the research inside the industrial firm is too small to form the basis for industrial and practical development. We see this situation even in the U.S.A. with the largest and most powerful of private enterprises, which in many instances are capable of keeping whole universities

inside their own structure. Still they find it necessary to use the university and to work with it to a much greater degree than we are accustomed to. Of course one could say that this is no concern of the university and may even be detrimental. I think that this is not a good argument. The University is one aspect of a big effort on the part of the society to develop such research and applied work which is necessary for the most high grade development. Without it the society cannot utilize the opportunities originating from its research and development for its industrial expansion. It will lag behind in general development and it will not be able to follow up its increasing in economic standards, and therefore also its social and culture work will lag behind.
It is possible to defend a sector of applied work in the university, and this is certainly not detrimental. The institutions and universities which have experience of this situation - those in my country and in other countries, especially in the U.S.A. - have found it stimulating and interesting to take up such contacts.
The only reserve is of course that this business must not go too far. You should not change the university. I also mean that basically it should be devoted to fundamental research and to its own seeking of the most profitable avenues for new projects. But still - besides that - there is a stimulation in a good possibility for applied work which is a sort of feed-back-process that gives new ideas also inside the fundamental field.
The conclusion of this discussion about the research duties of the university is of course that we must try to strike the balance between its fundamental research work and the part it can take in applied work. Most of the fundamental work in a society of the kind represented by The Netherlands and Sweden will be performed in universities anyway. Most of the applied and technological work will be performed in the private enterprises and other applied areas. But the interaction between these two in our society must be much stronger than before if we are going to exploit the results of modern science for our general development. I see this flow of ideas and innovations from the university into the practical applied field as something of a necessity. There are two ways to live in the modern world if you try to go on living as an industrial production society. One I would call the defensive strategy in production. That is when you defend your market. You change your product according to consumers wishes and you try to broaden the variety of products you have. But in this situation you always use what has come to be called 'the secondary or tertiary technology', that is technology developed by somebody else. This is rather dangerous because suddenly somebody who is more active than you presents an alternative technology, quite a new principle, and there you are. The other variety, the aggressive innovation, leads to what has come to be called 'primary technology' into new production field, into the kind of development which is the important and in the long run, the decisive one for the development of the practical effort.

In countries like The Netherlands and Sweden I believe that to be able to play a part in the agressive innovation leading to primary new technology you have to exploit basic research, fundamental research, in the universities much more than before. You really have to take care of the new ideas and the new possibilities coming out of such research for your production apparatus. To this purpose you have to create renewed and intensified contacts between the university and the fields of application. This is one of the most important problems to solve for most of the governments in Europe. It is not by chance that this whole question is one of the most important discussed in the question of the existence or nonexistence of a technological gap between Europe and the U.S.A. There is little doubt, that the United States have reached a higher status of industrial and economic development - mainly because of its greater ability to exploit the results of research and always to lead in primary technology. Here we must catch up.

I have now talked for quite some time of the importance of the university in maintaining education and training on a high level and in this way, of increasing the quality of man-power in our society. Also I have stressed the contribution to the technological production factor which the university can make in research. A characteristic feature coming up again and again in my description has been the close contact of the university with, and its diffuse borderline against, activities of the same kind in other sectors of its own country and on the international scene. One may call this a new openness: the future university will have wide open frontiers towards the outside society and towards the international scientific environment. The best university in any country would be an intellectual power centre forceful in knowledge and sharp in thinking - taking part in advancing the frontier of knowledge. In this way I believe it will not only be a national focus but also an international centre, which will contribute to the world fund of knowledge. But it will also be the channel through which all new knowledge created in other centres of learning is taken back to its own country.

In a way it will form an intellectual bridgehead of that country. I believe we have to create in the future universities both quality and size if we want to have a continued rapid development of our society. We must fit them into the national structure of practical life and also into a functional international scientific pattern. I am sure that every provision for such a development exists here in Rotterdam with your environment which is unique in combining the practical enterprise of world wide character with high intellectual achievements in arts and sciences. I wish you all success in your future work.