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Dr. KANESHIGE. I think you are referring to an organization under the Science and Technology Agency when you refer to the Disaster Prevention Institute.

Dr. RUSSELL. Nearer Kyoto.

Dr. KANESHIGE. I think it belongs to the University of Kyoto. If it belongs to the University of Kyoto, it is supported by the Government.

Dr. RUSSELL. It is doing essentially the same types of research as our U.S. Army Corps of Engineers Waterways Experiment Station, which here is being supported under the U.S. Army, and there they are doing essentially the same thing at what was referred to as the Disaster Prevention Institute.

Dr. KANESHIGE. Regarding your second question about the Osaka Municipal University, the university itself is supported by the city of Osaka and therefore if the laboratory you saw was in the university, I think, it is supported by the city of Osaka. If they were doing work that might have appeared to overstep the normal bounds of municipal concern, and were undertaking disaster prevention studies that looked more appropriate for a national undertaking, it must have been because that city once was badly hit by a typhoon and suffered floods by high tide that accompanied the storm, so that flood control was a matter of vital municipal interest.

Dr. RUSSELL. It is in Osaka and it is a part of the university and it is supported by the city. They have an excellent research program to meet national needs and it is making international contributions.

For example, they are working on the proposition of whether a fishing pier should have holes bored through it or not. At the University of Tokyo the director of this institute was taught there should be these holes in the fishing pier, but in his wave tank he demonstrated to us it should not be because as the waves come in the compression of the air caught under the pier does less damage than the spouting of water through the holes. This is fundamental research of national use for all fishing piers.

Dr. HANDLER. I think we should get on. Thank you very much, Dr. Kaneshige. We will take about a 3-minute break.

(Short recess was taken.)

Dr. HANDLER. Our final speaker for the afternoon is Prof. Henry Julius who comes to us from the Netherlands. He is going to talk to us on the subject of government-industry partnership in scientific applications with special reference to the Netherlands. Dr. Julius is director of the Central Organization for Applied Scientific Research in the Netherlands. We are delighted to have him with us this afternoon. [Applause.]

STATEMENT BY DR. H. W. JULIUS, CHAIRMAN, CENTRAL ORGANIZATION FOR APPLIED SCIENTIFIC RESEARCH (TNO), THE NETHERLANDS

GOVERNMENT-INDUSTRY PARTNERSHIP IN SCIENTIFIC APPLICATIONS

Dr. JULIUS. Thank you, Dr. Handler.

Mr. Chairman, ladies and gentleman, I have been asked to speak on government and industry partnership and I will confine myself strictly to that.

Science and industry in their unprecedented development have become firm partners. This is a fact so well recognized that mention of it is almost a commonplace. The relationship is generally looked upon as self-evident. Nevertheless, there are problems and even tensions. Unmistakably. For, if not, why then, Mr. Chairman, would your esteemed committee have brought this very subject up for discussion?

All those responsible, in one way or another, for the all-important economic development of their countries rack their brains to find the balance within the many complicated relationships in this modern "eternal triangle" of government, industry, and science.

Add to this that the picture is thoroughly different in the several member countries of our world family of nations and we may become aware of the dimensions of the problem we are dealing with.

In trying to consider the content of the triangle, there can be no other starting point for someone in my position than what is going on in my own country. This sounds rather self-concentrated, a trait that I myself do not appreciate very much, so please, Mr. Chairman, feel behind my outline the essence of the general problems that could be tackled in many different ways. Ours is one of these and, as I know for sure, certainly not the most desirable one.

The "lowlands" near the sea have largely been wrested from the water. No doubt this has caused the Dutch character to be very conservative on the one hand, progressive and enterprising on the other. This quality is real and significant; it generally entails a rather complicated structure as will be clear in a few moments. For this complexity I shall have to apologize beforehand.

For a proper understanding, two more of the Dutch nation's traits will have to be brought into the picture.

The one is that old sailorship has founded the Dutch tradition of a trading country from which stems the present days' mentality of commerce that predominates in the nation's style.

The other trait is the country's love of liberty. It roots historically in the Reformation which—again—was the expression of the country's strong contention for freedom of thought, even to such an extent that up to the present moment the rights of others for different views will not be disclaimed. On this basis stands Holland's universally forbearing attitude and it is at the root of today's mutual tolerance of many different opinions, approaches, and solutions.

I have deemed it essential, Mr. Chairman, to give you this very short picture of the nation's background in order to enable the best possible understanding of the only approach possible to me, i.e., the subtle Dutch structure in relation to your subject.

HISTORY AND PHILOSOPHY

The words "science policy," "research and development," "research management," and the like, are modern terms. But we should not fail to recognize that, without being in the least applied consciously, at the end of the 19th century the same concepts were operative already. About 1880, while the country was still agricultural throughout, it was struck by a not far from catastrophic agricultural crisis.

Desperate poverty of the peasants left no other way out than action taken by the Government, the first help being instruction and guidance

to the farmers. This proved to be a wise policy, but it was not enough. Soon it became clear that effective information should spring from solid knowledge. So the Government decided to establish a number of scientifically run stations for soil analysis, comprising test plots on arable land, and laboratories of a mainly chemical type.

In Holland this was the first and well conscious effort to support one of the essentials of the nation's economic structure through science.

The effect was highly encouraging, so much that even today our agricultural yield per acre is among the best of the world. Small wonder that ever since the quintessence of Holland's organizational pattern for science to be instrumental in promoting the nation's welfare has been essentially a responsibility of the Government. This is not limited to the domain of science; in most matters of public interest, social security, health, education, recreation, and the like, the governmental predominance is the rule. In many countries this structure is less favorably looked upon. However, there is a good reason for its being generally accepted in my country. It has always been part of the authorities' policy not to suppress private initiative; on the contrary, interest and action privately started have always been stimulated by the Government through subsidizing and still avoiding display of power and dirigism.

If I add that the universities, even the confessional ones, and the technological universities are the full or nearly the full financial responsibility of the Government, you will appreciate that the scientific community in Holland is used to addressing the Government for means for research. Of course, for one branch of scientific research this definitely will not hold good; namely, that performed by the industrial company for the sake of its own commercial position. But even where industry cannot afford its own scientific setup, the Dutch Government feels its responsibility just as it did in the eighties for agriculture.

BETWEEN THE TWO WORLD WARS

When the First World War had come to an end it had become clear, even to the Netherlands, which had remained neutral, that science and research were about to get a decisive influence on the total structure of society in all its aspects; an influence that after the Second World War turned out to be a multiple of all expectations in the twenties.

Nobel Prize holder Lorentz, at that time chairman of the Netherlands Royal Academy of Sciences, and some years later, his successor in this function, chaired two successive committees both studying how Dutch science and research could be organized to insure the best possible service to the Nation's prosperity.

In 1930 a bill passed our Parliament to become an act by which a body corporate came into being called the Central Organization for Applied Scientific Research, the aims of which should be "to insure that such research is put at the service of the community in the most efficient manner possible."

It is around this organization that revolves the relationship between government, science of the oriented type, and private enterprise, industry in particular, together with other social sectors. So I will

confine myself to this organization and neglect intentionally a small number of institutes not belonging to it.

START AND DEVELOPMENT OF THE ORGANIZATION; SECOND WORLD WAR AND AFTER

The start of the organization has been a difficult one. When World War II broke out, the organization was nothing more than a very limited trial and hope for the future, and its yearly budget was only Df 450,000. During the German occupation, however, the great and sad difficulties of the universities worked in favor of this still fully unobserved organization. When war was over, the organization had gained its ground. It had some institutes working, albeit under rather primitive and provisional circumstances.

By 1945 the reconstruction of the heavily damaged country could start. Its economy, more than under previous conditions, had to concentrate on industry without in the meantime neglecting its classical agricultural nature. The still young organization then got and seized its opportunity. It supplied the want and developed to its actual dimensions, now about fiftyfold of the volume it had at the moment of liberation in 1945, when its budget amounted to Df 2,500,000.

I shall now come to brass tacks, but not without having first apologized, Mr. Chairman, for this rather contemplative introduction. I could not do without this background, indispensable for good understanding; this I know for sure.

The organization just mentioned, the chairman of which is the speaker of this moment, may for short be indicated by the three initials of its Dutch name: TNO standing for Toegepast (applied) Natuurwetenschappelijk (scientific) Onderzoek (research).

Its legal structure is the following:

The Central Organization for Applied Scientific Research can be considered the axis on which turns the Dutch system of Government-industry partnership in scientific applications. As I said, it is a body corporate, created by law. The ultimate responsibility of the organization is vested in its board, the members of which are appointed by the Queen by and with the advice of the ministers who have countersigned the act. An eventual shift in the division of ministerial departments has been taken into account.

To quote from the law: "One-half of the ordinary members shall be appointed from among persons considered to be expert in the field of the natural sciences and the other half from among persons considered to be expert either in economic affairs generally or in those economic interests which are served by the natural sciences."

In addition, so-called temporary members can be appointed on the same basis when—I quote—"special circumstances render it desirable."

The number of ordinary members is related to the number of ministries interested in applied scientific research; the number of temporary members is unlimited. Most members and temporary members are appointed for 6 years and are eligible for reappointment. The age limit is agreed upon to be 70.

At this moment the board numbers 26 members.

By it are ruled and controlled the budget of all TNO organizations, the setup of which I will explain right away, as well as the yearly account of the whole organization which is rendered directly to the

Queen. The board has an executive committee to which the routine management of the organization is entrusted. It is this executive committee which factually is life and soul of the whole organization.

The board appoints a secretary and a treasurer. Their assignments relate to the proper running of all the administrative functions of the family of TNO-organizations.

The domain of applied scientific research in the Netherlands is much too vast and also far too much divergently specialized to have all its activities, servicing of social groups, and widely branched contacts combined in one organizational body. Therefore the act provides for so-called special organizations, each having the status of body corporate. They serve special fields or social sectors for which applied scientific research is indispensable.

The special TNO organizations are called into existence by statutory order in council, either on the recommendation of the central organization, or after its being consulted by one or by more than one minister in their joint interest. The names of these organizations bear the indication of the field they serve.

Four of them have been established; I give them in the order of historical seniority:

1. Organization for Industrial Research TNO (1934);
2. Organization for Nutrition and Food Research TNO (1940);
3. National Defense Research Organization TNO (1946);
4. Organization for Health Research TNO (1949).

Each of the special organizations has a board, the composition of which is largely comparable to that of the central organization. They may have executive committees (in fact only one has not) so that their way of working is a rather true copy of that of the mother organization.

That this family of research organizations shall intrinsically be an entity has been safeguarded by several measures.

Under a statutory order in council the executive committee of the central organization consists of the (four) chairmen of the special organizations and the vice chairman of the central organization plus the chairman of the central organization who, of course, also chairs its executive committee. This committee meets weekly; all matters of actual and general importance are discussed, considered and, as and when necessary, prepared for decision. For the necessary contacts, the chairman of the National Council for Agricultural Research joins these meetings. Actually the fact that all members of the executive committee have offices in the one main administrative building of the organization makes for easy contacts.

The secretariat and financial administration of each special organization are provided for by the secretary and treasurer of the central organization. The budgets are combined into one overall budget which is subject to improvement by the board of the central organization. The special organizations are bound to report on their activities at the end of an administrative year to the central organization. On the basis of the overall budget, the Government grants an annual subsidy to the central organization, which divides it between the organizations.

The bodies corporate are then entitled to spend their respective assigned parts. Under the "TNO act" the board of a special organization shall furnish the board of the central organization with all

the information it may require. In this context it should be kept in mind that the chairmen of the special organizations are members of the executive committee of the central organization.

All this will, no doubt, make the impression of being a rather complicated matter. And indeed it is. But with wise men in the chairs and on key positions, in the bureaus of TNO organizations and, finally, in the ministries, it has proved to be well workable. This does not mean that having a number of five bodies corporate to really work together, and thus make them serve one national goal as well as their own field of action, can be called an easy task. But the more the present speaker has got to know the TNO organization, the more he has learned to appreciate its original and visionary farseeing idealism, which still is the strong cement that has built it.

THE TRIANGLE: GOVERNMENT-ENTERPRISE-SCIENCE

The side of this triangle best to be drawn first is the one that can depict the relationship of the Government to TNO, its own creation: chapter I, section 3 of the act reads—briefly and to the point—"The Government shall grant the Central Organization an annual subsidy." The maximum amount of this subsidy will be determined by the Minister of Finance.

This brings us to the very heart of the matter: The organization has arisen from the original conception of governmental responsibility as to where science could contribute to the community's prosperity. The setup having been created, the responsibility for its upkeep and maintenance lies with the originator.

In 1932 the central organization started with a one-man office and 12,000 guilders governmental subsidy. The next year saw a lady secretary join and the subsidy rise to 20,000 Dutch guilders. (For comparison divide by 2.5, which will not yield the dollar equivalent to international exchange rate, but rather the equivalent according to purchasing power.)

In 1940 the governmental subvention was nearly 400,000 guilders. At the end of the war (1945) it had increased to 2.5 million (equals $1 million on purchase basis).

For the 1966 fiscal year the governmental subsidy has been roughly f.67 million, plus 20 million for building investment.

I pointed out that by law was created an independent body in order to have its policy made by experts and men of experience and with a view to placing it in a free position toward anyone, be it government itself, industry, defense, medical world, consumers, agriculture, and what not. To put a scientific organization in such a position had been a point of controversy when the first steps into the field of service-by-science were taken. However, it has been done and that is how it is. Meanwhile, it should be noted that the fundamental law that "he who holds the strings of the purse will rule the roost" has not been, and should not be, abandoned. Each of the ministers who signed the law, also each of the ministers who have called a special organization into existence and—last but not least—the Minister of Finance will propose for royal nomination a functionary—civil servant of their respective ministry—as a delegate to the central organization, or the relevant special organization. All these functionaries are entitled to attend the meetings of the central organization, the delegate of the

Minister of Finance preeminently so; the delegates of the ministers, sponsoring special organizations will attend the board meetings of these organizations. Essential in this context is that, at the places and moments indicated, these delegates have the "right to veto" (they are competent to lodge an objection to decisions made by the respective boards).

This sounds very rigid or even polemic. In practice, however, in all the length of the organization's existence the veto has been made use of only once or twice. In fact the very existence of this right is a sound basis for frequent and open consultation and exchange of views and plans which results in avoiding as effectively as possible the mutually disagreeable position of putting the process of veto into action.

Besides, the system of delegates warrants a good dictate of the ministries in the actual policy decisions of the boards.

All this is very well regulated and under control. Nevertheless, it will not be the regulations but it is the men on which the system runs. To make this very clear; even with the best type of rules and regulations an organization will fail unless the humans, working in its context, agree and strive to make it run. Holland, in addition, has one built-in advantage; it is a small country, everybody knows everybody else. This is the essential lubricant in the machine.

Now, Mr. Chairman, I must draw the second, and in our context the most important, side of the triangle, viz, the relationship between science and industry.

The terms of reference of the TNO organization, as I already said, are very broadmindedly formulated. As to the task of the organization, there will be no more engaging or restricting precepts than to insure that applied scientific research is put at the service of the community in the most efficient manner possible.

The organization shall be authorized to study problems in the field or to have such problems studied, to advise persons or institutions, and in general to foster and support applied scientific research and the application of the results it achieves.

So worded, many different ways of fulfilling its task are left open; it allows for the greatest flexibility. No wonder that outside forces, forces of the environment, have liberally shaped the organization. When the history of TNO started there already existed some institutes of the original governmental type fully comparable to the agricultural advisory stations (e.g. on fibers and textile, heat technology, fire prevention, and others).

The law provides for the transfer of these governmental institutes, including the original agricultural experimental stations, to the TNO organization. In fact, a small number were transferred indeed, but others, specially the agricultural ones, were not. There is no question about actually accepting this as a fact; although up to a certain point one could regret that the unity of all applied research within the domain of government has not been factually brought together under one umbrella. More important, indeed, is to see how the original principles have continued to be valid. When developing more rapidly, TNO saw the fulfillment of its duty to lie in the establishing of research laboratories. Things could have been different though. The TNO duty could have been the compiling of information through documentation, from within as well as from outside the country, then

the digesting of such information and the adapting of it for practical application. On this basis, a system for this bringing ready cooked information to the customer could have been built up.

But actually, the choice was made for real research institutes and rightly so, no doubt. We must not forget that the cradle of the organization was in the house of science itself, the Royal Netherlands Academy of Sciences. It was science that offered services to the needs of the country; it was not society that asked for the results of science. In the eyes and minds of the originators, the workship of science could be nothing else but an institute or a laboratory. Therefore, about 35 of these have been established. Working groups, coordinating committees, committees with special tasks, service departments (mathematics and statistics department, patent department) and the like complete the list. The total number of TNO employees amounts to nearly 4,000, of which 600 are university graduates. All in all, it is the biggest research unit in the Netherlands.

Potentially all the institutes and laboratories may serve industry in all the variety of its needs. Only a few of the institutes of the Organization for Health Research TNO are practically—though surely and definitely not in principle—hardly in contact with industry. But of course, the Organization for Industrial Research TNO is the main supplier for industry. This is reflected by the fact that half of the total budget and half of the total number of employees belong to the industrial research organization. To make the picture somewhat clearer I may point to the printed matter I have brought with me.

When industry—and I will now confine myself to this aspect—wishes to have its problem serviced by scientifically founded knowledge, or by some ad hoc scientific research, there are two entries.

Let the case be that of a middle-sized metalworking factory. It should be said—by the way—that in Holland middle size means 100 to 500 employees, of which one or two, or eventually three, are fully academically trained mechanical engineers. Perhaps from the younger generation of factory owners one, having had full-scale technical university qualification, may have become a member of the board. Surely, there will be no research department, but the contribution of the hypothetical three engineers, together with the know-how of the original founder and his devoted foremen, warrant a good and efficiently manufactured product. However, let us assume that the need for some improvement is felt.

The manager can then address the Institute for Metal Research TNO or, if he is not quite sure that the improvement will come from some branch of metallurgic research, it may address TNO's central office. This "HQ" will then pass the question to the TNO institute considered to be the most appropriate. So it does not matter whether the factory manager would either have contacted directly the institute of his choice, or the central or any peripheral TNO address. His question will be directed to the relevant place and thus we rightly claim that he who comes in touch with any place in TNO may rest assured that he will have the whole of TNO potentialities behind his problem. And this may be essential. For, even if his problem appears not to be a metallurgic one, but can better be solved by the use of some plastic, or through protecting metal parts by some paint or

other coating, or by chemical surface treatment, he will be shown the way in the TNO network.

Let us assume that the initial consultation leads to the conclusion that some research work in one or two of the institutes may solve the problem. Then the questioner may become a customer in the sense that an order for contract research is agreed. Here the advantageous position of TNO stands out, because the customer will have to deal with no more than one contracting party. For, in its turn, the contracting institute will put out to contract those very parts of the problem that can best be tackled by another of the very many TNO institutes.

In every contract there will be some latent partnership of the Government. Without that the solid basis of buildings and permanent staffs of the TNO institutes would never exist at the actual dimensions. There would be nothing of the routine, built up over the years, nor of the selection for creativity, or the high-level equipment, et cetera, were it not for the initiative of the Government. But there is more.

In case of a contract, a bargaining position is around the corner. The Government cannot be imagined to be the one of two negotiators who sells its services. This capacity now has been entrusted to TNO, for its research organizations are allowed to settle accounts "by requiring payment to be made in respect of research performed for particular persons or institutions or for advice rendered to them." This certainly has been one of the reasons to confer corporate status to TNO, thus making for the responsibilities the Government had accepted in principle.

Still another aspect will have to be brought into the picture. Contract research is a matter of confidence and, not infrequently, of secrecy. This is a managing problem. For a body corporate as such can never be sworn to secrecy. This can only be dealt with by building up a reputation of absolute reliability and of loyalty to the sponsor. I daresay that the organization has done its utmost in this respect; even the conditions of employment of every TNO employee in a crucial position can be completed by a so-called competition clause. But still, unfortunately, industry frequently remains somewhat suspicious and it would be wishful thinking to rest assured that private enterprise would not feel and fear government to be somewhere in the background of its own creation, TNO. This will not be openly said and, if asked directly, the point would be evaded or denied. But the matter-of-fact man knows what's on.

The result from all this will be that contract research is a vital relationship between the medium-sized enterprise and TNO but that it could be expanded and thus grow a stronger support for the industry which has a hard job to keep pace with rapid modern developments. This was on the medium-sized industries.

For the smaller on the one hand and for the big industries on the other, the situation is totally different.

For small industries (below 100 employees) of which there are still about 9,000 in our small country, the hard fact is that they do not know—even still now do not know—how to fit science in their shops. Putting the right question is one difficulty. Understanding the answer is another problem. This is a matter of permanent concern. Government and specifically the Ministry of Economic Affairs has an old established service called Netherlands Technical Consulting Serv-

ice, of which the terms of reference are to help industry, especially the small and very small firms, in every feasible respect.

For the 1 to 10 men's workshops it has done an immeasurably good job, as its advices even cover purely financial and elementary managing aspects. A technical workshop with a limited number of mechanics provides for help in troubleshooting. For more complicated requirements, possibly up to the research level, the appropriate part of TNO is contacted. To bring this governmental service under one heading with TNO, or even to incorporate it in the TNO organization, has been considered several times. At some future moment this will, I am convinced, be done. Do not forget, however, that a country wrested from the water makes dikes and if they appear not to be strong enough, will make new dikes and let the old exist.

Some 2 years ago, in collaboration with OECD, an instruction unit for simple and low-cost automation was established by the Organization for Industrial Research TNO. It has meanwhile had hundreds of young mechanics and even polytechnicians as its pupils. It is one of the very few teaching units in the organization; it has had considerable success and demonstrable effect. In these two ways, Netherlands Technical Consulting Service on the one hand and the low-cost automation instruction team on the other, the small industries are serviced through responsibility shared between Government and TNO. In these types of service research as such is hardly in the picture.

The big industries have a relationship to TNO that is fundamentally different. As big industries in this context should be considered the ones that have their own research capacity. I cannot omit pointing to the fact that the Netherlands have a small, but in relation to the nation's dimensions an exceptionally high, number of industries of international scope and size. From these I name five, Philips, Shell, AKU, Unilever, and Statemines. The industrial research capacity is altogether about equal to the total contribution of the Dutch Government to scientific research, universities included. I may consider it a known fact that their research is in the van of progress. This is not limited to development of new products and manufacturing engineering, but it holds even more true for fundamental research. Through international exchange, and through their patents and licenses policy, these industries are in the forefront by their own means.

Nevertheless, 15 to 20 percent of the TNO contract research comes from these industries, a fact that asks for some closer examination.

TNO has built up a very widely branched research capacity. It works together with many scientific authorities and it has been provided by the Government with an aggregate of research equipment—buildings and high-level instruments, apparatuses, workshops, staff, and personnel—that hardly has its equivalent as a coordinated research body in the country. Its coherence guarantees cooperation to the utmost and avoidance of wasteful duplication. From the governmental subsidy, which in the industrial sector is about equal to the yearly income from contract research, TNO's free exploratory research has been supported uninterruptedly for more than 20 postwar years. From this stimulating environment many specialists of high quality have originated. Cooperation with the universities and technological universities is wide; professors are advisors to TNO institutes, institute directors or university-trained staff members are professors extraordinary to the universities.

Thus an extremely versatile and adaptable research body has come to existence. The bigger industries frequently have their own research bodies, very much specialized in their own industrial fields, may these be ever so broad. Nevertheless from time to time, not too infrequently, as a matter of fact, they come across problems that lie beyond their scope. Many times the complexity of these problems is not to be neglected. To set up a new research department is not justified. Then to meet the needs of the big industries, TNO comes into the picture and at its best. It will then be no exception when two, three, or more TNO institutes work together, a project coordinator being appointed and the best of workers being brought into the project group.

In such cases close cooperation can be found possible between two or even three special TNO organizations, for instance, Industrial Organization, Defense Research Organization, and Organization for Health Research. Then the original intention of the law is manifested at its best. We thus still find the origin of the organization reflected; it has been science which offered, through the mediation of at that time the totally new concept of a coherent complex of research organizations (TNO), the assistance of science to society. It certainly would have come out differently if it had not been science that offered but society that had asked.

Mr. Chairman, to close my triangular exposé I still have to draw the third connecting line, the one between Government and industry, in the field of research. After what I have already said, it will be clear that in my country this direct relation will not be a very strong and determinating one. Some aspects, however, merit being mentioned briefly.

In the first place, the Dutch tax regulations allow an industry to mark in its books as deductible items all costs spent for research, may it be in the industry's own laboratory or in respect of research farmed out for example to TNO. This being so, it is another, though indirect, support of the Government to industrial research efforts and this accounts partly for the rather high priority that research has in my country.

Along with the increasing trend of international thinking it has not remained unobserved that especially the United States have a system that could almost be called the diametrical opposite of the Dutch pattern. Government-sponsored research in your country is frequently, or so to speak even preferably, entrusted to the big and biggest companies. Their research capacity was at hand in the years of the extreme effort of World War II. It had to be used; that is, it had as quickly as possible to be translated into practical application and, after a rapid development, brought to bear upon production.

This has led to enormous expansion of the research capacities of many companies; the bigger ones among them even have transformed their research groups into independent research corporations, receiving astronomic amounts out of the Federal research contracts. This has created the unprecedented scientific leadership of your nation. Could this fail to make a deep impression on any country which feels the importance of research for promoting its standards of life?

No wonder that the Government in my country, learning from your system, considers to award contracts to existing research departments of industry. In some cases, when special experiences exists in these

departments, doing so is fully justified. But to me as a leader of the TNO organization, it causes great concern. Research is, apart from being a matter of money, frequently much money, a matter of men and of built-up experience. If this granting of government contracts to industry might lead to extension of its research capacity, it will mean that the government enters into competition with the research body it has created itself. This is harmless as long as means are freely available. But all over the world the phenomenon of some kind of saturation of research effort is in the air, be it from the financial, the manpower or the purely psychological point of view; of course the level at which this phenomenon presents itself is utterly different in the different countries. Under these conditions for my country it would mean an enormous waste of capacity (again financial and of manpower) to induce new research activities, instead of making the existing ones as strong as possible. There can be a danger in taking over the system of others. Duplication, the not unusual phenomenon in research of exploring anew the well known and also the doubt whether the results can be really applied for the community, threaten around the corner.

Mr. Chairman, one could continue to illustrate many more aspects of the triangle of interaction, draw other lines of connection.

This is especially tempting when one is enthusiastic and yet full of concern about the setup to which one devotes one's daily work.

Let me conclude with one short statement.

Appreciation for one's own system should never cause blindness to its failures. I have sketched in my best possible way how our own TNO organization works. However, I can assure you that no one knows better than I do how it should work to render even better service to one of the most vital elements of my home country.

Thank you. (Applause.)

Dr. HANDLER. Thank you very much, Dr. Julius.

We have had a remarkable illustration today of the extent to which previous history and the culture which derives therefrom shapes the solution a given nation finds to problems which are generically a part of any system. Those we heard for Norway, Japan, Holland are all quite different from one another, and yet they are all designed to accomplish somewhat the same end for a nation.

I suppose the most important lesson to be learned there should be conveyed to our State Department rather than to our own internal operation of science.

I would like to point out also that, during the course of the day, the word "science" has been used repeatedly and in the main when it has been used it meant applied science, applied research. None of our three experts addressed themselves specifically to the manner in which his nation supports its own fundamental research efforts. At least they did not spend much time on it.

The only reason for calling this to your attention is to point out that each has a vigorous fundamental research effort which is quite ancient in each of these countries. You have only to stand in the Netherlands Academy of Science to know how old it is and to understand how much it has shaped the history of this country.

I think it is important to point out that in no nation known to us is it possible to have a really successful, competent, vigorous applied

research development effort without, in the same country, having an equally successful effort and competence in fundamental research. Each of these countries in point of fact has exactly that and this underlies the success of these efforts they have told us about.

Now may we go on to the discussion itself.

Dr. FURNAS. I certainly appreciate Dr. Julius, should I say succinct and rapid fire and clear presentation of the complicated structure at work. I am sure this is very forthright reporting and it is obvious, as I know well, it does work.

I think probably one of the secrets is the fact you pointed out in one of your parenthetical remarks, that this is a country in which everyone who is really important in this field knew each other. I think perhaps due to the integrity as well as the competence of the people involved is the secret of why it works.

I do have two questions on it which are essentially on the technique.

I gathered from your closing paragraph that TNO does grant limited contracts to industry for special purposes; is that correct?

Dr. JULIUS. Yes; it is correct.

Dr. FURNAS. Does TNO supply any support for universities in areas for their particular purposes?

Dr. JULIUS. May I ask a counter question?

Do you mean financially?

Dr. FURNAS. Financially.

Dr. JULIUS. No; financially practically not.

But along other lines very extensively; for students of the university may work for a considerable time in TNO institutions, even practically without any payment. And vice versa, a TNO worker may work for some project or some broader fundamental aspect for considerable time in universities.

There is no special transaction between these two, but the personal contacts and the personal service back and forth in information and even in instruments and use of personnel is intense.

We may say that in several places when you walk into university institutes someone has to tell you when you change from the one room of the university to the other room of the TNO, and vice versa again.

Dr. FURNAS. If I remember correctly, you pointed out there were joint appointments between TNO personnel and university faculties, both ways. Is that a formal joint point in such cases or simply informal?

Dr. JULIUS. It depends. When a TNO worker is a professor in a university, it mostly is informal. He simply brings in the problems he learns in TNO into the university and vice versa. In many cases it is more formally separated. Then the contract research done in TNO institute is supervised by a professor who is adviser to the project and he may be paid separately from his university income by the contractor through TNO.

Dr. FURNAS. He can be paid?

Dr. JULIUS. He can be paid, yes.

Dr. FURNAS. As an individual consultant?

Dr. JULIUS. Yes. But in some cases there may be a formal appointment, I will not say written contract with the board of trustees of the university and the board of TNO. We can make the connection at the high level.

Dr. FURNAS. In those connections, then I take it in the Netherlands the gentlemen's agreement is perfectly adequate; is that correct?

Dr. JULIUS. Oh, yes.

Dr. HANDLER. Dr. Noyes.

Dr. NOYES. Mr. Chairman.

Dr. Julius, is it not true also the work in the TNO laboratories may be included in thesis for degrees in universities?

Dr. JULIUS. In principle, yes, from the TNO side definitely so. Frequently however the university professor—I have been one myself—of the type that likes to keep the doctor thesis under his own control will not always accept the work done in the TNO laboratory. There is only one answer to that—that is his affair.

Dr. NOYES. In that respect you follow more the French system than you do the English system; is that correct?

Dr. JULIUS. We are in the center of a triangle: France, England, and Germany——

Dr. NOYES. Another triangle?

Dr. JULIUS. Yes. So we follow the one who fits best.

Dr. HANDLER. Dr. Chagas.

Dr. CHAGAS. Let me first congratulate you on your very, I would say speedy but very clear presentation. I have one comment and two questions. Part of my question was already part of the question you answered, but I would like to ask them to get more elaboration maybe.

My comment is that on page 5, on the second paragraph, I see you have established really the best base of scientific benefication when you say, "but with wise men in the chair and on key positions, the work can go easily on." I think this is a very important statement.

Dr. HANDLER. Thank you, Dr. Chagas.

Dr. CHAGAS. My second point, is there any danger for the university of a brain drain from universities to your organization?

Is it interesting for your organization how much it can be working with the universities—and are you taking into consideration, because any triangle has to have a certain harmony I suppose—and this is one of the points.

And the second point—and you must excuse me for being very rude maybe—but from some of my friends I have heard some criticism to the organizations of your universities which are being considered to be more on the conservative side of their structure. As I criticize very much the universities in my country, I ask you to forgive my criticism which I have from other people about your universities, and how much you believe that your organization can break up this sort of seal universities are sometimes placing around themselves.

Dr. JULIUS. May I answer first for the statement of Dr. Chagas that having wise men is the best way to work together. I must apologize but it is true.

For the second question, the brain drain, well, when you have a vigorous interchange of TNO and the universities, the one will call it the brain drain, the other will call it the blessing. It depends on the attitude.

If a TNO man—let me start from the other side. If a university man goes to the TNO, some people in the Government may call it a brain drain and a professor may call it a blessing. In the other direction I must say, only thinking from the TNO standpoint, we are always

looking for this contact of personnel of TNO coming into the university because it will give a close link between the two.

May I say, a little bit proudly, that most people that have worked with TNO are rather fond of the organization. It has taken a place in their hearts and one going to the university will not forget TNO. So we have many TNO people in the universities and they keep on making good connections back and forth.

So, to call it a brain drain, I should say, is not the word. Personally I am convinced this way of interchanging builds up a good atmosphere.

Now the university, as you depicted it, is not a TNO problem. It is a problem I am very much concerned about. Having been a university professor myself, I have not without reason abandoned to be one. The Dutch universities are extremely conservative. Nevertheless, they take up new things and that is why I said in the beginning they do have the mentality of the country wrested from the waters. They do not easily abandon a certain situation but they are rather willing to build up a new one. And that is what makes our country extremely complicated.

There is only one blessing, and that is, man knows how to forget and most of them forget how complicated things are and they work rather simply. So you are right that our universities are extremely conservative, but they are not unwilling to take up new things, and that is a different thing.

Dr. CHAGAS. Thank you.

Dr. HANDLER. Mr. Goland, please.

Mr. GOLAND. I want to make a brief comment because it might be helpful to compare certain experiences in this country with those of the TNO.

Dr. Julius raised the problem of convincing industry to use a laboratory for proprietary research when that laboratory is Government sponsored, either in whole or in part. While apparently the TNO has been able to overcome the barriers, I want to point out that the experience in this country and in others, such as Great Britain and Mexico, has not been equally successful. We have found that most companies wanting to undertake proprietary research and development insist on secrecy arrangements which are not compatible with a Government sponsored institution. In the United States, therefore, a complex of private industrial research institutes has been developed, which at present numbers more than a dozen, in locations spread across the face of the country. These are contract research organizations, equipped to conduct projects for industry on a job-shop basis, and I believe these institutions have been significant elements in advancing the industrial strength of our Nation.

It is interesting to note that several of these institutions are affiliated with universities, but the affiliation is essentially in name only. The program of the university is essentially completely divorced from that of the research institute, and suitable means for effecting significant coordination and cooperation have not been found. To many this means that the objectives and work habits of the two kinds of organizations are quite different, and that the university environment is not compatible with the demands of programed industrial research and development.

Finally, I want to remark on the excellent program which TNO has developed to serve small companies. In terms of research sponsorship, we in this country think of a company with 500 employees as small, yet TNO is able to work effectively with organizations having on the order of 100 employees. I might add that we find it extremely difficult to conduct meaningful research and development for the small U.S. company, although TNO has apparently developed the techniques which make this possible.

One of the excellent programs of international aid which has come to my attention is that of the Netherlands Government in which they conduct a series of workshops on research and development for the small- and medium-size company. These are attended by invited guests from all parts of the world, and who are provided with a fully paid fellowship for the approximately 6-month duration of the workshop. By bringing together representatives from a wide variety of countries, you can well imagine that the seminar discussions are truly worthwhile in exchanging experiences.

This kind of activity could well be brought to the attention of our own international aid groups. We may not be able to do as well as TNO in spreading the research and development gospel, but we might try.

Dr. JULIUS. Thank you very much.

Dr. HANDLER. Mr. Daddario.

Mr. DADDARIO. Dr. Julius, you classify as big industry that industry which has the capability of having a research organization of its own. You then go on to say that on occasion when it runs into a research problem which is too large for it to conduct within the scope of its research capability that it can use a TNO institute or multitude of TNO institutes to help them.

Dr. JULIUS. Yes.

Mr. DADDARIO. If as a result of this there develops a new invention, who has title to it then?

Dr. JULIUS. This is a question that cannot be answered very simply. It depends on the beginning of the cooperation. It may be a combination of industries. We then call it, a little bit after the English model, a research association. They may be big enough to have some research together. Most of these are stimulated by TNO, in contradistinction to the way they were set up in the United Kingdom where they have set up themselves. If such a research association has the dimension of a somewhat bigger industry and has its own research, it can address TNO. Then it can get what we call stimulated money. If it pays, let me say, 100,000 guilders for a project, the Government will spend another 100,000 guilders for the same project. In that case the patents are for the TNO organization.

With preference to the organization, we can give licenses to others who want to use that patent. This has been fixed in a contract beforehand. If, on the contrary, there is an industry which is doing research itself and it makes a straightforward contract with TNO, it can take up in its contract that the patents will be for this special industry. We have a patent department that deals with—I am very bad on numbers, I will not give the number of patents per year. The patent office, under its oath of secrecy, of course, can serve the organization and figure out what the best situation will be for the patent.

Beforehand it has been put into the contract whether the TNO organization will have the patent or not.

Mr. DADDARIO. Does the Patent Office, which handles the 300 or so patents that come out, stand in the position of the owner?

Dr. JULIUS. Yes; fully. It is a close unit within the TNO organization that serves the industry asking for research.

Dr. HANDLER. Dr. Whipple.

Dr. WHIPPLE. Mr. Chairman, Dr. Julius has given a most lucid explanation of a complicated and ingenious method. Just one detail is needed to clarify the relationship with what you call a medium-size business. Assume they ask TNO to help them out with a problem. TNO finds a solution which might not be patentable, which might be the substitution of a plastic for a metal or some such thing as that, but it is a definite step forward which is useful to them, and it very likely would be useful to other companies in competition or in somewhat similar operations. How is that research result handled? Is it made known to the industry that such a thing can be done? Is it kept secret? If another company comes in with the same question, are they given this answer, or do they have to spend some money to develop their own?

Dr. JULIUS. This is a very real situation. It may occur several times a year with the different institutes. The report or the solution of a problem within a contract is absolutely secret. If another firm comes with the same question to which the whole setup of results is directly applicable, we say always to the second one. "We have done that research but we are not free. We can advise you to go to the man who gave the first contract if he agrees. Do you mind that we ask him?" If he says, "I don't want you to contact anybody," then the question is closed, we are then admittedly in a somewhat difficult position because, as I have said, governmental money, public money, has been put in TNO and the one who has the first contract has been served at a relatively low price. But, as a taxpayer, the second one has put his money into TNO as well in an indirect way. So, when you have this difficulty—it may be mentally understood—he will blame TNO for being so unfair. We try to avoid this position and we try to convince him that the only reasonable way is to contact the other—the first one.

I must say this is the most frequent solution. It gradually becomes known in industry that many of their secrets are known to everybody. What we call a "factory secret" does frequently not exist after all. It is the great exception. When you talk with the people, mostly they understand what the position is and they come together. Then we say, "Well, all right, you make an appointment how the costs are divided. That is your matter." Then we send a report of the results to the other one. This is the most frequent solution. I must admit that under certain circumstances there is difficulty and we cannot deny that there are industries that do feel difficulties.

Mr. DE BLONAY. Dr. Julius has stated that although TNO plays a leading role in the formulation of Netherlands science policy, it is an organization which has direct access to the Ministry of Finance. I am sure that parliamentarians are very much interested, too, in the work of the TNO, and the question I wanted to ask is, Does there exist in the Dutch parliamentary procedure machinery for you to address a parliamentary committee as you do today before the U.S. Congress

and to enter into a discussion with a member of your own Parliament as you did with Congressman Daddario?

Dr. JULIUS. To answer that question, I must be a little bit careful. Let me do it in the way of a small story. I was asked to write an article on the science policy of the Netherlands, and when I took it to the editor he asked me a lot of questions, and one of these was practically the question you have put to me. He asked, "Why did you not answer that question in your paper?" I said, "Well, it is rather simple. I cannot touch spontaneously on something that does not exist."

The situation of the Parliament—let me call it the Second Chamber—compared with the House of Representatives here in the United States is quite different. All the work that is done here in the House of Representatives is done in the offices of the Ministries in Holland. What comes to Parliament is only the digest of the things that have been prepared in the Ministries. The Ministry of Finance has his contact with the Board of TNO, and because this is made independent from the governmental money as soon as it has been given to TNO, we cope with the matter with the Ministry of Finance. The Ministry of Finance notes that all the different Ministries concerned about the research activities of TNO do agree because they have been present in the boards of the different organizations where the programs are settled and the money is asked for. Then he, that is to say, the Minister of Finance, allocates TNO the subsidy over the different chapters of the budget relating to the different Ministries. So, every Ministry, everybody in the Parliament, everybody of the public knows in which fields the TNO organization is working. They can find it quickly in the budget. If they do not agree, they can say so, and then it goes back to the Ministries and it is remodeled. There is no direct influence and no direct responsibility on the work of the TNO as such in the Parliament.

Mr. MAJOR. Dr. Julius, toward the end of your presentation you mentioned that the Government in Holland contemplated now to give money to industry for research directly as a sort of compensation for the big contract for defense and space activities which you find in some other advanced countries. You also say that you, as the leader of the TNO, were very afraid of this, that this was competition which could become disorganized in a way.

I understand your anxiety. We have the same situation in our country and, as a matter of fact, we probably have an organization comparable to your organization in our country to do this work. In spite of the fact that we also run institutes and get it all coordinated, and in the beginning stage we are in doubt, we have experienced, as most other countries do, increased competence in this field with Government money automatically in partnership with an institute. In this way you can try to see what is best from the point of view of obtaining competence inside industry or in an institute.

The Canadians have had the same problem. They have asked the National Research Council to take care of this. I would ask you, have you considered such a solution in your own country?

Dr. JULIUS. The solution as such seems to be acceptable to me, but it is absolutely unrealistic as to my country because the intention, at least the ideas for the intention are developing that the money that the Government will spend for research by industry will be given

directly to industry eventually for an existing industrial research institute or industrial research. So far there are no objections. But when industry starts to expand its possibilities to take up new scientists and to increase their activities and eventually even make new buildings, then you have a difficult position. If there were a council through which the flow of money could be directed, I would fully agree, but this is what some ideas in the Ministries do not want. They want to give direct support to industry.

In the budget of the Ministry of Economic Affairs there has been this year for the first time an amount of money for direct flow to industry to do research. When it starts, it is all right; but when you look in the future, we see severe complications. Could we be so wise as to do it through a council or through an advisory body, it would be much better.

Dr. HANDLER. Three of our panelists asked for the floor almost half an hour ago. If they still remember their questions, we will keep going. Dr. Malina.

Dr. MALINA. Professor Julius, I have a question. Is the Dutch financial participation in ESRO, the European Space Research Organization, and in ELDO, the European Space Vehicle Launcher Development Organization controlled by the TNO?

Dr. JULIUS. Neither by TNO nor by its sister organization, ZWO, that is, the Organization for Pure Research. This is money that goes directly from the Government to these bodies you mentioned.

Dr. MALINA. Is the amount of funds that are being channeled into these European research and development organizations becoming appreciable relative to your own budget?

Dr. JULIUS. Becoming, yes, gradually. But when you ask me this fundamental question, I have to bring in very shortly a new development in my country. Mr. Kaneshige has spoken about the country examinations. When these country examinations in OECD started, Holland was the first one to be asked to participate. At that moment we asked for delay, because we were in very active development, leading to an Advisory Council for Science Policy composed of people from science to advise the Government directly about science policy. They will advise the Government, the Government remaining absolutely free to take their decisions, how to regulate the balance between all the different flows of money. By this council the money brought to CERN or ESRO or something of this type will be discussed. Up till now it is not. It is only taken up in the budget. The budget has to be approved by the Parliament. The Parliament can discuss it. They can send it back and have it changed or they can accept it. Thus there are separate flows that are not brought into mutual relation. Since one year we have this advisory council looking at all the chapters or items of money going to science, that is, together, the universities, the technical universities, the nuclear energy, space research, the international research, TNO, and the fundamental research organizations, the ZWO organization. Now these will all be considered by one council and it is hoped that the complicated situation will become somewhat less complicated or perhaps doubly complicated so that nobody will object any more.

Dr. HANDLER. Dr. Stever.

Dr. STEVER. Dr. Julius brought up the matter of patents owned by TNO and industry, and so on. In this country and I think many

others, the Government has found itself in a somewhat embarrassing and peculiar position with respect to patent ownership when it owns patents. It has two objectives in giving the patent monopoly. One is to bring out information, that is, to encourage invention and the disclosure of invention, but the other and possibly more important is to get that new information exploited.

In certain areas the exploitation is very expensive, more so, in fact, than the invention. Pharmaceuticals, for example, require not only the invention but a long period of perfection and testing before they are used on humans. Many people in this country think that our Government is a very poor exploiter of some of the ideas that it owns because it supported the research. I am sure you will find argument on that, but there are many who believe this is the case.

On the patents it has, can TNO sell them outright to an organization that needs a monopoly to exploit them, are they given to the lowest bidder, or what?

Dr. JULIUS. Theoretically, the situation is very simple. It can give them out and can ask money for it in return.

Dr. STEVER. But it grants the license completely, and the organization to which it is given or sold has the patent right? It is not common property?

Dr. JULIUS. That is true, but it is very difficult to sell them. We have a collection of patents that is unsold. The reason is very hard to understand unless you are inclined to admit that a period of prosperity is a very bad period for science, for if the industry can earn its money with its own products, it will not change to new ones. They will get the economic evaluation as far as possible of the old projects, and they will not switch over to new ones unless there is no longer money in the old ones.

We have patents which we are convinced, if they could be exploited, would be very useful, but we cannot find the industry to embark on them. So, the difficulty is not solved, but the theoretical situation is very simple.

Is that an answer to your question?

Dr. HANDLER. I think Dr. Meyer had a question.

Dr. MEYER (special consultant, Senate Subcommittee on Government Research). Under discussion here are institutes for the application of knowledge, and you allude to the fact that there are other institutions for fundamental knowledge, research. Nevertheless, does your organization encourage relevant fundamental research and, if so, to what extent?

Dr. JULIUS. I do not understand your question. Our organization doesn't stimulate anything out of its own work.

Dr. MEYER. I wondered whether you carry on in-house fundamental research relative to your practical goals.

Dr. JULIUS. Now it is clear to me. That depends. When we come to a very fundamental project, it may be that we take it up ourselves, feeling that it is oriented fundamental or objective fundamental or something like that. Basically there is a "free" sector in the activity of the institutes that depends on the relationship of contracts and governmental subsidy. Sometimes we go into the fundamental field, but if it becomes too fundamental, we hand it over to a university if they want to have it, or we can stimulate someone else to do it by a

subsidy of the pure research organization, or we stop it because it costs too much money for us to continue it.

There is also the opposite aspect that some fundamental work done by universities or done by the organizations for fundamental research may come into the applied sector, and then we are supposed to negotiate what part will be taken over by TNO and what part done by the original investigator. This situation is more theoretical than practical.

This is not very definite, but it is the only way of answering your question, because this is the real situation.

Dr. HANDLER. Dr. Zucrow, anybody with your name must be used to getting in the last question.

Dr. ZUCROW. Always.

Dr. Julius, I am very impressed with the fact that you apparently are able to help small industry. The land-grant college or university in this country has done an outstanding job in agriculture, and it always has been the hope and the prayer of every dean plus anybody in a laboratory to do something for small industry, but by and large I can say they have never been able to accomplish that objective.

I want to know what is the ingredient, having good laboratories apparently, is not the answer. What has happened in this country, is that the engineering experiment stations of the land-grant colleges work on problems for the Defense Department, on contract research. I think it is fine they are doing things to help the national defense and to advance science, but small industry still is a part of our economy, a segment of our economy which is receiving very little attention.

I bring this up not only to you but also to our chairman.

Dr. JULIUS. It is very hard to answer this question in a definite way. We are permanently striving to build up contacts with small agencies, but the father-to-son system of firms is not open for much improvement. It will probably take some time before they will be willing to accept that TNO can mean something for them. This will only happen when the difficulties are so big that they cannot do anything better than try to improve their situation—and this is a very sad situation in my opinion—they evaporate and stop their industry or they become part of a bigger firm. The tendency of fusion of firms and building up bigger concerns is so strong and rapid that I suppose that much of those small industries that are not satisfying and would need research will disappear. Most of those that want research will disappear and only those that are making products that are not too expensive so that they can do without research are the only ones that will remain. I am not optimistic in the least concerning that situation. They can get research and we should like to give it to them, but they will not accept it because they are not equipped and have not the mentality to accept the possible help we can give them.

Dr. HANDLER. Just so Dr. Zucrow won't always be last, we will take one last quickie.

Dr. LEON GREEN, Jr. (Air Force Research and Technology Division). I don't want to ask a question of Dr. Julius, but to thank him for his description of the beneficial working of this triangular arrangement between the Government and industry and the scientific community. This is because in this country there have been views of alarm at not a formally constituted arrangement, but an informal growth of what

some people tend to view as the insidious or dangerous arrangement between the military, industry, and the scientific community, and by the "military" I include the rest of the Government, too. This congressional committee and everybody concerned with science is part of the same triangle, even though it is informal.

Since I am part of the conspiracy, I haven't worried about it, but I am pleased to hear Dr. Julius say that instead of sapping our strength and making us into a contract saint, as the phrase goes, this is in fact a source of our strength.

Dr. HANDLER. Before turning the Chair back to Mr. Daddario, I should like to remind all of you that tomorrow Dr. Harrison Brown will be sitting in this spot as moderator, and the first speaker of the day will be Dr. Hornig, Director of the Office of Science and Technology. Following him we will hear from Dr. Zaheer from India and Dr. Chagas from Brazil, and after that we will have some comments and observations by Mr. de Blonay and Dr. Malina. Following that we will hear from the chairman again, who will wrap it all up.

Until then, I would like to turn the Chair over to Mr. Daddario and express my very great pleasure in having been permitted some small part in these proceedings.

Mr. DADDARIO. Dr. Handler, I want to thank you on behalf of the committee for having done an outstanding job, and to apologize to everybody because the air conditioning hasn't been functioning properly in this highly complicated scientific world in which we live.

It has been a very active and profitable day for us. The committee is extremely pleased with the participation of our speakers and the reactions to what they have said by the audience. We will look forward to more of this tomorrow. We thank all of you and look forward to seeing you at the reception at the Congressional Hotel.

Mr. FULTON. Could I decline a nomination here when the Air Force nominated those of us in Congress on this insidious triangle? We have gone through a campaign, and that is one new adjective I haven't had to meet until now.

Mr. DADDARIO. The meeting stands adjourned until tomorrow morning at 10 o'clock.

(The meeting adjourned at 4:45 p.m.)

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Physical chemist; born Milwaukee, Wis., 1920; son C. Arthur and Emma (Knuth). B.S. Harvard Univ., 1940; Ph.D. Harvard Univ., 1943; St. John's Coll., Oxford Univ., 1954–55 (Guggenheim grant and Fulbright scholarship); first Bourke overseas lecturer, Faraday Soc., London, 1955; LL.D. (hon.) Temple Univ., 1964; Univ. Notre Dame, 1965; Boston College, 1966; D.H.L. (hon.) Yeshiva Univ., New York, 1965; D. Sci. (hon.) Rensselaer Poly. Inst., 1965; Univ. Maryland, 1965; Ripon Coll., 1966. Married Lilli Schwenk, 1943; children—Joanna, Ellen, Christopher, Leslie. Res. Associate, Woods Hole Oceanographic Inst., 1944; gp. leader Los Alamos Lab., 1944–46; asst. prof., 1946; asso. prof. and dir., Metcalf Res. Lab., 1949; prof. 1951; asso. dean of grad. school, 1952; subsequently acting dean, Brown Univ., 1952–57; ch., Dept. Chem., Princeton, Univ., 1958–64; first incumbent, Donner Chair Sci., Princeton Univ., 1958; Sp. Asst., President Johnson for Sci. and Tech., 1964—; Ch., Federal Council Sci. and Tech., 1964—; Dir., Office Sci. and Tech., Exec. Office of President, 1964—; Ch., President's Sci. Advisory Committee, 1964—. Asso. editor, *J. Chem. Physics*, mem. Editorial Advisory Boards of *Spectochimica Acta* and *Molecular Physics;* pres., Radiation Instruments Co., 1945–47; Ch. Proj. Metcalf, Office Nav. Res., 1951–52; mem. Space Sci. Board, Nat. Acad. Sci., 1959–64; mem. Sci. Advisory Comm., 1960–64; mem. Kennedy Task Force on Space, 1960; mem. U.S. Delegation, USSR–US negotiations on space, 1962–63; mem. Advisory Committee, Office Sci. Res., U.S. Air Force, before 1964. Exec. Committee, Div. Phys. Inorg. Chem., Am. Chem. Soc., 1954–57; fellow, Am. Phys. Soc. (mem. exec. committee, Div. Chem. Physics, Ch. 1957–58); fellow, Am. Acad. Arts Sci.; fellow, Faraday Soc., London; mem. U.S. Nat. Acad. Sci., 1957—; mem. Board Overseers, Harvard Univ., 1964; hon. mem. Rumanian Acad. Sci., 1965. Published over seventy papers in technical journals on mol. and crystal structures, infrared and Roman spectra, shock and detonation waves, relaxation phenomena, fast chem. reactions at high temps.

JULIUS, H(ENRI) W.

Bacteriologist and Doctor of Medicine; born Hague, the Netherlands, Nov. 19, 1901; son, Charles Henri and Catharine Elisabeth (de Vogel). M.D., Univ. Leyden, 1927; married Geertruda Maria Peters, Sept. 8, 1927; children—Geertruda Maria and H. W., Jr.; researcher, serology and cancer, Univ. Leyden, 1927–30; chief ass't., bacteriology and virology, Univ. Utrecht, 1930–38; prof. bacteriology, infectious diseases and hygiene, 1938–51; Sec. and Rector Magnificus, 1952–54; prof. Extraordinary, 1959; chm., Org. for Nutrition and Food Research, 1947–50; chm., Central Org. Applied Sci. Res. in Netherlands (TNO), 1959—. Fulbright Fellowship, Univ. Cal. Med. School, 1951–52; Knightship, Order of Netherlands Lions, 1956; mem., Royal Netherlands Acad. Sci.; mem. Assoc. Natural Med.; mem., Acad. Sci. Lisbon. Author of over 90 sci. publications and essays on carcinogenesis, medical education, chemotherapy, immunology and social hygiene. Home: 12 Koningskade, The Hague.