U.S.-U.S.S.R. COOPERATIVE AGREEMENTS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL COOPERATION IN SCIENCE AND SPACE

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETY-SECOND CONGRESS

SECOND SESSION

JUNE 13, 14, 15, 20, 21, 1972

[No. 20]

Printed for the use of the
Committee on Science and Astronautics

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL COOPERATION IN SCIENCE AND SPACE

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETY-SECOND CONGRESS

SECOND SESSION

JUNE 13, 14, 15, 20, 21, 1972

[No.]

Printed for the use of the
Committee on Science and Astronautics

U.S. GOVERNMENT PRINTING OFFICE
80-787 WASHINGTON : 1972

COMMITTEE ON SCIENCE AND ASTRONAUTICS

GEORGE P. MILLER, California, *Chairman*

OLIN E. TEAGUE, Texas
KEN HECHLER, West Virginia
JOHN W. DAVIS, Georgia
THOMAS N. DOWNING, Virginia
DON FUQUA, Florida
EARLE CABELL, Texas
JAMES W. SYMINGTON, Missouri
RICHARD T. HANNA, California
WALTER FLOWERS, Alabama
ROBERT A. ROE, New Jersey
JOHN F. SEIBERLING, Jr., Ohio
WILLIAM R. COTTER, Connecticut
CHARLES B. RANGEL, New York
MORGAN F. MURPHY, Illinois
MIKE McCORMACK, Washington
MENDEL J. DAVIS, South Carolina
BOB BERGLAND, Minnesota

CHARLES A. MOSHER, Ohio
ALPHONZO BELL, California
THOMAS M. PELLY, Washington
JOHN W. WYDLER, New York
LARRY WINN, Jr., Kansas
ROBERT PRICE, Texas
LOUIS FREY, Jr., Florida
BARRY M. GOLDWATER, Jr., California
MARVIN L. ESCH, Michigan
R. LAWRENCE COUGHLIN, Pennsylvania
JOHN N. HAPPY CAMP, Oklahoma

CHARLES F. DUCANDER, *Executive Director and Chief Counsel*
JOHN A. CARSTARPHEN, Jr., *Chief Clerk and Counsel*
PHILIP B. YEAGER, *Counsel*
FRANK R. HAMMILL, Jr., *Counsel*
W. H. BOONE, *Technical Consultant*
JAMES E. WILSON, *Technical Consultant*
RICHARD P. HINES, *Staff Consultant*
HAROLD A. GOULD, *Technical Consultant*
J. THOMAS RATCHFORD, *Science Consultant*
PHILIP P. DICKINSON, *Technical Consultant*
WILLIAM G. WELLS, Jr., *Technical Consultant*
JOHN D. HOLMFELD, *Science Policy Consultant*
CARL SWARTZ, *Minority Staff*
JOSEPH DEL RIEGO, *Minority Staff*
ELIZABETH S. KERNAN, *Scientific Research Assistant*
FRANK J. GIROUX, *Clerk*
DENIS C. QUIGLEY, *Publications Clerk*
A. PATRICK NUCCIARONE, *Assistant Publications Clerk*

SUBCOMMITTEE ON INTERNATIONAL COOPERATION IN SCIENCE AND SPACE

JAMES W. SYMINGTON, Missouri, *Chairman*

JOHN W. DAVIS, Georgia
ROBERT A. ROE, New Jersey
WILLIAM R. COTTER, Connecticut
MORGAN F. MURPHY, Illinois
MENDEL J. DAVIS, South Carolina

LOUIS FREY, Jr., Florida
ALPHONZO BELL, California
LARRY WINN, Jr., Kansas
ROBERT PRICE, Texas
BARRY M. GOLDWATER, Jr., California

CONTENTS

WITNESSES

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS ON SCIENCE AND TECHNOLOGY, SPACE, ENVIRONMENT, AND HEALTH AND MEDICINE

TUESDAY, JUNE 13, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON INTERNATIONAL
COOPERATION IN SCIENCE AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m. in room 2318, Rayburn Office Building, Hon. James W. Symington (chairman of the subcommittee) presiding.

Mr. SYMINGTON. The subcommittee will be in order.

This morning, the Subcommittee on International Cooperation in Science and Space will begin 5 days of open hearings on the cooperative agreements on science and technology, medical science and public health, environmental protection and space exploration, which were recently entered into by the United States and the Soviet Union in Moscow.

We have invited distinguished witnesses to discuss these agreements with us in order to provide the committee with better insight into their full meaning, and their implications for the future. The committee would also like to explore potential methods for implementing these important international agreements.

Implicit in these accords, it seems to me, is an acknowledgement on the part of the executive leadership of both nations that science and technology know no international boundaries; that the problems of pollution and environmental protection are global in nature; that breakthroughs in health science are more likely to be achieved through the cooperative efforts of the great medical communities of our two nations; and that the exploration of our universe is, and should be, an enterprise of all mankind.

Woodrow Wilson, in an address before the U.S. Senate, had this to say: "There must be, not a balance of power, but a community of power; not organized rivalries, but an organized common peace."

Four wars, many thousands of American lives, and billions of tax dollars later, we stand on the threshold of the opportunity to test the validity of President Wilson's observation. We certainly have given "organized rivalries" a fair try.

Surely, the deeper significance of these agreements lies in the promise they hold for the reduction of tensions between the two signatories. It is difficult to shake hands and fists at the same time. These accords,

backed by the proper commitments, should herald an unprecedented era of mutual application to the common problems of humanity. It will be implicit, I am sure, in our discussions, that our interest in these positive expressions of United States-Soviet détente in no way diminishes the value we attach to past, present, and future arrangements of this kind we have with so many other nations in the world. There is plenty for us all to do, and limited time to do it.

The Congress has been asked to support these initiatives. I am confident it will do so, particularly if it has been given the opportunity to review them carefully. That is our purpose.

And to aid us in that purpose, I now take great pleasure in welcoming our leadoff witness, the very distinguished president of the Ford Foundation, a gentleman who brings extraordinary ability, experience, and perspective to our discussions, a familiar name in the highest councils of our Government, and an old friend, the Honorable McGeorge Bundy.

Good morning, Mr. Bundy.

(The biographical sketch of Mr. McGeorge Bundy follows:)

McGEORGE BUNDY, PRESIDENT OF THE FORD FOUNDATION

McGeorge Bundy was born in Boston, Massachusetts, March 30, 1919, son of Harvey Hollister and Katharine Lawrence (Putnam) Bundy. He received his preparatory education at the Dexter School, Brookline, Massachusetts, and the Groton (Massachusetts) School and was graduated A.B. in 1940 from Yale University. In the following year he became a Junior Fellow at Harvard University.

Mr. Bundy entered the U.S. Army as a Private in 1942 and was advanced through grades to the rank of Captain prior to his discharge in 1946, participating in Operation Husky, the invasion of Sicily, and Operation Overlord, the invasion of France.

Following the war he served during 1946–48 as Assistant to Henry L. Stimson, who was readying the manuscript of the book, "On Active Service in Peace and War" (1948), of which Mr. Bundy was coauthor.

Early in 1948 Mr. Bundy served as a consultant to the programs division of the Economic Cooperation Administration, which administered the Marshall Plan. In September 1948, he served as research analyst for foreign policy on a committee recruited by the Republican presidential candidate, Thomas E. Dewey. He then served as a political analyst for the Council on Foreign Relations, New York City, in a study of the Marshall Plan.

In 1949 Mr. Bundy returned to Harvard University as visiting lecturer in government. He was advanced to Associate Professor in 1951 and to Professor of Governmment in 1954, maintaining the latter position until 1961. He also was Dean of the Faculty of Arts and Sciences at Harvard University from 1953 to 1961.

In December, 1960, Mr. Bundy was appointed by President-elect John F. Kennedy to the post of Special Assistant to the President for National Security Affairs. In this capacity Mr. Bundy served as a staff officer on foreign and defense policy for Presidents Kennedy and Johnson until March 1, 1966 when he became President of the Ford Foundation.

Mr. Bundy is editor of "Pattern of Responsibility" (1952), and the author of "The Strength of Government" (1968). Honorary LL.D. degrees have been conferred upon him by Brown University, Harvard University, Oberlin College, Hofstra College, the University of Notre Dame, Brandeis University, and Boston University, and an honorary L.H.D. degree by Yale University. Mr. Bundy is a member of Phi Beta Kappa, the American Political Science Association, and the Council on Foreign Relations.

Traveling and playing tennis are his principal avocations.

Mr. Bundy was married at Beverly Farms, Massachusetts, June 10, 1950, to Mary B. Lothrop of Boston, Massachusetts. They have four sons, Stephen, Andrew, William and James.

STATEMENT OF McGEORGE BUNDY, PRESIDENT, THE FORD FOUNDATION

Mr. BUNDY. Mr. Chairman and members of the subcommittee, it is an honor to appear at these hearings on the four bilateral agreements on cooperation in space, health, environmental protection, and science and technology that were signed in Moscow May 23 and 24. If these agreements are to fulfill their promise, they will need the understanding and support of the public and the Congress, as well as the executive branch. I would like to begin, Mr. Chairman, by offering my warm congratulations to you for the initiative you have taken in holding these hearings so promptly.

These matters are of very great interest to us at the Ford Foundation because our organization is by far the largest private participant in exchanges which have developed with the Soviet Union and other Eastern European countries over the last 15 years, and my own interest, as you suggest, goes back also to a period where the opening of better communications with the Soviet Union was a constant preoccupation of the two administrations in which I served.

These agreements have a history that goes back at least to 1958. In that year, we were still in a period when President Eisenhower could warn us all, and did, in his state of the Union address, of the "increasingly serious" threat of Communist imperialism, and summed up his warning in these blunt words: "The Soviets are, in short, waging total cold war."

But in a prophetic part of that same address, President Eisenhower made a number of dramatic proposals, which he aimed specifically at the Soviet Union, for peaceful exchanges and cooperation. He urged the Soviet Government, and I quote: "to cooperate in turning principle into practice by prompt and tangible actions that will break down the unnatural barriers that have blocked the flow of thought and understanding between our people." He went on to propose exactly the kind of concrete cooperation which is now promised in these new agreements. Indeed, some of the subjects he offered for such cooperation foreshadow the language of Moscow 1972: Cancer, heart disease, and "science for peace." Finally and most significantly, his proposals, like these agreements were part of a whole series of what he called works of peace, in which he laid greatest emphasis on the need for "a real first step toward disarmament."

Most of what President Eisenhower thus proposed drew no affirmative Soviet response, but in one field—that of cultural and educational exchanges—the first bilateral agreement was signed in that same January of 1958. So both large aspirations and a small reality date back to that now distant year.

Moreover, every President since then has tried to reach out from the beginnings of the Eisenhower administration. In President Kennedy's administration, there was the remarkable speech at American University in which the President appealed directly for both sides to reexamine their attitudes toward the cold war. This speech drew an affirmative Soviet reply which, in turn, opened the way to the limited Test Ban Treaty of 1963.

Efforts of this same kind, on a still broader front, were a continuous part of the policy of President Johnson. His own clear and excellent

chapter on these efforts is called "Thawing the Cold War," and his list of achievements includes the first Civil Air Agreement, the Outer Space Treaty, the Consular Convention, special agreements on fishing, and, above all, the Nonproliferation Treaty, aimed at preventing the spread of nuclear weapons.

Now in 1972, another long step forward has been taken by our two countries, and President Nixon richly deserves the applause of his countrymen for all he has achieved for peace in Moscow.

What have we learned in these 14 years that may help us understand the meaning of the four Moscow agreements you have before you?

First, I think we must take note of the fact that it nearly always takes longer than we initially hope to get real agreements between our two countries. President Johnson put this point well when he concluded that: "Reaching agreements with the Soviets on almost anything would take time, but that agreement could be reached if there were enough patience and understanding on both sides."

There are many reasons for this slowness. The most important may be the fact that in each field we have had to start from a profound mutual ignorance and a settled habit at political levels of mutual suspicion. We do not treat our scholars and scientists as the Russians treat theirs, and it has been a long, slow business to develop mutually acceptable means of exchange and communication, and that is only one field. At the beginning, habits which seemed as natural as air on one side were quite literally incomprehensible on the other.

Second, I think we have had to learn that real progress must often also be limited progress. When we began to work for nuclear disarmament—way back in the 1940's—we sought foolproof safeguards and strict international controls, failing to recognize that such safeguards and controls would be totally incompatible with the political and ideological imperatives of the Soviet system. Now we know that it is necessary—and in some ways technically preferable—to rely on national means of verification. But we also know there is more safety in admittedly partial agreements, based on a recognized balance of nuclear power, than there was in the unlimited race of the 1950's.

These principles are less immediately visible, perhaps, in fields like health, science, and the environment, but they apply there, too. We do well not to pretend that communication and understanding are easy even in these less sensitive areas, or that political reservations do not exist, in differing ways, in both countries.

But there are two other lessons which are more encouraging. The first of these is that progress tends to be cumulative. Our growing experience in dealing with one another does help us to higher and deeper kinds of communication and understanding. Again this point may be most vivid in the matter of arms control. It is clear that both statesmen and experts on both sides have learned a great deal about the subject and about each other in the last 14 years, and there can be little doubt that the arms agreements of Moscow would have been impossible without that long learning process. But this point is clear also at the simplest level of cultural exchange. If we look back at the early period of those exchanges, in the late fifties and early sixties, and recollect the number of difficulties both sides had in such simple matters as trading visits of artistic groups like symphonies and danc-

ers, it is startling and instructive to review the comprehensive and detailed plan of exchanges set forth in the eighth 2-year agreement, which was signed last April 11 in Moscow. This agreement is impressive not only in the range of activities for which it provides, but also in the demonstration it gives of the number of different kinds of men and women, in both countries, who now have practical, and on the whole successful, experience with this process. The process of cultural exchange has not been simple, and there was a time in the late 1960's when Soviet interest seemed dampened, probably by domestic political fears. The upward trend has been neither unbroken nor rapid. But over the full 14 year period it is very clear indeed.

A second affirmative point that deserves particular emphasis here is that all these varied forms of bilateral relations tend to be mutually reinforcing. It really is true, between these two vastly different and enormously powerful societies, that all forms of serious communication are valuable beyond the immediate field in which they occur.

This is an important point, Mr. Chairman, because quite often one hears the argument from a qualified scientist or specialist that the actual research results that are produced by the rather complex process of cooperation may not be as great as what he and his team could achieve if they were left undisturbed in their own laboratories, and seen from the narrow point of the individual science, that argument has considerable force. But when you look at the wider question of effective communication between these two critically important social systems, you get a new and heavy argument in favor of the special efforts which are needed to develop effective cooperation.

An example of the value of communication—one which is not directly before you today—is that of the value and the significance of the increasingly informed and sophisticated studies which go on in each of our countries with respect to the other. At the height of the cold war the Soviets regularly denounced most American scholars working on Soviet questions as lackeys of imperialism, and there was a time when we too viewed most Soviet studies of American problems as relating mainly to espionage or propaganda. Both sides have learned better now, and for both sides it is better that in negotiations between our two countries each Government is now able to rely on much more sophisticated and deeper analysis of the realities of the other society, than was the case a decade ago.

Let me turn now from general considerations to the four specific agreements that are the immediate subject of these hearings. In essence, as I read them, they are documents which set forth purposes and procedures rather than at this stage concrete plans of action. It is quite natural that this should be so, for precisely the reason that in these fields, as I have already said, we must expect to learn by doing. I feel confident that the expert witnesses from the administration can tell you much more than any outsider possibly can about the size and shape of the specific undertakings which are likely to be early on the agenda in each of the four cases.

In reading the agreements, however, I observe two facts which I think may have practical and constructive significance. First, insofar as the agreements do designate specific responsible agencies in each government, it appears that those designated do indeed have the combination of political influence and technical skill which is necessary if

practical results are to be achieved. It seems right, for example, that there should be a direct relationship between our Office of Science and Technology and the State Committee of the U.S.S.R. Council of Ministers for Science and Technology. These two agencies, OST and the State Committee, are in a position to make agreements that will work. The same thing is obviously true of the relationship which is established in space between NASA and the Soviet Academy of Sciences. Many of our past relations with the Soviet Union in these fields have been defined by the cultural agreements negotiated between diplomats, and it has not been very frequent that the two governments have allowed direct and businesslike negotiation between operating agencies. Until we see their results in operation, it would be premature to claim that these new agreements mark a definite and durable shift to more practical and less politically inhibited forms of cooperation, but at least the possibility is open, and I hope that you will wish to explore it with expert witnesses.

A second implication of these agreements is that the two parties intend to move on from the stage of exchanges of information and individuals to specific cooperative undertakings. One of these, the proposed joint space mission, is already concrete in its purpose and will clearly require intense and sustained cooperation between large technical teams. Other cooperative ventures are foreshadowed, if not so sharply described, in the other agreements. Active cooperation is much harder than exchanges, and we must therefore be prepared to expect that there may be delays and difficulties in one or more of these undertakings, just as we must also expect that there will be limits on the degree of cooperation that is achieved. But if these cautionary words are suggested by our past experience, it is also right to value this new prospect of achieving cooperation both for what it will gradually teach us about working together in each field and for the impact it may have on wider relations between our two countries. I believe that President Nixon stated this point clearly and well when he said in his address to the Congress, and I quote:

> By forming habits of cooperation and strengthening institutional ties in areas of peaceful enterprise, these four agreements will create on both sides a steadily growing vested interest in the maintenance of good relations between our two countries.

In closing, Mr. Chairman, I would like to make one last point which is at once obvious and subtle, (but a little less important now because you've already made it yourself in your opening statement). As we move into a period in which there may be considerably enlarged bilaterial cooperation in peaceful subjects between the Soviet Union and the United States, it will be extremely important for us not to neglect the opportunities and obligations for cooperation with many other nations in these and other fields. We should not treat as mere window-dressing the assurance in the Moscow Declaration of Basic Principles that in strengthening their own bilateral relations neither the Soviet Union nor the United States intend any inattention to its interests and obligations with respect to other states. That we have such interests and obligations is self-evident, and of course the point is underlined this week by the continuing discussion of environmental questions to a worldwide forum at Stockholm.

It is easy to state the obvious proposition that bilateral cooperation should not lead to neglect of wider responsibilities, but to frame and execute policies that respect this requirement is a much more complicated matter, and it seems to me that the mandate of your subcommittee gives it a constructive opportunity to keep public and official attention clearly focused on this issue. For if we are indeed to move from the age of exchange to that of active cooperation, there will be significant budgetary implications which will necessarily and closely engage both this committee and others with responsibilites for authorization and appropriations. Active cooperation is much more expensive than technical and cultural exchanges, and where there is a new level of cost there must be a new level of congressional engagement. It happens that in the exchanges of earlier years the private sector—and in particular the Ford Foundation—has often had a larger financial role than the U.S. Government itself. But the kinds of undertakings which are now in prospect will require a very different level of financial support. So perhaps one consequence of these agreements is that primary fiscal responsibility will shift, in this field, from private institutions like the one I represent, toward public bodies like this subcommittee.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Thank you very much for an extremely stimulating and helpful statement, and one which raises questions on this side of the table.

May I say how grateful I am for your coming to Washington, not only during a particularly busy week, but on a particularly busy day in your schedule, to help us in our deliberations.

Before we turn to the questions, I would like to mention that we have with us today our ranking Republican member of the subcommittee, Louis Frey of Florida. Also present is Charles Mosher of Ohio, who is the ranking Republican member of the full committee. Mr. Mosher and I have made a number of international forays in the past. We are also joined today by Mr. John Seiberling of Ohio on the Democratic side.

We are grateful for the presence and interest of three distinguished members of the Soviet Embassy, Mr. Victor Isakov, Counselor—The political counselor. I believe; Mr. Victor Sakovich, Cultural Counselor; and Evgeniy Belov, Scientific Counselor, all three of whose responsibilities bring them here, and they are most welcome.

Mr. Bundy, your testimony emphasizes the need to reassure the international community that we are not embarked on some kind of exclusive arrangement between the Americans and the Soviets at the expense of our relationships with other nations.

You mentioned the Stockholm Conference. Of course, that is one in which, for understandable political reasons, the Soviet Union felt obliged not to attend. Clearly, whatever initiatives the two nations undertake under these accords ought to be of the kind that stimulates attendance and participation. We would agree with that.

I'm wondering if you would have any thoughts on the possibility of extending, let us say, this kind of cooperation to such organized rivalries as NATO, and the Warsaw Pact countries, working in scientific teams to resolve, let us say, shared European problems of environment, health, and so forth?

Mr. BUNDY. My own experience here is limited. My personal feeling has been that—and here I may have a difference with the present administration, and it is a small one—that organizations initially put together for the purposes of collective security, and held together primarily by their military and political meaning, are really not the best places in which to develop extensive cooperative programs in these other fields. I therefore would be inclined to doubt the value of looking toward explicitly designed programs of cooperation which engage NATO on one side and the Warsaw Pact powers on the other.

It seems to me somewhat more likely that it will be wise to defer the questions of the format for particular regional cooperation on these kinds of subjects, until we know more about the evolving discussions of European security which are now on the agenda, although without a timetable, as a result of the Moscow meeting.

More broadly, Mr. Chairman, I didn't wish to give the impression that I think that there is anything wrong about it. In these kinds of special bilateral efforts, one of the reasons that we need agreements of this kind is that because of the very great differences between our kind of society and the Soviet society, you simply do not get easy movement and exchange among persons with common interests without a well developed and systematic process.

Of course, that's not true in our relations with most of the other countries in the world. We have no serious problem in discussing questions of environmental difficulties with our friends in Canada or the United Kingdom. We have only linguistic problems in discussions with other Europeans and other American countries, because people can move easily. You do not have to have the protection of an international agreement to get access to your opposite numbers and, all in all, outside the Communist countries the system of interchange among scientists, experts in health, students of environment and all of the subjects under these agreements, is a self-sustaining process in very large measure, of a sort which is quite different from the necessity for special connection, especially approved and ordered relations, which is a necessary part of the effort to develop stronger communications between the Soviet society and our society.

Mr. SYMINGTON. I would be interested next in your thoughts concerning what might prove the most effective composition, on the American side, of the joint commissions meeting in the quest of science, health and environment.

No such commission is established in the space agreement, because mechanisms already exist for that type of exchange.

It is not quite clear, from the language here, how these members are to be selected, or from what disciplines. I imagine there would be considerable interest in them, and the Government would do well to anticipate any objections that might be raised in advance.

Have you any helpful suggestions?

Mr. BUNDY. Probably the most helpful thing that anyone can do when people are charged with representing various committees, is to avoid specific suggestions, Mr. Chairman.

I think it's unquestionable that there will be an awful lot of people interested in participating. The scientific community in the United States is characterized, and has been for many years, by a very con-

siderable interest in cooperative communication with the Soviet Union. There have been some signs in recent years that some of those who have encountered difficulties—and there have been such difficulties—have lost some of their enthusiasm. Still, in the current mood and with the prospect of active cooperation, clearly you can expect a good many people will, and should, want to get into the act.

The administration's problems will begin in some of these fields by the fact that more than one agency of the U.S. executive branch here in Washington has claims. I think the kindest and most sensible thing for me to do is to say that that is a problem, but it's not my problem.

Mr. MOSHER. Mr. Chairman?

Mr. SYMINGTON. Yes, Mr. Mosher.

Mr. MOSHER. Would you say, however, that some part of the congressional representation should get into the act?

Mr. BUNDY. There is provision in the declaration of principles for increased exchange among legislative representatives. This doesn't apply specifically to any one of the agreements, Mr. Mosher, as I read it. But it is an expression, at least, by the two governments that increased legislative contact would be important.

I'm not sure that's really a very responsive answer to your question, because it's not at all clear to me that real participation in these kinds of agreements on the Soviet side is likely to have a very large legislative component. In practical terms, I really don't know. I am no expert on that. But it seems to me that at least it's a question that arises as to the way in which our Government will keep an effective relation between those in the executive branch with immediate sort of leadoff responsibility, and those in the Congress, who will have responsibility as they go through regular acts of authorizations and appropriations, which may be providing the structure and the funds for a specific cooperative undertaking.

I've been involved for some time, as some members of the committee know, in the possibility of an East-West institute that would include the Soviet Union and the United States and other countries. That is a complicated undertaking because it is multinational, and it has seemed, I know, to all of us involved in this that it was critically important to maintain full communication with interested Members of the Congress while those negotiations were proceeding.

I have no relation to it now. That matter is now in the hands of Dr. Handler of the National Academy, but I do think your question underlines the point I was trying to make at the close of my own testimony, namely, that the more serious and substantial these processes of cooperation become, the more there is the requirement for effective engagement of appropriate Members or committees of Congress, so that they know what is going on in time to have an input, and they're not simply confronted with a fait accompli at what might be an inconvenient point.

Mr. SYMINGTON. There are implications in these agreements, of course, for expanded trade between these two nations, and I would expect that the two nations may be inclined to review their trade restrictions and trade practices.

Do you agree that, if done, this would probably give quite a boost to the agreements, and vice versa, dealing with what we're talking about: the exchange, not only of ideas, but of goods and services?

Mr. BUNDY. I don't have any question but what the trade negotiation is a very important one. It is probably even more difficult than cooperation in these essentially noncommercial fields that are before you in the four agreements, and I think the historical record tends to bear that out.

One of the major efforts of the Johnson administration was an effort to get relaxation in the terms governing East-West trade, and particularly trade with the Soviet Union. Mr. Johnson appointed a committee—I think, a very distinguished committee—led by Irwin Miller, a businessman and economist, who recommended that it would be strongly in the interests of the United States to take a commonsense two-way street businesslike approach to increasing East-West trade. But, for a whole variety of reasons, there was not the necessary sentiment in the Congress at that time for making trade possible on the ordinary most favored nation basis.

While I'm not familiar with the details, it does appear to me, from the communiques and press conferences at the Moscow meeting, that we don't yet have a trade agreement. We have an agreement to go on working to get a trade agreement. In that sense, we are not yet able to say concretely what the real prospects for an expansion of trade and for new relationships in trade are.

But I certainly agree with your underlying point that if you can get a good working agreement, that too serves the same general purpose of increasing mutual understanding and mutual reliance that the other agreements may help to serve.

Mr. SYMINGTON. Thank you.

Mr. Mosher, do you have some questions?

Mr. MOSHER. Just a couple of questions for clarification concerning Mr. Bundy's comments on page 3.

Mr. Bundy, if you could give some background, it would be of assistance to us. You say that "We do not treat our scholars and scientists as the Russians treat theirs."

Do you want to expand on that for our edification?

Mr. BUNDY. I'll see if I can do it in a way that is fair to all sides, Mr. Mosher.

I happened to be involved in this, and I will take you back if you don't mind, because this is where I got my first exposure to these problems, as dean of the faculty of arts and sciences at Harvard in the late 1950's, when Harvard was one of the designated cooperating universities under the first exchange agreements.

One simple way of putting it is our professors are not in the habit of awaiting political instructions, and that statement cannot be made with quite the same clarity on the other side of the line.

Another point—an institutional point—is that our universities don't expect to be told by the Director of Cultural Affairs of the Department of State exactly how they conduct their affairs. I don't know just who does give those instructions to universities in the Soviet Union, but there is some one. Therefore, both the attitudes of the individuals and the attitudes of the institutions are really different.

I'm not saying at all that there are not scholars and scientists of great quality, whose independent intellectual contributions have been of the first importance, in the Soviet Union, nor am I saying that everything about that highly organized system is necessarily restric-

tive. I'm simply saying that it's very different, and that the situation for an American scholar or scientist going to the Soviet Union is one which requires kinds of clearances in advance, kinds of approvals, kinds of arrangements of schedule, which would seem to him flatly incredible if he were going to study, say in Italy or in Argentina or in Japan, although there are cultural and social difficulties in most foreign study.

We have had real difficulty in learning how to come to terms with that, but at the same time, we have effected the exchange of some scores of scientists. This is a matter on which, I am quite sure, Mr. Pollack knows vastly more than I do, but it is not an easy match. Let me put it that way.

Mr. MOSHER. Do you have any feeling, or reason to believe, that this situation that existed when you were dean at Harvard is modified, or is evolving into a changing relationship, or changing situation?

Mr. BUNDY. When you live with these difficulties you can learn to distinguish those which are really not of major substance, and which are a matter of learning how to live with a different bureaucratic system, and those which are real blocks to particular inquiry.

There have been, over the years, certain scholars who simply were not encouraged to come to the Soviet Union. The exact boundaries have changed from time to time, and I'm not closely familiar with the current sense of just who is more welcome than who else.

There was, for example, a period after the fall of Khruschev when American applicants seemed to be going through a tighter net of screening than had been the case in 1963 and 1964, and these situations change from season to season. I have the impression that there has been a considerably more open view, coming, I suspect, from high political decisions, in the Soviet Government's approach to these matters since 1970.

I think I would concur in the general tenor of Mr. Kissinger's remarks, when he was asked in his press conference how it was that there were some disagreeable remarks about the nature of Soviet foreign policy in the President's Annual Foreign Policy Review. He said, "Well, that was about a part of past history, and these agreements are about a future part of history," and I think it's always right for us to be hopeful and to press for the new opportunity.

That allows me to say something, if I may, that I left out of my statement. I believe it to be true—and I think it is something that, as a people we can take a good deal of pride in—that most of the affirmative effort, most of the pushing to try to open up these relations, has come from the American side, and that the limits on what can be done have more often than not come from the Soviet side.

I don't want to make that too sweeping because there are some kinds of inhibitions in our own arrangements. High technology computers have been a sensitive matter for us at one time or another, and there are other places at which we have not been as open as we might have been. But, in the main, we have gotten where we are today because of persistent and undiscouraged American effort.

Mr. MOSHER. On our own side do you detect any significant changes in the situation of our scholars and scientists vis-a-vis the American Government?

Mr. BUNDY. I have a feeling they're less amply nourished.

Mr. MOSHER. You used the word "inhibition." Is there any changing situation regarding the inhibitions? Actually, I don't have any in mind. I just wondered if you saw any.

Mr. BUNDY. No. I think our scientists in this country are operating in an environment of very general academic freedom, and in particular, that the American Government has not had a restrictive, but rather on balance a liberating effect upon American scientists, who have had the lion's share of the support and, to a lesser but now growing degree, on other American scholars too, increasingly through the National Endowments. I'm not at all a believer in the notion that there has been some systematic imposition of a Government point of view on the American scientific or scholarly community. The degree of the scientific and scholarly criticism of the U.S. Government completely disproves that proposition.

Mr. MOSHER. The mere fact that budget constraints exist and there is increased competition for Federal subsidies does not have any bad effect?

Mr. BUNDY. Let me be careful here, Mr. Mosher. I don't mean to say that all the budget cuts that have been made in support for specific institutional or individual research operations have been fortunate. I don't think that is the case. This is an enormously complicated subject. I have been very glad to see the reinforcement, which must be coming largely from this committee, which has been given through the National Science Foundation, in recent years, because I do share the view, which has been expressed by many people on both sides of the aisle, and in and out of Government, that the Science Foundation is, for the long haul, a better instrument of support for American science, in scholarship, in research, and in training, than the user agencies, of which the most conspicuous, of course, have been the defense agencies.

Mr. MOSHER. Mr. Chairman, apparently I have taken us off on a tangent. I'll ask just one more question.

On page 3, just for our background information and interpretation, your phrase "rely on national means of verification," what distinction are you making there?

Mr. BUNDY. I'm making the distinction—which is spelled out very clearly in some of the press conferences around the agreement—the distinction between trying to get some sort of on-site inspection, or agreed visiting by international teams, and the capacity to use all of your own national means of information, which certainly include nowadays—I think this is certainly not the kind of classified information you can now be nervous about—space photography. That capability, together with other abilities which have been developed in the intelligence communities of our Nation.

It allows us, within quite acceptable limits, to have confidence in the kinds of estimates we make as to how many missiles, launchers, or submarines, there are, and how big they are, and how much they can do, and how they have to be weighed in the strategic balance. I share the administration's view that it is better really to rely on this than to try to get what would almost certainly be rather fragile forms of international inspection, which could come to an end suddenly and leave you with a blind eye.

Mr. MOSHER. Are you saying that the days have passed, either in Moscow or Washington, where there needs to be any furor over the disclosure of something like the U–2? We mutually respect each other's efforts as sophisticated technologists in the launch of vehicles in space?

Mr. BUNDY. I think we have agreements which particularly protect space movements. It would clearly be a very grave and dangerous act for either side to interfere with the other side's systems of collecting information through satellites. I think both sides know that. I think there's no immediate danger of that.

The case of the U–2 was different, of course, because although it flew at unheard of altitudes, and it was not reachable until 1960, still it was an airplane, and an airplane over one's own territory was an entirely different matter in political terms.

Mr. MOSHER. Thank you.

Mr. SYMINGTON. Mr. Frey?

Mr. FREY. Thank you, Mr. Chairman.

To begin with, I would like to state that I think that the purpose of these hearings is really not only to look at the tangibles, but the many intangibles and I hope that not only the question of cooperation with the Soviets but with many other nations will be considered, because I think this is one of the real keys to the future of all mankind.

NASA's chartered to benefit all mankind, and I hope we can live up to it. As of today I think we could do a lot more through many, many areas of cooperation, not only in terms of benefiting all mankind, but getting people involved in projects which couldn't be done by one nation, either financially or otherwise.

One of the things that impressed me, looking down the road, was your statement concerning the greater role of the U.S. Government itself, which I think is pretty obvious that it's going to have to happen. But at the same time, I wondered if, in your opinion, it's going to be possible that there will be a great deal of cooperation from nongovernment sources in terms of industry itself in this country.

This is going to lay the groundwork possibly, say in the communications area, for work with the Intelsat and Comsat.

Mr. BUNDY. Yes; I think there is a possibility of that kind, and I think even the agreements referred to the desirability of private agencies or enterprises having roles in these kinds of cooperative undertakings.

Mr. FREY. What I really was asking is do you think this is going to break down the barriers that you've expressed in the past or do you think we're going to have to go a long way before we can reach that point?

Mr. BUNDY. My personal inclination is to expect that it will be quite slow, that there are real difficulties in learning how, in a straightforward sense, to do business between systems as different as our two. I think the opportunity is there, but I think you have to await the events to see how rapidly it will be developed.

Mr. FREY. One of the questions I heard raised earlier not only on this agreement but on the question of international cooperation in space, has been that there might be a feeling that by doing this and working with other countries, the United States may, fairly or un-

fairly, be seeking other sources of revenue through these projects in some areas where, because of our budgetary restraints they can't be begun. I, for one, do not believe that this is necessarily true at all.

Do you see any great problem, from your background and experience, in asking other nations to bear their fair share of any of these?

Mr. BUNDY. The key question, of course, is: What's a fair share? And that has to be examined case by case.

Mr. FREY. Anything to begin with is more than nothing, and it seems to me that once you get over that hurdle you have at least made a start.

Mr. BUNDY. I think one of the difficulties that you have—I'm not here talking about specific enterprises—is that sometimes we appear to be inviting people to share the costs but without really giving them a chance to share the responsibilities or any of the authority that is involved, and I think that sometimes can create difficulties, but my own view is that there are ways and means of working these things out.

Mr. FREY. That feeling does exist, which I voiced. Don't you feel that there is a question about that?

Mr. BUNDY. I'm not familiar enough with it to do more than to say that I can see how that feeling would arise, and it seems to me there are ways and means of developing means of cooperation in which both the economic and the other forms of share participation are equitably worked out.

Mr. FREY. I think one of the real keys to this situation is going to be the Space Shuttle when completed in 1978, because at that point we are going to have a low cost transportation system with a means for sharing experiments, for people in different countries to develop different experiments and work with them. This might be one sure way of working together, and I think it may be the real key to getting many other nations into the act.

Outside of that, thank you very much for coming. We appreciate your testimony. You've given us a lot to think about.

Mr. BUNDY. Thank you.

Mr. SYMINGTON. Thank you, Mr. Frey.

Mr. Bundy, you certainly have done that.

You raised a very good point at the close of your paper that this will involve a new level of congressional engagement.

I suspect that the administration is going to pursue these agreements with vigor, and they'll be after us for some new money. I would think that, within reason, it would be money well invested.

I know that your time is limited. We thank you very, very much for your kindness in joining us today. It's been a tremendous help to us. Perhaps at a future time we might be writing you for some future observations as these hearings develop, if you wouldn't mind our doing that.

Mr. BUNDY. It's been a pleasure for me, Mr. Chairman. I'm very grateful to you for allowing me to come on early because I do have to go back to New York. Thank you very much.

Mr. SYMINGTON. Thank you, sir.

Our next witness, in deference to protocol for these occasions, would have actually been on first, but it was necessary for Mr. Bundy to leave early for New York City, and we departed from our normal schedule in order to enable him to do so.

It is to our next witness that we look for an overview of the intent, hopes, and aspirations inherent in these agreements. He is Mr. Herman Pollack, Director of the Bureau of International Scientific and Technological Affairs, Department of State. He has the rank of Assistant Secretary of State, which he has held since 1967.

He's head of the office which provides policy guidance concerning the international scientific and technological activities of the Government. He's been deeply involved in the negotiations which preceded the meetings on the agreements that are the subject of our hearings. He's in an excellent position to inform our committee on these agreements, and to answer any questions we might have.

We welcome your appearance here, Mr. Pollack; and now you may proceed with your statement.

(The biographical sketch of Mr. Pollack follows:)

MR. HERMAN POLLACK, DIRECTOR, BUREAU OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS

Mr. Pollack was born in New York City on October 22, 1919, and is a graduate of the City College of New York, where he was elected to Phi Beta Kappa. He received his Master's degree in International Affairs from George Washington University. He began his Government service in 1941 in the Office of Price Administration, following a fellowship in the Department of Government at CCNY. Following his Army service, he served with the War Shipping Administration and later with the Foreign Economic Administration. Mr. Pollack came to the Department of State in October 1946, and has held positions as Deputy and Acting Executive Director of the Bureau of European Affairs, Executive Assistant to the Assistant Secretary for Administration, Director of the Management Staff, and Deputy Assistant Secretary for Personnel. He attended the National War College in 1963–64, was appointed Deputy Director, International Scientific and Technological Affairs (SCI) on September 13, 1964, and Acting Director on January 1, 1965. The Department of State announced his appointment as Director on July 14, 1967.

In 1949 Mr. Pollack married Dr. June Rae Cohen of Washington, D.C. She is currently serving as Area Physician with the Montgomery County Health Department. The Pollacks and their three children reside at 7000 Selkirk Drive, Bethesda, Maryland.

As Director of the Bureau of International Scientific and Technological Affairs, Mr. Pollack is a Principal Officer of the Department of State with rank and authority equivalent to an Assistant Secretary of State. It is the responsibility of the Director and his staff to formulate and implement policies and proposals for U.S. international science and technology programs, to advise the Secretary in his consideration of scientific and technological factors affecting foreign policy, to provide policy guidance to the international scientific and technological activities of the Government, to represent the Department in appropriate international negotiations in science and technology, and to direct the Scientific Attache Program.

Mr. POLLACK. Thank you, Mr. Chairman.

I have asked Mr. Richard Davies, who is Deputy Assistant Secretary for the Bureau of European Affairs, to join me at the table, since I assume that your questions may range over a wide enough area to justify the two of us being here.

Mr. SYMINGTON. We welcome you, Mr. Davies.

Mr. DAVIES. Thank you, Mr. Chairman.

STATEMENT OF HERMAN POLLACK, DIRECTOR OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS, DEPARTMENT OF STATE, ACCOMPANIED BY RICHARD T. DAVIES, DEPUTY ASSISTANT SECRETARY FOR EUROPEAN AFFAIRS, DEPARTMENT OF STATE

Mr. POLLACK. I welcome the opportunity to testify before this subcommittee today because the subject of the hearing is one of the most notable examples we have yet seen of the use of science to promote bilateral relations. It well may represent an historic turning point in the history of international relations in science. But beyond that it is always a pleasure to appear before Congressman Symington who has many friends and admirers, myself included, in the Department of State in which he occupied with distinction a senior post several years ago.

My remarks today will be brief. I shall say a few words about the policy background to the science agreements with the Soviet Union, describe them briefly, and lastly offer a few preliminary observations which will reveal how the Department of State is approaching these agreements. I shall make no attempt today to go into depth on the content or substance of any of these agreements. That will be better done by the knowledgeable men who will be responsible for the execution of each of the agreements, and each of whom will appear before you later in these hearings.

The United States has long pursued the foreign policy objective of reducing tensions with the Soviet Union and seeking ways to develop a stable and mutually constructive relationship. I think Mr. Bundy has done an excellent job of reviewing the history of these efforts.

It is in this framework that in his speech to the United Nations General Assembly in October of 1970, which he addressed primarily to the leaders of the Soviet Union, President Nixon said:

> The issue of war and peace cannot be solved unless we in the United States and the Soviet Union demonstrate both the will and the capacity to put our relationship on a basis consistent with the aspirations of mankind. . . . In the world today we are at a crossroads. We can follow the old way, playing the traditional game of international relations, but at ever-increasing risk. Everyone will lose. No one will gain. Or we can take a new road. I invite the leaders of the Soviet Union to join us in taking that new road. . . .

Over a year later in his third annual report to the Congress of February 9, 1972, on U.S. foreign policy, the President enumerated a number of major problem areas in which he initiated exchanges with the Soviet leaders and listed a series of agreements on additional measures "striking both in their diversity and in their promise of mutual advantage." Included in the latter were specific initiatives in space and health, key areas of science and technology. In this report, the President renewed our commitment to a new relationship with the U.S.S.R., and among the tasks set was an examination with Soviet leaders of the possibility of additional bilateral cooperation.

By the time of the summit last month the desire for a change and improvement in relations was a working premise for both sides. Thus, it became possible, among other things, to agree to a declaration of basic principles of mutual relations between the U.S.A. and the

U.S.S.R. directed toward this end. One of these—the eighth—provided:

> The two sides consider it timely and useful to develop mutual contacts and cooperation in the fields of science and technology. Where suitable, the U.S.A. and the U.S.S.R. will conclude appropriate agreements dealing with concrete cooperation in these fields.

On June 1, the day of his return to the United States from his visits to Moscow, Tehran, and Warsaw, the President gave an accounting to the Congress of his meetings with Soviet leaders. He pointed out on that occasion that the foundations had been laid for a new relationship between the two most powerful nations in the world, noting especially the progress that had been made in solving difficult issues. He also called attention to the fact that agreement had been reached to expand U.S. and Soviet cooperation in many areas of science and technology, in recognition of the fact that the quest for useful knowledge transcends differences in ideologies and social systems.

In a similar vein, the Secretary of State, during his recent report to the NATO Allies in Bonn, depicted the science agreements concluded during the summit as providing the framework for mutually useful contact between Soviet and American specialists in numerous fields. He also emphasized that they constitute concrete measures which will help develop the free exchange of ideas and persons essential for a genuine East-West détente.

So much for the general background. Mr. Richard Davies, Deputy Assistant Secretary of European Affairs, will be glad to expand on this background later if you so wish.

During the visit of the President to the Soviet Union May 22–30, four agreements were signed on cooperation in various aspects of science and technology. The agreements on space and on environmental protection were signed by the President. Those concerning science and technology, and medical science and health, were signed by the Secretary of State. They represent the culmination of years of patient U.S. effort to establish meaningful contact and a basis for cooperation in these fields.

For more than a decade, U.S. Government agencies and our National Academy of Sciences have endeavored to arrange with Soviet counterparts exchanges of delegations and individual scientists in order to expand the contacts between our scientific communities and thereby promote science, and as a way to learn more about the state of science and technology in the Soviet Union. Through these exchanges, we have succeeded in greatly enlarging the contacts between the two scientific communities and have made possible an exploration of the state of science and technology in both countries.

U.S. scientists have been attracted to the undeniable achievements of Soviet science in many fields and have become convinced that deeper contact would serve our interests, both technical and political. By 1970, we began to detect a growing willingness on the part of the Soviet Union to explore possibilities for collaborative efforts in various scientific fields, notably atomic energy, space, and health sciences.

The agreement on exchanges and cooperation signed on April 11 of this year, and the four summit agreements concluded last month, document the readiness on both sides to engage in cooperative efforts. They

could represent a historical change in the pattern of scientific relations which we have sought for years and to which the Soviet Union has now agreed.

The activities pursued in accordance with the agreements could become part of a trend of even broader significance, for there is an ingredient in the scientific ventures with the U.S.S.R. which transcends the realm of science and technology. The cooperative ventures both sides have in mind will bring together distinguished and influential representatives of the two nations. Moreover, the several joint commissions overseeing the activities will have access to the highest levels of government. The pursuit of collaborative efforts in bilateral and multilateral arenas will, we sincerely hope, assure greater movement of persons and ideas between the countries engaged. A brief résumé of the agreements concluded will illustrate this potential.

The Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes signed on May 24, 1972, includes the plan of the signatories to conduct a joint docking mission scheduled for 1975. This test mission is a first step in possible cooperation in future joint rendezvous, docking, rescue missions, and joint experiments in space. It brings to fruition years of consultations which began in October 1970, and subsequently led to agreed undertakings in such important areas of space science and applications as space meteorology; space techniques for the study of the earth's environment; the exploration of space, the moon, and the planets; and space biology and medicine.

The Agreement on Cooperation in the Field of Environmental Protection, the most comprehensive bilateral agreement on this subject, calls for joint research development, mutual cooperation, and exchange of information in 11 specific areas of environmental protection. These are: Air pollution, water pollution; environmental pollution associated with agricultural production; enhancement of the urban environment; preservation of nature and organization of national parks; marine pollution; biological and genetic consequences of environmental pollution; influence of environmental changes on climate; earthquake prediction; Arctic and subarctic ecological systems; and legal and administrative measures for protecting environmental quality.

The Agreement on Cooperation in the Field of Medical Science and Public Health commits the parties to develop and extend mutually beneficial cooperation on the basis of reciprocity, with initial efforts focusing on the most widespread and serious diseases such as tumors and cardiovascular, and the effects of the environment on man's health. Like the agreement on space, it is the outcome of specific discussions and negotiations between U.S. and Soviet specialists since 1970.

The comprehensive Agreement on Cooperation in Science and Technology was designed to accelerate the development of substantive scientific and technical contacts, and to promote their evolution into mutually beneficial collaborative work. Joint contribution and reciprocity will be the keynote. Under this new agreement, collaborative undertakings will be developed, evaluated, and coordinated for the first time at the executive levels of government.

One feature that distinguishes the four summit agreements and the exchange agreements arrived at in February of this year from earlier

scientific and technical arrangements with the Soviets, is the emphasis on joint endeavor that the scientific leaders on both sides clearly have in mind. All of these agreements in one way or another provide for joint development and implementaton of programs and projects; joint research, including exchange of results; organization of joint courses, conferences, and symposia; as well as exchange of information and documentation; and the more traditional exchange of scientists and specialists. It is the joint endeavor aspect of the new agreements that, in my view, holds the greatest promise for the future.

It should also be noted that the relationships in science with the Soviet Union which we are now discussing are not unique in U.S. foreign relations. Such cooperation has been an important component of our relations with Japan, France, Germany, and other countries. As we develop these joint efforts across the broad spectrum of the recent U.S.-Soviet agreements, we hope they presage the establishment of freer patterns of cooperative work with the Soviet Union such as we and other leading industrial nations of the world already enjoy.

Additionally, it should also be noted that the new agreements do not mark a radical departure from relations in science and technology we have been developing with a number of other Communist countries. We have extensive programs of joint research and scientific exchanges with Poland and Yugoslavia, supported in part by our Public Law 480 currency holdings. A program is developing rapidly with Rumania, and others have been initiated with additional East European countries. By the same token, an expansion of U.S.-Soviet cooperative projects under the new agreements will probably accelerate development of additional arrangements in these East European countries.

The prospects for common scientific ventures with the U.S.S.R. are promising. If we bear in mind the basic criterion of mutual interest, joint effort in many fields should be a plus for both sides. This is true in part because of the distinct advances both countries have made in such sophisticated fields as atomic energy and space, but also because of geographical comparability, which makes particularly rewarding common efforts in such fields as weather modification, arid lands, Arctic environment, energy resources development, and oceanography, among others.

We are not under the slightest illusion that the signing of the new agreements is the end of a carefully explored and painstakingly developed road. For example, changes in behavior and style on the part of the Soviet Union, regarding the freedoms customarily afforded scientists and scientific endeavors, will be necessary if the potentialities of the agreements are to be fully realized. We sincerely hope, however, that practice will bear out the promise inherent in them. In those areas in which we identify a U.S. interest, we shall lead the way; and we are prepared to respond positively to any Soviet initiatives in which there is a genuine two-way contribution and sharing of benefits.

I believe this committee is familiar with my view that science cooperation and international politics can mix, provided, of course, the science is sound and the criteria for its conduct is scientific. It is the intention of the American technical leaders that such will be the case in this instance. It is their understanding that their counterparts in the Soviet Union share that intention. Thus, the prospects are that

these agreements will indeed not only foster the relationships of the United States and the Soviet Union, but produce good science as well.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Thank you very much for a thorough and interesting overview of these agreements, Mr. Pollack. We have a good many questions about them.

One that I have at the outset relates to your statement on page 8, at the top of the page: "Collaborative undertakings will be developed, evaluated, and coordinated for the first time at the executive levels of Government." These agreements provide for joint Commissions to be established.

Do I take it from this statement of yours that on the American side and on the Soviet side, the membership of those Commissions will include the President, the head of government, the Chief of State? Is that what you meant to convey?

Mr. POLLACK. No, Mr. Chairman. That sentence relates solely to the Agreement on Cooperation in Science and Technology, and it refers to the fact that the executive agents were designated on our side as the Office of Science and Technology, which is a branch of the Executive Office of the President; and on the Soviet side as the State Committee of the U.S.S.R. Council on Ministers for Science and Technology, which is the equivalent counterpart, as to be distinguished from the Soviet Academy of Sciences, which has previously been the principal vehicle for cooperative undertakings.

Mr. SYMINGTON. I understood that previously on our side the National Academy of Sciences would have had some responsibility. Would that be so? Is this not the case?

Mr. POLLACK. This is no derogation from the work that the National Academy of Sciences will continue to carry on under our science and cultural agreements. This is a new and additional effort to develop additional areas of cooperation beyond those now existing and those just agreed to in the summit agreements.

Mr. SYMINGTON. The National Academy, as far as you can tell us today, has no specific role to play under the agreement on science and technology?

Mr. POLLACK. No specific assignment has been made to the National Academy, but I'm sure they will have a role to play as a consequence of the relationship that exists between the Federal agencies that will be carrying on these programs and the Academy of Sciences on a continuing basis, so I'm sure the resources of the Academy will be called on.

Mr. SYMINGTON. Is it possible for you to elaborate this morning on the likely form that the joint Commissions to be established under these agreements will take, the number of their members, the likely sources for memberships, and the point of authority? Would that be Presidential? Would it be delegated?

Mr. POLLACK. The question of the composition of that group is under discussion and consideration by Dr. David at this time. Dr. David has been designated to head the U.S. side of that joint Commission. I am not aware that any firm conclusions have been arrived at, either as to numbers or as to composition, or diversity of membership. All of these questions, however, are being studied and discussed.

Mr. SYMINGTON. Thank you.

I wonder if you have had an opportunity to determine how the Soviets themselves view these agreements, and what hopes or plans they have for implementation?

Mr. POLLACK. The latest word, or the only word at this point, really that I have on that came to my attention late yesterday afternoon, and it's a report of an article by Mr. Gvishiani that appeared in Izvestiya on the 6th of June. It has only been read cursorily by me, as I haven't had more time to go through it, but it speaks in affirmative fashion of these agreements, as we have indeed been doing here today. I will be glad to make this available to the committee, if you would find it useful.

Mr. SYMINGTON. Yes, indeed. We would be happy to have it, and without objection, it will be entered as part of the record at this point. We thank you for it.

(The Izvestiya article referred to is as follows:)

[Moscow Izvestiya in Russian, June 6, 1972, Morning Edition, p. 4L]

III. JUNE 9, 1972 U.S.S.R. INTERNATIONAL AFFAIRS—THE AMERICAS

U.S.S.R.-U.S. SCIENTIFIC TIES BASIS FOR FURTHER EVOLUTION

(Article by D. M. Gvishianis "For the Good of Mankind"; first paragraph is Izvestiya introduction)

[Text] The Soviet-American intergovernmental agreement on cooperation in the sphere of science and technology is the subject of comment by D. M. Gvishiani, USSR Academy of Sciences corresponding member and USSR Council of Ministers State Committee for Science and Technology deputy chairman.

The conclusion of an agreement between the USSR and the United States in the sphere of science and technology, together with agreements on cooperation in the sphere of space, environmental protection, medical science, and public health, reflects the aspiration of the sides to insure the expansion of mutually beneficial ties and promotes the further improvement of relations between the two states. The constructive and realistic approach displayed during the summit negotiations found specific expression, in particular, in the conclusion of an agreement on cooperation in the sphere of science and technology.

It should be emphasized above all that the agreement signed reflects the objective aim of the development of scientific and technical cooperation between the USSR and the United States. The basis of this need is the high scientific and technical potential of both countries and the interest ensuing from this in organizing an exchange of experience between scientists and specialists and in combining efforts in developing most important problems for the good of accelerating technical progress of both countries and for the good of all mankind.

As the joint Soviet-American communique notes, the cooperation that has so far existed in such spheres as atomic energy, space research, public health, and so forth has been of definite benefit and has made a positive contribution to the development of relations between the USSR and the United States. However, one cannot fail to note that the volume and nature of scientific and technical links between our countries far from matches the real possibilities and requirements.

Nevertheless, Soviet and American scientists and specialists, albeit on a limited scale, have exchanged experience at international congress, conferences, and symposiums and have brought about bilateral contacts. This has enabled them to familiarize themselves to a certain degree with the achievements of both countries in various spheres of science and technology and to bring to light a mutual interest in establishing cooperation on certain urgent problems.

The agreement on exchanges in the sphere of science, technology, education, culture, and other spheres signed for the first time in 1958 was a definite stage in the development of scientific and technical links between the USSR and the United States. This agreement, which ran for 2 years, was subsequently renewed several times and for 14 years was the main basis of scientific and technical con-

tacts between the USSR and the United States. An average 10 to 20 exchanges of scientific and technical delegations and five to 10 exchanges of agricultural delegations were provided for each 2-year period: these exchanges were of a fact-finding nature on predetermined topics. This agreement played a positive role. It was, however, not designed for the organization of deeper cooperation, that is, for the implementation of joint scientific research and planning and design work, the realization of major joint projects, and so forth.

Together with exchanges of delegations in accordance with the aforementioned agreement, trips by American scientists, specialists, and businessmen on tourist lines have developed greatly in recent years. The majority of these trips have been of a businesslike nature. They have afforded representatives of the United States the opportunity to acquaint themselves with our scientific institutions and industrial enterprises and discuss with their Soviet colleagues questions of mutual interest. Last year visits were made literally every week by American scientists and specialists to the State Committee for Science and Technology, the USSR Academy of Sciences, and other Soviet organizations. It is typical that in the period since 1959, contacts outside the framework of the agreement on exchanges have exceeded the official exchanges of delegations many times over. All this demonstrates the objectively urgent necessity for broadening the legal basis regulating mutual relations in this important sphere.

American scientists and representatives of business circles who have visited the USSR in recent years have been able to satisfy themselves that the scientific and technical potential of our country is constantly increasing. As is known, the basis of this potential consists of the 5,000-plus scientific research institutes in which 970,000 scientists work. American scientists and specialists were able to acquaint themselves with the organization of scientific research in the USSR and also with the high standard of development of the leading sectors of industry.

Possessing a mighty scientific and technical potential, the Soviet Union is consistently developing scientific and technical cooperation with all interested states. The results of such cooperation, not only with the socialist countries but also with a number of Western countries, are well known. In this respect the links between the USSR and France are very significant. Considerable experience has been accumulated in ties with Italy, Austria, Finland, Belgium, Sweden, Norway, and other countries with which the USSR has intergovernmental agreements on scientific, technical, and economic cooperation. The creation of a commission for economic, scientific, and technical cooperation between the USSR and the FRG opens good prospects in this sphere.

The evolution of scientific and technical contacts between the USSR and the United States has objectively led to the necessity for expanding the framework of scientific and technical exchanges and for them to be conducted in accordance with existing possibilities and requirements.

The Soviet Union's consistent position as regards the development of Soviet-American links was undoubtedly of great significance in reaching an understanding with the American side on expanding cooperation in the scientific and technical sphere and in the conclusion of the present intergovernmental agreement. This position was recorded in the 24th CPSU Congress decisions which express the Soviet Union's readiness to develop scientific, technical, and economic links with the United States in such a way that they are effected on an equal footing and on a mutually profitable basis and so that the volume of these exchanges is more in accordance with the level of the economic potential of the USSR and the United States.

An important factor stimulating the development of international cooperation in the sphere of science and technology, including bilateral ties between the USSR and the United States, is the fact that in our age of the rapid development of the scientific and technical revolution not a single country, no matter how mighty and highly developed, can develop science and technology without participation in international cooperation.

It is precisely from an acknowledgement of this fact that Article 2 of the Soviet-American intergovernmental agreement on cooperation in the sphere of science and technology proceeds: This article states that the basic objective of scientific and technical cooperation between the USSR and the United States . . . "is to provide both sides with broad possibilities for uniting the efforts of the scientists and specialists and both countries in working out the most important problems whose solution will promote the progress of science and technology to the good of both countries and of all mankind."

We are profoundly convinced that the development of Soviet-American scientific and technical cooperation and the consistent practical fulfillment of the agreement will undoubtedly provide the opportunity for saving time and resources and for insuring the best results in the solution of those scientific and technical problems which will be proposed for cooperation.

As for the specific fields of this cooperation, they are at present difficult to determine. In many sectors of science and technology our countries' achievements are at a high level. However, there are always many unsolved problems in science and technology where joint work can prove useful. The choice of the main directions of cooperation and the organization of specific cooperation work is the task of the joint Soviet-American commission on scientific and technical cooperation which will be created in accordance with article 7 of the agreement. The organizations responsible for the fulfillment of the agreement are, on the Soviet side, the USSR Council of Ministers, state Committee for Science and Technology, and, on the American side the Office of Science and Technology of the Executive Office of the President.

The intergovernmental agreement on cooperation between the USSR and the United States in the sphere of science and technology provides for the most diverse forms of developments of scientific and technical ties, including the exchange of scientists and specialists and scientific and technical information and documentation, joint research, developments, and tests, and the exchange of results, research, and experience between scientific research institutes and organizations. I would like particularly to stress that the agreement affords an opportunity for the development of direct contacts between interested institutions, organizations, and enterprises of both countries.

The agreement on cooperation in the sphere of science and technology is of important political significance. The objective of this agreement is clearly defined in the recently published joint Soviet-American communique. This states that "the expansion of scientific and technical cooperation, on the basis of mutual benefit and joint efforts, aimed at achieving common objectives accords with the interests of both peoples and promotes the further improvement of relations between the two countries."

The significance of this agreement undoubtedly goes beyond the framework of bilateral Soviet-American relations, insofar as scientific and technical cooperation between the USSR and the United States, which is to solve a whole series of problems of world significance, is an important contribution to the cause of the development of science and technology and, consequently, to the cause of economic and social progress throughout the world.

Mr. SYMINGTON. With regard to the various documents which are the subjects of these hearings, I wonder if any or all of those documents could be submitted to make our record complete?

Mr. POLLACK. I'll be glad to do that, Mr. Chairman.

Mr. SYMINGTON. Thank you.

(The documents to be furnished are as follows:)

AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE UNION OF SOVIET SOCIALIST REPUBLICS ON COOPERATION IN THE FIELDS OF SCIENCE AND TECHNOLOGY

The Government of the United States of America and the Government of the Union of Soviet Socialist Republics;

Recognizing that benefits can accrue to both countries from the development of cooperation in the fields of science and technology;

Wishing to assist in establishing closer and more regular cooperation between scientific and technical organizations of both countries;

Taking into consideration that such cooperation will serve to strengthen friendly relations between both countries;

In accordance with the Agreement between the United States of America and the Union of Soviet Socialist Republics on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural, and Other Fields, signed April 11, 1972, and in order to develop further the mutually beneficial cooperation between the two countries;

Have agreed as follows:

ARTICLE 1

Both Parties pledge themselves to assist and develop scientific and technical cooperation between both countries on the basis of mutual benefit, equality and reciprocity.

ARTICLE 2

The main objective of this cooperation is to provide broad opportunities for both Parties to combine the efforts of their scientists and specialists in working on major problems, whose solution will promote the progress of science and technology for the benefit of both countries and of mankind.

ARTICLE 3

The forms of cooperation in science and technology may include the following:

a. Exchange of scientists and specialists;

b. Exchange of scientific and technical information and documentation;

c. Joint development and implementation of programs and projects in the fields of basic and applied sciences;

d. Joint research, development and testing, and exchange of research results and experience between scientific research institutions and organizations;

e. Organization of joint courses, conferences and symposia;

f. Rendering of help, as appropriate, on both sides in establishing contacts and arrangements between United States firms and Soviet enterprises where a mutual interest develops; and

g. Other forms of scientific and technical cooperation as may be mutually agreed.

ARTICLE 4

1. Pursuant to the aims of this Agreement, both Parties will, as appropriate, encourage and facilitate the establishment and development of direct contacts and cooperation between agencies, organizations and firms of both countries and the conclusion, as appropriate, of implementing agreements for particular cooperative activities engaged in under this Agreement.

2. Such agreements between agencies, organizations and enterprises will be concluded in accordance with the laws of both countries. Such agreements may cover the subjects of cooperation, organizations engaged in the implementation of projects and programs, the procedures which should be followed, and any other appropriate details.

ARTICLE 5

Unless otherwise provided in an implementing agreement, each Party or participating agency, organization or enterprise shall bear the costs of its participation and that of its personnel in cooperative activities engaged in under this Agreement, in accordance with existing laws in both countries.

ARTICLE 6

Nothing in this Agreement shall be interpreted to prejudice other agreements in the fields of science and technology concluded between the Parties.

ARTICLE 7

1. For the implementation of this Agreement there shall be established a U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation. Meetings will be convened not less than once a year in Moscow and Washington, alternately.

2. The Commission shall consider proposals for the development of cooperation in specific areas; prepare suggestions and recommendations, as appropriate, for the two Parties; develop and approve measures and programs for implementation of this Agreement; designate, as appropriate, the agencies organizations or enterprises responsible for carrying out cooperative activities; and seek to assure their proper implementation.

3. The Executive Agent, which will be responsible for assuring the carrying out on its side of the Agreement, shall be, for the United States of America, the Office of Science and Technology in the Executive Office of the President and, for the Union of Soviet Socialist Republics, the State Committee of the U.S.S.R. Council of Ministers for Science and Technology. The Joint Commission will con-

sist of United States and Soviet delegations established on an equal basis of which the chairmen and members are to be designated by the respective Executive Agents with approval by the respective Parties. Regulations regarding the operation of the Commission shall be agreed by the chairmen.

4. To carry out its functions the Commission may create temporary or permanent joint subcommittees, councils or working groups.

5. During the period between meetings of the Commission additions or amendments may be made to already approved cooperative activities, as may be mutually agreed.

ARTICLE 8

1. This Agreement shall enter into force upon signature and shall remain in force for five years. It may be modified or extended by mutual agreement of the Parties.

2. The termination of this Agreement shall not affect the validity of agreements made hereunder between agencies, organizations and enterprises of both countries.

Done at Moscow this day of May, 1972, in duplicate, in the English and Russian languages, both equally authentic.

For the Government of the United States of America: William P. Rogers, the Secretary of State.

For the Government of the Union of Soviet Socialist Republics: V. A. Kirillin, Chairman of the State Committee for Science and Technology.

EXECUTIVE OFFICE OF THE PRESIDENT, OFFICE OF SCIENCE AND TECHNOLOGY, WASHINGTON, D.C.

FACT SHEET—BRIEFING ON U.S.-U.S.S.R. COOPERATION IN SCIENCE & TECHNOLOGY AGREEMENT

The new U.S.-Soviet Agreement on Science and Technology establishes—at the top levels of the two governments—a new basis for future cooperative efforts.

Significance of the agreement lies in the following:

That cooperation will help both countries by finding solutions to common problems.

That mutual benefit, benefits to both parties, is to be the primary basis for all joint efforts carried out under the agreement.

That the President's commitment of earlier this year to turn science and technology to the service of man can now be carried out more expeditiously on the international front.

That research and development aimed at goals such as new sources of energy; management and systems science; use of natural resources; weather modification; high energy physics and other scientific ventures will be more vigorously pursued in the United States; and

That commercial activity based on new technology and addressed to worldwide needs and desires will be stimulated here in the U.S.

Previous U.S.-Soviet contacts in science and technology have been largely based on exchange agreements going back to 1958. They have taken place on agency-to-agency, institution-to-institution and person-to-person levels. Now, for the first time, new joint activities will be developed, evaluated and coordinated at the executive levels of government.

The agreement establishes a U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation. The responsible agency for the United States is the Office of Science and Technology in the Executive Office of the President. The Soviet lead agency is the State Committee of the U.S.S.R. Council of Ministers for Science and Technology.

The Commission's framework will be developed in the near future. The first meeting will take place sometime thereafter at a time to be agreed upon. The agreement itself will have a lifetime of five years and may be renewed.

Though specific areas of mutually beneficial effort will not be identified until the Commission becomes functional, there are many possibilities. As examples, these could include:

Energy research.—In which each country has specific areas of expertise.

Arctic research.—In which both the Soviet Union and the U.S. are expanding their knowledge; or,

Management science.—In which the United States has made significant strides of value to other nations.

Other possibilities include atmospheric sciences, including weather modification; superconductivity; mining technology; marine resources; and many other areas of both fundamental and applied sciences.

The science and Technology agreement will augment more specific and separate agreements in the areas of health and environment which were signed yesterday (Tuesday).

Excluded from the Agreement are joint activities in areas deemed sensitive by either country for national security reasons.

Both nations will endeavor to facilitate such ventures as:

Exchanges of scientists and technologists;

Exchanges of scientific and technical information;

The development and implementation of programs and projects in both basic and applied fields of science;

Joint efforts and exchanges between their research institutions and organizations;

The development of courses, symposia, and conferences;

Establishing contacts between American firms and Soviet State Enterprises where a mutual interest develops.

And, other cooperation such as a continuing review of those efforts which may develop in the future.

The new Agreement is one more step in a gradual move from a period of confrontation to one of negotiation and cooperation between the two scientific and technological giants. By placing primary emphasis on "the mutual benefits" to be gained from cooperation, it minimizes the effects of otherwise conflicting demands in the different social, economic and political value systems.

One direct benefit is that of accomplishing jointly that which neither is likely to undertake alone. Another is the likelihood of synergistic relationships in which the combined efforts of the two parties will produce greater results than either could expect from unilateral efforts.

The procedures of the Commission will be agreed to at a meeting between Dr. Edward E. David, Jr., Director of the Office of Science and Technology and President Nixon's Science Adviser, and his still-to-be-named counterpart in the U.S.S.R.

Meetings will be held at least once a year and will alternate between Washington and Moscow.

FACT SHEET—AGREEMENT ON COOPERATION IN THE FIELDS OF SCIENCE AND TECHNOLOGY—MAY 24, 1972

Today's Agreement on Cooperation in the Fields of Science and Technology augments and expands by formal agreement United States and USSR cooperation on the exchange and development of scientific and technological information. The Agreement became effective immediately upon signature by Secretary of State Rogers and Chairman of the State Committee for Science and Technology, V. A. Kirillin, and remains in force for five years.

Although some exchange of scholars and information was provided for under the 1971–1972 Agreements on Exchanges and Cooperation in Scientific, Educational, Cultural and Other Fields (signed April 11, 1972), today's action will broaden both participation by U.S. and Soviet citizens, and the range of areas in which cooperation may ensue. The Exchanges and Cooperation Agreement provides for visits of three to four weeks by 21 delegations (consisting of four to six persons each) from each side. The exchange is designated for 18 areas such as irrigation projects, conservation of water resources, coal mine safety, highway safety.

Today's agreement allows for delegation exchanges in number sufficient to meet the needs of a designated research area, and could as much as double those permissible under the Exchanges and Cooperation Agreement. Any area of nonsensitive, basic or applied research—including management science—may be considered by the Commission for cooperative efforts under the agreement.

The possibility of a formal agreement in this area by the two countries was discussed by Secretary Stans during his November 20–December 1 visit last year.

Since then, Dr. Edward David, Science Adviser to the President and Director of the Office of Science and Technology, has been in consultations with the USSR. He plans to visit the Soviet Union in the near future to resume discussions on the implementation of the agreement.

Outline of the agreement.—The agreement provides for cooperative exchange through:

Exchange of scientists and specialists;

Exchange of scientific and technical information and documentation;

Joint development and implementation of programs and projects in the fields of basic and applied sciences;

Joint research, development and testing, and exchange of research results and experience between scientific research institutions and organizations;

Organization of joint courses, conferences and symposia;

Rendering of help as appropriate, on both sides in establishing contacts and arrangements between United States firms and Soviet enterprises where a mutual interest develops; and

Other forms of scientific and technical cooperation as may be mutually agreed.

A Joint Commission of six to eight members (the exact number will be worked out between the parties) will be established, chaired on the U.S. side by Dr. Edward David. Members from the U.S. will be selected by the Office of Science and Technology, and drawn from government, academic, and industry resources. Meetings will be convened not less than once a year in Washington and Moscow alternately. The Commission will make judgments on areas in which cooperation is recommended, and designate the appropriate agencies and firms to implement the agreements.

The government agencies responsible for supervising the implementation of the agreement are the Office of Science and Technology in the U.S. and the State Committee of the USSR Council of Ministers for Science and Technology in the Soviet Union.

AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS CONCERNING COOPERATION IN THE EXPLORATION AND USE OF OUTER SPACE FOR PEACEFUL PURPOSES

The United States of America and the Union of Soviet Socialist Republics;

Considering the role which the U.S.A. and the U.S.S.R. play in the exploration and use of outer space for peaceful purposes;

Striving for a further expansion of cooperation between the U.S.A. and the U.S.S.R. in the exploration and use of outer space for peaceful purposes;

Noting the positive cooperation which the parties have already experienced in this area;

Desiring to make the results of scientific research gained from the exploration and use of outer space for peaceful purposes available for the benefit of the peoples of the two countries and of all peoples of the world;

Taking into consideration the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, as well as the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space;

In accordance with the Agreement between the United States of America and the Union of Soviet Socialistic Republics on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural, and Other Fields, signed April 11, 1972, and in order to develop further the principles of mutually beneficial cooperation between the two countries;

Have agreed as follows:

ARTICLE 1

The Parties will develop cooperation in the fields of space meteorology; study of the natural environment; exploration of near earth space, the moon and the planets; and space biology and medicine; and, in particular, will cooperate to take all appropriate measures to encourage and achieve the fulfillment of the Summary of Results of Discussion on Space Coperation Between the U.S. National Aeronautics and Space Administration and the Academy of Sciences of the U.S.S.R. dated January 21, 1971.

ARTICLE 2

The Parties will carry out such cooperation by means of mutual exchanges of scientific information and delegations, through meetings of scientists and specialists of both countries, and also in such other ways as may be mutually agreed. Joint working groups may be created for the development and implementation of appropriate programs of cooperation.

ARTICLE 3

The Parties have agreed to carry out projects for developing compatible rendezvous and docking systems of United States and Soviet manned spacecraft and stations in order to enhance the safety of manned flight in space and to provide the opportunity for conducting joint scientific experiments in the future. It is planned that the first experimental flight to test these systems be conducted during 1975, envisaging the docking of a United States Apollo-type spacecraft and a Soviet Soyuz-type spacecraft with visits of astronauts in each other's spacecraft. The implementation of these projects will be carried out on the basis of principles and procedures which will be developed in accordance with the Summary of Results of the Meeting Between Representatives of the U.S. National Aeronautics and Space Administration and the U.S.S.R. Academy of Sciences on the Question of Developing Compatible Systems for Rendezvous and Docking of Manned Spacecraft and Space Stations of the U.S.A. and the U.S.S.R. dated April 6, 1972.

ARTICLE 4

The Parties will encourage international efforts to resolve problems of international law in the exploration and use of outer space for peaceful purposes with the aim of strengthening the legal order in space and further developing international space law and will cooperate in this field.

ARTICLE 5

The Parties may by mutual agreement determine other areas of cooperation in the exploration and use of outer space for peaceful purposes.

ARTICLE 6

This Agreement shall enter into force upon signature and shall remain in force for five years. It may be modified or extended by mutual agreement of the Parties.

Done at Moscow this 24th day of May 1972 in duplicate, in the English and Russian languages, both equally authentic.

For the United States of America:

RICHARD NIXON,
President of the United States of America.

For the Union of Soviet Socialist Republics:

A. N. KOSYGIN,
Chairman of the Council of Ministers of the U.S.S.R.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., May 24, 1972.

Release No: 72-109—U.S./U.S.S.R. Rendezvous and docking agreement.

The National Aeronautics and Space Administration today released the text of an April 1972 agreement with the Academy of Sciences of the USSR on the organization, development, scheduling, and conduct of a test docking mission for manned spacecraft in 1975. The agreement will be the basis for implementing those sections of the space accord reached by the President this week in Moscow which relate to the test docking mission.

The April agreement builds on three previous agreements of October 1970, June 1971, and November–December 1971, on the design and flight testing of compatible rendezvous and docking systems. The April meeting was requested by NASA to satisfy management and operational considerations attaching to a joint mission prior to possible commitment at a government-to-government level.

Dr. George M. Low, Deputy Administrator, headed the NASA delegation which included Arnold W. Frutkin, Assistant Administrator for International Affairs, and Dr. Glynn Lunney, Special Assistant to the Apollo Program Manager. The Soviet delegation was headed by Vice President of the Soviet Academy of Sciences, V. A. Kotelnikov, and included Academican B. N. Petrov, Drs. I. P. Rum-

yantsev, K. D. Bushuyev and others. Drs. Lunney and Bushuyev have been designated the Project Managers for the test mission.

During the April meeting, agreement was reached on such matters as regular and direct contact through frequent telephone and telex communications as well as visits; the requirement for and control of detailed formal documentation; joint reviews of designs and hardware at various stages of development; the requirement for joint tests of interconnecting systems; early participation in the joint preparations by flight operations specialists; the development of crew training and orientation plans; and the training in each country of the other country's flight crew and operations personnel.

Agreement was reached also on the requirement for and level of detail of project schedules, including early specification of development milestones and countdown and launch dates.

Agreement was reached as well on the principles of communications, command and control of the flight; the requirements for flight plans and mission rules for normal and contingency situations; the immediate transmission of flight television received in one country to the other's control center; the level of reciprocal language familiarity; and the need to develop public information plans taking into account the obligations and practices of both sides.

Beyond the test mission which is planned for 1975, the accord announced in Moscow provides that future generations of manned spacecraft of both the United States and the Soviet Union will be capable of docking with each other. That capability will facilitate emergency assistance to astronauts in difficulty and will make possible the conduct of cooperative projects, with attendant economies.

The two major technological powers in the world, the United States and the Soviet Union, have agreed to enter on a joint effort continuing the major technological venture in which they are now both engaged, the exploration of space.

As a result of negotiations which have been in progress since October, 1970, it has been agreed that a joint test rendezvous and docking mission would be planned for 1975, using specially modified Apollo and Soyuz type spacecraft.

This agreement means that a full project schedule will be developed and that both sides are committed to meeting the schedule. Training exercises will be conducted in each country for the other country's flight and ground operations crews. Also it is expected that, as a minimum, flight crews would learn the other country's language well enough to handle normal operations and respond to contingency situations which may arise.

In addition to creating a new climate of cooperation between the United States and Soviet Union, the agreement will have a significant domestic impact, including

(1) The program would utilize about $100 million in Apollo hardware (Apollo command and service module and Saturn 1B) which has already been constructed as back-up for current Apollo flights. This hardware would not be otherwise utilized.

(2) An additional expenditure of about $250 million will be needed to finance the mission and provide for the development of compatible systems. Of course, such an appropriation is dependent upon Congressional approval.

(3) This program would fill what would otherwise be a gap in the manned American space program between the Skylab and Space Shuttle projects. This project will also keep in place the Apollo space team, thus preserving the technological capabilities and expertise which have been developed over the past several years by the thousands of people involved with the space team.

(4) The project will also have an impact on domestic jobs, stabilizing many that might otherwise be jeopardized and creating as many as 4,400 additional ones. These new jobs will be in addition to the 50,000 new jobs which the space shuttle program is expected to create.

MEETING BETWEEN REPRESENTATIVES OF THE U.S. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) AND THE U.S.S.R. ACADEMY OF SCIENCES (THE ACADEMY) ON THE QUESTION OF DEVELOPING COMPATIBLE SYSTEMS FOR THE RENDEZVOUS AND DOCKING OF MANNED SPACECRAFT AND SPACE STATIONS OF THE U.S.A. AND THE U.S.S.R.

During April 4–6, 1972, in Moscow, the Deputy Administrator of NASA, Dr. George M. Low, and the Acting President of the Academy, Academician V. A. Kotelnikov, met to continue discussions of questions relating to the development

of compatible rendezvous and docking systems for manned spacecraft and space stations. Official representatives of both sides participated.

Both sides confirmed the desirability of (a) continuing further work to develop such systems and (b) conducting a test mission of such systems during 1975.

NASA and the Academy agreed that the first joint experimental testing of compatible rendezvous and docking systems should be conducted with the use of Apollo-type and Soyuz-type spacecraft employing systems developed by both sides in accordance with the Summaries of Results and related documentation resulting from previous meetings.

During the meeting, the Soviet side presented technical materials on the Soyuz-type spacecraft. Technical materials relating to the proposed joint flight of Apollo and Soyuz-type spacecraft shall be forwarded to the American side in May 1972.

NASA and the Academy agree that a common understanding of basic principles for organizing, developing, scheduling, and conducting such a test mission is required as a necessary prerequisite to the possible approval by their governments of such a test mission.

To provide a basis for understanding and developing such principles, the U.S. side has prepared a number of draft documents including, particularly, the following ones:

A. Proprosed Oragnization Plan for the Apollo/Soyuz Test Mission.

B. Apollo/Soyuz Test Mission Considerations (brief summary of document A).

C. A Project Technical Proposal Document.

D. A Project Schedule Document.

These documents are accepted as the basis for the development of jointly prepared documents.

Both sides agree that the specific content of these documents will be jointly developed and agreed upon at the next meeting of working groups in July 1972, to provide the necessary basis for successful implementation of a joint mission, should such a mission be approved by the two governments.

The following points, to which both sides agree, while not comprehensive, illustrate in summary fashion some of the major requirements which are contained in document B:

A. For the preparatory (pre-launch) period—

1. Regular and direct contact will be provided through communication links and visits as required.

2. A complete project schedule will be developed and commitments will be made on both sides to meet this schedule in order to avoid costly delays to either party.

3. Arrangements will be made for necessary contact and understanding between specialists engaged in developing and conducting the project.

4. A comprehensive test, qualification, and simulation program will be developed.

5. A sufficient level of familiarization and training, where applicable, with the other country's vehicle and/or normal training equipment must be defined and provided for safety-of-flight assurance. The necessary training exercises will be conducted in each country for the other country's flight crew and ground operations personnel.

6. The parties recognize in particular that they must jointly make a concerted effort to arrive at a full agreement on the engineering aspects of the mission during the meeting of working groups in July 1972.

7. Two years prior to the flight, responsible persons who will directly participate in the flight operations should be included in the working groups in order to assure a proper level of mutual understanding and a continuity of personnel into the real-time operation.

B. For the mission operation—

1. Control of the flight of the Apollo-type spacecraft will be accomplished by the American Control Center and that of the Soyuz by the Soviet Control Center, with sufficient communication channels between centers for proper coordination.

2. In the course of control, decisions concerning questions affecting joint elements of the flight program, including countdown coordination, will be made after consultation with the control center of the other country.

3. Joint elements of the flight will be conducted according to coordinated and approved mission documentation, including contingency plans.

4. In the conduct of the flight, pre-planned exchanges of technical information and status will be performed on a scheduled basis.

5. The host country control center or host country spacecraft commander will have primary responsibility for deciding the appropriate pre-planned contingency course of action for a given situation in the host vehicle. Each country will prepare detailed rules for various equipment failures requiring any of the pre-planned contingency courses of action.

6. In situations requiring immediate responses, or when out of contact with ground personnel, decision will be taken by the commander of the host ship according to the pre-planned, contingency courses of action.

7. Any television downlink will be immediately transmitted to the other country's control center. The capability to listen to the voice communications between the vehicles and the ground will be available to the other country's control center on a pre-planned basis and, upon joint consent, as further required or deemed desirable.

8. Both sides will continue to consider techniques for providing additional information and background to the other country's control center personnel to assist in mutual understanding (including the placement of representatives in each other's control centers).

9. As a minimum, flight crews should be trained in the other country's language well enough to understand it and act in response as appropriate to established voice communications regarding normal and contingency courses of action.

10. A public information plan will be developed which takes into account the obligations and practices of both sides.

Done in Moscow, April 6, 1972, in English and Russian, both languages having equal force.

GEORGE M. LOW.
ARNOLD W. FRUTKIN.
GLYNN S. LUNNEY.
V. A. KOTELNIKOV.
B. N. PETREV.
I. P. RUMYANTSEV.
K. D. BUSHUYEV.

SUMMARY OF AGREEMENTS REACHED

October 28, 1970:

Agreed to design compatible rendezvous and docking systems for future manned spacecraft.

Agreed to a procedure by which the two sides could, through a combination of independent action and coordination, arrive at compatible systems.

Established three joint working groups.

June 21–25, 1971:

Agreed to study the technical and economic implications of early test missions using existing vehicles.

Agreed on coordinate systems to be used for rendezvous purposes.

Agreed on single, documentation of requirements for atmospheres, hatches, and crew transfer techniques.

Agreed on air lock volume.

Agreed on placement of structural elements and equipment.

Agreed on optical and radio beacon characteristics.

Agreed on requirements for communications between spacecraft and between spacecraft and ground stations.

Agreed on characteristics of control systems.

Agreed on docking system basic functions and design features, and spacecraft mass properties.

November 29–December 6, 1971:

Agreed on technical feasibility of a test mission using existing spacecraft.

Agreed on objectives and preliminary documentation requirements for a possible test mission.

Substantially completed documentation on life support systems, coordinate systems and constraints on spacecraft configuration.

Identified guidance and control systems and on-board equipment of U.S. and U.S.S.R. spacecraft which would need to be compatible.

Substantially completed documentation on lights, docking targets and contact conditions, control systems and radio tracking.

Agreed to basic values for a compatible docking system including tunnel diameter for astronaut passage.

Reached preliminary agreement on the basis for design of an androgynous docking device.

April 4–6, 1972:

Confirmed the desirability of conducting a test mission using existing spacecraft in 1975.

Accepted, as the basis for joint specification of management and operational guidelines for joint mission, documents on "Proposed Organization Plan for the Apollo/Soyuz Test Mission," "Apollo/Soyuz Test Mission Considerations," "A Project Technical Proposal Document," and "A Project Schedule Document."

Agreed on specific principles illustrative of those which will apply in the preparatory and operational periods:

Frequent direct contact between project personnel on both sides.

Detailed commitments to schedules.

A comprehensive test, qualification, training and simulation program.

Involvement of mission flight and ground crew personnel in joint working groups two years before the mission.

Engineering agreement in July 1972.

Control of own spacecraft and spacecraft situations, with certain preplanned guideilnes to be worked out.

Consultation on control actions affecting joint elements of the mission.

Pre-planned in-flight information exchanges, including TV.

Reciprocal language familiarity among flight crews.

A public information program respecting the policies and practices of both sides.

KEY PERSONNEL

Soviet:

M. V. Keldysh, President, Academy of Sciences of the USSR.

V. A. Kotelnikov, Vice-President, Academy of Sciences.

B. N. Petrov, Academician and President of Intercosmos.

K. D. Bushuyev, Apollo-Soyuz Test Project Director, Chairman of Joint Working Group One.

V. P. Legostayev, Chairman, Working Group Two.

V. S. Syromyatnikov, Chairman, Working Group Three.

I. P. Rumyantsev, Intercosmos.

United States:

G. M. Low, Deputy Administrator, NASA.

D. D. Myers, Associate Administrator for Manned Space Flight, NASA.

A. W. Frutkin, Assistant Administrtor for International Affairs.

R. R. Gilruth, Former Director, Manned Spacecraft Center, Houston, Texas.

C. C. Kraft, Director, Manned Spacecraft Center.

G. S. Lunney, Apollo-Soyuz Test Project Director, Chairman, Working Group One.

D. C. Cheatham, Chairman, Working Group Two.

D. C. Wade, Chairman, Working Group Three.

CHRONOLOGY OF EVENTS U.S.–U.S.S.R. NEGOTIATIONS ON COMPATIBLE RENDEZVOUS AND DOCKING SYSTEMS

April 24, 1970.—In an informal meeting in New York, Dr. Paine, then Administrator of NASA, suggested to Soviet Academician Blagonravov cooperation in the area of astronaut safety, including compatible docking fixtures for space stations and shuttles.

May 1970.—Dr. Paine indicated the NASA interest in common docking to President Handler of the U.S. National Academy of Sciences, who relayed the suggestion to President Keldysh of the Academy of Sciences of the USSR.

July 31, 1970.—Dr. Paine suggested to Academician Keldysh that this possibility be considered in a projected meeting.

September 11, 1970, October 10, 1970.—Academician Keldysh and NASA's Acting Administrator, Dr. Low, agreed on an October 26–28 meeting in Moscow.

October 26–28, 1970.—Discussions of possible docking arrangements were held in Moscow, resulting in agreement that the two sides would attempt to design

compatible docking systems for future manned spacecraft. Agreement reached on procedures and on a schedule for joint efforts to design compatible rendezvous and docking arrangements. Three Joint Working Groups were established.

January 1971, June 21–25, 1971.—Dr. Low suggested to President Keldysh that Apollo and Soyuz spacecraft be considered for a rendezvous and docking mission.

June 21–25, 1971.—The three Joint Working Groups, meeting in Houston, considered the technical requirements for compatible systems including the general methods and means for rendezvous and docking, radio and optical reference systems, communications systems, life support and crew transfer systems, and docking assemblies. They agreed in principle or in detail on a number of technical solutions and requirements and identified a number of other problems which required additional development and discussion. They agreed that studies should be made of the technical and economic implications of flight experiments to test the technical solutions for compatible systems.

November 29–December 6, 1971.—The three Joint Working Groups met again in Moscow and made progress in planning a possible joint test mission as well as advancing the definition of technical requirements for compatible systems in future spacecraft. They agreed on the technical feasibility of such a test mission.

March 27–April 3, 1972.—Working Group Number 3, responsible for assuring compatibility of docking systems and tunnels, met in Houston. Results to be confirmed in 60 days.

April 4–6, 1972.—NASA delegation headed by Dr. Low met with Soviet delegation in Moscow, confirmed the desirability of a test mission and established understanding on the management and operation of a joint test mission. Agreed to use specified documents as basis for development of joint documentation. Agreed on illustrative principles for preparatory and operational phases.

May 10–17, 1972.—Working Group Number 2 responsible for compatibility of radio guidance systems, optics and other guidance and communications systems, met in Moscow. Results to be confirmed in 60 days.

AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE UNION OF SOVIET SOCIALIST REPUBLICS ON COOPERATION IN THE FIELD OF MEDICAL SCIENCE AND PUBLIC HEALTH

The Government of the United States of America and the Government of the Union of Soviet Socialist Republics;

Realizing the significance which medical science and public health have for mankind today;

Recognizing the desirability of joining in a common effort to promote their further development;

Desiring to promote the broadening of cooperation in this field, and by so doing to promote a general improvement of health;

Desiring to reaffirm the understanding reached in the Letters of Agreement between the Department of Health, Education, and Welfare of the United States of America and the Ministry of Health of the Union of Soviet Socialist Republics, signed February 11, 1972;

And in accordance with the Agreement between the United States of America and the Union of Soviet Socialist Republics on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural, and Other Fields, signed April 11, 1972;

Have agreed as follows:

ARTICLE 1

The Parties undertake to develop and extend mutually beneficial cooperation in the field of medical science and public health. By mutual agreement and on the basis of reciprocity, they will determine the various directions of this cooperation, proceeding from the experience acquired by the Parties in the course of previous contacts, visits, and exchanges.

The Parties agree to direct their initial joint efforts toward combatting the most widespread and serious diseases, such as cardio-vascular and oncological diseases, because of the major threat they pose to man's health, toward solving the problems associated with the effects of the environment on man's health, as well as toward the resolution of other important health problems.

ARTICLE 2

The cooperation provided for in the preceding article may be implemented specifically in the following ways:

—Coordinated scientific research programs and other activities in health fields of mutual interest;

—Exchanges of specialists and delegations;

—Organization of colloquia, scientific conferences and lectures;

—Exchange of information;

—Familiarization with technical aids and equipment.

ARTICLE 3

The Parties will encourage and facilititate the establishment of direct and regular contacts between United States and Soviet medical institutions and organizations.

The Parties will also encourage and facilitate exchanges of equipment, pharmaceutical products, and technological developments related to medicine and public health.

ARTICLE 4

The Parties will continue to provide assistance to international medical organizations, specifically the World Health Organization, and will afford these organizations the opportunity of drawing on the knowledge gained by the Parties, including knowledge gained in the course of their joint efforts.

ARTICLE 5

The Parties will delegate the practical implementation of this Agreement to the U.S.-U.S.S.R. Joint Committee for Health Cooperation. The Joint Committee shall periodically work out specific programs of cooperation, creating working subgroups whenever necessary, and shall be responsible for supervising implementation of these programs.

ARTICLE 6

Cooperation shall be financed on the basis of reciprocal agreements worked out by the Joint Committee, using the resources of the Department of Health, Education, and Welfare of the United States of America and the Ministry of Health of the Union of Soviet Socialist Republics, as well as the resources of institutions participating in direct interinstitutional cooperation.

ARTICLE 7

This Agreement shall enter into force upon signature and shall remain in force for five years, after which it will be extended for successive five-year periods unless one Party notifies the other of the termination thereof not less than six months prior to its expiration.

Done on May 23, 1972 in Moscow in duplicate, in the English and Russian languages, both texts being equally authentic.

(signed) WILLIAM P. ROGERS
Secretary of State
(For the Government of the United States of America)

(signed) BORIS V. PETROVSKY
Minister of Health
(For the Government of the Union of Soviet Socialist Republics)

FACT SHEET: HEALTH AGREEMENT WITH SOVIET UNION

(1) The Medical Science and Public Health Cooperation Agreement was signed at Moscow by U.S. Secretary of State William P. Rogers and Soviet Minister of Health Boris V. Petrovsky on May 23.

(2) The parties agreed to cooperate on a regular, long-range basis in the field of medical science and public health.

(3) The initial focus will be on research concerning the most widespread and serious diseases:

1. heart disease;
2. cancer; and
3. health problems associated with the environment.

(4) This Agreement will have the practical consequence of allowing two advanced scientific communities to work together in pushing back the frontiers of knowledge, eliminating certain duplications in their efforts and building on each others successes. This will save both countries time and expense and will increase the possibilities for scientific breakthroughs.

(5) The means of cooperation will be wide-ranging. They will include:

1. The exchange of information, specialists and delegations;
2. joint studies;
3. the organization of symposia, scientific conferences and lectures;
4. direct contacts between individual scientists, scientific medical societies and editorial boards of medical journals;
5. joint development of new types of medical equipment and durgs.

(6) The Agreement builds on 14 years of exchange in the health field—but most earlier exchanges were brief, sporadic and unrelated to one another. The Agreement provides for continuing, long-range collaboration.

(7) The Agreement results from careful, patient planning. The United States first proposed broadened health exchange programs in October 1970 and the Soviet Union responded favorably in February of 1971. Planning began in Geneva in May of 1971 and letters formalizing the new program were signed by U.S. HEW Secretary Elliot L. Richardson and USSR Minister of Health Boris V. Petrovsky on February 11, 1972.

The first meeting of the newly-established US-USSR Joint Committee for Health Cooperation was held in Moscow from March 27–31, 1972. The co-chairmen of the Committee are Dr. Roger O. Egeberg and Dr. Dmitri Venedictov. It was this Joint Committee that made the initial plans which are included in the new Agreement. This Joint Committee will also be responsible for the practical implementation of the Agreement.

As cooperation continues, new areas for collaboration will be considered. Very preliminary discussions indicate that problems such as the delivery of health services, influenza, occupational health, and the organic basis of schizophrenia might be taken up.

SECRETARY OF HEALTH, EDUCATION, AND WELFARE,
Washington, D.C., February 11, 1972.

His Excellency Dr. BORIS V. PETROVSKY,
Minister of Health, Ministry of Health of the U.S.S.R.,
Moscow, U.S.S.R.

DEAR MISTER MINISTER: In accordance with the agreement between the United States of America and the Union of Soviet Socialist Republics on Exchanges in the Scientific, Technical, Educational, Cultural and Other Fields, and following the understanding reached by the representatives of the Department of Health, Education, and Welfare of the USA. and the Ministry of Health of the U.S.S.R., I confirm the intention of the Department of Health, Education, and Welfare to promote expansion of cooperation between the two countries in the field of health and medical science.

We agree that the first three areas recommended for such cooperation should include cardiovascular diseases, malignant neoplasms and environmental health. In accordance with the agreement between the USA and the USSR on Exchanges in the Scientific, Technical, Educational, and Cultural and Other Fields, responsibility for US-Soviet cooperation in the field of health and medical science has been assigned to the Department of Health, Education, and Welfare and on the Soviet side this responsibility has been assigned to your Ministry.

The National Institutes of Health of this Department will be directly responsible for implementing cooperation in the initial three areas on behalf of the United States. The resources of its National Heart and Lung Institute, the National Institute of Environmental Health Sciences, and the Fogarty International Center will be utilized in carrying out programs in these three areas.

To implement such cooperation it is proposed that a US-USSR Joint Committee for Health Cooperation be established for which the Secretary of Health. Education, and Welfare or his designate and the Minister of Health of the USSR or his designate will serve as co-chairmen.

The other members of the Committee on the United States side will include the Director, Office of International Health (assistant co-chairman), the Director of the National Heart and Lung Institute, the Director of the National Cancer Institute, and the Director of the National Institute of Environmental Health Sciences. Alternates may be named as necessary.

We understand that the Soviet side intends to set up a similar committee which will include the Director of the Department of Foreign Relations who is a member of the Collegium of the Ministry of Health (assistant co-chairman), the Director of the A. L. Myasnikov Institute of Cardiology, the Director of the Institute of Experimental and Clinical Oncology, and the Director of the A. N. Sysin Institute of General and Communal Hygiene of the Academy of Medical Sciences of the USSR.

It is our understanding that these agencies and persons responsible for the cooperation will establish direct contact, forming when necessary subcommittees or panels of experts from each country in each particular area. These subcommittees will serve to implement program objectives approved by the US–USSR Joint Committee for Health Cooperation through collaborative joint research efforts, exchange of specialists, sponsoring of joint symposia, and other agreed upon means to develop this cooperation. The subcommittees will report periodically to the Joint Committee on progress achieved and the significance of results obtained.

We believe that the US–USSR Joint Committee for Health Cooperation should meet once a year alternately in the USA and the USSR. The first session of the Committee may be held, if it is so agreed, in the second half of March 1972. It is my understanding that you will propose Moscow for this first meeting, and we shall be pleased to accept your kind invitation.

With kindest regards,

Sincerely,

ELLIOT L. RICHARDSON,
Secretary.

AGREEMENT ON COOPERATION IN THE FIELD OF ENVIRONMENTAL PROTECTION BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS

The Government of the United States of America and the Government of the Union of Soviet Socialist Republics:

Attaching great importance to the problems of environmental protection;

Proceeding on the assumption that the proper utilization of contemporary scientific, technical and managerial achievements can, with appropriate control of their undesirable consequences, make possible the improvement of the interrelationship between man and nature;

Considering that the development of mutual cooperation in the field of environmental protection, taking into account the experience of countries with different social and economic systems, will be beneficial to the United States of America and the Union of Soviet Socialist Republics, as well as to other countries;

Considering that economic and social development for the benefit of future generations requires the protection and enhancement of the human environment today;

Desiring to facilitate the establishment of closer and long-term cooperation between interested organizations of the two countries in this field.

In accordance with the Agreement between the United States of America and the Union of Soviet Socialist Republics on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural, and Other Fields in 1972–1973, signed April 11, 1972, and developing further the principles of mutually beneficial cooperation between the two countries;

Have agreed as follows:

ARTICLE 1

The Parties will develop cooperation in the field of environmental protection on the basis of equality, reciprocity, and mutual benefit.

ARTICLE 2

This cooperation will be aimed at achieving the most important aspects of the problems of the environment and will be devoted to working out measures to

prevent pollution, to study pollution and its effect on the environment, and to develop the basis for controlling the impact of human activities on nature.

It will be implemented, in particular, in the following areas:

air pollution;
water pollution;
environmental pollution associated with agricultural production;
enhancement of the urban environment;
preservation of nature and the organization of preserves;
marine pollution;
biological and genetic consequences of environmental pollution;
influence of environmental changes on climate;
earthquake prediction;
arctic and subarctic ecological systems;
legal and administrative measures for protecting environmental quality.

In the course of this cooperation the Parties will devote special attention to joint efforts improving existing technologies and developing new technologies which do not pollute the environment, to the introduction of these new technologies into everyday use, and to the study of their economic aspects.

The Parties declare that, upon mutual agreement, they will share the results of such cooperation with other countries.

ARTICLE 3

The Parties will conduct cooperative activities in the field of environmental protection by the following means:

exchange of scientists, experts and research scholars;
organization of bilateral conferences, symposia and meetings of experts;
exchange of scientific and technical information and documentation, and the results of research on environment;
joint development and implementation of programs and projects in the field of basic and applied sciences;
other forms of cooperation which may be agreed upon in the course of the implementation of this Agreement.

ARTICLE 4

Proceeding from the aims of this Agreement the Parties will encourage and facilitate, as appropriate, the establishment and development of direct contacts and cooperation between institutions and organizations, governmental, public and private, of the two countries, and the conclusion, where appropriate, of separate agreements and contracts.

ARTICLE 5

For the implementation of this Agreement a US–USSR Joint Committee on Cooperation in the Field of Environmental Protection shall be established. As a rule this Joint Committee shall meet once a year in Washington and Moscow, alternately. The Joint Committee shall approve concrete measures and programs of cooperation, designate the participating organizations responsible for the realization of these programs and make recommendations, as appropriate, to the two Governments.

Each Party shall designate a coordinator. These coordinators, between sessions of the Joint Committee, shall maintain contact between the United States and Soviet parts, supervise the implementation of the pertinent cooperative programs, specify the individual sections of these programs and coordinate the activities of organizations participating in environmental cooperation in accordance with this Agreement.

ARTICLE 6

Nothing in this Agreement shall be construed to prejudice other agreements concluded between the two Parties.

ARTICLE 7

This Agreement shall enter into force upon signature and shall remain in force for five years after which it will be extended for successive five year periods unless one Party notifies the other of termination thereof not less than six months prior to its expiration.

The termination of this Agreement shall not affect the validity of agreements and contracts between interested institutions and organizations of the two countries concluded on the basis of this Agreement.

DONE on May 23, 1972 at Moscow in duplicate, in the English and Russian languages, both texts being equally authentic.

For the United States of America:
Richard Nixon

For the Union of Soviet Socialist Republics:
N. V. Podgorny

FACT SHEET: U.S.-USSR ENVIRONMENTAL PROTECTION AGREEMENT

1. The Agreement on Cooperation in the Field of Environmental Protection between the Governments of the United States of America and the Union of Soviet Socialist Republics was signed in Moscow May 23, 1972 by President Nixon for the U.S. and by President Podgorny for the U.S.S.R.

The agreement is the first of its kind between the two countries and represents the first comprehensive one on the environment between two major nations. We have no similar agreement with other nations, although we have several formal and informal arrangements with other nations and organizations relating to specific problems.

The agreement calls for joint research development, mutual cooperation and exchange of information in all eleven specific areas of environmental protection. These are: air pollution, water pollution; environmental pollution associated with agricultural production; enhancement of the urban environment; preservation of nature and organization of national parks; marine pollution; biological and genetic consequences of environmental pollution; influence of environmental changes on climate; earthquake prediction; arctic and subarctic ecological systems; and legal and administrative measures for protecting environmental quality.

2. Three factors make this agreement unique: It marks the first time the two countries have decided to work together in all areas of environmental problems;

In the past agreements on environmental problems have involved only exchanges of scientists for relatively short periods of time. This agreement identifies potential cooperative programs between the two countries to be implemented at a much higher level and focuses on long-term problems. It is open-ended, will remain in force for five years, and can be extended successive five-year periods unless either government wants to end it;

The agreement will identify the relative effectiveness of legal and administrative measure to protect the environment as practiced by two radically different forms of government. In the U.S. control is exercised through legislative and regulatory measures; in the U.S.S.R. it is exercised through a state-controlled mechanism.

3. Bilateral programs envisioned through the agreement would involve exchange of scientists; experts and research scholars; organization of bilateral conferences symposia and meetings of experts; exchange of information and research findings and the development and implementation of joint programs and projects.

The agreement will establish a U.S.-U.S.S.R. Joint Committee on Cooperation in the Field of Environmental Protection, which will meet once a year in Washington and Moscow, alternately. Between these sessions contact will be maintained by two Coordinators—one Soviet and one American. It is expected that the Coordinators will be designated shortly and that U.S.-U.S.S.R. Joint Committee will meet in the near future to work out details of bilateral programs.

4. Agreement is result of careful planning and private and governmental exchanges on problems of environmental quality over past few years. Following the preparation of draft proposals from interested U.S. agencies, by the Council on Environmental Quality working with the National Security Council, CEQ Chairman, Russell E. Train, was asked by the White House in November, 1971 to head an interagency task force to study the possibility of a U.S.-U.S.S.R. environmental agreement.

Train met with Soviet Ambassador in Dobrynin in March, 1972 to discuss specific areas for bilateral cooperation which the task force had developed and possible forms for the agreement. In April, 1972, the Soviet Union invited the U.S.

to send a small technical delegation to Moscow to develop a draft agreement. In early May, a four-man team headed by Dr. Gordon MacDonald of CEQ went to Moscow and agreement was reached on a draft text. The negotiations were conducted quickly and successfully with no major substantive disagreement on either side.

5. The agreement has practical importance to the rest of the world because it underlines the significance the two major powers place on the importance of environmental issues. It may very well lead to other kinds of bilateral agreements between countries who share similar kinds of problems. And it provides a positive push to the United Nations activities on the environment to be highlighted by the two-week U.N. Conference on the Human Environment beginning June 5. Although the Soviets have so far declined to participate in the conference because the inclusion of East Germany is still not resolved, this agreement shows their clear and real interest in environmental issues.

6. Agreement is expected to promote trade relations because it will allow purchase of technology in use by either nation to meet environmental goals.

7. On balance the U.S. will gain as much as the Soviets from the agreement. For example, although we are ahead in several areas of technology in combatting air and water pollution, the Soviets have made significant progress in such areas as arctic and subarctic ecology and in controlling urban sprawl and improving public urban mass transportation.

AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON EXCHANGES AND COOPERATION IN SCIENTIFIC, TECHNICAL, EDUCATIONAL, CULTURAL, AND OTHER FIELDS IN 1972–73

The Government of the United States of America and the Government of the Union of the Soviet Socialist Republics;

Believing that exchanges and cooperation will contribute to the broadening of mutual understanding between the American and Soviet peoples and to the development of relations between the two countries;

Have agreed to the following program of exchanges and cooperation for 1972 and 1973.

Section I

GENERAL

1. The exchanges and visits provided for herein shall be subject to the Constitution and applicable laws and regulations of the respective countries. Within this framework, both Parties will use their best efforts to promote favorable conditions for the fulfillment of these exchanges and visits in accordance with the objectives of this Agreement.

2. The Parties, for the purposes of effective implementation of the Agreement, agree that:

(a) The programs and itineraries, lengths of stay, dates of arrival, financial and transportation arrangements and other details of the exchanges and visits provided for in the Agreement, except as otherwise herein stated, shall be agreed upon on a mutually acceptable basis, as a rule not less than thirty days in advance, through diplomatic channels or between appropriate organizations requested by the Parties to carry out these exchanges;

(b) Applications for visas for visitors under this Agreement shall be submitted, as a rule, not less than twenty days before the estimated time of departure;

(c) Each of the Parties shall have the right to include in delegations interpreters or members of its Embassy, whose number shall be agreed to in advance, and who shall be considered as within the agreed total membership of such delegations;

(d) Unless otherwise provided for in this Agreement, and except where other specific arrangements have been agreed upon, visitors under this Agreement shall arrange to pay their own expenses, including international travel, internal travel and costs of maintenance in the receiving country. When it is requested, the receiving side will consider possibilities for covering internal transportation and lodging.

3. The exchanges and visits enumerated in this Agreement shall not preclude other visits and exchanges which may be arranged by the two countries or un-

dertaken by their organizations or individual citizens, it being understood that arrangements for additional visits and exchanges, as appropriate, will be facilitated by prior agreement through diplomatic channels or between appropriate organizations.

Section II

SPECIALIZED AGREEMENTS IN SCIENCE AND TECHNOLOGY

1. The Parties will take all appropriate measures to encourage and achieve the fulfillment of the following agreements whose texts shall be deemed to be annexed to this Agreement:

(a) the Agreement between the National Academy of Sciences of the United States of America and the Academy of Sciences of the Union of Soviet Socialist Republics for 1972 and 1973;

(b) the Agreement between the American Council of Learned Societies of the United States of America and the Academy of Sciences of the Union of Soviet Socialist Republics for 1972 and 1973;

(c) the Memorandum on Cooperation in the Peaceful Uses of Atomic Energy between the Atomic Energy Commission of the United States of America and the State Committee on the Utilization of Atomic Energy of the Union of Soviet Socialist Republics for 1972 and 1973;

(d) the Summary of Results of Discussions on Space Cooperation Between the National Aeronautics and Space Administration of the United States of America and the Academy of Sciences of the Union of Soviet Socialist Republics, of January 21, 1971;

(e) The Letters of Agreement between the Department of Health, Education and Welfare of the United States of America and the Ministry of Health of the Union of Soviet Socialist Republics, on cooperation in the field of health and medical sciences, signed on February 11, 1972.

2. The Parties agree that additional visits or exchanges may be agreed upon through diplomatic channels, between the above-mentioned organizations or between other appropriate organizations whose participation in these additional visits and exchanges is approved by the Parties. These visits or exchanges, whether for the purpose of participating in scientific meetings, exchanging experiences, conducting studies or delivering lectures, shall take place as far as possible on a reciprocal basis.

Section III

SCIENCE AND TECHNOLOGY

1. The Parties will encourage and facilitate, as appropriate, exchanges and cooperation in the fields of science and technology between appropriate organizations of the two countries, in particular by exchanging delegations, specialists, and scientific and technical information; organizing lectures and bilateral seminars and symposia; and conducting specialized exhibitions and joint scientific research work. These activities shall take place as far as possible on a reciprocal basis.

2. The Parties will also facilitate, as appropriate, the conclusion of mutually beneficial agreements between United States and Soviet Governmental organizations for scientific and technological cooperation and, when appropriate, render facilitative assistance to non-governmental organizations.

3. The Parties agree to provide for the exchange of not less than 20 delegations from each side, consisting of four to six persons each, for visits of three to four weeks (the size of the delegations and the duration of these visits may be changed by mutual consent). For planning purposes, it is estimated that not less than 70 man-months of specialist exchanges will be required on each side for the two-year period for implementation of these visits. This figure may be increased by mutual consent.

4. Exchanges under this Agreement shall be carried out for the purpose of familiarization with scientific and technological achievements in both countries and, when it is considered mutually beneficial, to develop cooperation in the following fields, among others: antarctic research; astronomy; coal industry; construction and building materials industry; electric power (station construction, generation, transmission); ferrous and nonferrous metallurgy; food industry; geology; land reclamation; light industry; machine building; man and his environment; meteorology; oceanography; oil and gas industry; science information; standards and standardization; and transportation.

5. The Parties agree that those uncompleted exchanges from the 1970–71 Agreement listed in the Annex to this section will be completed in the nearest future.

6. In accordance with the provisions of paragraph 3 of this Section, the Parties also agree to carry out the following exchanges during the period of this agreement:

(a) Methods and equipment for on-site oil processing: automatic and remote-control systems; applications of chemical methods of initial processing and treatment of oil;

(b) Irrigation projects and conservation of water resources: planning and design of large irrigation projects; automation of irrigation systems; use of computers for design, construction and operation of irrigation systems;

(c) Construction of coal industry plants: application of highly efficient drilling and loading machines and equipment;

(d) Geophysical interpretation: interpretation of magnetic and gravity data and techniques used in mineral resources appraisal and geologic studies;

(e) Construction of livestock complexes: introduction of effective structures and materials, application of new industrial methods;

(f) Precipitation management by weather modification: cloud seeding technology for managing precipitation to augment sources of water supply for multipurpose uses;

(g) Organization of technical maintenance, repair, and renovation of agricultural machinery;

(h) Construction techniques of large hydroelectric power plants and associated dams: use of precast elements in hydroplant construction; placement of mass concrete in large dams; new teachniques in the economics of construction;

(i) Design and construction of high-tonnage facilities for the production of ammonia and mineral fertilizers;

(j) Special cements and polymer concretes: installations using such cements and polymers in concrete for special applications; new construction materials and their applications;

(k) Design, construction, operation, and economic effectiveness of fish by-pass installation;

(l) Coal mine safety and methane control: scientific research; control technology for gassy mines; consideration of a joint research project;

(m) Organization and operation of blocks of turbines having outputs of 500–800 megawatts or more;

(n) Vehicle and road safety: human factors of highway safety, including driver training, pedestrian safety, and the effects of alcohol;

(o) Transporting and handling of freight, fleet operation, and hydrostructures in inland water transport;

(p) Patent management and licensing: research programs; industrial potential of innovation; managing the patent functions; locating licensable subject matter and prospective licensees.

The Parties will agree on the subjects of the remaining exchanges at a later date.

7. The Parties further agree that, in accordance with paragraph 3 of Section I of the present Agreement, any other specific proposals for topics of exchanges and cooperation in the fields of science and technology, put forward additionally by the two Parties through diplomatic channels, will be considered expeditiously, and the Parties will inform each other of the results of their consideration of these proposals within six weeks. Exchanges agreed upon through this procedure will have the same status as those cited in the text of this Agreement.

Section IV

AGRICULTURE

1. The Parties agree to provide for the exchange of ten delegations of agricultural scientists and specialists from each side, on mutually agreed topics, consisting of four to six persons each for three to four weeks. (The size of the delegations and the duration of these visits may be changed by mutual consent.)

2. The Parties agree that five of the delegations, provided for in paragraph 1 of this Section, will be in the following fields:

For the United States:

(a) Seed collection: collection of germ plasm for soil-conserving plants;

(b) Farm mechanization: the mechanization of crop and livestock production;

(c) Animal diseases: methods for treating and preventing specific animal diseases;

(d) Sunflower breeding;

(e) Large-scale plant protection.

For the Soviet Union:

(a) Organization of beef cattle production including intensified feeding of young cattle;

(b) Technology of maintaining dairy cattle and organization of labor on large mechanized farms;

(c) Commercial methods of producing veterinary biological preparations;

(d) Mechanized cultivation, harvesting and post-harvest handling of vegetables and fruits; organization and technology of their storage and processing;

(e) Production of corn with increased lysine content.

The Parties will agree on the subjects of the five remaining delegations from each side at a later date.

3. The Parties agree that in accordance with paragraph 3 of Section I of this Agreement, other subjects for exchange and cooperation in agriculture, which may be proposed additionally by the Parties through diplomatic channels, will be considered without delay.

Section V

PUBLIC HEALTH AND MEDICAL SCIENCES

1. The Parties agree to facilitate further cooperation in the fields of public health and medical sciences, as provided for in the Letters of Agreement between the United States Department of Health, Education, and Welfare and the Ministry of Health of the Union of Soviet Socialist Republics, signed on February 11, 1972.

2. Details of cooperation shall be agreed upon by the US-USSR Joint Committee on Health Cooperation, established in accordance with the cited Letters of Agreement.

3. For planning purposes, it is estimated that 100 man-months of specialist exchanges will be required on each side for the two-year period for implementation of this cooperation.

4. Financial and administrative conditions of these exchanges shall be agreed upon directly between the United States Department of Health, Education, and Welfare and the Ministry of Health of the Union of Soviet Socialist Republics.

Section VI

EDUCATION

1. The Parties agree to provide for the exchange annually from each side of:

(a) Up to 40 graduate students, post-graduates, young researchers and instructors for study and post-graduate work in the natural sciences, technical sciences, humanities and social sciences, for periods of stay from one semester up to one academic year, including five-week courses before the beginning of the academic year to improve participants' competence in the Russian or English language;

(b) Up to 25 language teachers to participate in summer courses of ten weeks to improve their competence in the Russian or English language;

(c) Up to 20 professors and instructors of universities and other institutions of higher learning to conduct scholarly research for periods of stay up to one academic year, the total volume of these exchanges not to exceed 50 man-months for each side;

(d) Up to four professors from universities and other higher educational institutions for periods of stay from one semester up to one academic year to offer instruction and to lecture in the natural sciences, technical sciences, humanities, and social sciences in accordance with the desires of the receiving side:

(e) Up to four specialists in the fields of language, literature or linguistics for periods of stay from one semester up to one academic year to offer instruction and to lecture in universities or institutions of higher learning.

2. The Parties agree to encourage invitations from individual universities or other institutions of higher learning to students and scholars of the other side for the purpose of study, consultation, research or lecturing.

3. The Parties agree to provide for conditions necessary to fulfill agreed programs, including use of scholarly and scientific materials, and, where appropriate and possible, work in laboratories, archives and institutions outside the system of higher educational establishments.

4. The Parties agree to exchange one delegation from each side in the field of higher and specialized secondary education, composed of three to five specialists, for a period of two weeks on topics to be agreed upon later.

5. The Parties agree to proivde for the exchange of delegations consisting of from three to five specialists in the field of education for a period of up to three weeks in the following areas: the U.S. side, in the field of the education of the handicapped; the Soviet side, in a field to be agreed upon later.

6. The Parties agree to facilitate the conducting of bilateral seminars of United States and Soviet specialists in the field of education: twelve from each side for a period from two to four weeks on subjects to be agreed upon. One such seminar will be conducted annually in the Soviet Union and in the United States in turn.

7. The Parties agree to encourage the exchange, by appropriate organizations, of educational and teaching materials, including textbooks, syllabi and curricula, materials on methodology, children's literature, slides, samples of teaching instruments and visual aids.

8. The Parties agree that the exchanges specified above will be implemented in accordance with the appropriate provisions of the Annex to this Section.

Section VII

PERFORMING ARTS

1. The Parties agree to encourage and support, on a reciprocal basis, appearances of theatrical, musical, choral and choreographic groups, orchestras and individual performers.

2. The Parties agree to facilitate the tours of six major performing arts groups from each side to be exchanged correspondingly during 1972 and 1973.

3. Commercial contracts acceptable to the Parties will be concluded between appropriate organizations or impresarios of the United State and concert organizations of the Soviet Union well in advance and, whenever possible, at least nine months before the beginning of the tours. The receiving Party will seek to satisfy the wishes of the sending Party concerning the timing and duration of the tours as well as the number of cities to be visited.

4. The Parties agree to facilitate the tours of up to 20 individual performers from each side during 1972–1973. Suggestions for tours of individual performers may be made by appropriate organizations or impresarios of the United States and concert organizations of the Soviet Union.

5. In the event of additional mutually acceptable exchanges and tours in performing arts, the provisions of Paragraph 3 or Paragraph 4 will apply.

Section VIII

CINEMATOGRAPHY

1. The Parties agree that the sale and purchase of motion pictures of their respective film industries, through commercial channels, may take place on the basis of equal opportunity.

2. The Parties agree to encourage the exchange and to provide for the distribution of documentary films in the fields of science, culture, technology, education and other fields, including films for university-level use, in accordance with lists to be agreed upon between the Parties.

3. The Parties, when requested by organizations or individuals of their respective countries, agree to give favorable consideration, as appropriate, to other film proposals, including the holding of film premieres in each country, the exchange of appropriate delegations to these premieres, and the joint production of feature films and short and full-length educational and scientific films.

4. The Parties agree to facilitate the exchange of delegations of creative and other technical specialists.

Section IX

PUBLICATIONS, EXHIBITIONS, RADIO AND TELEVISION

The Parties agree:

Publications

1. To render practical assistance for the successful distribution of the magazines *Amerika* in the Soviet Union and *Soviet Life* in the United States on the basis of reciprocity and to consult as necessary in order to find ways to increase the distribution of these magazines. The Parties agree to distribute free of charge unsold copies of the magazines among visitors to mutually arranged exhibitions on the condition that the issues of the magazines will contain materials devoted to the subject of the exhibition.

2. To encourage the exchange of books, magazines, newspapers and other publications devoted to scientific, technical, cultural and general educational subjects between the libraries, universities and other organizations of each country.

3. To encourage exchanges and visits of journalists, editors and publishers, as well as their participation in appropriate professional meetings and conferences.

Exhibitions

4. To exchange one circulating exhibition from each side during 1973.

The subject of the United States exhibition in the Soviet Union will be: Outdoor Recreation in the U.S.A.

The subject of the Soviet exhibition in the United States will be: Soviet Youth.

5. To show each exhibition in six cities for a period of up to 28 actual showing days in each city. The Parties will discuss in a preliminary fashion the nature and general content of each exhibition and will acquaint each other about the exhibitions before their official opening, in particular through the mutual exchange of catalogues, prospectuses and other information pertinent to the exhibitions. Other conditions for conducting the exhibitions (dates, premises, number of personnel, financial terms, etc.) shall be subject to agreement by the Parties. Arrangements for conducting the exhibitions will be concluded by November 20, 1972.

6. To render assistance for the exchange of exhibitions between the museums of the two countries.

7. To arrange through diplomatic channels other exhibitions and participation in national exhibitions which may take place in either country.

Radio and television

8. To promote exchanges of materials in the field of radio and television including literature and taped and filmed programs.

9. To promote exchanges of delegations and individuals engaged in radio and television matters.

Section X

GOVERNMENT, SOCIAL, CIVIC, CULTURAL, AND PROFESSIONAL EXCHANGES

1. The Parties agree to render assistance to members of the Congress of the United States of America and deputies of the Supreme Soviet of the Union of Soviet Socialist Republics, as well as to officials of the national governments of both countries, visiting the Soviet Union and the United States respectively, concerning which the Parties will agree in advance through diplomatic channels.

2. The Parties agree to encourage exchanges of representatives of municipal, local and state governments of the United States and the Soviet Union to study various functions of government at these levels.

3. The Parties agree to encourage joint undertakings and exchanges between appropriate organizations active in civic and social life, including youth and women's organizations, recognizing that the decision to implement such joint undertakings and exchanges remains a concern of the organizations themselves.

4. The Parties agree to provide for reciprocal exchanges and visits of writers, composers, musicologists, playwrights, theater directors, artists, architects, art historians, museum specialists, specialists in various fields of law and those in other cultural and professional fields, to familiarize themselves with their respective fields and to participate in meetings and symposia. The Parties agree to in-

form each other of proposed visitors and to arrange programs for them well in advance of their arrival.

5. The Parties note that commemorative activities may take place in their countries in connection with jubilee celebrations recognized by major international bodies.

Section XI

SPORTS

1. The Parties agree to encourage reciprocal exchanges of athletes and athletic teams as well as visits of specialists in the fields of physical education and sports.

2. These exchanges and visits will be agreed upon between the appropriate United States and Soviet sports organizations.

Section XII

TOURISM

The Parties agree to encourage arrangements for tourist travel between the two countries and measures to satisfy the requests of tourists, as individuals or in groups, to acquaint themselves with the life, work and culture of the people of each country.

Section XIII

PROCEDURE FOR A MEETING OF THE PARTIES

The Parties agree to hold, within one year after the signing of this Agreement, a meeting of their representatives to discuss the implementation of exchanges and the development of the program for 1973.

Section XIV

ENTRY INTO FORCE

This Agreement shall enter into force on signature with effect from January 1, 1972.

In witness whereof, the undersigned, being duly authorized, have signed this Agreement, and thereto have affixed their seals.

DONE at Moscow in duplicate, in the English and Russian languages, both equally authentic, this eleventh day of April, one thousand nine hundred seventy-two.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:
(SEAL)

FOR THE GOVERNMENT OF THE UNION OF SOVIET SOCIALIST REPUBLICS:
(SEAL)

Annex to section III: Science and technology

List of Exchanges of delegations carried over from the 1970–1971 Agreement into the present Agreement:

1. Antarctic Research;
2. High-Voltage Power Transmission;
3. Management Systems;
4. Chemical Abstracting;
5. Transport.

Annex to section VI: Education

GENERAL

(Applies to paragraphs 1–a, 1–b, 1–c and 2)

1. By agreement between the International Research and Exchanges Board (IREX) and the Ministry of Higher and Specialized Secondary Education of the USSR (Ministry), the receiving side will provide for participants in the exchange: tuition and fees for training in universities and other institutions of higher learning, research conditions necessary for conducting their scholarly program, payment for suitable living quarters, and a monthly stipend. In case of illness of, or accident resulting in injury to, a participant, the receiving side will

bear medical costs, including hospital expenses, as agreed between the two sides. The sending side will bear all costs for travel of its participants.

The receiving side will lend assistance in providing suitable accommodations for spouses and minor children of the participants. The sending side will bear all costs for spouses and minor children accompanying the participants in the exchange in the receiving country. In case of illness of, or accident resulting in injury to, a spouse or minor child, the receiving side will bear medical costs, including hospital expenses, as agreed between the two sides.

EXCHANGES OF GRADUATE STUDENTS, POSTGRADUATES, YOUNG RESEARCHERS AND INSTRUCTORS

(Applies to paragraph 1–a)

2. IREX and the Ministry will exchange lists of nominees and the necessary information about each nominee and his program not later than March 1 for the next academic year. Representatives of IREX and the Ministry will meet in the Soviet Union no later than May 10, 1972 and in the United States no later than May 10, 1973 for a mutual exchange of information concerning placement of the participants for the forthcoming academic year and to discuss details connected with the exchange.

Participants who are to start their work at the beginning of the academic year will arrive during the period August 1–10, as agreed upon by IREX and the Ministry, at the universities in each country which will provide courses in language preparation. Those accepted for the second semester will arrive during the period February 1–10. If a participant cannot arrive in the receiving country on the agreed date, the sending side will inform the receiving side of this fact as far in advance as possible and a new date for his arrival will be settled by agreement. Applications for extensions of agreed periods of stay may be submitted during the participant's period of study and will be considered by the receiving side.

The receiving side will provide the participants in the exchanges, upon their arrival in the country, with the following stipends:

In the USA—200 dollars a month;

In the USSR—165 rubles a month.

EXCHANGE OF LANGUAGE TEACHERS

(Applies to paragraph 1–b)

3. IREX and the Ministry will agree on the dates for the courses and will exchange lists of participants, drafts of the programs for the courses, and commentaries on them by May 10 of each year. Participants in these exchanges may be accompanied by one or two leaders. The receiving side will provide to the participants the following stipends:

In the USA—180 dollars month;

In the USSR—150 rubles a month.

The stay of the participants in the exchanges in the receiving country will include excursions to two of its cities, with total duration of up to one week, to be considered within the agreed duration of the exchange. The receiving side will bear all costs for these excursions.

EXCHANGES OF PROFESSORS AND INSTRUCTORS

(Applies to paragraph 1–c)

4. IREX and the Ministry will exchange lists of professors and instructors, the necessary information concerning each of them, and his program of research:

For those proposed by the sending side for the first semester, by March 15 of each year;

For those proposed for the second semester, by October 15.

The receiving side will inform the sending side concerning acceptance of the scholars by universities and other institutions of higher learning within two months after the above-mentioned documents are received.

The receiving side will provide to the participants of these exchanges the following stipends:

In the USA—280 dollars a month;

In the USSR—240 rubles a month.

EXCHANGE OF LECTURERS

(Applies to paragraph 1–d and 1–e)

5. The Parties will exchange requests for subjects of lecturers by December 1 of each year. The receiving side will specify the name of the inviting university or other institution of higher learning, the field of specialization, and the courses to be taught, language requirements and length of stay.

By March 15 following, the Parties will exchange lists of lecturers, and the necessary information about each. The receiving Party shall inform the sending Party of the decision of the institution of higher learning by April 15.

The receiving party will provide living quarters for the lecturers and will lend assistance in finding accommodations for accompanying spouses and minor children. In case of illness of, or accident resulting in injury to, a spouse or minor child, the receiving Party will bear medical costs, including hospital expenses, as agreed between the two Parties. The sending Party will bear all other costs for spouses and minor children accompanying participants. The Parties will provide the following stipends:

In the USA—280 dollars a month;

In the USSR—240 rubles a month.

The sending Party will be responsible for all travel expenses.

INVITATIONS TO INDIVIDUAL SCHOLARS

(Applies to Paragraph 2)

6. Such visits will be based on the terms of invitation from individual universities or other institutions of higher education of the two sides. IREX and the Ministry agree to transmit the invitations and to support and facilitate implementation of these visits on the basis of reciprocity.

SEMINARS

(Applies to paragraph 6)

7. The Parties will coordinate the topics, times, procedures, arrangements and location for the seminars. The sending Party will bear all costs of the travel of its participants. The receiving Party will bear all costs of maintenance of the visiting delegation.

The receiving Party shall confirm arrangements two months prior to the seminar and the sending Party shall submit the list of its participants thirty days prior to the seminar date.

VISITS OF REPRESENTATIVES

(Applies to paragraph 8)

8. Each side may send, at its own expense, its representatives to the receiving country for familiarization with the conditions of study and sojourn of its participants in these exchanges.

Mr. SYMINGTON. Mr. Frey?

Mr. FREY. Thank you, Mr. Chairman.

Mr. Pollack, thank you very much for a very fine statement. Both you and Mr. Bundy seem optimistic about these agreements. Of course we all are optimistic about them, and it may well be that the quest for scientific knowledge transcends ideologies in social systems, but I think it also has been said that difficulties do lie ahead, and maybe you could outline for the committee, from a State Department standpoint, what difficulties you foresee, if any.

Mr. POLLACK. I am not looking forward to any future difficulties. I was alluding to the fact, as was Mr. Bundy, that in the past there have been problems that our scientists have encountered in working with their counterparts in the Soviet Union that you would not ordi-

narily encounter, let's say in working with the scientific communities of Great Britain or France, or other of the Western nations.

This does, I think, arise out of the difference in the social systems of the two countries and the attitudes of the two countries toward its technical population. It is my hope that the seriousness of the intentions with which both the Soviets and the United States enter into these agreements would be reflected in the way in which they are managed on both sides, and we look forward to these agreements being carried out in that kind of a spirit.

Mr. FREY. For instance, when the American astronauts visited Russia, were there any particular problems that resulted from their accomplishment, with the Soviets in space?

Mr. POLLACK. No. On the contrary, they were very well received and were shown everything they were interested in seeing, and came back full of praise for the Soviet interest and their reception in the Soviet Union.

Mr. FREY. Has there been any indication, to your knowledge, of the fact that perhaps some of the people from the Soviet side in developing this agreement might at some future time testify before this committee?

Mr. POLLACK. Do I have any knowledge with regard to that?

Mr. FREY. Yes.

Mr. POLLACK. No, sir; I do not.

Mr. FREY. Do you think that's a possibility?

Mr. POLLACK. That's a question that I really don't have an answer for. I don't know how another foreign government official would provide testimony before the U.S. Congress. Your committee, of course, runs the annual Panel on Science and Technology Meeting, and you've had foreign witnesses, or panelists, come before you then. As far as I know, that may be the only instance in which foreign government nationals do appear before a committee.

Mr. SYMINGTON. I can tell you that we did invite any observations or expressions that our Soviet friends here in Washington might have and might wish to submit, and that invitation remains open.

I think in receiving the paper to be put into the record this morning we actually have what we could expect to be testimony on their part. They have shown an interest in these hearings. As I said before, we have invited observations from our Soviet friends here, and they are most welcome to submit them at any time. If they have any thoughts they would like to contribute, they are most welcome to do so.

Mr. FREY. I certainly agree with the chairman.

One question too that was on my mind concerns the programs in Poland and Yugoslavia that are supported in part by our Public Law 480 holdings. Basically, what are they?

Mr. POLLACK. They are a very wide range of programs in which a large number of U.S. agencies are participating. What they constitute are, generally speaking, research programs that are carried on by the scientists in Yugoslavia and Poland, but the nature of their research is designated by the U.S. agency. It is supported by Public Law 480 funds which Congress appropriates, which are obtained through

the appropriation process before the various congressional appropriation subcommittees. They are especially active in the field of health.

The Department of Transportation and the Department of Housing and Community Development are now moving actively into these areas into these countries, and into this program.

I have here two statements, one on Polish cooperation and one on Yugoslavian, which I would be glad to submit for further response to your query.

In Poland in 1971 there was a total of 90 projects, and the amount of money, equipment, and so on, is $10 million. There is a larger program in Yugoslavia and it is now up to about the level of $20 million, and my recollection is that over a dozen agencies are involved in these activities.

Mr. FREY. In addition to submitting those, could you also submit for the record information on any other nations in which such a program is developed and the amount of money involved?

Mr. POLLACK. Yes, we will be glad to provide that.

(The information to be furnished is as follows:)

U.S. POLISH COOPERATION IN SCIENCE AND TECHNOLOGY

The development of scientific cooperation with Poland sponsored by U.S. Government Agencies under Public Law 480 began in 1961. Since that time NIH, DHEW, and the Agriculture Research Service of USDA initiated cooperative research with Polish counterpart institutions, specifically with the Polish Ministry of Health and Academy of Sciences. The Smithsonian Institution initiated a program shortly thereafter. For the FY 1971 period, approximately 90 projects amounting to over 10 million dollars equivalent in Polish Zlotys became effective.

Following the visit of Polish Science Minister Jan Kaczmarek to the United States in May 1971 agreement was reached on a considerably expanded program of cooperation involving additional U.S. agencies. Over the past year Secretary Volpe concluded an understanding with his Polish counterpart regarding cooperation in various aspects of transportation technology. In addition, the Departments of Interior and Commerce (NBS and NOAA), EPA, and NSF have sent groups of specialists to Poland and have arranged for cooperative research projects with equivalent Polish institutions. For FY 1972 nine U.S. Agencies (HEW, Agriculture, EPA, Interior, DOT, NSF, NBS, Smithsonian and the Library of Congress) have allocated $11.7 million in PL–480 local currency for cooperative research projects in Poland (see table).

POLAND

U.S. AGENCY PUBLIC LAW 480 CURRENCY ALLOCATIONS SCIENTIFIC AND TECHNOLOGICAL COOPERATION

[In dollar equivalents]

U.S. Agency	Fiscal year— 1972	1973
1. Department of Health, Education, and Welfare (HEW)	$7,402,000	$6,459,000
2. Department of Agriculture	1,000,000	2,400,000
3. Environmental Protection Agency	2,500,000	3,000,000
4. Department of Interior	160,000	420,000
5. Department of Transportation		[1] 500,000
6. National Science Foundation	493,000	1,150,000
7. Department of Commerce:		
NOAA		400,000
NBS	25,000	350,000
8. Smithsonian Institution	57,884	425,000
9. Library of Congress	50,000	110,000
Total	11,687,884	15,214,000

[1] Including $250,000 unobligated in fiscal year 1972 but carried over to fiscal year 1973.

YUGOSLAVIA

Cooperation in Science and Technology

Under the provisions of PL–480 Yugoslavia, like Poland, has had programs of cooperative research in the agricultural sciences and health since the early sixties. Smithsonian has also engaged in joint work in limnology and archeology for several years.

In 1971, following the visit of the President to Yugoslavia (and of Science Minister Bulc to the U.S.) in the fall of 1970, joint research financed with our PL–480 dinars expanded greatly. EPA, Interior, NSF and the technical bureaus of Commerce (NOAA and NBS) negotiated extensive programs of research collaboration with their Yugoslav counterparts. By the end of FY 1972 Agency authorized projects totalled approximately 22 million in U.S. owned excess local currency.

Unfortunately, these local currencies are being expended very rapidly for a great variety of U.S. uses in addition to joint research. Even in the two to three years during which limited amounts will remain available, there will be a considerable restriction in their use. Additional methods of financing and conducting cooperative research must be devised, possibly along the lines of the proposed binational foundation with Israel, where U.S. excess currency holdings were also depleted.

India–Poland–Yugoslavia

In the above three countries there is a wide variety of outstanding basic research projects in biomedical and public health, education, agriculture, engineering pollution and human environment problems and oceanographic studies. It is noted that four agencies (NOAA, DOT, Interior and NBS) recently joined in the foreign currency research activities. Two-thirds of all the excess currencies of the U.S. Government is currently being used for science programs in these three countries.

Israel

Excess currencies in Israel will be depleted by June 30, 1973 and no further new projects will be started as of this date. Ongoing projects will be funded for two more years (FY 1975). The major portion of the research activities are in the health area of social rehabilitation, basic engineering, archeological excavation and translation studies.

Morocco–Tunisia

Besides the excellent archeological, systematic biology and museum research studies of Smithsonian, the major portion of the rest of the research is in health, education and basic science and technology. These studies are not large but have proven valuable in their contributions to ongoing programs in the U.S.

Egypt (ARE)

An interesting point for Egypt is the presence of a large U.S. Naval Medical Research Unit which has been in operation for more than 20 years. Over the period of years it has made major contributions to the diagnosis and treatment of a vast array of viral, bacterial and parasitic diseases. From time to time this Unit has been the only diplomatic and science link between the U.S. Government and the Arab Republic of Egypt. The rest of the programs are mainly in biomedical and health-related research, education, agriculture, archeological, historical and museum studies.

Pakistan

The level of funding for science and technology is still a respectful 5.7 million even though the war with India temporarily disrupted ongoing programs. These projects are in the somewhat same general areas as those in India but on a smaller scale. Agriculture and basic medical research accounts for over half of the work. The SRS has obtained valuable information from their demonstration and rehabilitation studies as has the Smithsonian and NSF with their systematic biology and basic exploration projects.

EXCESS FOREIGN CURRENCY BUDGETS AND REQUESTS FOR SCIENTIFIC ACTIVITIES ABROAD—FISCAL YEAR 1970–73

Agency	Fiscal year 1970	Fiscal year 1971	Fiscal year 1972 [1]	Planned request Fiscal year 1973
HEW/PHS/NIH	$3,455,000	$32,444,000	$25,545,000	$31,400,000
HEW/SRS	2,000,000	4,000,000	[2] 9,818,000	11,000,00
HEW/Office of Education	1,000,000	3,000,000	3,000,000	4,000,000
EPA		3,500,000	[3] 10,645,000	5,000,000
USDA	5,000,000	5,000,000	10,000,000	20,000,000
Smithsonian	2,316,000	2,500,000	5,500,000	6,000,000
DOD/Navy		900,000	2,905,000	3,000,000
DOD/Air Force		400,000		
NSF	2,000,000	2,000,000	3,000,000	6,000,000
NOAA		15,000	900,000	1,100,000
DOT			500,000	500,000
Interior	15,000		490,000	1,000,000
NBS	500,000	500,000	900,000	1,000,000
HUD			[4] 300,000	
AEC			[5] 80,000	([6])
Total	16,286,000	54,259,000	73,583,000	90,000,000

[1] Allocated but not all obligated during fiscal year 1972.
[2] Decrease attributable to agencies transferred to EPA.
[3] Includes $6,500,000 for single project.
[4] HUD funds requested for Yugoslavia but not appropriated.
[5] Being budgeted as dollar purchase of excess foreign currencies.
[6] Being developed.

Source: Budget presentations of individual agencies

FISCAL YEAR 1972 EXCESS FOREIGN CURRENCY BUDGET FOR SCIENTIFIC ACTIVITIES ABROAD BY COUNTRY AND AGENCY

Agency	India	Israel	Morocco	Pakistan	Poland	Tunisia	ARE	Yugoslavia	Total
HEW/PHS/NIH	$6,203,762	$64,000	$415,000	$1,759,738	$7,395,555	$912,050	$1,375,100	$7,339,795	$25,545,000
HEW/SRS	1,800,000	400,000	500,000	1,500,000	1,618,000	600,000	800,000	2,500,000	9,818,000
HEW/Office of Education	1,545,000		245,000	175,000	175,000	200,000	325,000	500,000	3,125,000
EPA	2,290,000			325,000	1,350,000			6,680,000	10,645,000
USDA	4,050,000		100,000	1,400,000	600,000	265,000	85,000	3,500,000	10,000,000
Smithsonian	1,500,000	600,000	600,000	250,000	420,000	1,200,000	300,000	620,000	5,500,000
DOD/Navy							2,500,000	355,000	2,905,000
NSF	1,200,000	200,000	50,000	300,000	545,000	100,000		470,000	3,000,000
NOAA	350,000	40,000			385,000			125,000	9,000,000
DOT					250,000			250,000	500,000
Interior					175,000			325,000	500,000
NBS	350,000	40,000			385,000			125,000	900,000
HUD								[1] 300,000	
AEC	350,000	40,000	50,000	300,000	385,000	100,000	2,500,000	300,000	80,000
Total	19,288,762	[2] 1,344,000	1,910,000	5,709,738	13,298,555	3,307,050	5,435,100	22,784,795	73,043,000

[1] HUD funds requested but never appropriated.

[2] Excess currencies for the purposes of scientific and research activities by U.S. agencies will be depleted by June 1973.

Source: Budget presentations of individual Agencies, Revised: June 19, 1972.

Mr. FREY. Of course we're delighted to hear you refer in your statement to the possible expansion of these activities. I was just wondering if you would want to state what particular ones you have in mind?

Mr. POLLACK. I think the first chore under the new Agreement on Cooperation in Science and Technology will be to try to identify those which would be most attractive to the Soviet Union and to us.

Mr. FREY. I wish, if you could, you would clarify your statement on page 8 that, "It is the joint endeavor aspect of the new agreements that holds the greatest promise for the future."

In saying that, I think I understand what you mean.

That obviously doesn't preclude at a future time expanding this activity to multinations does it?

Mr. POLLACK. No; not at all.

Mr. FREY. It's not exclusive in any way?

Mr. POLLACK. No.

Mr. FREY. I recognize that, but I just wanted to get that in the record for clarification.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Thank you.

Before I ask Mr. Mosher for his questions, I would like to ask one.

These agreements appear to be executive agreements, as I understand them, and yet there has been some general indication from administration sources concerning their hope of support from the Congress.

I wonder if there is any specific kind of support, other than general approbation, that is desired by the executive branch.

Mr. POLLACK. The approbation is important in and of itself. It would be my hope that the Congress, as well as the American people, would give support to what the President is attempting to achieve, and I think did achieve, in Moscow, and that support would be very significant, not only to us but I think it would be well understood in Moscow.

I'm sure that you can anticipate that the agencies that are responsible for these agreements—and this would be true whether they were with the Soviet Union or with another country—will find it necessary to have funds to cover travel, to manage the costs of the symposia, and other such ventures. Much of the work, I think, to be done in the substantive areas, will be work that has already been planned here. This is not so much to undertake new activities that we otherwise would not be doing—especially I think this is true in the health field and in the environmental field—as it would be to expand the capabilities in this and comparable activities in a joint fashion with the Soviet Union.

So I would imagine that these agencies, as they compose their budgets for next year, will take into account the cost that will be arising out of the agreements that we have reached here with the Soviet Union, and I would hope that the Congress would take a favorable attitude toward meeting those costs as well.

The space program is a little different, because the venture there is a new and different venture and may require new appropriations of $250 million. I don't think I can make the same statement with respect to the Joint Commission.

Mr. SYMINGTON. That may be a unique agreement among these in that respect, although the moneys to be required to properly initiate these agreements may not be of that magnitude.

Going back to my original inquiry, I think that it might serve the purposes of the administration to provide the Congress with a resolution to be submitted for approval by the Congress. I anticipate that this might evolve from the opportunity that this committee and other committees can take advantage of, to learn about these agreements, and inform the other Members of Congress what they are all about, for their approval.

Mr. POLLACK. Favorable appropriation activity and the adoption of a resolution would be two tangible ways in which the Congress might demonstrate their support of the future of these agreements.

Mr. SYMINGTON. Thank you.

Mr. Mosher?

Mr. MOSHER. Mr. Chairman, I suggest that there may have been in our conversations here today, at least somewhat earlier in our conversations, an unfortunate and maybe inaccurate impression that we in this country have been, through these years preceding the summit, pressing for these agreements, and that, on the other hand, in Russia there's been sort of a monolithic resistence to the agreements.

I suggest probably for accuracy's sake our record should show that this isn't so; that there actually was considerable disagreement and suspicion, fully as much over here, as we approached the summit, and I suspect such was the case over there. I suspect there was not a monolithic resistence over there, but a great deal of discussion, and urging, and hopefulness that these agreements could be reached. Is that probably so?

Mr. POLLACK. I don't take issue with your comment, Mr. Mosher.

Mr. MOSHER. Thank you.

Mr. SYMINGTON. There are some differences between the agreements, and I'm not sure we can attach significances to all differences, but I thought it might be helpful to mention them. For example, the Health and Environment Agreements are automatically extended after the termination of their 5-year period, while the other two, Space, and Science and Technology, can be extended only by new mutual agreement.

I wonder if that was just a drafting oversight, intending to arrive at the same point. Could you tell us whether we should interpret that distinction to mean that there is something special about the latter two agreements that requires renewal?

Mr. POLLACK. I'm unaware of any deep significance in the variations in language that appear in the agreements. Most of those variations are the consequence of slightly different histories behind each of the agreements, different personalities engaged in working out the details.

Mr. SYMINGTON. I would have thought so, because I'm sure after the initial 5-year period in each case that there will be sufficient experience to warrant some new approaches.

Mr. POLLACK. Possibly. That's one of the provisions that the agreement does provide.

Mr. SYMINGTON. The Science and Technology Agreement is of particular interest, I think, to our full committee and our Subcommittee on Science, Research and Development. That agreement refers to the exchange of scientific and technical information and documentation. We've seen both political and industrial and labor opposition to the so-called export of American technology and its potential impact on the U.S. trade position in the future.

Is this a problem which the implementers of these agreements must contend with, as I suspect that it might be?

Mr. POLLACK. It is a problem that is not unique to the relationship with the Soviet Union. It is a general area of concern in the U.S. Government at this time, and clearly the view that movement of technology should be carefully reviewed, for purposes of not only security considerations, but also economic and commercial. It is now a factor in the way in which we approach these kinds of arrangements with other countries.

Mr. SYMINGTON. Mr. Frey?

Mr. FREY. A provision in the Space Agreement refers to problems of international law. I understand that there are three treaties now in existence.

What areas of international law have to be resolved and what are we doing about it?

Mr. POLLACK. There is still pending a Soviet initiative before the United Nations for a treaty on the moon, which is one of the things which I think the Soviet side had in mind in this area. I am not aware that there are any other major areas.

Mr. WEBBER. There have been some discussions before the Subcommittee on Science and Technology and the Space Science and Applications Subcommittee on the effect of outer space activities and their relationship to sovereignty and proprietary rights of each nation. This has to do particularly with a series of satellites, called the natural resource sensing satellites.

I think this too is something the Soviets had in mind when they proposed this initiative.

Mr. FREY. That raises a good question.

What is the problem, and what does it look like it's going to do?

Mr. POLLACK. In our view, there is a minimal problem at this point. What we're trying to conduct is an experimental undertaking. We don't have any experience at the moment. It is our view that the information that would be acquired from the experimental ERTS satellite would, of course, be made available on an open basis to any scientist with a reason to wish to acquire it.

The nature of the activities that are going to be conducted under ERTS don't in themselves give rise to the concerns respecting sovereignty. That may, depending upon the outcome of this and what the next generation, or the third, or fourth generation look like, then come into being. It is our general view that this is a problem that is prospective rather than real at this time.

Mr. FREY. Thank you, sir.

Mr. SYMINGTON. With respect to the Earth Resource Satellite information, I think the problem appears more real to some of our friends than it may to us; that is, if I correctly interpret what I heard at the United Nations a month or so ago, when I visited as chairman of this subcommittee to learn something of the worldwide attitude toward the U.S. space program. It seemed clear that it was in the international law province, incident to securing information on the resources of other countries, proprietary rights, sovereign rights of privacy, this kind of thing.

I think it was their feeling that the Department of State was either minimizing or underestimating the nature or degree of these problems, that they wanted to get started sooner talking about them, but

they were advised by the Department that there was an insufficient technical basis on which to begin such legal discussions, that is to say, that we weren't sure what kind of information was due to derive from this experiment and that it was too early to discuss the sharing process.

Would that be a fair statement?

Mr. POLLACK. That's a very fair statement, and I would only add to it that I feel certain the experiment will move forward into an operational phase. But at this point it is literally the case that we really don't know enough about what the problem is to be able to develop the law to handle it. That there is a problem, at least a perceived problem, is very clear in the minds of many of the Governments.

Mr. SYMINGTON. We had a panel discussion on this program earlier this year, and it appeared to us that we were getting some fairly vivid ideas in regard to the kinds of information that would be developed by these satellites, but I take it that it's not sufficiently vivid to warrant discussing them with our friends.

Mr. POLLACK. I think, Mr. Chairman, that would be described in the future tense, or the future generations, that may or may not come into being. We will be in a much better position to address, on our own part, the nature of this problem once we have had the experience, the results of that experiment that is now scheduled, to consider and evaluate it.

Mr. FREY. Mr. Chairman, may I ask one question?

Mr. SYMINGTON. Go right ahead.

Mr. FREY. Regarding the Stockholm conference, which would seem rather conducive to solving international environmental problems, there have been obvious difficulties of: (*a*) attendance; and (*b*) reaching any kind of an agreement.

Could you elaborate on what the difficulty has been and what the major issues have been?

Mr. POLLACK. I think fundamentally the problem we are encountering in Stockholm is that history moves usually slowly, and especially when it moves into an area that is poorly understood, and controversial as is the subject of what humanity will do about the environment in which it lives and what steps will be taken to prevent its further degradation.

What is being revealed, to my view, in Stockholm is that the education of the countries is at remarkably different levels. The perception of concern on the part of the people is different, just as it is throughout the United States. For people living in the open spaces of the West, it is completely different from that of the man living in New York City. And in Stockholm those who expected very great changes in the course of human history of Stockholm were bound to be disappointed. History just doesn't move that quickly in an area of this kind.

One of the benefits that should result from the U.S.-Soviet Environmental Agreement—and we have a comparable agreement in that area with Japan and Germany, and coverage in our scientific agreement program with France and some of the other countries—one of the benefits that you can hope for out of these undertakings, and particularly if they do become multilateral, as we would like them to be, is that the appreciation of what the problem is and what can, both technically and realistically, be done about it, will become more widespread.

I don't personally think that Stockholm is going to be the last time that the governments of the world get together to address this question. It would be my hope that in future such occasions, the approach will be much more practical, directed more toward the problems that have to be dealt with, than it's going to be possible for this one to do.

Mr. FREY. Are you trying to say in a nice way that sufficient groundwork wasn't done?

Mr. POLLACK. No. I think for the purposes of beginning, the groundwork for this was extraordinary, but you have to make a beginning, and this was just that, a beginning.

It reminds me a little bit of the Conference on Outer Space in Vienna in 1967. I think if that group met today the discussion would have a far different character, because the understanding of what we can and can't do in space because of applications is far more sophisticated and widespread today than it was at that time. There too they were projecting everything into the future, and that future was very short, about 5 or 10 years. The understanding we have of what can and cannot be done in space is now incredibly larger. I suspect that would be the case 5 years from now with respect to the environment.

Mr. SYMINGTON. There's been considerable tension, really, between the small powers desiring the application of certain industrial processes and larger powers which might deem them destructive to their environment. The small powers are skeptical of the "environmental" obstacles to their development.

Mr. POLLACK. You put your finger on one of the underlying problems of dealing with the environment internationally.

Mr. SYMINGTON. Mr. Bundy closed his statement by saying that these agreements contain significant budgetary implications.

I guess it's premature to speculate to which budgets some of these additions might be added. I know, for example, we have provided in our budget for the National Science Foundation opportunities for American scientists to work with scientists abroad. Perhaps the health question could be dealt with through the Public Health Subcommittee.

Does the State Department have any thoughts along this line, or hasn't it reached this point yet?

Mr. POLLACK. To be candid, I would say that I'm going on the assumption that the health activity would be financed by appropriations made available to the several institutions that are participating; that the environmental activity would be funded in principal by funds available to the Environmental Protection Agency, and possibly to the Council on Environmental Quality. Certainly the space activity will be funded out of the appropriations to NASA. There may be some general support—I predict there probably would be—coming out of the National Science Foundation and possibly out of the appropriations that the Department of State receives for the cultural program.

I don't want to make a prediction yet on what we'll do about funding the activities under the Joint Commission on Science and Technology because the speculation is too great as to what they're likely to be, but basically I think the agencies responsible for the programs would want

to retain financial responsibility, and that would be the simplest way to manage the responsibility for funding their activities.

Mr. SYMINGTON. I realize, as we are examining this program, it's in somewhat of an embryonic stage. We're grateful for your willingness to come and give us, at this stage, your point of view.

If there are no further questions, we will adjourn this committee meeting, with great thanks to you and Mr. Davies for giving us the benefit of your views and understanding.

Thank you so much.

Mr. POLLACK. Thank you, Mr. Chairman.

Mr. DAVIES. Thank you, Mr. Chairman.

Mr. SYMINGTON. The committee is adjourned for the day.

(Whereupon, the subcommittee was adjourned at 11:55 a.m., to reconvene at 10 a.m., on Wednesday, June 14, 1972.)

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS ON SCIENCE AND TECHNOLOGY, SPACE, ENVIRONMENT, AND HEALTH AND MEDICINE

WEDNESDAY, JUNE 14, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON INTERNATIONAL
COOPERATION IN SCIENCE AND SPACE
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10 a.m., in Room 2318, Rayburn House Office Building, the Hon. James W. Symington (chairman of the subcommittee), presiding.

Mr. SYMINGTON. This subcommittee will be in order.

Good morning.

I am very anxious to hear from our distinguished witnesses today. This is the second day of public hearings on the recently executed cooperative agreements between the United States and the Soviet Union on science and technology, medical science and public health, environmental protection, and space exploration.

Our purpose is to inform the members of this subcommittee, the full committee, the Congress, and the American people, on the nature and scope of these important accords.

Yesterday we were privileged to hear from the distinguished president of the Ford Foundation, the former foreign policy adviser to Presidents Kennedy and Johnson, the Honorable McGeorge Bundy. The subcommittee also received testimony from the Honorable Herman Pollack, Director of International Scientific and Technological Affairs, of the Department of State. He was instrumental in the negotiations which led to all four of the agreements.

Today we are very pleased and highly honored to have three distinguished witnesses. The first is our good friend, the Honorable Edward E. David, Jr., Science Adviser to the President; the second witness is Dr. James B. Fisk, president of Bell Telephone Laboratories. They will discuss the agreement on science and technology.

Our third witness, Dr. Philip Handler, president of the National Academy of Sciences, will provide a general overview of all four agreements from the standpoint of the American scientific community.

We begin, as I mentioned, with Dr. David. He is the man perhaps most instrumental in developing the terms of the agreement on science and technology. As the Director of the Office of Science and Technology of the Executive Office of the President, he will have primary responsibility for implementing this agreement for the United States.

Accompanying Dr. David today is Dr. Norman P. Neureiter of the Office of Science and Technology, Executive Office of the President.

Dr. David, the subcommittee is very pleased and grateful, considering the many demands on your time, for your presence here this morning to share with us your insights as they bear on these agreements. We welcome your statement.

(The biographical sketch of Dr. David follows:)

EDWARD E. DAVID, JR.

Science Adviser to the President, and Director, Office of Science and Technology, was born in Wilmington, N.C., January 25, 1925. He received a B.S. degree in Electrical Engineering from Georgia Institute of Technology in 1945, and the S.M. and Sc.D. from Massachusetts Institute of Technology in 1947 and 1950 respectively. Prior to coming to Washington in September 1970, Dr. David was Executive Director, Research, Communication Principles Division of the Bell Telephone Labs.

Dr. David joined the Bell Laboratories in 1950 and worked subsequently in underwater sound and communication acoustics. From 1963 on he specialized in doing research in advanced computing techniques with particular emphasis on "man-machine communication." He has been granted eight patents for his inventions relating to underwater sound, sound localization, and speech processing.

He is the originator of "The Man-Made World", a new course for high school students concerning the principles behind technology. The course was developed to provide "technological literacy" for the general student and was the result of collaboration by teachers, professors, and engineers from industry. The course is now being taught in about 300 high schools.

He was selected by the honorary engineering society, Eta Kappa Nu, as one of the country's outstanding young engineers in 1954. In 1958 Dr. David received the George W. McCarty Award from the Georgia Institute of Technology as the outstanding young alumnus of the year. In 1959 he was designated by the Summit, N.J., Junior Chamber of Commerce as its outstanding young man of the year.

The author of many technical articles on communication theory, speech hearing, speech recognition and processing, vocoders, and computing, Dr. David is co-author of two books: "Man's World of Sound" and "Waves and the Ear".

Dr. David is a member of the National Academy of Sciences and the National Academy of Engineering. He is a Fellow of the American Academy of Arts and Sciences, the Acoustical Society of America, the American Association for the Advancement of Science, the Institute of Electrical and Electronics Engineers, and is a member of the Association for Computing Machinery, the Audio Engineering Society, and the Engineering Society of Detroit.

Prior to joining the government, Dr. David was also Professor of Electrical Engineering at Stevens Institute of Technology and a member of the Board of Directors of the Summit, New Jersey, Speech School.

Dr. David is the recipient of honorary doctorate degrees from Stevens Institute of Technology and the Polytechnic Institute of Brooklyn.

He was married December 23, 1950, to the former Ann Hirshberg of Atlanta, Georgia. They have one chlid, a daughter, Nancy.

STATEMENT OF DR. EDWARD E. DAVID, JR., SCIENCE ADVISER TO THE PRESIDENT, EXECUTIVE OFFICE OF THE PRESIDENT, ACCOMPANIED BY DR. NORMAN P. NEUREITER, TECHNICAL ASSISTANT, OFFICE OF SCIENCE AND TECHNOLOGY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. DAVID. Mr. Chairman, before I begin my formal statement I would like to thank you and your committee for your interest in these four agreements. I think in order for them to achieve their potential for this country, it will take the support not only of the public but

of the Congress. Your immediate interest in this whole area, and our ability to put our views on the record at an early stage, and to solicit your support and the support of the American people through these hearings is most welcome from our viewpoint.

It is our view that these four agreements represent a development of really very major significance to our overall international scientific and technological relationships. Their great political significance to U.S.-Soviet relations has also been widely noted, but I shall leave that aspect for comment by the diplomatic witnesses on your agenda.

I want first to try to put these new agreements into the broad context of our overall national policies for science and technology. Then I will comment on the specific Agreement for Cooperation in Science and Technology. It is, as you say, my immediate responsibility on the U.S. side to implement this particular agreement.

One year ago, Mr. Chairman, your predecessor as chairman of this subcommittee invited me here to discuss this Nation's programs of international cooperation in science and technology. At that time, I referred to the efforts in my Office of Science and Technology, in connection with the Department of State, to develop a more coherent policy framework to guide our international relationships.

Just as we have moved toward stating a national strategy for domestic research and development, we have made progress toward a policy for international science and technology. The President's Message to Congress of March 16 set down two cardinal principles with regard to international science and technology, and I would like to quote briefly. He said:

> The cause of scientific and technological progress has always been advanced when men have been able to reach across international boundaries in common pursuits. Toward this end, we must now work to facilitate the flow of people and the exchange of ideas, and to recognize that the basic problems in each nation are shared by every nation . . . this nation can benefit substantially from the experience of other countries, even as we help other countries by sharing our information and facilities and specialists with them.

And later the President added, in a more political context:

> Science and technology can also provide important links with countries which have different political systems from ours.

These two principles underlie the Moscow agreements for scentific and technical cooperation.

As an illustration, I would like to put the first principle in a more personal light: In science, international collaboration has been based for many years on personal camaraderie and on scientific literature. I myself have scientific friends in Japan, the U.S.S.R., Sweden, Italy, and other countries. We have worked in the same field of speech communication for some years, and we have corresponded, and compared notes at international conferences, and even visited each others' laboratories. However, our research was as much competitive as cooperative, and certainly not part of any international plan to divide the work to be done or to make it complementary. Such personal contacts have been productive, and I am sure they will remain so.

But in science and technology today the world is moving beyond the old era of personal diplomacy and into a new era of mutual endeavor. Pollution, disease control, cancer research, energy supply, agricultural productivity, weather prediction and control, urban congestion

and worldwide communications are but a few examples of common concerns. Taking effective action on these subjects goes well beyond the personal relations between professionals.

In these and other areas the U.S.S.R. has strong scientific and technical competence, as evidenced by the fact that one-quarter of the world's scientific and technical literature is of Soviet origin. It is clearly to our advantage as well as theirs to link our strong scientific and technical arms in attacking problems for the benefits of both countries and of mankind.

Let me now turn to the four specific areas of recent agreement—space, medical science and health, environment, and science and technology.

Some observers have wondered if so many agreements were necessary and if they were not overlapping. The answer is that each accomplishes a specific purpose, and each provides a formal basis for cooperation between the two countries in a particular area of broad significance to both countries. Each develops a special institutional link between the two countries and emphasizes a concrete commitment on both sides to joint activity. They augment and complement one another.

In space, NASA is cooperating directly with the Soviet Academy of Sciences.

In medicine and health HEW and NIH have now established working ties with the Soviet Ministry of Health and the Soviet Academy of Medical Sciences.

The environmental agreement identifies 11 specific areas of common environmental concern, in which United States and Soviet specialists from a potentially wide range of institutions in both countries will undertake joint programs.

Finally, the Agreement for Cooperation in the Fields of Science and Technology invokes two new principles in United States-Soviet scientific and technical relationships.

First, it is aimed at combining the efforts of scientists and engineers in each country to work on major problems. For the past 14 years the United States and the U.S.S.R. have engaged in scientific and technical cooperation as part of the long-standing Agreement on Exchanges and Cooperation in Scientific, Educational, Cultural and other fields—commonly known as the Bilateral Exchanges Agreement. It covered a very limited number of fields, and its mode of operation involved principally exchanges and visits of scientists and engineers, rather than a cooperative problem-solving approach.

Second, the Summit Agreement declares that the two nations will seek to work together on the basis of mutual benefit, equality and reciprocity in any nonsensitive area of common interest in basic and applied science and technology.

By setting the criterion of mutual benefit for cooperative programs the agreement assures that our cooperation will be carried out on a quid pro quo basis. The same principle guides international ventures in the business world and is the basis of truly successful cooperation among developed nations.

I want to doubly emphasize this point. It has been asked if this Commission will not become a one-way channel for the Soviets to

acquire superior U.S. technology. The answer is a resounding "No." Although there need not be a rigid demand for perfect reciprocity in each individual project, the key criterion of mutual benefit requires an overall balance in our cooperative programs.

As you know, the agreement calls for a Joint Commission on Scientific and Technical Cooperation, for the explicit purposes of identifying, establishing and monitoring cooperative programs.

The lead institutions in operating the Joint Commission will be my Office of Science and Technology and the State Committee of the U.S.S.R. Council of Ministries for Science and Technology. These are the top-level science policy institutions in the two countries and, for the first time, the agreement establishes an institutional link between them and provides for a continuing dialogue.

I expect to meet in the near future with my Soviet counterpart chairman to agree on guidelines and procedures for the Commission and the agenda for the first meeting.

I expect the U.S. side to have some four or five core members, with an additional three or four members selected for specific meetings, depending on the agenda. U.S. members will come from Government, industry, universities, and private foundations, as appropriate. But we have not yet selected the membership.

The Commission will meet at least once a year in the U.S.S.R. and the United States alternately. Secretariats will be established on both sides to maintain contacts between sessions. For each cooperative program direct contacts will be established between the responsible U.S. agency and its Soviet counterpart. The Joint Commission will, in turn, follow closely the progress of the cooperation.

Even as relations between the United States and the U.S.S.R. improve, there are still great differences between us—political, economic, social, philosophical, organizational. The normal and continuous interchange of scientists, engineers, tourists, business executives, publications and capital which exists between the United States and many of the developed countries of the West simply does not exist with the U.S.S.R. Our trade with the Soviets is minimal, our exchange of scientists has been limited to rather formalized and administratively often cumbersome arrangements on both sides, and communications have been frustrated by difficulties which go beyond simple language problems.

The United States is moving, however, as the summit has dramatically demonstrated, toward a new relationship with the U.S.S.R. The purpose of this Commission is to provide a focus for this new relationship as it applies to science and technology. By establishing the Joint Commission at the top in both governments, individuals and institutions in both countries will be encouraged to seek out appropriate cooperative ties. Furthermore, when a joint program is established by the Commission a high-level mechanism will exist in both countries to follow up closely its execution. At the annual Commission meetings the new joint projects will be discussed, progress of the on-going programs reviewed, and any problems arising can be discussed and, hopefully, overcome. With flexible Commission membership we will be able to bring the best-qualified people together from both countries for technical discussions.

I believe that this new mechanism provides the greatest potential for successful cooperation since our science exchanges with the U.S.S.R. began 14 years ago.

I know you are interested in the areas which the Commission will discuss. First let me say that the United States-Soviet contacts in some of the most promising areas—space, environment, and medicine and health—have progressed to the point where the three separate agreements which are being considered by your subcommittee have been possible.

Certainly beyond these you, of course, understand that anything I say today can be only illustrative, since we have not yet had a meeting of the Joint Commission, nor exchanged views on these matters with our Soviet counterparts. The important idea is that the Commission has great flexibility in selecting the problems and subjects for cooperation, unlike the narrower range of earlier cooperative activities. Some areas of possible interest will be:

Energy research, including nuclear reactors, breeder reactors, fusion, solar energy, magnetohydrodynamics;

There is a wide range of projects in the basic sciences, such as theoretical physics, advanced thermodynamics, mathematics, superconductivity, high energy physics, heterogeneous catalysis, and many others;

There are areas of Arctic studies and technologies which are very clearly possible;

There are the management, analysis, and planning sciences and methodologies, which are related to systems analysis and to systems methodologies;

There is oceanography and the marine sciences. Doubtless many other additional areas will be suggested as both sides move toward the first Commission meeting.

Mr. Chairman, I have presented a very brief summary of my views on the potential lying behind these new agreements. I am very hopeful that this potential can be realized.

I welcome the close continued interest of this subcommittee in the progress of the Joint Commission. I appreciate the opportunity to appear here and place my views before you.

Thank you.

Mr. SYMINGTON. Thank you very much, Dr. David, for an interesting and enlightening overview of these agreements and their content.

We certainly will have questions for you. But without objection, I think it might be appropriate first to hear from Dr. Fisk, following which we will address our questions to both of you.

Dr. James B. Fisk, president of Bell Telephone Laboratories, will discuss the Science and Technology Agreement from the point of view of American industry.

Let me pause at this point to say a few words of introduction regarding Dr. Fisk. After a long and distinguished career at the Bell Telephone Laboratories, Dr. Fisk became its President in 1959. He is a familiar figure to this Committee, for he serves on our Research and Management Advisory Panel.

Dr. Fisk, we welcome your statement.

(The biographical sketch of Dr. Fisk follows:)

JAMES B. FISK

James B. Fisk was born in West Warwick, Rhode Island in 1910. He received his B.S. and Ph.D. degrees from Massachusetts Institute of Technology in 1931 and 1935, respectively. From 1932 to 1934 he was a Proctor traveling fellow at Cambridge University, England. Mr. Fisk joined the technical staff of Bell Telephone Laboratories in 1939, and became president in 1959. He received a Presidential Certificate of Merit in 1946 for his work on magnetrons. He served for six years on the General Advisory Committee of the Atomic Energy Commission. He was Chairman of the United States Technical Delegation at the Geneva Nuclear Test Ban Conference in 1958 and 1959. He was a member of the President's Science Advisory Committee from its beginning to 1960 and is now consultant to PSAC. Mr. Fisk is a life member of the Massachusetts Institute of Technology and a member of the Corporation's Executive Committee. He is a director of the American National Bank & Trust in Morristown, N.J., the American Cyanamid Company, the Equitable Life Assurance Society of the United States, and Cummins Engine Company.

STATEMENT OF DR. JAMES B. FISK, PRESIDENT, BELL TELEPHONE LABORATORIES, INC.

Dr. FISK. Thank you, Mr. Chairman, and members of the subcommittee.

It is a pleasure to be here today to comment on the remarkable spectrum of agreements on scientific and technical cooperation, signed at the Moscow summit between the United States and the U.S.S.R. I want to try to represent three vantage points in my testimony today: First, as a consultant to the Office of Science and Technology; second, as a former negotiator with the Soviets during the nuclear test ban talks in the late fifties; and finally, as president of an American private organization whose activity is industrial research and development.

I personally am very pleased to see these agreements as a reality. More than a year ago Ed David asked me to make an informal review for him of the status of U.S.-U.S.S.R. scientific and technical relations and to project them into the future. Some of my observations were the following:

(1) The Soviets have a large and prolific scientific community—now producing about 25 percent of the world's scientific and technical literature.

(2) Despite the formal exchanges agreement between the countries, contacts in science and technology have been largely what I would call scientific and technical tourism—the exchange of individuals or delegations to see what the other side is doing. With a few exceptions, there was little followup on these visits leading to continuing cooperation.

(3) Many private, personal relationships have developed, but contacts are sporadic and communication poor.

(4) Even simple exchanges between the United States and the U.S.S.R. have often been difficult to administer, as a result on both sides of poor communication, frequent misunderstandings, security concerns, and sensitivity to varying tensions in overall United States-U.S.S.R. relations.

(5) The quality of Soviet research in many areas appears to be high and in the few areas where direct cooperation had begun, it has been technically valuable to both sides.

Specifically, in addition to the space cooperation discussions which had already begun as I looked into this subject, there had been an excellent example of cooperation in the high energy physics field. An American research team had gone to the U.S.S.R. to perform an experiment on the Soviet's particle accelerator at Serpukhov. At that time this was the largest accelerator in the world. In return a Soviet team will be working at the National Accelerator Laboratory in Batavia, Ill.

I concluded from the general quality of Soviet work in many areas, without making an exhaustive study of individual fields, that U.S. researchers could derive direct technical benefits from closer cooperation with Soviet colleagues. Furthermore, I have felt for many years that science and technology provide a unique medium for constructive interaction of the United States with the socialist countries. I believe that more cooperation between United States and Soviet individuals and institutions in these fields can increase the general level of mutual understanding and appreciation between the two countries.

However, it also appeared to me on the basis of previous experience with the Soviets, that a new framework—a new mechanism—was needed for identifying and establishing cooperative programs, preferably at a high level in both Governments.

At that time, none of us knew of President Nixon's visit to China, nor of the subsequent Moscow summit. We did not foresee any near-term prospect for incorporation of such views into policy.

Needless to say I am greatly pleased at the direction United States-Soviet relations have taken at the summit. I am hopeful that the Agreement on Science and Technology and the establishment of the Joint Commission will permit the development of the degree of cooperation between us which two of the world's largest scientific and technical powers should properly have.

One reason I am hopeful is that there is clearly a new atmosphere in United States-Soviet relations today as compared to several years ago. While I believe our cooperation in research and development, particularly on problems we have in common, can help us to peacefully coexist over the long term, I personally feel that we would not have these agreements if it were not for a fundamental change in Soviet attitudes over the past 10 to 15 years, from suspicion to mutual respect and the beginnings of understanding.

Let me conclude with a few comments about other implications of these new agreements. These present agreements are, of course, not trade agreements. You will recall that President Nixon also announced at the Moscow summit that the United States will move with the Soviets toward signing of a trade agreement, with the next step to be formation of a Joint Commission on Trade. You are doubtless aware of the difficult economic and financial questions which will have to be discussed and resolved in that Trade Commission. They are well beyond the scope of my report today. However, because technology is at the present time the basis of much of the world's trade, there is inevitably a connection between scientific and technical cooperation and trade.

For instance, industrial innovation and a firm's business success are likely to be closely linked with the level of its technology and hence with the new scientific and technical developments on which technology is based. Innovation is an area of priority concern for Soviet eco-

nomic planners, even as the development of new technologies for dealing with major problems in the public sector is a priority issue in the United States.

Increasingly, U.S. exports must be based on superior high technology products and processes. To provide our firms with adequate access to Eastern markets in these fields, careful attention must be given to U.S. export controls and their applications. The purpose of these controls on exports is to protect U.S. security interests, of course. This is, and must remain, a prime concern. However, I believe the new Joint Commission may indirectly have a positive and beneficial impact on technological trade between the United States and the U.S.S.R.

If the United States and Soviet scientific and technical communities can develop closer contacts and joint projects, particularly in scientific fields and areas of broad public concern, we will have a much better understanding of Soviet technical capabilities. Our export control decisions could thus be based on truly substantive judgments about the risks involved.

I believe that we will find Soviet achievements to be significant in many areas of modern science and technology. I believe that more knowledge will mean more favorable decisions on permitting individual items to be exported. In an even more general sense, of course, as our cooperation increases, our mutual trust will likewise increase, again creating a climate for more commercial activity between our countries.

In conclusion, Mr. Chairman, I thank you for the opportunity to appear here today. I believe the steps recently taken in Moscow and the signing of these multiple agreements, including formation of the new Joint Commission on Scientific and Technical Cooperation, can greatly improve the exchange of knowledge in both directions between the United States and the U.S.S.R. to the benefit of both nations and the cause of a more peaceful world.

Mr. SYMINGTON. Thank you for a thoughtful and valuable statement, Dr. Fisk. I would make one observation with respect to your suggestion that there has been a fundamental change in Soviet attitudes over the past 10 or 15 years.

I am sure that is evident.

You would agree, I think, there has been some change in our own attitudes, too.

Dr. FISK. I agree.

Mr. SYMINGTON. Dr. David, you mentioned on page 5 of your statement that past scientific agreements involved exchanges and visits rather than problem-solving.

What did we gain from the exchanges and visits? Did they provide just a chance to get to know some of the personalities with whom we may be dealing now? Or was there some discussion of mutual problems and some sharing of information?

Dr. DAVID. You mean our previous exchanges?

Mr. SYMINGTON. Yes.

Dr. DAVID. Mr. Chairman, I think there has been an evolution over the period of time in which that agreement has been enforced. In the beginning it was a matter of getting to know one another, and it was mostly becoming acquainted.

We were reluctant to show everything that we were doing, even on the civilian side; similarly, the Soviet Union restricted our visits to

certain areas which they felt were quite noncritical. So it was a very exploratory and tentative kind of relationship.

Over the years, as we have gotten to know each other better I think this has changed a great deal. In addition to finding out what the state of the art in both countries is in science and technology and in reviewing the progress on, particularly, basic science issues, we came to find out a great deal about our Soviet colleagues in terms of their capabilities and in terms of their interests, and they about us, and our interests.

At that stage it became clear there were a large number of common interests that went beyond basic sciences, and that a problem-solving approach might conceivably be possible.

I think it has been an evolving thing, and we now see a discreet step in that evolution, which is quite significant.

Mr. SYMINGTON. You do mention problem areas. I think the committee is curious to know the modus by which these commissions will work toward the solution, let us say, of a problem like that which affects Lake Erie and Lake Baikal. The composition of the Commission itself, including linguistic skills, on the American side would have some bearing on its ability to communicate and usefully spend time together to work on these problems.

I also want to inquire further about what you mean by a "flexible commission membership," a term you use on page 8 of your statement. Does that mean people outside of the scientific disciplines are to be included?

Dr. DAVID. I believe we should use the secretariat of the Commission to set an agenda for discussion, well in advance of these meetings, so we can bring together experts from both sides, technical people, on a matter such as water pollution and water pollution control, and to have at the Commission meetings people who can inform us and make judgments as to whether there would be a mutual gain by pooling our efforts. That is what I mean by a "flexible membership." We want to be able to bring in at any of these meetings as ad hoc members of the Commission people who understand and know and can make recommendations about the specific field.

Mr. SYMINGTON. I think that is an important point. You are not going to be locked into a 12-member Commission with certain skills, but you will be able to bring in as consultants the men with specific skills and designate them, I take it, temporary members of the Commission.

Dr. DAVID. That is correct, Mr. Chairman.

A feature of this agreement, I feel is very valuable, is that actual pursuit of these agreements or particular programs which are the result of the agreement can be done on a technical level which involves contacts between the scientific and technological communities of the two countries rather than between the diplomats.

I think the programs laid out by diplomats, or even science administrators, are less likely to be relevant and fruitful than those laid out by the technical people and then presented to the diplomats for their approval.

Mr. SYMINGTON. I was very much interested in Dr. Fisk's emphasis on the relationship between trade and these agreements. In the earlier conversation, I think I shared with him my concern about this, and there it is laid out clearly in his paper.

I would like to ask, Dr. Fisk, if you perceive any problems under the current restrictions that are placed, let us say, on U.S. manufacturers that would inhibit the effective implementation of these agreements?

Dr. FISK. Mr. Chairman, it seems to me it is largely a matter of interpretation of the present rules, and attempting to weigh the potential risks of releasing a particular item for export.

My feeling is that as we become better acquainted and have a certain number of joint projects, we would be in a better position to make these judgments and, hopefully, then to find an increasing amount of trade resulting from this knowledge and understanding.

I do not know the current situation under the Battle act well enough to give you explicit examples. But it would seem to me that a side benefit of this agreement, and perhaps a rather direct benefit of it, could be placing us in a better position to make judgments on trade matters.

Mr. SYMINGTON. Dr. David seems confident that there is no problem of loss of U.S. trade advantages through exchange of skills and devices which we have developed. This has been a concern of the American industrial community, and of the American labor community, as well.

Do you feel because of the cooperative nature of the agreements and the mutuality required that this can be kept in balance? I would expect certain strains to appear from time to time, would you not?

Dr. DAVID. I think these are obviously subject to negotiations. Of course, that is the reason we have a Commission, to examine these things jointly and arrive at common agreement.

However, I might say with respect to the question of export of technology, perhaps the principal need of American high technology industry is for access to markets. And it seems to me any trade agreement which might come in the future would have as a principal aspect from our side, access to the marketplaces of Eastern Europe.

With respect to the technology for serving that marketplace, I believe we can compete and we can continue to compete with the world on a very effective basis.

Mr. SYMINGTON. I would hope that in the early deliberations of the various Commissions, they will try to develop the possibilities for cooperation under these agreements that exist, without any real risk of running into the technological exchange problem, so that we can get up some momentum with things that work and do not give us problems, before we run right up against controversial situations which diminish some of the enthusiasm which I would like to see continue in this country for these agreements.

I do have other questions, but—Mr. Frey?

Mr. FREY. Thank you, Mr. Chairman.

We appreciate your statements, gentlemen.

I have several questions that are directed to either of you, then I have a couple I want to ask specifically as to the agreements on science and technology and environment. You use such words as "reciprocity" and "mutual benefit." They are lawyerlike words, of course, with no specific meaning. But how are these determinations going to be made? Are these the kind of things that economically you can point to? I guess not.

What problems do you see? Do you see any great problem with this type of approach?

Dr. DAVID. If I may answer first, Mr. Frey, I believe we have mechanisms in the executive branch of the Government to evaluate the value and utility of technologies.

For example, we know what digital computers can do, what their value has been here, in Western Europe, in Japan. We can call on experts to talk about the significance of those tools in societies which do not have as large access to them as we have. Those values can be brought out in tangible forms, they do not have to be stated in generalities.

Similarly, the values that we might gain from the Soviet Union can be evaluated.

Mr. FREY. Let me complicate it a little. When we look at the values, what input would you expect the Department of Defense to have, for instance?

Dr. DAVID. We would expect a range of opinions. I don't think this Commission can cooperate independent of other agencies of Government nor independent of industry. I think the secretariat on our side and the Office of Science and Technology will have to have a range of advice on each program to be sure we see all the factors.

Mr. FREY. Would that include on the Commission, for instance, a member from the Defense Department?

Mr. DAVID. We have not decided on the membership of the Commission, Mr. Frey. However, we have people on the staff of the Office of Science and Technology who are well acquainted with the military and with the Pentagon needs and desires. So we can bring these to bear. We would also expect to get advice from them.

Mr. FREY. Continuing with that line of questioning, what about the effect of the military classification system narrowing the scope of the agreements? Can we find any way to estimate the percentage of modern science and technology which would fall within this classification system?

Dr. DAVID. Particularly in science, but also I think in technology, the areas that are excluded as sensitive areas, as specifically stated in the agreement, as being not subject to the agreement, are really quite narrow. It is weapons and weapons systems technology, which is easily recognizable, and although in terms of funding it may be large, in terms of actual content and significance for the civilian side of the economy and for mutual problem solving, I think it is relatively small.

Mr. FREY. Could you give us a quick comparison of the United States-Russian scientific agreement with the United States-Chinese proposal resulting from the recent Peking trip?

Dr. DAVID. Our relations with the Soviet Union have virtually progressed——

Mr. FREY. Past the Ping-Pong stage?

Dr. DAVID. Past the Ping-Pong stage is a good term, I think.

We have reached the stage that both Governments have enough confidence in each other to enter into a formal agreement permitting agency-to-agency and man-to-man interaction.

I think our relations with the Chinese are much less formal. We are now trying to build primarily on informal exchanges of people, sci-

entific tourism. We are at a much earlier stage with the Chinese than with the Soviet Union.

Mr. FREY. Is your office entering into a new role under these new agreements, vis-a-vis the National Academy of Sciences? Do you see any particular change of the thrust of your office under these proposed agreements?

Dr. DAVID. I see no great change in the relationships between my office and the Academy of Sciences, which as you know has an agreement under the exchanges program with the Soviet Union, which is financed by the National Science Foundation. I see that continuing as part of our larger program, now, and I would not see the role of the Academy changing at all.

Mr. FREY. You referred to the fact that the Soviets have one-fourth of the world's scientific and technical literature. What amount do we have, and would you make a comparison of the quality?

Dr. DAVID. Quality judgments are difficult to make. I believe our contribution to the world's scientific literature is over 50 percent. So together we produce, I would say, on the order of 80 percent of the world's scientific literature.

With respect to the quality, I think perhaps ours is more developed, in the sense that we have a larger number of informal journals and communications which are of significance, than the Soviets do. We have magazines running the gamut from very scholarly journals to what we call trade publications. Often I find things of value in both of them.

I would say our literature is much more diverse both in subject matter and in scope.

Mr. FREY. One other thing, and I would like to explore it at some time further, are there particular areas in which the Soviets are especially strong or weak, that you could highlight for us?

Dr. DAVID. If I take two examples, I think they will serve.

An area in which I believe we are far ahead, not only as far as the eastern countries are concerned but also as far as any country is concerned, is the area of computers and related technologies, such as integrated circuits, communications facilities, and so forth. We really are preeminent in that field as far as the world is concerned.

On the other hand, if you take the area of thermonuclear fusion for civilian purposes, the most recent substantial advance in that field came from Soviet effort, the Tokomak principle. It has been only with some effort that we have managed to duplicate what the Soviets have done in that field.

Mr. FREY. You feel, however, that overall, there will be benefit of roughly equivalent nature to this country in what we are doing?

Dr. DAVID. That is what we intend.

Mr. FREY. Do you think it would be of any help at all, or useful or not useful, if for instance this committee proposed a "sense of Congress" resolution in support of the various agreements?

Dr. DAVID. I think that would be very helpful, Mr. Frey.

Mr. FREY. To switch to a couple other questions I was interested in: For instance, in the area of computer technology, do we have on an industry basis any great problems as to patents, licensing, and so forth, that would be a real drawback to what we are doing?

Dr. FISK. I think there are very real problems of patent rights and how they are treated in the various countries. This is certainly an area the Commission itself will want to address. I think it has been a barrier in the past, and if it is to be a barrier in the future, they will have to worry about it.

Mr. FREY. I am really asking, I guess, is this the kind of problem you are going to have to resolve before you go further, it is one of the things that could bring this to a screeching halt?

Dr. FISK. It could present real difficulties, and I think it has to have a lot of attention.

Mr. FREY. Putting on your industry hat, yesterday we talked about most Government expenditures under this proposal, and obviously in the space thing we will have it, and I frankly support it, I think it is a good thing.

On the other hand, down the line the question is obviously going to be raised again about trade and industry. It has to be related.

I wonder if you would elaborate on how you see economic benefit developing from these agreements and—what other questions might be raised besides the question of patents?

Dr. FISK. Perhaps Dr. David ought to talk on this one. But it seems to me the kinds of trading agreements you can foresee are the same kind really that you see between this country and any other nation with which we deal.

I would see them developing in much the same way, provided we can overcome the patent problems and some of the related difficulties.

The dealings that we have with other nations are primarily between individual industrial concerns. And in this case, we would be dealing, U.S. industries would be dealing, presumably, with the various state organizations in the U.S.S.R.

I think we have to learn how to work through these different mechanisms.

Mr. FREY. One instance: I read the agreements a couple times, and it was interesting the word "communications" was left out, if I am not mistaken, in the science and technology line. We touched on everything else but "communications." Was there a reason?

Dr. DAVID. In what sense, Mr. Frey?

Mr. FREY. The space agreement refers to developing different things for exploration, science, biology, medicine, and so forth. I wondered why there was no reference to communications in it.

Dr. DAVID. In communications technology, at least, there might be conceivably some things of joint interest. There was no particular reason to leave it out. It is one of a number of other fields that could be added. Certainly it is possible under the science and technology agreement to undertake that sort of cooperation.

In speech communication, for example, we know of very excellent work in the Soviet Union which could form the basis of a cooperative arrangement. There was no reason to leave it out, that I see.

In terms of exchange of technical and scientific information—a very important aspect—it is implicit in all these agreements that there would continue to be an active exchange of scientific and technical information.

Mr. FREY. As far as your office is concerned, assuming this agreement is implemented, do you know what it will call for in terms of extra people, how much? Do you have any estimate on that?

Dr. DAVID. We have not confronted that issue yet, Mr. Frey. I do see the Office of Science and Technology taking on a much more central role in the whole area of international science and technology exchange. I think we have to lean heavily on agencies such as the State Department and the National Science Foundation for aid in this. We have to depend on the agencies and industry to execute the programs agreed upon.

In terms of policy and oversight, I see the Office of Science and Technology assuming a more central role.

Mr. FREY. Which obviously would mean you would have to have more people to do it.

Dr. DAVID. Possibly.

Mr. FREY. We will end on that. That is a good answer.

Mr. SYMINGTON. The OST employs how many people? About 30?

Dr. DAVID. Total authorized strength this year is 50, of which about 25 are professionals.

Mr. SYMINGTON. And the Soviet agency with which you will be making the arrangements, they have, I understand, several thousand employees. So in order for OST to deal as an equal, you might say, with that agency you will have to have considerable assistance from the private sector, the Academy, and so forth? Is that how you expect to do it? You do not propose to expand?

Dr. DAVID. The Soviet counterpart agency is a line agency of their Government, has responsibility for a large number of their technical activities. We are not a line agency, which I think accounts for the difference in size.

You can be sure in policy matters that we may be outnumbered, but we will never be outfought.

Mr. SYMINGTON. OK. That is the way.

You mentioned that the National Academy of Sciences, their exchange program and their affairs, with their Soviet counterparts, would become a part of your effort. At the moment they determine when, where, and which exchanges will occur, I suspect, under their own criteria.

In order to remain relevant to what you are doing, I imagine they would have to accept direction from you? Or would not?

Dr. DAVID. Our relations with the Academy are, I think, very good. I think the operation of the Academy programs can indeed be shaped to overall Government policy. We depend heavily on the Academy, which tries and helps us to assure quality. This is the principal function I see them performing.

Mr. SYMINGTON. I do not want to make an inopportune or untimely suggestion. But I would think Academy representation might be considered in the formulations of the various commissions, certainly that of science and technology.

Dr. DAVID. Certainly it will be.

Mr. SYMINGTON. Mr. Cotter.

Mr. COTTER. Thank you, Mr. Chairman.

Dr. David, on page 3 you mentioned that collaboration in the past has been based on personal camaraderie, and you went on to say that research is at much competitive as cooperative.

Can you explain in detail what collaboration has existed in the past with the U.S.S.R.?

Dr. DAVID. The collaboration has been informal, if any. It has been a case of people working in the same field exchanging information. To the degree there has been synergism, it has prevented duplication of work. Primarily it has been this kind of relationship—exchange of information on a personal basis over a cup of coffee, something of that kind, I presume, exchange of papers at international meetings.

Mr. COTTER. You say it has been as much competitive as cooperative. Could you detail tht?

Dr. DAVID. Just as it is competitive in this country. I recall doing an experiment, and I knew a similiar experiment was being undertaken in the Soviet Union by people there I knew. It was a great race to see who could finish his experiment first and get the technical information out to the public.

That relationship, as I say, is not necessarily wasteful. Actually it increases productivity. I expect to see some of that continue, certainly.

Mr. COTTER. When may we expect some meaningful discussions to begin? Do you have any timetable on that?

Dr. DAVID. I am leaving at the end of this month—June 22 is the presently expected date, unless it is changed—for Moscow to set up the working relationships for this commission. We expect to begin informal discussions of possible cooperation in specific fields at that time. I do not expect to reach any conclusions on this trip. We hope to set a date, perhaps for September, for the first commission meeting.

At that time we hope to be able to produce some decisions which would lead to new programs.

Mr. COTTER. Thank you very much.

That is all I have, Mr. Chairman.

Mr. SYMINGTON. Thank you, Mr. Cotter.

We are going to want to move very soon to hear Dr. Handler.

Mr. Frey, did you have something else?

Mr. FREY. Yes, Mr. Chairman.

First, although I guess it is hard to estimate, it appears to me what we are going to do will require substantial backing, from OMB, also. It is great to fight, I am all for it, but I hope we have success.

Do you have the backing of the administration, in your opinion, to carry out these agreements?

Dr. DAVID. In my opinion, I have no doubt of that. I found in dealing with OMB several things are helpful. First of all, a presidential imprimatur on a program is very helpful indeed; second, it helps that the program is sound, the science good, and the objectives well defined. I think a sound program presented that way very often gains the support of OMB. I expect to see those two——

Mr. FREY. In other words, your answer is "Yes?"

Dr. DAVID. Absolutely.

Mr. SYMINGTON. Would you expect to come to the Congress for new money in substantial amounts? Or is this still conjectural in your minds?

Do you have the resources now to proceed?

Dr. DAVID. I think we have the resources as of the moment.

The question of additional resources needed to pursue this we can only tell after we decide on the fields. Those appropriations, if any, would come through normal changes, not through OST.

Mr. SYMINGTON. Dr. David, and Dr. Fisk, we are very grateful to have had your testimony. I wish we had more time to visit with you this morning. I hope you will permit us to address an occasional inquiry to you, perhaps even to supplement this record.

With that, on behalf of the committee, I extend our deep thanks to you both for visiting with us, and giving us this valuable information and insight.

Thank you.

Dr. DAVID. Thank you for the opportunity.

Mr. SYMINGTON. Our final witness this morning is the distinguished President of the National Academy of Sciences, our old and good friend, Dr. Philip Handler.

After many years as an outstanding educator Dr. Handler was elected President of the National Academy about 3 years ago. He is a well-known figure on the Washington scene and the national scientific scene, and he has testified frequently before this committee.

We are delighted to have you with us today, Dr. Handler, and we will be pleased to hear your statement. I note the fact that it is a little longer than average. You would be welcome to extract key points and summarize your paper, if you wish.

Dr. HANDLER. I would, sir.

Mr. SYMINGTON. Thank you.

(The biographical sketch of Dr. Handler follows:)

PHILIP HANDLER

Educator; born New York City, August 13, 1917; son of Jacob and Lena (Heisen) Handler; married Lucille P. Marcus, December 6, 1939; children—Mark, Eric Paul.

B.S., City College of New York, 1936; Ph. D., University of Illinois, 1939.

Instructor, Duke University, 1939–40, Associate, 1940–41, assistant professor of physiology, 1941–44, associate professor of biochemistry and nutrition, 1944–49, professor since 1949, chairman Department of Biochemistry 1950–60, James B. Duke Professor of Biochemistry, 1961–, President, National Academy of Sciences, July 1, 1969—.

Director of Atomic Energy Commission fellowship training program, 1948–53; consultant U.S. Public Health Service, Atomic Energy Commission, National Research Council, Veterans Administration; chairman biochemistry study section, National Institutes of Health, 1956–59, national advisory committee on research facilities and resources, 1963—; member, National Health Advisory Council, U.S. Public Health Service, 1959–62; member, biology and medicine research facilities panel, National Science Foundation, 1958–61; member, divisional committee for biological and medical sciences, 1960–62; member, National Science Board, National Science Foundation, 1962—, vice-chairman, 1964–66, chairman, 1966—; chairman, committee on radiation and aging, National Institutes of Health-Atomic Energy Commission, 1952–62; member, President's Science Advisory Committee, 1964–67; President's Commission on Heart Disease, Cancer and Stroke, 1964–65; President's Task Force on Science Policy, 1969—.

Trustee, Foundation for Advanced Education in the Medical Sciences, Cold Spring Harbor Laboratory on Quantitative Biology; member, Unitarian Service Committee, Medical Mission to Japan, 1951.

Member, American Society of Biological Chemists (secretary, 1953–58, councilor, 1958–61, president, 1962–63), Federation of American Societies for Experi-

mental Biology (executive committee, 1959—, chairman of the board, 1964–65), National Academy of Sciences, American Institute of Nutrition, American Association for the Advancement of Science, Society for Experimental Biology and Medicine (president, southeast sector, 1953–54), American Chemical Society, New York Academy of Sciences, Sigma Xi.

Author: Principles of Biochemistry (textbook); also technical publications; member, editorial committee, Journal of Theoretical Biology, 1961—, Journal of Comparative Biochemistry and Physiology, 1962—; editor: Geriatrics, 1957—.

Office: National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, D.C. 20418.

STATEMENT OF DR. PHILIP HANDLER, PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Dr. HANDLER. Mr. Chairman, members of the committee, I appreciate the opportunity to be with you this morning to present some views concerning the opportunities offered by the various accords negotiated in Moscow by President Nixon. Unhappily, the time available for preparation of this statement was limited and previous obligations took me away from Washington for much of the time since receipt of your invitation. I have had opportunity to discuss these matters with several colleagues but consider that the statement to follow is relatively immature and insufficiently penetrating. In any case, this statement represents my personal views and are not necessarily those of the Academy, collectively.

Let me make it plain, at the outset, that I consider the totality of these agreements to be a fully major achievement and that I hope that they will be implemented with imagination and in the spirit of good will which, patently, underlies them. They offer hope that the history of mankind may have turned a corner—and in the right direction. That note of high optimism does not so much reflect the actual language of the signed protocols but rather the fact that it was possible for the President of the United States, constructively, to discuss arms control and cooperation in matters relating to science, space, the environment, public health, and the uses of technology with the leaders of the Soviet Union. It was the very fact of the signature of these protocols, more than what was signed, that I hold to be of such great significance. The language of each protocol is extremely broad, each a veritable hunting license for mutually beneficial cooperative endeavors whereas the restrictions are minimal. Ultimate success, of course, must depend entirely on the manner of their implementation.

The National Academy of Sciences has formally served as a principal instrument for furthering scientific exchange with the Soviets for 12 years. The inter-Academy agreement, between our Academy and the Soviet Academy of Sciences has been the principal instrumentality which has facilitated the exchange of scientists between our two countries. In this program, individual scientists arrange to spend 1, 2, or more months in a specified laboratory which, in turn, must agree to receive them. Similar programs are, in effect, with the Academies of Poland, Bulgaria, Yugoslavia, Hungary, Czechoslovakia, and Romania. The exchange of scientists with the Soviet Academy has been fully implemented since initial signature of that agreement, although the rate of such exchange has been pitifully small. The agreement for this year, which had provided for exchange of only a total of 108 man-months, in each direction, was increased by 20 percent in an agreement

signed 2 months ago. If the "spirit of Moscow" is to prevail, that rate of exchange must be increased sharply. This program has certainly been successful in that all of the available opportunities have indeed fully been utilized and, at least on our side, over subscribed.

Like the new protocols, this agreement also speaks to the need that each exchange be "mutually beneficial." Yet, American scientists in the Soviet Union have not always received the support and assistance required to maximize the benefit of their visits and, not infrequently, have been somewhat harassed. Rarely have we been informed of the basis for rejection of American applicants when this has happened. Regrettably also, rarely has it been possible successfully to invite a specified Russian scientist. Indeed, our record in successfully inviting distinguished Soviet scientists to scientific meetings or to spend some months in an American laboratory leaves much to be desired, whereas we bend every effort to receive comfortably each Soviet scientist whose should note that, in a few instances, we have been embarrassed by the desire to come is made known to us through this official channel. I request of a Russian visitor to spend some time in one of the several areas we have declared to be "out-of-bounds," simply in reciprocity for the fact that there are such areas in the Soviet Union. Most were finally resolved successfully—even if by assuring that the visitor would always be within sight of an American "guide." But if the level of exchange is to be expanded significantly, this nonsense must cease—on both sides.

This exchange experience, to date, should be regarded as an only slightly qualified success, scientifically, but may also be regarded as one of the ice-breakers that paved the way for the Moscow accords. It should be clear that the ultimate goal must be the normalization of such exchanges, with Russian and American scientists free to move back and forth, working in laboratories of their own choice without the need for such formal mechanisms, viz, in the informal manner of our scientific relations with the nations of Western Europe which operate largely on a scientist-to-scientist basis rather than a government-to-government basis. Perhaps there is a natural sequence. With the Chinese, we have initiated scientific tourism; with the Russians, formed exchange and collaboration. Hopefully, one day we may engage in the free flow characteristic of our scientific relations with the English, Israelis, Japanese and Scandinavians, for example.

It is regrettable that there is no provision among the various signed agreements expressly designed to promote progress in this direction. Planning for the implementation of each of the protocols is to be the function of a joint U.S.A.-U.S.S.R. commission composed of representatives of a unit of the executive branch of our Government and of its counterpart in the Soviet Government. Patently, some such formality is all that could possibly have been provided, as a mechanism, in these brief protocols of such wide sweep. But I hope that this does not mean that the potential harshness of such negotiations was avoided in the Kremlin by transfer to the Commission Room. Further, I hope that, for our part, this will not have generated a pattern in which only Government-directed and initiated research programs will find support. Granted that the Federal Government is the primary financial supporter of research and development in our country, granted that the specific major problems which are mentioned in those protocols are

quite properly matters of concern with respect to the common weal rather than the progress of science; it is to be hoped that there will be room within the arrangements yet to be established for expression of the judgments of the scientific, industrial, and academic communities and that these programs will in considerable part be responsible to the individual genius of our scientific communities. Before establishment of these commissions and such infrastructure as they may require, I trust that considerable thought will be given to their membership, to assure adequate input from the scientific and industrial communities.

The Academy serves as the adhering body to the various international scientific unions, individually, as well as to the International Council of Scientific Unions. Through this mechanism we have accumulated considerable experience in conversing with our Soviet counterparts in many areas of science. These arrangements have served both to build personal bridges between a segment of the American scientific community and that in the Soviet Union as well as to build a body of experience with respect to the sometimes tender nature of negotiations with formal Soviet scientific delegations. In these formal settings, such relationships are not without political considerations and overtones which render them somewhat more complicated than equivalent relationships with representatives of the scientific bodies in the Western World. One may hope that in the future these relationships will become easier in consequence of the actions taken in Moscow.

A principal mode of scientist-to-scientist understanding has arisen by attendance at the large scientific congresses and diverse smaller meetings devoted to specific topics sponsored by these unions. It is to be hoped that future Soviet delegations to such international scientific meetings will be comprised of their most qualified scientists. This has not always been the case. Indeed, I regret to note that some of the most distinguished known Soviet scientists have been missing from a number of international meetings this spring. If the warmth of the Moscow accords were to spill over into these multinational scientific meetings, the latter could become an even yet more successful scientific bridge between our nations while assuring that the fruits of science may be shared among all the nations of the world.

The protocols speak to the desirability of bilateral symposia and colloquia on a great variety of subject matter of joint interest. Such workshops are powerful means for the advancement of a scientific field as well as for the forging of personal friendships, the sum of which might contribute to reduction of international tensions. Indeed, in many subject areas, such colloquia could prove to be the most important single form of cooperation. One must be careful, however, that, as in all of these programs, these bilateral meetings not be done to such excess as to offend the sensibilities of the scientific communities of other nations with whom we regularly engage in multinational discourse. Just to pick one possibility, an area for early consideration might be to compare progress in the field of computer-aided instruction and of other educational technologies which, we hope, may soon be based on growing knowledge of the brain and of the learning process. Such bilateral efforts could be expanded, subsequently, to embrace techniques for assistance of the educational programs of developing nations.

In many areas of science and technology, at least equally effective, if not more so, would be a plan whereby significant numbers of senior and junior Soviet scientists could attend the major meetings in the United States sponsored by our national scientific and professional societies. This would give them the full flavor, detail and breadth of our scientific enterprise and allow informal interaction with many individuals who, otherwise, are but names on the heading of scientific papers. I am insufficiently informed concerning such meetings in the Soviet Union to be sure of the extent of reciprocal opportunity for Americans. In planning such exchanges, as in planning joint research efforts, one must recognize that there are major scientific areas in which current American efforts are more sophisticated and more advanced than are those of their Russian counterparts. Not because of any innate superiority but because of historical differences in the course of science in the two countries. This is certainly the case with respect to the high level of American research in agriculture and biological science, computer science and computer usage in the conduct of research. There are genuinely excellent individual Russian laboratories in many subject areas, and they have magnificent new facilities for some research fields, but the overall picture is spottier than is ours. Accordingly, the appropriate and mutually acceptable pattern should be one in which individual scientists seek experiences in those laboratories or meetings where the ongoing level of activity is at least as sophisticated as their own, viz, to work in the laboratory of a recognized leader in the field, or take advantage of some unique expensive facility or natural resource.

If, however, these mechanisms are to be successful, there must be provided funds in support of such international travel. Unhappily, quite the opposite trend has been evident in recent years and opportunities for overseas collaboration by individual American scientists have been dwindling. In this, as in all other aspects of these various accords, there can be no meaningful implementation without the requisite funds.

In this regard, one should note the desirability of some regularization of translation programs both from Russian to English and English to Russian. This is a task of considerable magnitude and commensurate expense. Merely to illustrate, let me note that last year, in mathematics alone, about 10,000 pages of mathematics were translated from Russian to English. The total dimensions of this two-way translation are not known to me. It seems unlikely that there would be any virtue in the establishment of a mutual translation service and one can imagine real disadvantages although discussions of such an arrangement might conceivably be fruitful. Incidentally, our translations also serve the rest of the world since the scientists of other nations utilize our English language versions of selected portions of the Russian literature.

Several of the Moscow protocols speak of the sharing of information. It is not entirely clear what kind of information is to be shared on a bilateral basis. What is most important is that new information, developed in the course of Soviet-American collaborative research, become part of the world pool of open scientific literature. It is by that mechanism that science is both evaluated and shared. I would be most

apprehensive if there were to develop any tendency to the accumulation of a pool of bilateral proprietary scientific (rather than technological) information. Indeed, a primary criterion for the evaluation of any project offered for mutual collaboration should be publication of the results in the open scientific literature.

I cannot help but digress to note that there is a simple but serious deterrent to such amicable progress—the general ignorance of the Russian language among the American scientific and technical community. In the last two decades we have, perhaps arrogantly, come to assume that English is the current lingua franca of educated individuals and that our tongue will suffice in international discourse. The expanded relationships with the Soviet Union envisioned in the Moscow agreements cannot reasonably be effected on that basis alone and it will become imperative that some fraction of our young scientists acquire some reasonable degree of fluency in Russian.

As you will know, Russian-American collaboration is already a successful reality in some areas of science. The program of research in the Antarctic is both the most successful demonstration of scientific cooperation and of peaceful cohabitation—albeit at extremely low population density, to be sure, and there may be a lesson in that—now in process.

The high cost and unique nature of certain large physical facilities has virtually forced such cooperation in some instances. Most noteworthy, perhaps, has been the American team which conducted experiments at the Serpukhov accelerator and the Russian team which has made use of the large machine at Batavia. Because of the very long leadtime and enormous cost of the next generation of such accelerators, of which, therefore, there will be but one, American and Soviet scientists through the joint offices of the American and Soviet Academies, and with the knowledge of the U.S. Atomic Energy Commission, made arrangements to begin planning that next machine which can only be funded and operated on an international basis, much as is the large European accelerator at CERN in Geneva. One can readily visualize similar joint planning for the next generation of optical and radio telescopes. In this sense, these enterprises are analogous to the ongoing joint planning of the docking of an Apollo-type satellite with a Soyuz-type satellite the initial planning of which I was pleased to catalyze at a meeting with President Keldysh of the Soviet Academy in Moscow in May 1970. Importantly, it is imperative in these large ventures that there be ample provision for the scientific programs of qualified scientists from all other nations. Although these bilateral agreements serve the cause of peace as well as of scientific and technical progress, our enthusiasm for these joint enterprises with the Soviets should not be permitted to injure our relationships with the scientific communities of other nations.

Representatives of the Soviet Union have also been highly cooperative in planning a mechanism for international collaboration in the development of a relatively new intellectual tool for the management of societal problems. The committee, 2 years ago, authorized the inclusion within the appropriation to the National Science Foundation of funds to support the creation of an International Institute of Applied Systems Analysis. This Institute will be brought into being, not

by intergovernmental agreement, but by agreement among the Academies of Science or specifically designated societies of 12 nations—Britain, France, West Germany, Italy, Japan, Canada, and the United States plus the Soviet Union, Poland, East Germany and, we believe, Bulgaria and Czechoslovakia. Dr. Dzherman Gvishiani, Deputy Chief of the State Council for Science and Technology, who has represented the Soviet Union in these matters, has been cordial, effective, and most cooperative. By current plans, the Charter of the Institute should be signed within the next 30 days. It will concern itself with improved methodology and the use of systems analysis for the understanding and management of problems common to industrialized societies, as for example, national requirements for adequate health care, institutional arrangements for large clinical centers, various aspects of population control, conservation of natural resources and the environment, techniques for the projection of manpower requirements, et cetera. If the attitude displayed in these negotiations also prevails in those discussions which will implement the Moscow agreements, the signs augur well for genuine progress.

The language and subject matter embraced by the agreements concerned with science and technology, public health, and the environment are extraordinarily broad and deliberately inexplicit as is that concerned with space, except for the specific reference to the common docking experiment. The question that then arises is whether there are indeed meaningful, mutually beneficial opportunities for joint ventures by American and Soviet scientists and engineers, arrangements which are not artificial or contrived, desirable joint projects which awaited generation of the favorable circumstances created by the agreements in Moscow. I doubt not but that previous witnesses and those to come will have paraded a collection of various projects before you, projects of greater or lesser significance, now envisioned in sharp or vague detail. I hope that I shall not repeat their descriptions.

Because of article 11 of the joint agreement between our two Academies, which, for 2 years, has provided for approval of cooperative, joint research efforts, we began to compile such a list about a year ago. Although we canvassed among a tiny segment of the scientific community, literally dozens of such proposals were presented to us. Most represented opportunities of the sort which arise in our scientific relations with other nations, that is to say, smaller projects in each of which an American scientist would like to work with a scientist of the Soviet Union of whose work he is aware and whose efforts would be complementary in addressing a defined problem. Typical, perhaps, is the desire of an American biochemist whose research is concerned with the structure of cell membranes to work with a Soviet chemist who has synthesized a unique set of organic compounds with properties such that they can serve as "probes" of the detailed molecular structure of cell membranes. It matters not which one works in the other's laboratory. It is to such relations that I spoke earlier when I referred to the hope for future "normalization of relations." Other proposals, however, offered special attributes which rendered them attractive in the present context. It may be useful to the committee to note some of these.

Our Committee on International Exchange of Persons (responsible for the operation of the Fulbright-Hays exchange program) advocates

the desirability of "cluster exchanges," in each of which a senior scientist, his graduate students and postdoctoral fellows as a group, might spend a year at an institution in the other country. Several examples appear to be ready and waiting, for example, one cluster to spend a year in Moscow studying the effects of heavy metals on the environment and a Russian cluster interested in spending a year in a cooperative program concerned with rural health care somewhere in the States. Others could undoubtedly be stimulated with no difficulty. There are several very powerful Soviet centers of mathematics; one concerned with logic and the theory of algorithms could certainly attract clusters of American scholars in exchange for a group which might, for example, spend an equivalent period at the Courant Institute in New York.

In the field of education and manpower, currently so troublesome to us, there are numerous individuals desiring a closer look at the Russian system, wondering whether it has proved to be more successful than ours.

As you will surely have heard, in the field of space research there is already extensive information sharing with respect to meteorology, remote sensing of the earth, as well as planetary exploration with instrumented vehicles. The Soviets are working with us in the multilateral GARP program. Joint U.S.-U.S.S.R. working groups are currently active in these and other areas and it is to be hoped that the present climate will serve to reinforce these efforts.

There are almost innumerable opportunities for joint efforts in the field of the environment, broadly defined. The Soviets have large and successful scientific groups concerned with a variety of aspects of the Arctic, its ecological systems, the properties of the tundra, maintenance of ice-free channels, management of wildlife, survival in its hostile climate, and understanding of the peoples of the far North. Numerous American laboratories have proposed collaboration in such studies. Be it said that, to date, most of our overtures to engage in joint activities with Soviet groups in the Arctic have encountered a frosty reception. If these were now to be thawed, this would be a genuine accomplishment. Moreover, if scientific groups from Canada, Greenland, and the Scandinavian nations could also be involved, an effective consortium of polar nations might be generated for investigation and for oversight of the sound development and management of the Arctic.

An immense effort will be required to establish with some confidence the toxicological properties and dose response to the multitude of chemicals in the environment, particularly now that it is believed that the possibility of mutagenesis and carcinogenesis by such compounds must also be examined. I have previously suggested that this be undertaken as a truly worldwide, international exercise because of the size of the task and the generality of the applicability of such findings. A good beginning could be made by a joint agreement of these two nations, dividing the task and agreeing to common protocols for such studies. In this country, such an effort is now only barely beginning; this is the specific purpose to which we are now adapting the Pine Bluff, Ark., laboratory of the U.S. Army, a superb establishment previously used in our efforts to examine the potentiality of biological weapons—a current version of transformation of "sword into plowshare." The other side of this coin is the need for a system to monitor

the rates of mutagenesis and carcinogenesis, in an epidemiological hunt which might assist in the identification of culpable chemicals, if such there be. Although this, too, should be a worldwide effort, a bilateral program would be a great start.

More general programs relating to the setting of standards of air or water quality, would probably be more difficult to establish. In this instance, bilaterality seems rather inappropriate, while the difficulties of the Stockholm Conference underscore the complexity of the task of securing worldwide agreement on anything more than platitudes concerning the environment.

On the other hand, in view of the vast costs now visualized if the environment is to be protected while we also enjoy the best of industrialized civilization, any joint effort with respect to improving available technologies for environmental control, or sharing of information in this regard, must certainly be welcomed.

In the field of medicine and public health, other than its environmental aspects, considerable imagination will be required to generate truly significant cooperative ventures which are more than the sum of their national parts. The numerous, relatively immobile and homogeneous ethnic groups within the Soviet Union offer excellent opportunity for gathering understanding concerning intrinsic human factors which contribute to the incidence of atherosclerosis and of various tumors. This opportunity should be exploited before the population of the Soviet Union becomes as mobile and, hence, as heterogeneous as is ours. Otherwise, normal sharing of information and scientific exchange may be the principal desirable forms of cooperation.

In the field of social science, demographic and other questions imperative to the development of a rational population policy are desirable and appropriate fields for common and joint study. Known American groups wish to engage in joint development of social indicators and their use for social forecasting in our quite different societies; another wishes to join a Russian group which is engaged in the early stages of attempting mathematical modeling of societal change; several scientists have suggested that there is a rich field for joint computer-aided research in linguistics.

There is a plethora of possibilities in the earth sciences; for example, correlation of geology and geophysics of Alaska and northeastern Siberia, which are virtually mirror images if examined on a map; joint exploration of areas where there is evidence of pre-Paleozoic life; study of the similar volcanic successions in the Trans-Caucasus and northeastern United States. A variety of joint oceanographic studies offer the opportunity for American scientists to work on Russian vessels and vice versa. Collaboration, but not yet joint work, is already underway in the study of boundary-layer physics, with its consequences to the dissipation of energy from the planet. Two groups of our foremost earth scientists have proposed a joint program to examine the evolution and structure of the entire lithosphere. Groups of Americans are already in contact with Soviet counterparts concerned with the heat balance of continents covered with snow and ice and their effect on the global circulation, with others engaged in studies of the motion and deformation of Arctic pack ice and with the hydrological balance of continental areas which drain into the Arctic Ocean. And certainly, it is time for collaboration between those engaged in numeri-

cal modeling of the global atmosphere at NCAR and its Russian equivalent. Whereas, in the United States, several groups have become sophisticated in their attempts to learn how to prevent or control earthquakes. Russian groups have been more active and successful in their attempts to learn how to predict earthquakes. Collaboration between the two should surely be mutually beneficial.

In physics, more generally, besides the ongoing collaborations of groups engaged in particle and nuclear physics, we might note the desirability of collaboration of Americans seeking to develop an approach to controlled fusion with their Russian counterparts who have been more successful in attempts to develop a stable plasma. The highly successful collaboration in very long baseline interferometry radioastronomy should surely be continued. On a smaller scale, other scientists would like to collaborate in the study of multilayered dielectric films. A unique example relates to an unexplained anomaly in the transmission of sound through long distances in water. Apparently its unraveling requires studies through long distances of waters which are large, deep, of relatively homogeneous composition, and at several temperatures. One set of such measurements has already been made in warm Lake Tanganyika by an American group which now wishes to use Lake Baikal for the second part of its experiment to take advantage of the low temperature of this large lake. And although it is a matter of record, I cannot help but note that the best single book on the theory of general relativity is the result of a collaboration between a professor at California Institute of Technology and another at Moscow University.

In the fields of biology and chemistry, most suggested desirable collaborations are of the type typical of small science. Still, an American group wishes to examine the physiological adaptations of the fauna residing in the deep cold waters of that same Lake Baikal, and a detailed joint study of the systematics and ecology of holarctic animals has already been approved as a joint venture under the auspices of the two Academies.

Considering the very small segment of the American scientific community which was canvassed, and considering that we have no knowledge, at this time, of equivalent suggestions from the Soviet side, it would certainly appear that there are indeed numerous opportunities for useful, unique, not-at-all contrived, "mutually beneficial" cooperative, joint ventures in all areas of science.

In all likelihood, other witnesses will describe applied research which is closer to the point of application. It remains to be seen whether such collaborative efforts would break off at that time and, indeed, what policy should be developed in such instances. Before the eventuality arises, there should be some understanding of an acceptable patent policy. Presumably these will have been discussed by others who have appeared before you.

I have taken so much time in providing these examples to emphasize the fact that, whereas the language of the protocols is strongly directed to joint ventures in fields which should find early application to societal problems, there exist innumerable opportunities for collaborative efforts in areas of more fundamental science, opportunities already known and partially explored by the scientists concerned,

with a few such efforts already ongoing. Implementation of the various accords at this level would seem, to me, to be a propitious manner in which to start. The collaborators share a joint scientific culture, the sense of international competition, whether for world markets or prestige, a decidedly less serious barrier, and only trivial effort should be required to initiate these programs.

Although these collaborative endeavors might well have been initiated under the terms of article 11 of the agreement between the National Academy of Sciences and the Soviet Academy of Sciences, present circumstances certainly encourage and facilitate such arrangements, provided that the implementation mechanisms yet to be developed will lower the effort necessary to overcome the resistance normal to the bureaucracy of both nations, and that the requisite funds are provided. If so, there might well be what Russell Train described as "a whole new ball game with the Soviet Union."

As I conclude, I must reiterate a point made earlier. A substantial program in implementation of the Moscow accords will not come cheaply. It cannot be accomplished merely by appropriating a small sum for plane fare. Nor should it be accomplished by diversion of funds already programed and planned for the next fiscal year. The costs should be identified and provided in quite considerable part by supplemental appropriations to support those activities to be initiated in fiscal year 1973. While this recommendation is probably equally applicable to all other affected agencies, I can be quite certain with respect to the National Science Foundation. For the National Science Foundation it is now apparent that the fiscal year 1973 appropriation will permit, at best, a program level allowing for inflation and about $30 million less than the research support requested in the President's budget. That is already a tight budget, and I hope that it will not be further injured.

In summary, Mr. Chairman, I can only warmly applaud the initiatives taken in Moscow by President Nixon and the Soviet leaders. Quite possibly, the programs and projects which will result might have been undertaken under already existing circumstances without quite so much visible need for summitry. But if the latter insure that such projects and programs will be indeed undertaken, that will be sufficient justification.

In this hour, when science and technology are under attack by many of our citizens, particularly younger citizens who do not find the present world to their taste—and who can blame them?—I continue to believe that science-based technology remains the principal mechanism whereby man can hope to alleviate his own condition. Since the climate generated by the Moscow agreements will serve as additional incentive for support of such scientific and technological endeavors in both nations, while also promoting the cause of peace, I can only be highly pleased. I have noted some small caveats, but they can surely be managed if we are mindful. Now, let us get on with it.

Thank you.

Mr. SYMINGTON. Thank you, Dr. Handler, for what I consider to be an extremely important contribution to our discussions and to the committee's understanding of what is really involved in these agreements.

I noticed that you began your statement by observing that the very fact of the signature in and of itself is more important than what was signed, and indicated success would depend on the manner of implementation. Then you raised what I consider more than just a few caveats, but some very fundamental problems that you perceive in implementation.

If I understood you correctly, you are concerned that these agreements could become immersed, or their implementation could become immersed, in bureaucratic wrangling and perhaps maneuvering for one kind of advantage or another which is not necessarily relevant to progress, and you would like to see the scientific communities in some depth in both countries, regardless of their connection with officialdom, participate in carrying out the intent of these agreements.

What measures do you think should be taken on our side to insure that that will occur?

Dr. HANDLER. I have complete confidence in Dr. David and his colleagues. They have their roots deeply in the scientific community. As long as they keep those roots, are not too seriously impeded by the normal kinds of bureaucratic procedure which seem to be built into government everywhere in the world and are very difficult to escape, I have no concern.

My point was that the scientists of our country and the Soviet Union have no difficulty in talking to each other, in understanding each other, planning joint operations where these are logical, just agreeing to work in each other's laboratories. If discussions for future arrangements are conducted at the level of science itself by scientists, there will be relatively little problem.

When the science borders on the technological and the applied, then matters could get sticky.

Dr. Fisk said that earlier.

It seems to me that we should capitalize on the basis which already exists, the scientific rapport which has been established—sticky, but there, and real.

I know of no American scientists who have been to the Soviet Union or to international meetings who cannot speak warmly and glowingly of his conversations and relationships with one or more of the Soviet scientists. It seems to me that is the platform on which to build. At the other end, the President of the United States and Mr. Brezhnev sign a treaty. In between, we have to make it go.

I simply hope we can make sure that that mechanism does not become overladen with bureaucracy and, at all times, involves the working scientists, themselves.

Mr. SYMINGTON. As I have listened to the testimony this morning, yours and that of the preceding witnesses, it seems to me there are three or four possible barriers to the effective implementation of these agreements. One would be patent problems. Another would be trade restrictions of one kind or another.

Another would be the security aspects of certain exchanges of information. Particularly—I know on our side—the Department of Defense has actually funded a great deal of scientific research, and they consider it in a certain proprietary fashion.

Dr. HANDLER. But they also fund a great deal of science which is not proprietary.

Mr. SYMINGTON. Right. What I leading to was this: In light of the need, as I expressed to Dr. David, to get things off the ground, to generate some momentum so the American public and the people of the Soviet Union, to the extent that that is possible and necessary, retain a certain enthusiasm for going forward, in the catalog of programs that you omitted from your oral testimony, can you pinpoint any where you would perceive the fewest barriers of the kinds I have described?

Dr. HANDLER. The minimal blockage is in the area of small science.

For big science, you need formal agreements. To bring a whole team of Americans to Serpukhov, a team of Soviets to Batavia, requires a certain amount of previous negotiations. We have really done our best to arrange for the Soviet team to make the first use of Batavia. The first experiment to be done when the beam was on was to be that by a Soviet group. I don't think that worked, I am not sure. I don't think they arrived in time to do it. But that was a token, a symbol offered in a meaningful way.

To arrange Apollo-Soyuz docking is a very complex and difficult thing to arrange. The fact we have gotten this far is a minor miracle. It is to be applauded.

On the other hand, at the University of Pennsylvania there is an international expert in cellular biology. At the University of Moscow there is a man who has synthesized a series of organic compounds which are marvelous for the study of biological cells. We shall facilitate their cooperation.

Mr. SYMINGTON. I suppose these one-to-one relationships minimize linguistic difficulties. When you send teams, four or five people stand in the back until it is explained the next day.

Dr. HANDLER. There are areas in which we can work cooperatively very fruitfully. In the Arctic, there is a whole series of projects in geophysics and geology. Particularly with respect to the Arctic, there has been accumulated a long list of really fruitful potential truly collaborative projects with the Soviets with respect to the study of the Artic region. They are really ahead of us. They have much more experience than we in certain aspects of understanding the tundra, the maintenance of free-flowing streams, understanding of the peoples of the north. But, until now, our overtures for cooperation have not been very warmly received.

We have groups who would love to work with them, and have been inhibited, hindered, in the past. It has been difficult to make these arrangements.

We could really form a sort of joint consortium, including the Scandinavian nations and Canada, as kind of a multilateral group to worry about the Arctic which we share. The scientific groups are all poised, they are there. They have national boundaries interposed between them at the present time. They have common problems, each has a different expertise to contribute. In this new atmosphere, this might be an easy one to get going.

Mr. SYMINGTON. You referred in your paper to what could be considered threats to continuation of our scientific exchange programs with other countries.

Dr. HANDLER. It is a minor threat. One simply need be mindful of it, that is all. In the enthusiasm for this new relationship, one must recognize that the other nations of the world with whom we have had long

scientific intercourse also have a stake in our space program, have a stake in our high-energy particle physics program, and the like. We must make sure they are always "cut in on the deal" and are not pushed aside and given second place in the scheduling of such facilities, for example.

Mr. SYMINGTON. Mr. Frey.

Mr. FREY. Thank you, Mr. Chairman.

I think I already know the answer; but for the record, in your professional opinion, in your position, do you feel that from a scientific standpoint the United States is going to benefit from this program? It is not going to be necessarily a one-way street, just an outgoing of science and technology?

Dr. HANDLER. Yes, sir. I believe we will benefit.

Mr. FREY. You have pointed out some of the problems, and, with the chairman, I think they are not just caveats, but I think there are some at least potential problems.

I have a couple questions, specifically.

You referred to the different roles of the National Academy of Sciences and the Soviet Academy. Could you expand on that?

One of the other things I would like to know is your opinion of the political clout that your group must operate in furthering some of these things. I use that in the broad sense.

Dr. HANDLER. We have no clout, sir.

Mr. FREY. I wish you had more, I guess I am trying to say.

Dr. HANDLER. We are an anomalous organization. In the Government organizational manual we are listed in the back with the Red Cross, as a quasi-governmental organization. I don't know what that means.

We were brought into being by the Congress in 1863, and the charter signed by President Lincoln. The charter contains a principle sentence, which says we shall, whenever called upon by any Department of the Government, conduct experiments, provide advice, et cetera, et cetera. Other than abjuring us to behave in the ways of an Academy, that is all it says.

So we are not quite in or quite out of the Government, if you will. We are a private body, privately incorporated, live on our own means, receive no appropriated funds, do not appear in the annual budget book, and so forth. In that sense we are clearly not an arm of the Government.

The Soviet Academy, however, is an operating arm of the Government. The members of their Academy, like the members of the National Academy are, if you will, the most distinguished scientists in their nation—as presumably are ours.

However, in the Soviet Union, these elected distinguished figures are then the chief operating individuals responsible for specific institutes of the Soviet Union. Those institutes are funded through the appropriated budget of the Soviet Academy, which is an operating arm of their Government. For example, the entire space program, apart, I take it, from its military aspects, in the Soviet Union is operated by the Soviet Academy.

Our position is advisory, theirs is operational. So that is hardly a symmetrical relationship, sir.

Mr. FREY. What percentage of our meetings, reports, so forth, are all documented, compared to the Russians.

Dr. HANDLER. If I understand the question——

Mr. FREY. In your estimation, what percentage of Soviet scientific knowledge is on record? I assume most of ours is.

Dr. HANDLER. The overwhelming bulk of ours is and the bulk of theirs must be. They produce a prodigious amount of literature. If they are holding back, somewhere, on scientific matters they consider classified for their purposes we would not know about that.

What can be said is that they are very busy and have a huge scientific and engineering community which is able and productive. That is the reason we translated 10,000 pages of mathematics alone last year; incidentally they have several very powerful mathematical groups.

Mr. FREY. Do you believe it would be beneficial if this committee proposed a "sense of Congress" resolution supporting what is going on in terms of the agreements?

Dr. HANDLER. I had not thought of it until you asked that of Dr. David. My answer would be the same as his. I think it would be important and gracious, and quite helpful.

Mr. FREY. I skimmed the other part of your statement. This is the first time we have had anything definitive on what could be done, as you suggest. I certainly appreciate that.

Basically, you referred to the Stockholm meeting and the problems of the environment.

If I read your statement correctly, you do not feel the same kind of problem obviously would exist with a highly industrialized nation such as the Soviet Union.

Was that the import of that?

Dr. HANDLER. In these bilateral arrangements we have agreed on what we can talk about and do together successfully. When the representatives of the more than 200 nation states in the world get together with their highly disparate qualities, getting agreement on matters before them—is extremely complex.

Mr. FREY. The chairman has pointed out something, I think, extremely important in what we are going to do. We better be very careful in any area we get in that we carefully prepare the groundwork. If not, and we get into a situation such as at Stockholm, I think everything many of us want will go down the drain. That is probably a pretty good example of what we should not do.

Dr. HANDLER. I see no reason we should get into that difficulty, sir.

Mr. FREY. Nor do I.

In the things you have outlined there are many areas where obviously it would be mutually beneficial, without any of the problems we can see.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Thank you, Mr. Frey.

Dr. Handler, you mentioned you wouldn't like to see a pattern generated in which only Government-directed research programs would find support. At the close of your paper you point out the need for financial resources to pursue these arrangements.

First, I would not automatically conclude that the interests of our Government are incompatible with those of the scientific community.

Dr. HANDLER. Oh, scarcely, sir. It is our Government that has made American science the powerful instrument which it is.

Mr. SYMINGTON. We want to be sure that we maintain a sense in Congress that any funds voted are going to be invested in projects that are likely to make life better at some future point, in the environment, and so on. I am sure we can do that. I imagine they could divide whatever resources they have between programs directed through Government channels and encouragement to the individual scientist or private association that they want to pursue a goal not incompatible with, yet not prescribed by, Government.

Dr. HANDLER. I could not take exception to that.

Mr. SYMINGTON. We are pleased to be visited by the chairman of our task force on energy, Congressman McCormack of the State of Washington, and there is one question I would like to raise with you: This would seem to be an area of tremendous opportunity for two great energy-conscious and needful powers to work on.

Is this an area where we can actually complement one another's efforts at some saving in time and cost, share the information and begin to develop sooner than could either alone, alternative sources of energy to the fossil fuel sources?

Dr. HANDLER. I could step back a bit. I think Dr. David mentioned the progress the Soviet scientists have made with respect to the Tokomak principle—arrangement for fusion. That is a long way from solving the energy problem at this moment. But if we can jointly work on that, there are, at this time, several intriguing ideas, to develop fusion, ideas, quite different from the Tokomak concept. Useful fusion is far in the future; perhaps we can go a long way down that path together.

Mr. SYMINGTON. These agreements should make it easier for example, to avoid what I understand was ignorance in our community of the promise that the Tokomak experiment held for reaching certain temperatures for certain periods.

With Mr. McCormack a number of us visited the one down in Texas and met some of the scientists there. We were informed our scientific community had been skeptical for a long time about the reports they were getting, until it went over and checked them out and found they were accurate.

Dr. HANDLER. The British group did that first, and we listened.

Mr. SYMINGTON. Right, a British group with a laser test.

I would hope we could, through these arrangements, accumulate this knowledge in a timely fashion.

Dr. HANDLER. We could, too, quite conceivably at the present time cooperate in this area, although I don't know with which specific group.

I am sure that others would be interested, with respect to the technologies relating to the protection of the environment. Given the kind of sources of energy we must use at the present time, the cost of protecting the environment against what we do to it by virtue of the production and utilization of energy are enormous, and those costs are going to grow. Anyone who can offer a useful advance in this derivative technology for protecting the environment while we get our energy, at the moment from the fossil fuels or nuclear fission fuels, could both save huge amounts of money and at the same time assist

in protection of environment. That is a perfectly rational field in which to cooperate. They have as much to gain as we have in that one.

Mr. SYMINGTON. Do you see the emergence of new academic programs at, say the college level, developing a cadre of future young American scientists conversant in the Russian language?

Dr. HANDLER. Oh, yes. It really can be done. Perhaps the best way is one of these 3-to-6-months total immersion courses. I am sure that these agreements will become a stimulus to some young people in college to study Russian instead of Spanish or French or German, which is the American tradition for second languages. It doesn't mean they all must, but if some will, it will help. It is embarrassing to be in an international meeting and discover that all the Americans are inept in everything but English—and sometimes in that, too. It is really quite arrogant to ask that all of the peoples in the world speak our language.

Mr. SYMINGTON. This would broaden support, too, I think for the ideas behind these agreements.

Are there other questions?

Dr. Handler, I am very grateful to you, as I am sure you know, for this paper and for your responses. I hope the Government will not go too much further into all of this without consulting you.

Thank you very much.

Dr. HANDLER. Thank you, sir.

(Whereupon, at 12 noon, the subcommittee was adjourned.)

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS ON SCIENCE AND TECHNOLOGY, SPACE, ENVIRONMENT, AND HEALTH AND MEDICINE

THURSDAY, JUNE 15, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON INTERNATIONAL
COOPERATION IN SCIENCE AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10 a.m., in room 2318, Rayburn House Office Building, Hon. James W. Symington (chairman of the subcommittee) presiding.

Mr. SYMINGTON. The committee will be in order.

This is the third day of hearings before the Subcommittee on International Cooperation in Science and Space.

The subcommittee is reviewing the four United States-Soviet agreements negotiated by the President in Moscow which deal with matters of science and technology, environment, health, and space.

This morning our witness will be Dr. George M. Low, Deputy Administrator of the National Aeronautics and Space Administration.

Dr. Low will testify regarding the new agreement between the United States and the Soviet Union concerning cooperation in the exploration and use of outer space for peaceful purposes.

Dr. Low is an aeronautical engineer whose entire career has been devoted to the Nation's aeronautical and space programs, beginning with the National Advisory Committee for Aeronautics, predecessor agency to NASA. He has steadily risen in the organization over the years. He was appointed to his present position as Deputy Administrator of NASA in 1969.

Dr. Low is accompanied by Mr. Arnold W. Frutkin, NASA's Assistant Administrator for International Affairs.

On behalf of the subcommittee I extend a warm welcome to both of you gentlemen.

Dr. Low is particularly an old friend of mine and of the committee, and we certainly welcome you, sir. You may begin with your prepared statement.

Dr. Low. Thank you, Mr. Chairman.

(The biographical sketch of Dr. Low follows:)

GEORGE M. LOW

Dr. Low is an aeronautical engineer who has devoted his entire career to the government's aeronautical and space programs. He began his career as a research

80-787—72——7

scientist at the Lewis Research Center of the National Advisory Committee for Aeronautics in Cleveland, specializing in the fields of heat transfer, boundary layer flows, and internal aerodynamics.

When the National Aeronautics and Space Administration was organized in October 1958, he was named Chief of Manned Space Flight. At NASA Headquarters in Washington, he was responsible for the Mercury and Gemini programs and was chairman of the special committee that formulated the original plans for the Apollo mannned lunar landing. He became more directly involved with manned space flight operations when he was named Deputy Director of NASA's Manned Spacecraft Center in Houston in 1964.

Following the Apollo fire in January 1967, he was asked to direct personally the Apollo Spacecraft Program to supervise the rebuilding of the vehicle and to assure its flight worthiness. He played a leading role in planning and executing all of the Apollo missions and originated the plans for Apollo 8, the first manned lunar orbit flight. During the time Dr. Low directed the program, five manned flights were flown, including Apollo 11 in July 1969, the first manned lunar landing.

In November 1969, Dr. Low was appointed Deputy Administrator of NASA by President Nixon, in which position he presently serves. From September 1970 to May 1971 he served as Acting Administrator of NASA.

Dr. Low was born in Vienna, Austria, in June 1926, and became a naturalized citizen in 1945 while serving in the U.S. Army. He received a Master of Science degree in Aeronautical Engineering from Rensselaer Polytechnic Institute in 1950 and an Honorary Doctrate in Engineering in 1969. He is a Fellow in the American Institute of Aeronautics and Astronautics and in the American Astronautical Society, a Member of the National Academy of Engineering and a Trustee, Rensselaer Polytechnic Institute.

He has received many special honors, including NASA's Outstanding Leadership Medal, NASA's Distinguished Service Medal twice, the Arthur S. Flemming Award as one of the ten outstanding young men in government, the AAS Space Flight Award, the Louis W. Hill Space Transportation Award from AIAA, and the National Space Club's Astronautics Engineer Award.

STATEMENT OF DR. GEORGE M. LOW, DEPUTY ADMINISTRATOR, NASA, ACCOMPANIED BY ARNOLD W. FRUTKIN, ASSISTANT ADMINISTRATOR FOR INTERNATIONAL AFFAIRS, NASA

Dr. Low. Mr. Chairman, members of the committee, I welcome this opportunity to provide information to the subcommittee regarding the recent Moscow summit agreement on cooperation in space between the United States and the Soviet Union. With your permission, I should like to submit my prepared text for the record and then abbreviate it rather considerably in this presentation.

Mr. SYMINGTON. It is so ordered.

(The prepared statement of Dr. Low follows:)

PREPARED STATEMENT OF GEORGE M. LOW, DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

I welcome this opportunity to provide information to the Subcommittee regarding the recent Moscow Summit agreement on cooperation in space between the United States and the Soviet Union.

My plan this morning is to summarize the substance of the agreement which President Nixon and Premier Kosygin signed on May 24 and then to comment briefly on the background, status, and significance of the activities for which it provides. We have already provided the Subcommittee with copies of the May 24 agreement and other basic documents.

U.S.-U.S.S.R. SPACE AGREEMENT OF MAY 1972

I turn first to the substance of the agreement, in which both parties assume four commitments:

1. To fulfill the NASA/Soviet Academy agreement of January 1971 on space science and applications. This agreement provides for cooperation in the fields of

space meteorology; the study of the natural environment; the exploration of near-earth space, the Moon, and the planets; and space biology and medicine.

2. To develop compatible rendezvous and docking systems for future generations of manned spacecraft of the United States and the Soviet Union. This is a logical extension of the NASA/Soviet Academy agreement of October 1970, which provided for joint definition of the requirements for the design of such compatible systems.

3. To conduct an experimental flight during 1975 to test such compatible systems. This flight will involve docking by a US Apollo-type spacecraft and a Soviet Soyuz-type spacecraft and visits by crew members of both countries to each other's spacecraft. This project, which grew out of the NASA/Soviet Academy studies, is to be carried out on the basis of principles and procedures as agreed by representatives of both parties in April 1972.

4. To encourage international efforts to resolve problems of international law in the exploration and use of outer space for peaceful purposes with the aim of strengthening the legal order in space and further developing international space law. This last commitment relates to the ongoing effort in the context of the United Nations Outer Space Committee which has resulted in a treaty on principles governing the activities of States in the exploration and use of outer Space and in an agreement on assistance to astronauts and the return of space objects. This is an area in which the Department of State takes the lead and NASA plays a supporting role.

SPACE SCIENCE AND APPLICATIONS

I shall confine my comments to the aspects of the Moscow agreement which affect NASA most directly, beginning with the commitment to fulfill the NASA/Soviet Academy agreement of January 1971 on space science and applications. Under that agreement, Joint Working Groups have been activated and some significant progress made.

In space meteorology.—A Joint Working Group is organizing experiments designed to advance our knowledge of temperature sounding from satellites and microwave measurement of precipitation zones, ice conditions, and sea surface roughness and temperature. Another Joint Working Group has provided for coordination of meridional sounding rocket networks in the eastern and western hemispheres and has begun to exchange the resulting operational and scientific meteorological data.

In the study of the natural environment.—A Joint Working Group is defining coordinated experiments in remote sensing of the environment, principally relating to vegetation, geology and the oceans. Each side will pursue the agreed experiments through coordinated surface and aerospace observations at designated sites in its own territory. The oceanographic effort will continue satellite and ship measurements over the same ocean area.

In the scientific investigation of near-earth space, the Moon, and the planets.—There have been exchanges of lunar samples, the rapid telex exchange of findings of special interest obtained by the US Mariner 9 and the USSR Mars 2 and 3 during their encounters with Mars, and working sessions to consider the scientific objectives, strategy, and results of investigations of the terrestrial and outer planets. Experts from both sides have been working on a common system of lunar coordinates and a program for compiling a complete map of the moon on the scale of 1 : 5,000,000.

In space biology and medicine.—A Joint Working Group has exchanged highly detailed data and results from the Soyuz/Salyut and Apollo programs, established procedures for a continuing exchange of information, and is considering certain common standards and procedures to increase the comparability of information.

All this represents a good beginning under the January 1971 agreement. Much remains to be done, however, the inclusion of this agreement in the Summit accord should lend considerable force to the NASA/Soviet Academy cooperation in space science and applications and perhaps accelerate progress under it.

RENDEZVOUS AND DOCKING

Turning now to rendezvous and docking, I think it will be useful to review the events which led to the May 24 agreement to test compatible systems in a joint mission during 1975.

The chain of events began in April 1970, when Dr. Paine, then Administrator of NASA, suggested to Soviet Academician Blagonravov during an informal meeting in New York the possibility of cooperation in the area of astronaut safety, including compatible docking fixtures for space stations and shuttles. Dr. Handler, President of the National Academy of Sciences here, lent his good offices to conveying our interest to President Keldysh of the Soviet Academy. In July, Dr. Paine suggested directly to President Keldysh that this possibility be considered. Actual discussions on possible docking arrangements began in Moscow, October 26–28, 1970, between teams led by Dr. Gilruth of NASA and Academician Boris Petrov of the Soviet Academy. The parties agreed to establish three Joint Working Groups which would define the design requirements of compatible systems for future US and USSR manned spacecraft.

Since October 1970, there has been a continuing exchange of visits, correspondence and documentation, but progress can best be marked by summarizing the key meetings which have taken place.

In January 1971, in Moscow, I suggested to President Keldysh that we consider using Apollo and Soyuz spacecraft for an early rendezvous and docking test mission.

In June 1971, the three Joint Working Groups met in Houston. They agreed in principle or in detail on a number of technical solutions and requirements for compatible systems. They identified other problems which required additional consideration. In addition, the Soviet side, responding to my suggestion to President Keldysh, proposed that we weigh the possibility of using Apollo and Salyut spacecraft for a first test docking. We agreed to study the technical and economic implications of possible missions to test in flight the compatible systems we were designing.

In November-December 1971, the three Joint Working Groups, meeting in Moscow, made significant progress in advancing the definition of technical requirements for compatible systems in future spacecraft. They also agreed that a test mission in the mid-'70s was indeed feasible.

In April 1972, I went to Moscow, accompanied by Mr. Arnold W. Frutkin, NASA Assistant Administrator for International Affairs, and Dr. Glynn S. Lunney of the Manned Spacecraft Center, who had been appointed NASA Project Director. In discussions with Soviet representatives led by Academician Kotelnikov, Acting President of the Soviet Academy, we concluded that a test mission was desirable. The Soviet side reported that their studies now indicated use of a Soviet Soyuz spacecraft in conjunction with an Apollo Command and Service Module. We then directed our full attention to assuring that our technical understanding was matched by understanding on the critical management and operational principles and procedures necessary to the successful conduct of so complex a mission, involving the spacecraft and control centers of two nations. In the joint Summary of Results of April 6, 1972, we recorded our agreement on such essentials as regular and direct contact, detailed formal documentation, joint reviews of designs and hardware at various stages of development, joint tests of interconnecting systems, early participation in joint preparations by flight operations specialists, development of crew training and orientation plans, training in each country of the other country's flight crew and operations personnel, detailed project schedules, principles of flight command and control, flight plans and mission rules for normal and contingency situations, immediate transmission of flight television received in one country to the others control center, the level of reciprocal language familiarity, and the need to develop public information plans taking into account the obligations and practices of both sides.

With agreement reached on these fundamentals, NASA was able to inform the President that a joint test mission was feasible and desirable and suitable for an executive agreement.

I note again that the agreement which the President signed in Moscow specifies that the test mission will be carried out on the basis of principles and procedures which will be developed in accord with the agreement reached in Moscow in April.

THE TEST MISSION

The Apollo spacecraft which we will use to perform the test mission will be a modified version of the Command and Service Module flown during the first several lunar landing missions. It will incorporate a new system, called the Docking Module. The basic spacecraft was manufactured and checked out for

the Apollo program and is presently in storage as left-over hardware. Some modifications will be required as a result of unique mission requirements, including additional propellants for the reaction control system, heaters for thermal control, and controls and displays required for operation of the Docking Module. The Docking Module is a cylindrical structure, about five feet in diameter and ten feet in length. Equipped with the necessary stored gases, displays, and controls, it will serve as an airlock for the internal transfer of crewmen between the different atmospheres of the two spacecraft. In addition, much of the new compatible equipment will be located in this structure. On its forward end there will be the new peripheral, universal docking device which is being designed by the two sides. Radio communications, docking displays, and antennas will also be mounted on the Module.

The Soyuz spacecraft to be used by the Soviets has been the primary manned vehicle for the Soviet space program since it was introduced in 1967. This spacecraft consists of an Orbital Module, a Descent Module, and an Instrument Module. The exact configuration to be used in the test mission will be a modification of the basic Soyuz design including the compatible rendezvous and docking equipment and possibly other requirements unique to the test mission. Most of the new compatible systems will be located on the Orbital Module. For example, the new docking system will be installed on the front end of that module.

A possible mission profile would include the launching of the Apollo spacecraft on a Saturn IB from Cape Kennedy. The vehicle would be inserted into a low Earth orbit, on the order of 110 nautical miles. After separation from the second Saturn stage (S–IVB), the Apollo would turn around, dock, and extract the Docking Module internally mounted in the adapter area in essentially the same fashion as the Lunar Module is extracted on current lunar missions. The plane of the orbit would be inclined 51.6° to the equator, in order to pass over the USSR launch site. The Apollo altitude would be selected and adjusted periodically, if necessary, in order to provide daily launch opportunities for the Soyuz spacecraft. As soon as practical after the Apollo launch, the Soyuz spacecraft would be launched and maneuvered into a target orbit on the order of 145 nautical miles. Once the Soyuz spacecraft is in orbit, the Apollo would begin an active rendezvous sequence to arrive in the vicinity of the Soyuz within one, or perhaps two days, after the Soyuz launch. The Apollo radio and optical guidance systems would be used in this sequence. At the time of station keeping, the Apollo spacecraft would be maneuvered to dock with the Soyuz, using a new docking alignment system and the new peripheral-type compatible docking system.

Once the two vehicles had docked, a period of up to two days would be devoted to joint activities. The exact duration of the docked phase would depend upon further definition of specific crew activities, including the possibility of joint operation of scientific experiments. American astronauts would enter the Soyuz internally through the Docking Module, carrying voice communications equipment and a television camera. After an initial visit, an American astronaut would accompany a Soviet cosmonaut back to the Apollo. This return visit would require an intermediate stop of approximately two hours in the Docking Module while both crewmen perform the necessary oxygen prebreathing to go safely to the lower operating pressure of Apollo. On completion of the docked phase, the two vehicles would separate and perhaps perform further tests of the docking system and the optical and radio aids and equipments. The vehicles would then be maneuvered to separate orbits for return to Earth.

BENEFITS

I want to emphasize that each party has agreed to build its own equipment in its own way to common specifications so as to assure compatibility. The exchange of hardware or technology is not an objective of the project, although radio beacons may be exchanged for the test mission. For the test mission, both the U.S. and the USSR will adapt existing spacecraft. For the future, each side will design its spacecraft for its own requirements in the light of its own engineering and operational philosophy. Each will settle on compatible, not necessarily identical, designs for those systems on which rendezvous and docking depend. Those systems include radio communications and radio guidance for rendezvous, optical tracking beacons, the universal docking mechanism itself, docking aids and targets, and equipment for crew transfer.

The benefits which we stand to achieve are important:

If US and Soviet manned spacecraft can rendezvous, dock, and transfer crew members, both countries will have increased their chances of rescuing astronauts in distress without commensurate increases in the costs of a standby rescue capability. It is here that the joint test mission is particularly important. It will give us the opportunity to identify and resolve under the best possible conditions the problems we can expect to flow from differences in language, equipment, and operational procedures.

The test mission also points the way to joint activities by the US and the Soviet Union in space once our future systems, incorporating compatible rendezvous and docking arrangements, are flying. We are looking into the future here, but it is not too much to hope that through such joint activities it will be possible to achieve much more in space—to enhance the benefits of space exploration—than we would from our separable programs.

For the United States, the joint test mission provides a constructive way to continue our capability for manned space flight and its support which were developed so successfully during the Apollo Program in both government and industry. In the absence of such a project, there would be no US manned space flights between the last of the Skylab flights in 1973 and the first Space Shuttle missions in 1978.

Finally, I believe that the cooperation provided for in the Moscow agreement makes even more sense in the larger scheme of things. I am thinking particularly of the joint test mission, where the United States and the Soviet Union have agreed to commit to a project which depends for success on the skill and good faith of both countries. If we can work together to achieve such an intimate and complex common goal, if we can in fact operate jointly in space, we will have built mutual confidence and trust. The symbol of US and Soviet spacemen meeting in orbit before the eyes of the entire world cannot help but ameliorate attitudes, viewpoints and expectations throughout the world.

Dr. Low. In the Moscow agreement signed by President Nixon and Premier Kosygin on May 24, both parties assume three commitments which affect NASA very directly.

They are, first: to fulfill the NASA/Soviet Academy of Sciences agreement of January 1971 on cooperation in space science and applications;

Second, to develop compatible rendezvous and docking systems for future generations of manned spacecraft of the U.S. and U.S.S.R.

Third, to conduct an experimental flight during 1975 to test such compatible systems.

The NASA/Soviet Academy agreement of January 1971 provides for cooperation in several major areas of space research.

In meteorology, it aims to improve meteorological data exchanges, advance research by meteorological satellites, and develop meteorological sounding rocket networks.

In the study of the natural environment, its objective is coordinated air/space/surface measurements of common ocean areas and of land sites in each country.

In space science, it looks to exchanges of results as well as of views on objectives and strategies in the exploration of near-earth space, the moon—including the exchange of lunar samples—and the planets.

In space biology and medicine, it provides for the exchange of data and results, particularly in manned space flight.

Under this agreement, our joint working groups have made considerable progress. We are designing joint experiments to advance knowledge of the techniques of space meteorology. We have begun exchanging operational and meteorological data from sounding rocket networks in the Eastern and Western Hemispheres. We are defining coordinated experiments in remote sensing of the environment. We have exchanged findings of special interest obtained from the United

States and Soviet probes of Mars. We have held working sessions on the exploration of the outer planets. We have exchanged lunar samples. We have exchanged highly detailed data and results of biomedical experience in the Soyuz/Salyut and Apollo programs.

This is a good beginning, but much remains to be done. The inclusion of the NASA/Soviet Academy agreement in the summit accord should lend it force and perhaps accelerate progress under it.

Now let me turn to rendezvous and docking. Actual discussions of possible docking arrangements began in Moscow in October 1970. There experts from NASA and the Soviet Academy provided for the definition of design requirements for future manned spacecraft.

In January 1971, when I was in Moscow for the science and applications negotiations, I suggested to President Keldysh that we consider an early rendezvous and docking test mission using existing spacecraft.

In June 1971, in Houston, Soviet experts meeting with us in the space center responded favorably to this suggestion, and both sides agreed to study the technical and economic implications of test missions.

In December 1971, joint working groups meeting in Moscow concluded that a test mission was desirable. This conclusion, combined with agreement on management and operational principles to apply in the test mission, which we reached when I was in Moscow last April, opened the way for the committing May 24 agreement signed by President Nixon and Premier Kosygin.

The systems which must be compatible if we are to conduct a successful mission include radio communications, radio guidance and optical tracking for rendezvous, docking aids and targets, equipment for crew transfer, and of course the docking system itself. For the latter we have chosen a universal system that will dispense with the probe and drogue devices used in Apollo. Any two spacecraft equipped with the new system will be able to come together and interlock much as you would interlace your fingers as you bring your two hands together. Being a peripheral system, the new mechanism will permit unobstructed internal passage between docked spacecraft.

The basic spacecraft we plan to use in the test mission is a command and service module left over from the Apollo program. In order to provide an airlock for the internal transfer of crewmen between the different spacecraft atmospheres, and to avoid the extensive changes in the Apollo spacecraft which will be required if we were to fit it with the new docking mechanism, we have chosen to build a docking module. This is a cylindrical structure, about 5 feet in diameter and 10 in length, which is equipped with the necessary stored gases, displays, and controls. At one end is the familiar Apollo docking mechanism. At the other, the end which will interface with the Soyuz, is the new universal docking assembly.

I have models in front of me. After, when I have finished my prepared statement, perhaps I can discuss this further with the aid of the models.

Mr. SYMINGTON. Fine.

Dr. LOW. A possible mission profile would begin with a launching from Cape Kennedy on a Saturn I–B into low-earth orbit. After the Apollo separates from the second Saturn stage, it would turn around,

rock, and extract the docking module. The plane of the orbit would be inclined 51.6° to the Equator in order to pass over the Soviet launch site. Soon after the Apollo launching, the Soyuz spacecraft would be launched into an orbit of about 145 nautical miles. The Apollo would then begin an active rendezvous sequence designed to bring the two craft close together, rendezvous and dock. Once locked together, the way would be open for reciprocal visits and activities including the possibility of joint operation of scientific experiments.

The benefits which we stand to achieve are important. Let me list a few.

If the United States and Soviet manned spacecraft can rendezvous, dock, and transfer crewmembers, both countries will have increased their chances of rescuing astronauts in distress without commensurate increases in the costs of a standby rescue capability.

Second, the test mission also points the way to joint activities by the United States and the Soviet Union in space once our future systems, incorporating compatible docking arrangements, are flying.

Third, for the United States, the joint test mission provides a constructive way to maintain in the mid-1970's the capability for manned space flight and its support which was developed so successfully during the Apollo program in both Government and industry.

Finally, I believe that the cooperation provided for in the Moscow agreement makes even more sense in the larger scheme of things. I am thinking particularly of the joint test mission, where the United States and the Soviet Union have agreed to commit to a project which depends for success on the skill and good faith of both countries. If we can work together to achieve such an intimate and complex common goal, if we can, in fact, operate jointly in space, we will have built mutual confidence and trust.

The symbol of United States and Soviet spacemen meeting in orbit before the eyes of the entire world cannot help but ameliorate attitudes, viewpoints, and expectations throughout the world.

Mr. Chairman, this completes my summary statement. Perhaps I could spend a moment with the model. I have two models before me. One is a model given to me by Soviet delegations of the Soyuz spacecraft.

This model is one of Soyuz 10, the first of these spacecraft to rendezvous and dock with their Salyut space stations. It consists of three basic modules: an orbiter module, in which the crew spends their time in orbit, the reentry module is similar to the command module in the Apollo spacecraft, and a propulsion module which is in this model equipped with solar panels for electric power. It is not clear that these same solar panels would be used in the joint docking mission we are now undertaking.

This particular model, Soyuz 10, is equipped with their previous docking system which they used in the Salyut mission, and looks very much like the probe we have in the Apollo spacecraft. This is, as I say, the existing Soyuz spacecraft.

On this other model it is shown docked to an Apollo command and service module.

I will take this apart and put it together as it could come together in a rendezvous and docking mission. This is the Apollo command module in which our astronauts live, work, navigate, move their spacecraft

about. This is the service module, a propulsion system which, in Apollo, is used to put this module into lunar orbit and inject it from lunar orbit. For the docking mission we will use a command and service module left over from the Apollo program.

In all of our spacecraft so far we have a pure oxygen atmosphere of about one-third of the standard atmosphere, roughly 5 pounds per square inch pressure.

Mr. SYMINGTON. Dr. Low, I want to welcome our chairman, Congressman George Miller, to the hearings.

The CHAIRMAN. Thank you.

Dr. LOW. Good morning, Mr. Chairman.

Mr. SYMINGTON. It is great to have you back, Mr. Chairman.

The CHAIRMAN. Even for a short term.

Mr. SYMINGTON. Dr. Low has presented his prepared testimony in summary fashion, and is now describing with models the docking mission itself.

Dr. LOW. The Soyuz spacecraft uses a standard atmosphere just as we breathe here—oxygen and nitrogen at about 14.7 or 15 pounds per square inch.

We, therefore, have to provide a means of getting back and forth from our one-third pure oxygen atmosphere to the full oxygen-nitrogent atmosphere. To do this we are incorporating into this mission what we call a docking module, in effect an airlock, so that as our astronauts or their cosmonauts transfer from one spacecraft to the other, they can, in this airlock, adapt to the other atmosphere, and also so we will not transport the atmosphere from one configuration to the other, we will not mix nitrogen into our spacecraft, nor reduce the pressure in the Soviet spacecraft.

In an actual docking mission, then, we would launch the Apollo atop a Saturn I–B, the same Saturn I–B we used on the Apollo 7 earth orbital mission. This would be like what we are used to seeing in Apollo spacecraft. The docking module would be housed in the same adapter that houses the lunar module in the lunar mission.

After being inserted into orbit it would turn around and pull this docking module out of the Saturn I-B adapter, and dock it to the front end of the command module. This means that on the one end of the docking module we would have the same docking system we use now in Apollo.

We would then be in orbit in this configuration.

Some time after we have inserted into orbit, the Soviets would launch the Soyuz atop their launch vehicle and establish it in an orbit compatible for rendezvous. Then we would rendezvous with them, station keep and dock.

Looking at this end this is our newly developed, jointly developed universal docking system.

This consists of a number of fingers that interlace, so any spacecraft so equipped could dock with any other and we don't need a special device in one that can only dock with another particular spacecraft, as in Apollo. The universal system would look the same on both sides, though built independently on each side of the ocean.

Using this docking system, we could make a hard dock, and then would be flying in this configuration jointly in space.

If next, for example, we planned to visit the Soviets first, one of our astronauts would get into the docking module, which initially would be at our 5 p.s.i. pure oxygen atmosphere. We would then bring in oxygen to bring up the atmosphere to the 14.7 p.s.i. oxygen-nitrogen atmosphere. Then we would have the same atmosphere in our docking module as in the Soyuz orbital module. Of course we would have closed the hatch on the Apollo side and opened the hatch on the Soyuz side and get in here and breathe the same atmosphere.

Coming back, perhaps coming back together with one of the Soviet cosmonauts, we have more difficulty. Because, going from a normal atmosphere of 14.7 p.s.i. to a pure oxygen atmosphere at 5 p.s.i., we have to prebreathe pure oxygen to get the nitrogen out of the system; just as a diver coming up from the depth must come up slowly to get the nitrogen out of his bloodstream, so as we come from an air atmosphere into a lower pressure atmosphere, we have to get the nitrogen out of the blood, so we have to prebreathe.

So we would go back into the docking module, which is still at the normal air atmosphere, we could close the hatch, the astronauts and cosmonauts would put on oxygen masks and breathe oxygen approximtaely 2 hours, and then we could lower the pressure to the one-third atmosphere at pure oxygen, open the hatch to Apollo, and visit the Apollo.

In the cosmonaut's return to his spacecraft, after perhaps doing joint experiments, we could separate the spacecraft, repeat the atmospheric process, and each come back to our launch sites.

I am prepared to answer questions, Mr. Chairman, about the docking mission, about the January 1971 agreement, or any other areas you would like to discuss.

Mr. SYMINGTON. That is extremely interesting, Dr. Low, and a very thoughtful and thorough presentation. I am sure my colleagues have a number of questions.

Do I take it the return trip to the Apollo would be something like getting the bends, if these people did not breathe pure oxygen for a couple of hours?

Dr. Low. Yes.

We have the same situation each time we launch an Apollo.

Because then of course we take our astronauts from the low-level air environment into space at 5 p.s.i. So before every flight our astronauts breathe pure oxygen for 2 hours or so, for the same reason we have this problem.

Mr. SYMINGTON. What are the reasons for opting for different atmospheres between the two countries?

Dr. Low. We have to first look back in history, then project into the future. We decided for our manned space flight programs, Mercury, Gemini, and Apollo, to use the pure oxygen atmosphere single-gas system, because for each of our manned space flight programs we were extremely weight-limited, and we felt we could build a lighter system using a lower atmosphere and one gas only.

So, historically, in all three of our programs we have been always weight limited, and we went to that atmosphere.

The Soviet Union perhaps was not as weight-limited. Initially they had a heavier launch vehicle capability, so they immediately went to the normal atmosphere that all of us are used to breathing—air at sea level pressure, 14.7 pounds per square inch.

We have decided for future spacecraft, particularly the Space Shuttle, we will also go to that atmosphere, because weight will no longer be a limitation to us.

We therefore agreed in our working session with our Soviet counterparts to look for future docking missions to the atmosphere they have had right along, the one we are going to. In the test mission, using existing hardware, we have to make arrangements to make the two spacecraft compatible. The docking module does that.

Mr. SYMINGTON. I understand the additional investment to consummate this experiment on our side is roughly $250 million.

Dr. LOW. That is correct.

Mr. SYMINGTON. How is that money allocated?

Dr. LOW. It is going, as most of NASA's funds go, primarily to industry. Part of it will go toward the checkout of the leftover Apollo command and service module. This needs to be checked out and slightly modified, but the modification will be minimal.

Second, it will go for the development of the docking module.

Finally, it will go toward the preparation and checkout of the Saturn launch vehicle and the flight applications at Cape Kennedy, the mission operations in Houston for the flight itself.

Mr. SYMINGTON. For the record, and the committee's curiosity, the Apollo vehicle which you say is left over, what would be the rough value of that as added to the $250 million?

Dr. LOW. I think we have estimated an Apollo command and service module at roughly $50 million and launch vehicle at approximately $45 million.

Mr. SYMINGTON. So you have something like $95 million of investment made already?

Dr. LOW. Of investment made in hardware that otherwise would not be used.

Mr. SYMINGTON. Is this the last of the extra Apollo vehicles?

Dr. LOW. No, Mr. Chairman. We need in Skylab one Saturn V, three Saturn I–B's and three command and service modules. Assuming we do not fly the Skylab backup, which assumes the flight is successful, we will have left over additional Saturn I–B's, (I do not have the exact number but I can provide it for the record) additional command and service modules in various stages of preparation, and I believe two Saturn V's.

(Information for the record follows:)

Assuming the successful completion of the Apollo, Skylab and Apollo-Soyuz Test Programs, without the need for utilizing the back-up vehicles presently assigned, the hardware remaining in inventory is as follows:

Two complete Saturn V launch vehicles.

Two complete Saturn IB launch vehicles.

One complete Command Service Module.

Two incomplete Command Service Modules. These are undergoing limited production effort to assure that we retain the option at this time to use these flight vehicles for possible future programs. Major systems are available for these spacecraft, but not installed in them.

One additional IU.

Three additional Saturn IB vehicle first stages.

Mr. SYMINGTON. If this flight meets all projected requirements, is it contemplated the remaining equipment would be used for another such flight or is that on your down-the-road projection for continuing this form of experiment?

Dr. Low. We have no plans for utilization of the remaining leftover Apollo hardware.

As we have testified before the full committee, we are in this situation because Apollo turned out to be more successful than we were able to plan for in the early 1960's. But in answer to your specific question, Mr. Symington, we believe, if this test mission does indeed prove out our systems, the next compatible system on our side will be the Space Shuttle designed to be compatible for docking with whatever the Soviets are flying at that time.

Mr. SYMINGTON. Is it possible to tell us what the additional Soviet investment might be in order to complete this experiment?

Dr. Low. No. We have not discussed funding with them. I can only talk in terms of hardware.

They will not develop the docking module. We felt this was our job to do, because after all it is our atmosphere that is not compatible with the future.

Also, we felt it was easier to have the docking module instead of modifying the front end of the Apollo, which would have been a very complicated thing, to incorporate the universal docking system. I don't know whether they have leftover hardware or have to build new hardware.

They clearly have to modify the front end of their orbital module to take the new universal docking system. And that, at least in our terms, would be a fairly expensive proposition.

I don't know whether it is for them or not.

Mr. SYMINGTON. The decision to go with the Soyuz instead of the Salyut was based on what determinations?

Dr. Low. I would like again to go back in history, if I may.

Originally when we started talking about compatible docking systems, in October 1970, we talked only of future systems. This of course would have been the Space Shuttle.

In January 1971, when I had meetings on other subjects with President Keldysh of their Academy, I suggested we might consider a test mission, and at that time suggested that this might be done with Soyuz and Apollo, because that is all we knew about. This was our first discussion on this test mission subject.

Later, the Soviets proposed to change to the Salyut, which at the time, of course, was their first and only Salyut—it was flying, that was during the June and July 1971 meetings. We worked together on defining that program. When Dr. Lunney, Mr. Frutkin and I were in Moscow in April preparing for the summit meeting, the Soviet side suggested they would like to go back to the Soyuz instead of the Salyut.

The basic reason, as they explained it to us was, I think, twofold: First, technical change required in the Salyut. It is equipped only with one docking adapter. In order to dock, they would have to man it with their own Soyuz, then provide a second docking adapter for us to dock with the Apollo. This would have involved a very significant change in their hardware which they would rather not undertake.

Second, from the operational point of view, the Soyuz-Apollo mission is simpler than the Salyut. Because we have to coordinate only two launches if we do an Apollo-Soyuz mission. However, if we did a

Soyuz/Salyut-Apollo mission, then there would be three launches to coordinate. The Soyuz would have to come up and dock with Salyut to man it; then the Apollo spacecraft would have to come up and dock also with the Salyut. So it is much simpler to do the Apollo-Soyuz mission.

Mr. SYMINGTON. When the vehicles separate, do our astronauts go back into their usual orbit, land in the water, and the cosmonauts go back to theirs and land somewhere in the Soviet mainland?

Dr. LOW. Yes. As far as the usual orbit is concerned we will land from the 51.6° orbit in one of our usual landing areas. Of course this overflies a large part of the ocean. Fifty-one point six degrees is very close to the orbit we will fly in Skylab, anyway. We will have a water landing; they will presumably have a land landing, because that is what their spacecraft is designed for.

Mr. SYMINGTON. Mr. Chairman.

The CHAIRMAN. Dr. Low, this adapter you described, when you come back to land will that be jettisoned?

Dr. LOW. Yes, Mr. Chairman, it will be jettisoned in orbit before we land.

Mr. SYMINGTON. Mr. Frey.

Mr. FREY. Thank you, Mr. Chairman.

First, do you feel it would be helpful, if this or any other committee came up with a "sense of Congress" resolution supporting this activity?

Dr. LOW. Mr. Frey, I am not exactly familiar with what a "sense of Congress" resolution is. I must plead ignorance.

Mr. FREY. A resolution in essence putting the Congress on record as supporting this activity and backing it up 100 percent.

Dr. LOW. I would certainly think that such a resolution would be helpful to us.

Mr. FREY. I am sure you do. I just wanted it for the record.

I was interested in your talks and discussions. How deep has been the cooperation? Have you run into any real hangups along the line?

Dr. LOW. I think, Mr. Frey, the hangups, if any, have been technical, just as we have them in our own discussions with our own technical people when we talk, between two contractors, between two NASA centers.

I believe the experience I have personally had in my two major discussions with the Soviet Union—one in January 1971, the other in April 1972—have been the most gratifying experiences I have had in a long time. Both sides clearly have come a long way in the development of the technology for space flight. In fact, when from some time in the future we look back in history books I think people will be amazed how two major nations have reached this point in time at about the same point in history.

Both sides very clearly feel so much is to be learned and so much gained not only for the Soviet Union and the United States but for mankind everywhere that it is an essential thing for us to work together in this environment, to work together in space, and I believe that for these reasons the meetings have gone extremely well.

Mr. FREY. Let me push you a little more on this.

As you and I both know, the Russian space efforts, military and civilian, are merged. In ours, of course, there is a definite distinction

between our efforts, with perhaps some overlap. Is this a mere fact of the government structure? Do you see any problems for the future, potentially, or any ones you have had, because of this?

Dr. Low. No; not because of this.

We have dealt with the Academy of Sciences. The Academy has been designated as the organization there to deal with us on this cooperation, and obviously they are the people who are deeply involved in space in the area we are working with them.

There is one area of difference. It is a different philosophy in announcing what we will do in the future. The Soviets have a tradition, if you will, that generally they announce only after the fact what they have accomplished. In our case we have always talked about what we plan to do ahead of time.

We were concerned that perhaps this difference in philosophy would make our negotiations somewhat more difficult. But in this area it has not. Particularly in this docking mission, we fully agreed during the April meeting that we will have to jointly schedule, will have to jointly say what we are going to do, when, with what kind of hardware. We agreed we would train and orient our astronauts and their cosmonauts in each other's facilities, each other's country; and they are perfectly willing to do that.

Mr. FREY. Another point: We have Apollo 17 the last Apollo mission, coming up, hopefully in December. But there has been at least to my knowledge no Soviet governmental or space officials personally either involved in this, or has there?

Dr. Low. Not a space official.

Mr. FREY. You and Dr. Fletcher at this point might think it appropriate to extend an invitation to some of the people who may be involved in this program, to come over and participate in it as sort of groundwork for what we do in the future.

Dr. Low. We are certainly going to consider that, Mr. Frey.

Mr. FREY. I think this committee would be interested in knowing how your efforts in this area proceed.

One last thing to clarify for the record: We do have a lot of hardware setting around that members of this committee have seen in various stages of storage. We have considerable money invested in this. Of course part of it is due to our success, as you say. But I would hope that, you are continually reviewing how to use this equipment for other potential or possible missions, depending upon budgetary considerations of course.

Second, you have not written off the possibility of the gap in the space program between 1975 and 1978, really between 1973 and 1978, because this manned mission will be the only one, in using this equipment, if it is available, with the Soviet Union, is that correct?

Dr. Low. That is correct. The problem, as you have stated, is a budgetary one, that within the limitations of the funding as we see it for the next few years we had to make a choice of flying out all the old hardware or getting on with the new, and we made the choice to fly this one mission, then go to the Shuttle.

Mr. FREY. When we had the previous testimony, of course, there was no way of bringing up the joint mission.

Dr. Low. That is correct.

Although in our testimony before the committee we did mention that discussions were going on and that this was certainly a possibility.

Mr. FREY. I want personally to congratulate you for the work you have done on this. We speak of the benefits of the space program, tangible and intangible. It appears to me that potentially it will benefit all mankind. Two nations like this, with differing backgrounds and philosophies, doing something like this out in the open is just tremendous, and in some way maybe the greatest benefit of all of the space programs that we have ever seen.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Thank you, Mr. Frey.

Mr. Chairman.

The CHAIRMAN. I would like to make an observation on Mr. Frey's last statement.

For many years it has been my privilege to be one of the observers to the U.N. Committee on Peaceful Uses of Outer Space. I am happy to hear him say that they were dealing with the Russian Academy of Sciences in this field. Our own experience, as that of Mr. Frutkin, with Academician Blagonravov and others from the Academy of Sciences, was very good. They worked together very carefully and very excellently. I am happy to know that this is the agency in Russia with which you are going to work. Whoever brought this about I think did a great thing.

I assure you the dedication of the scientists is as great as ours. They are going to try to get the best and the most out of this undertaking I think it is a very fine one.

Mr. FREY. If the chairman would yield.

I certainly want to say that the chairman of this committee has pushed for this. I think the Nation owes a great debt of gratitude to him. What is resulting is the payoff of a lot of work by a lot of people, and the chairman has spearheaded it for years and years. I think, speaking for all of us, we are deeply grateful.

Mr. SYMINGTON. I think we can say "Amen" to that, Mr. Chairman.

I had planned myself to extend to you, Mr. Chairman, heartfelt appreciation we on this committee have, and which we think the Nation should have, for your dedication to this effort, when a great many people were skeptical that anything could get off the ground.

We have come a long way, and we are getting something off the ground that may have an impact on prospects for world peace beyond anything we can imagine.

There is a French theologian, Tielhard de Chardin, who had a theory that "things rising converge." I have felt for some time, having read his book, that there is a relevance in the space program to that, that the hopes of man, somehow, going up can come together.

Dr. Low, you were asked about inviting the Soviet representatives to the launching of the next Apollo.

Actually, such an invitation is normally extended, is that not true?

Dr. Low. Yes. We have extended invitations in the past, I think for almost all of our manned launches, if not all, and they have not accepted because the Soviets to date have felt they could not reciprocate, and in all of our dealings they have wanted to have an even-handed reciprocal exchange.

I might add, however, that at the last launch, the Russian poet, Yevtushenko, was present and I understand has written a poem not about the launch itself but about a view of the launch vehicle the night before.

Mr. SYMINGTON. Yes. I believe I have read that. It is a great work.

Mr. Cotter.

Mr. COTTER. Thank you, Mr. Chairman.

Dr. Low, I got lost. You mentioned a cost of $250 million. Is that correct?

Dr. Low. Yes, Mr. Cotter.

Mr. COTTER. Can you break that down for me?

Dr. Low. Yes, sir.

Mr. Cotter, I can give you a preliminary breakdown. It will be refined over the next months.

Out of the $250 million we are now estimating $122 million to bring the spacecraft itself into the fully checked-out configuration; $58 million for the docking module, $10 million for scientific experiments, $17 million for the launch vehicle, and $43 million for launch operations.

Mr. COTTER. What is the estimated cost of an Apollo launch?

Dr. Low. About $500 million, as I recall.

Mr. COTTER. You mention that in the Space Shuttle there would have to be some attempt to make it compatible with anything which the Russians may have. Is there any estimated cost on that?

Dr. Low. No additional cost for that, Mr. Cotter, because we had always planned to design the Space Shuttle with a normal air atmosphere. As far as the docking adapter, docking mechanism, is concerned, we had not yet designed one. We will incorporate the universal docking system in the Shuttle. So if anything I guess one might say it should be a simpler design and less costly for that one piece of equipment on the Space Shuttle.

Mr. COTTER. What is the timetable for this docking?

Dr. Low. 1975, with no firm month selected yet; I imagine one of the summer months.

Mr. COTTER. So in the future budgetary provisions would have to be made for this $250 million?

Dr. Low. Yes, Mr. Cotter. In fiscal year 1973 we will have to transfer some funds between Skylab and this mission, and in future years, 1974, 1975, we will have to make a special budgetary request for this purpose.

Mr. COTTER. Thank you.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Mr. Price.

Mr. PRICE. Thank you, Mr. Chairman.

Dr. Low, I want to pay the respects due you for all the efforts you and your associates have made in bringing about this historic exchange of views.

I echo the statement of Mr. Symington in regard to Mr. Miller, our chairman, for his leadership and the effort he has given in working toward this contribution to mankind in this endeavor.

But really, Dr. Low, I have some grave reservations about this whole operation. As you perhaps know, or perhaps do not know, this agreement was signed by the President of the United States, and signed for the Soviets by a man who would be in comparison like a

man signing as the head of one of our political parties, technically. I think it is a fact which is misunderstood by many people.[1]

I have grave reservations about the development that has gone on in the past. As you know, they lost their last three men that came down, because of the unsafe development of their lock system on their door, whereas we have much greater sophistication in this area. As you know, when they sever their module from their launch vehicle, they rip it apart instead of severing it as we do. I just feel that they have much more to gain by what they can learn from our sophisticated developments than we have to gain from them.

Now, the first question would be: Are they going to share in any of the cost of the development of this air lock adapter? Or are we going to bear the total expense of making it compatible with their module?

Dr. Low. Mr. Price, as far as your specific question is concerned, no, they will not share the expense of the air lock, because we feel, as I testified before, that up to this point on the interface, the point where this universal docking system is, it is our job to become compatible with the future systems, because this is a test of the future systems. We have elected to do this with the docking module which we find is a cheaper approach for us than modifying our spacecraft itself.

They are going to absorb the expense on their side for mating their existing docking device with the universal docking device, which I think I said is jointly designed. They will provide their spacecraft, and of course everything that goes with it. There will be no exchange of funds.

Mr. PRICE. Will that hardware be brought over here and tested before it is tried?

Dr. LOW. We plan to exchange hardware, and test it in each country.

Mr. PRICE. Do you believe this compatible mating not only on this flight but in the future, the Skylabs, will mean we will be releasing any of our military or other sensitive space data which might in any way compromise our national security?

Dr. LOW. Absolutely not. This is one area where I think we are extremely sensitive.

Our objective here, as in all other areas of space cooperation, is to share the results of the space flights, and make it possible to do so, not to share technology. I think on both sides we have probably been very careful to meet that objective.

I would like to comment, if I may, on your first remarks, Mr. Price.

First, as far as who signed the agreement with Mr. Nixon, I am not the qualified person to comment.

Mr. PRICE. Is your part of the agreement part of this agreement?

Dr. LOW. I am talking about—

Mr. PRICE. Is the NASA cooperation a part of the agreement the President signed?

Dr. LOW. By reference, yes, Mr. Price.

As far as the sophistication of the Soviet gear is concerned, they did have an unfortunate accident. But so did we, at times, in Apollo.

Mr. PRICE. That brings up a point right there, too, with regard to safety. I am sure you have given this much more thought and are

---

[1] The Agreement was signed for the United States of America by Richard Nixon, President of the United States, for the Union of Soviet Socialist Republics by A. N. Kosygin, Chairman of the Council of Ministers of the U.S.S.R.

much more qualified to discuss it than I am, but I have questions in my mind.

As you know, we had the fire, and changed a lot of things, a lot of materials. Is there a possibility, in making this transfer, that as they go through these locks if something were to happen in their module and it caught fire for some reason, does our craft have the capacity to bring back six men?

Dr. Low. No; it does not.

Mr. Price. In other words, three of one or the other would have to be abandoned, if it got right down to it?

Dr. Low. If it were a problem in either craft that would not allow that craft to come back, there might be some limitation in this test mission to bringing all the crew back in the other.

On the other hand, as far as flammability, to answer that question, we have the flammability problem in part because of the pure oxygen atmosphere, that is one of the penalties we pay for it.

Mr. Price. But that happens to be the best atmosphere, though, as far as safety is concerned with the atmosphere?

Dr. Low. As far as safety is concerned I think their atmosphere is better than ours, safer. That is why we go towards it in the Shuttle. Our pure oxygen atmosphere was an exigency because of the weight limitation in our previous programs.

Mr. Price. And you have no reservations?

It appears to me we are sharing the sophistication we have developed with a nation which has not come up to our quality standard, and they are going to learn a lot more and benefit a lot more from our quality work than we are from theirs.

Dr. Low. I don't think so, Mr. Price.

I discussed this at great length with our technical people who, for example, jointly designed the docking mechanism. I said, "If you stood back and wanted to give credit as to whose ideas are really incorported in that, who contributed the most?"

Dr. Lunney told me that the initial concept in the October 1970 meeting was proposed conceptually by us. The Soviets at that time said they had been thinking of something very similar. But as far as the design concept, making it work, putting it together, doing the hard work on it, our people would have been hard pressed to take more credit than they would give the other side.

They worked it as engineers to engineers. The people in the Soviet Union who have designed their spacecraft, their systems, in the past, sat down with ours. From our technical people—and I even talked to our interpreters who listened to both sides—I asked "Who contributes the most, who says the most in these meetings?" And they said, "Boy, it is give and take, and I could not tell that one side is giving or taking more than the other."

It is a joint effort of individuals who are certainly equally technically competent and have brought systems to the same state-of-the-art.

Mr. Price. You think their door and their severance systems between the two modules are equal or equivalent to ours in the past?

Dr. Low. I don't know the details of the accident that they had, Mr. Price.

Mr. PRICE. You know the method by which they rip apart, instead of our pyrotechnical or guillotine severence, that severs our connections, versus their ripping them and tearing them apart, in their operation.

Dr. LOW. I don't know that.

Mr. PRICE. And you know the seal around the door.

Dr. LOW. I don't know that.

Mr. PRICE. You know we are much more sophisticated, or that accident would never have happened to the Russians.

Dr. LOW. Mr. Price, I don't know that it is the seal of the door that gave way.

I know both of us separate many things pyrotechnically. One of my obligations when I had that area was to worry about doing things pyrotechnically. We rip and tear things apart, many things, as they do.

I don't know the cause of the accident.

Mr. PRICE. I have talked to some of the experts who built ours, and they say there is no comparison between theirs and ours, that their door is like shutting a refrigerator door, compared to ours.

Dr. LOW. Have you seen the door on our lunar module?

Mr. PRICE. Yes.

Dr. LOW. The door on our lunar module, as best I can describe it, looks very much like the door on their Soyuz reentry module.

As you know, I was deeply involved in our own Apollo program. I have been in their Soyuz. I don't know what experts we have that have seen the two of them.

I cannot agree, Mr. Price, that we are taking a risk here, because I have looked at both sides. I have looked at both ends, and I have probably been more deeply involved than anybody else in this country in probing with them the details of how we are going to do this mission.

The reason I went over in April was that we did want to determine in detail with them the operational aspects of the flight which we had not previously discussed. And I said myself, and so recommended to the President, that we are ready to undertake a joint mission.

Mr. PRICE. Well, Dr. Low, I have every confidence in you. But I want to warn you—and you have more experience at it—that they will use our technology to their advantage. As you know, it is my conclusion that they have not ever lived up to any agreement they have ever made in history. And I think as long as they can they will use us to develop their equipment in every way they can, and then they will abandon us when that time comes.

This idea of compatability is a wonderful thing, and peace, all this sort of thing. But I don't think we want to rush headlong into this thing blindly, not knowing that they technically will bleed us of everything they can bleed us of. I think we ought to be very aware of this possibility. Because, as you know, there are military sidelights to these programs that we have spent billions of dollars for, and we have not spent them for nothing. I for one do not want to be giving them a bunch of knowhow and data, building them up to us equally. We have done enough of that in the past with atomic weaponry, and everything else.

It is a very wonderful thing to do, but we surely want to be aware of their techniques in advancing their philosophy, and their techniques of doing things.

Dr. Low. I agree with you, Mr. Price.

I think we have demonstrated now through 2 years of technical discussions with them that this is a give-and-take situation where we each try to march down toward a common goal together. Our people have been extremely careful—as have theirs—to do this on a quid pro quo basis.

Mr. Price. I don't want to do all the giving and let them do all the taking. That is the main thing.

Dr. Low. I agree with you.

Mr. Price. And you are the ambassador of that.

Dr. Low. I think it is a serious responsibility we in NASA have to make sure that we do have equality in our exchanges. I think to date we have had.

Mr. Price. The whole purpose is to develop a rescue capability, is it not?

Dr. Low. In this instance. In the January 1971 science and applications agreement, the purpose is to share in the results of space flight.

Mr. Price. Say we dock, and you develop this concept. This then means—and we are through with our Apollo missions, then you are talking about the rescue capabilities of the Shuttle, then?

Dr. Low. Yes.

Mr. Price. That is our next vehicle.

Then are their vehicles and ours going to be capable, after docking, of bringing the other crew members aboard if something should happen and return them to earth?

Dr. Low. Yes.

Mr. Price. They will be big enough that each crew could——

Dr. Low. Certainly in our case the Shuttle will be. I can only assume that at that time they will have spacecraft which will be the equivalent of the Shuttle.

Mr. Price. What are we going to do with our last lunar module? Is it going to wind up down in the Smithsonian?

Dr. Low. I will have to find out, Mr. Price. I don't know.

(Information requested for the record follows:)

The last unassigned lunar module, LM–9, was declared excess to program requirements in May 1971 and was made available to our spares system for removal of components for support of the remaining Apollo missions.

As stated by Dr. Petrone in his testimony on February 22, 1972, before the Subcommittee on Manned Space Flight of the Committee on Science and Astronautics of the U.S. House of Representatives, in response to a question from Congressman Price concerning the possibility of another flight to the moon ". . . we do not have the lunar module to carry out the type of missions we have seen or what we plan to carry on on flights 15 and 16. Grumman has disposed of their equipment and assets. We don't have any more lunar modules."

As described by Dr. Petrone in his testimony on the same subject in response to Congressman Price's question concerning investment in back up parts and inventory, (Page 183, line 39) "What we have done in our spare system to avoid a buildup, we have bootstrapped ourselves in spares. As we came to the end of the program, we picked the time at which we would not buy additional items. The spares inventory by using the 'bootstrap system' has been kept to a minimum."

After removal of components from LM–9 as necessary for the support of Apollo flights as described by Dr. Petrone in his discussion of our "bootstrap system", it may become an artifact available for exhibit in the Smithsonian.

Mr. Price. How much is a lunar module worth? Can you estimate?

Dr. Low. Let me get that number. It is probably on the order of $50 million.

(Information requested for the record follows:)

The average recurring unit production cost for an H-Mission LM of the type flown through Apollo 14 is $40 million.

The average recurring unit production cost for a J-Mission LM flown on Apollo 15 and 16 and scheduled to fly on Apollo 17 is $50 million.

LM–9 was of the H-Mission configuration.

Mr. PRICE. That will look good down in the Smithsonian, a $50 million lunar module.

Dr. LOW. I am not sure, Mr. Price, whether there is a last lunar module, because at the time we made the decision to cancel the last couple of Apollo flights we also decided not to finish any hardware that was left. I would have to look it up to find out whether anything was completely assembled.

Mr. PRICE. You don't know what stage of development it was?

Dr. LOW. I do not remember.

The Smithsonian does have Lunar Module No. 2, which was planned for an unmanned flight which was not needed after Lunar Module No. 1 flew. We skipped one flight there.

Mr. PRICE. In other words, it was a $50 million display down there, is that correct?

Dr. LOW. Yes; if you want to do it—yes; it is.

Mr. PRICE. I have a hard time, you know, out in the Panhandle of Texas, selling a $50 million lunar module sitting up here in the Smithsonian, which many of these people do not get a chance to see. When I go and vote for appropriations for a space program, you know, they say "We have a lot of things out here we need money for, too." These are some of the fights we have to make as a Member.

Dr. LOW. I understand that, Mr. Price.

I think the only answer I can give to a question like that is to say one has to view the total Apollo program in context of its total cost.

In 1961 we committed to go to the moon for somewhere between $20 and $40 billion. We did the first lunar landing at about $20 billion, which I think is about the only program this country has had where this kind of achievement can be talked about and has been made.

In going there, getting there, we had to plan for a certain sequence of missions.

Mr. PRICE. Yes.

Dr. LOW. The success of Apollo though, is largely due to the fact we had the ability to change that sequence and capitalize on success.

For that reason LM 2 was not flown. LM 1 was successful enough that we decided we could skip that flight and not use that piece of hardware.

So out of the Apollo cost we probably save money, although it would have saved more had we not built LM 2. On the other hand, if we had not built it and had needed it. Apollo would have slipped out a year or two or three, and it would have cost much more.

I hope on balance a postaudit will show we did it about right.

Mr. PRICE. Well, you have done a great job. I am not criticizing you.

Dr. LOW. I know you are not.

Mr. PRICE. I am trying to probe some of the aspects we are faced with.

We could go on and on. We will have to get together some time and discuss it.

Mr. Chairman, I thank you for the opportunity to question the witness.

Mr. SYMINGTON. Thank you, Mr. Price.

I think this is a rare opportunity for our Soviet guests who are here today to see the manner in which we deliberate all sides of questions of this kind.

Whether or not President Kaldysh has to appear before the Presidium and present his program in the same manner I am not sure. But we do have to explore all points of view as we proceed to develop our policies.

I would observe, I feel the agreement was also signed for our side by the head of a political party. [Laughter.]

Mr. PRICE. It is a fact, Mr. Chairman. It was.

Mr. SYMINGTON. I have some further questions.

Dr. Low, I should like to ask some questions of detail.

Are there plans in this coming mission for joint use of the tracking systems of the two countries? Will they be separately functioning, will they be interlocking?

Dr. LOW. There will not be joint use in that sense, Mr. Chairman. However, we will have communications lines for voice and television between their control center and ours. This we have already agreed to.

Mr. SYMINGTON. There were recent lunar sample exchanges?

Dr. LOW. Yes. We have exchanged samples from each of our lunar missions, with the possible exception of Apollo 16, about which I am not sure.

Mr. SYMINGTON. Under what agreement were those samples exchanged?

Dr. LOW. Under the Low-Keldysh agreement of January 1971. At that time we agreed under the area of scientific exploration of near earth space, the moon, and the planets, to exchange approximately 3 grams of lunar material from each space flight.

Mr. SYMINGTON. Have we determined that the samples are rather similar in chemical content?

Dr. LOW. As a matter of fact, they are not.

Our scientists who have now analyzed the Luna 16 sample, which is the first one of theirs that we received, gained a great deal of additional information, even though we had only 3 grams, to complement what we have had from our own landing sites. It gives us one more landing site, where we have not been.

Mr. SYMINGTON. Will there be some report on the comparative studies made?

Dr. LOW. Mr. Frutkin?

Mr. FRUTKIN. Mr. Chairman, there is a superb report, in our view, of the analysis by American scientists of lunar samples provided by the Soviets which was published some months ago, which could be provided to the committee if it desires.

Mr. SYMINGTON. I believe it would be helpful. We would decide at a later date whether to make it part of this record, but I would like to see it.

(Information requested for the record follows:)

RESULTS OF INVESTIGATIONS OF THE LUNA 16 SAMPLE AS PUBLISHED IN EARTH AND PLANETARY SCIENCE LETTERS, VOL. 13, PP. 223–466, NO. 2, 1972

Background.—Luna 16, which landed in Mare Fecunditatis on September 20, 1970, returned to earth with 101 grams of regolith in the form of a core 35 cm long. Various parts of the Luna 16 core were exchanged for representative samples from the Apollo 11 and 12 sites by the USSR Academy of Sciences and NASA. The Luna 16 samples received by the United States consisted of two 1½ gram aliquots of soil from 6–8 cm (level A) and 29–31 cm (level gamma) depths and one 62–mg basalt fragment. The material arrived in the United States in June 1971 and after preparation at MSC, parts of the Luna 16 samples were distributed to selected P.I.'s in the Lunar Sample Program. The results of their studies have now been published in Earth and Planetary Science Letters, Vol. 13, No. 2, 1972. Altogether nearly 80 scientists combined to publish 27 articles on a little more than 3 grams of material within 7 months of the initiation of the study. An additional article described the geologic setting of the Luna 16 site.

THE GEOLOGIC SETTING (FROM MCCAULEY AND SCOTT, EARTH PLANET SCIENCE LETTERS, VOL. 13, NO. 2).

The Luna 16 landing site is similar in its geologic setting to Apollos 11 and 12. All three sites are located on basaltic mare fill which occurs mostly within multi-ring basins formed by impact earlier in the moon's history. A regolith developed by impact bombardment is present at each of these sites. The regolith is composed mostly of locally derived volcanic material, but also contains exotic fine fragments that have been ballistically transported into the landing sites by large impact events which formed craters such as Langrenus and Copernicus. These exotic fragments probably consist mostly of earlier reworked multi-ring basin debris and, although not directly traceable to individual sources, they do represent a good statistical sample of the composition of most of the premare terrae regions.

Scientific Results.—The intensive study of the Luna 16 material clearly demonstrates that even a very small sample of lunar soil may contain significant information about the planet particularly when considered as part of a larger body of knowledge.

Igneous lithic fragments at the Luna 16 site fall into two groups: a basaltic group characterized by an Al_2O_3 content of roughly 16 weight percent (low alumina) and an anorthositic-noritic-troctolitic (ANT) group characterized by an Al_2O_3 content of roughly 25 weight percent (high alumina). The basaltic group probably are fragments of the mare-fill. Texture, mineralogy, and chemistry of the basaltic group suggest that the basalt flooding Mare Fecunditatis had a similar magmatic history to the mare basalts at the Apollo 11 and 12 sites, that is, rapid crystallization from highly fractionated, totally liquid, highly reduced melts. The Luna 16 mare basalt, like lunar basalt in general, is distinct in bulk chemistry from terrestrial basalt in having a low Na content. The Fe, Ti, and U contents are generally higher than in terrestrial basalts.

The ANT or high alumina group is also characterized by a higher content of MgO and a lower content of TiO_2, FeO, MnO, Na_2O, K_2O and P_2O than the basaltic group. Rock of such composition are probably of none-mare origin. The most likely source of this material is the crater Langrenus, 140 km in diameter, located about 280 km SW of the landing site. Noritic rocks rich in potassium, rare earth elements, and phosphorus ("KREEP"), which constitute the third known major type of lunar crustal igneous rocks, are apparently absent or insignificant at the Luna 16 site. For this and other reasons the Luna 16 site is more like the Apollo 11 site than other Apollo sites.

The regolith at the Luna 16 site also includes a variety of microbreccia and glass fragments as well as chondrules. Microbreccias are composed either of basaltic fragments or more commonly of locally derived mixtures of a high proportion of basaltic with a small proportion of ANT materials. Most glasses were produced directly from igneous rocks, not from the microbreccias. Chondrules in the Luna 16 sample have ANT but not basaltic composition. Shock metamorphic effects are common in fragments of Luna 16 soil. These effects are virtually identical to those observed in the Apollo samples and suggest that regolith formation by meteorite impact is a general process over the entire moon.

The age of the largest basalt fragment in the Luna 16 sample, the 62-mg fragment, has been determined by Rb-Sr internal isochron and the Ar-Ar gas retention method which yield consistent results. The ages are respectively $3.42 \pm 0.18 \times 10^9$ years and $3.45 \pm 0.04 \times 10^9$ years. The close agreement of these two ages suggests that the time of flooding of the Mare Fecunditatis was roughly 3.4×10^9 years ago, which is later than the flooding of Mare Tranquillitatis (about 3.7×10^9 years ago) but earlier than the flooding of Oceanus Procellarum and Mare Imbrium (about 3.3×10^9 years ago).

The soil from the Luna 16 site, as well as the soil from all Apollo sites, lies very close to a Rb-Sr isochron of 4.6×10^9 years which must correspond to the lunar differentiation process closely following the time of formation of the moon.

Evidence from particle track densities, neutron irradiation doses and rare gas content of the Luna 16 soil indicates that the regolith is both unusually thin and extremely old in comparison with Apollo sites. Interestingly, on the basis of impact crater densities, earlier studies had suggested that the Mare Fecunditatis surface was the oldest mare surface on the moon. Radiation damage by heavy solar particles is strikingly greater in the Luna 16 samples than in samples from the four Apollo sites. The Luna 16 soil has been irradiated very close to the surface and has not been mixed or "gardened" much deeper than 30 cm for the past 3×10^9 years or more. The mixing depths are less by a factor of 3 than those calculated for Apollo 11 and 12, and the shallowness of the mixing depth at Luna 16 is consistent with the observed overall coarsening of the soil column toward the bottom. Large excesses of Ar observed in the Luna 16 soil also imply a long period of reimplantation by solar wind. Luna 16 samples within 1 to 2 meters of the surface must have been there about twice as long as Apollo 11 samples.

Electrostatic agitation by bombarding electrons may induce soil migration. It is suggested that less movement of the soil at Mare Fecunditatis has taken place, perhaps because of its proximity to the limb and consequent lower exposure to energetic electrons in the earth's magnetospheric tail.

In terms of trace element chemistry the most distinctive feature of the Luna 16 soil is that in comparison with chondrites, the Eu anomaly is the smallest ever found in lunar regolith. Rare earth elements in general are less abundant in the Luna 16 soil than in Apollo samples.

Dr. Low. If I may add one point, Mr. Chairman, I think it is an important point.

So far, of course, we have had more lunar landing flights than they have had. They have had two, we have had Apollo 11 through 16, and missed 13, so that makes five on our side. But we have only one more flight, and I fully expect that they will continue to go to the moon unmanned, or perhaps manned, during the time period we will not go. Our agreement is essentially open-ended, and we expect to receive samples from them over the years ahead.

Mr. SYMINGTON. There was to be a joint report on biology and medicine based on United States and Soviet flights. Has that been published?

Dr. LOW. It has not been published.

Mr. FRUTKIN. The joint work, Mr. Chairman, on space biology and medicine, which will be called "The Foundations of Space Biology and Medicine," has been proceeding very well over the past 2 years since it was resumed.

It is now expected that the editorial work will be completed in October or November of this year. There are some chapters remaining to be prepared by United States and Soviet scientists. The majority of the chapters have been prepared and are in hand, and we are rather optimistic that this work will come to fruition toward the end of this year, probably for publication in the following year.

Mr. SYMINGTON. On the matter of the mutuality and reciprocity in the joint program, I have no doubt but that we place complete reliance on our scientific approaches. But I believe, Dr. Low, you did point out

earlier that the natural atmosphere of the Soviet equipment is what we will be going to in the future, that we opted for the pure oxygen environment in the past because of weight limitations, and that did result, in at least one instance, in a tragedy for us, did it not?

Dr. Low. Yes; the Apollo fire.

Mr. SYMINGTON. What is the status of the 1962 agreement to exchange data on meteorology, earth magnetism, and space biology?

Dr. Low. We just referred to the Medical Editorial Board.

On the weather agreement, meteorological agreement of 1962, that work has continued at rather low key throughout the years. There have been weather exchanges, exchanges of weather data.

After the January 1971 agreement we picked up on that again and resolved on both sides to make that a more useful system of data exchange and that work is now going on.

On the exchange of information on the magnetosphere, I don't know whether that is completed—it is a very low key scientific exchange. Not much has been done on that.

Mr. SYMINGTON. Have we information concerning Soviet interest in earth resources surveys from space? And is there any discussion going on between NASA and the Soviet academy in that area?

Dr. Low. Yes. One of the points of the Low-Keldysh agreement of 1971 is to jointly work on matters of the environment, and specifically we agreed to select test sites, each in our own country, and a point test site over the ocean, to calibrate and compare instruments so that we can jointly extend the understanding of how one can make environmental measurements from space. That work has progressed through some working groups now, to where we have selected the sites and begun to select instruments, each our own, and we will just exchange results.

Mr. SYMINGTON. Does that mean they have a program comparable to our ERTS program?

Dr. Low. They have discussed with us two kinds of programs: One is measurement similar to the ERTS-type measurement; made from their Cosmos series of satellites; and, second, measurements similar to those we have made on Apollo 9, for example, from their manned Soyuz and Salyut flights.

I don't know whether they have a specific dedicated satellite like ERTS coming along. They have not discussed it.

Mr. FRUTKIN. They have given us some indication, Mr. Chairman, that they were unlikely in the near future to have a satellite like ERTS dedicated to earth resources survey.

Mr. SYMINGTON. Then are they using remote sensing equipment to achieve comparable information?

Dr. Low. Yes; they are, as part of the Cosmos series. They showed us for example some results in January of 1971 taken, I believe, from their Cosmos 243 satellite, which had extensive remote sensing equipment on board.

Mr. SYMINGTON. It is roughly comparable to the type and character of the systems that we have?

Dr. Low. It was comparable to what we had at that time. Now, it was not comparable to what we will have in ERTS.

Mr. SYMINGTON. We had with us yesterday Dr. Philip Handler, President of the National Academy of Sciences, who laid some stress

on the need to learn Russian, at the graduate if not the college and secondary level, in order to make agreements of this kind more workable, and so not so much would have to be done through interpreters.

Do you share that view of his?

Dr. Low. Yes, up to a point.

First of all, we did agree in the April agreement, and there is a copy of that agreement in front of you, I believe, on how to handle language during the joint manned space flight. We agreed that each side will develop an understanding of the other's language particularly in response to the normal kind of discussion that goes on in the space flight.

As far as our technical discussions are concerned, so far we have always worked with interpreters. We have had interpreters at each of our working group sessions. I also feel a bit chagrined because my opposite numbers on the Soviet side can always understand English, and I cannot understand Russian.

I have decided that I will make every effort to gain as much understanding of their language as I can, and so will many of our other people. We are very serious about this business, and we intend to learn what we can.

As you told me earlier, Mr. Chairman, since you know their language, I understand it is a very difficult one to learn.

Mr. SYMINGTON. I have a limited knowledge of it. It is really not all that difficult, once you learn the alphabet. One great thing about it is that once you know how to spell a word you know exactly how to pronounce it. That is not true in English.

I do see in the joint communique of May 29 between the President and General Secretary Brezhnev, under "Exchanges in the Field of Science, Technology, Education and Culture," "The United States, noting the existence of an extensive program of English language instructions in the Soviet Union, indicated its intention to encourage Russian language programs in the United States."

So I guess that puts us all on notice that we are about to be encouraged. [Laughter.]

I think it is a good idea.

Is there, either under the space agreement or the environmental agreement, any emphasis to be laid on studies of the upper atmosphere with respect to the possible effects of supersonic aircraft flight? That was something of an issue in the debate concerning our own SST program some months ago, along with other problems presented by supersonic flight.

Dr. Low. It is not in the space agreement, Mr. Chairman. In fact our total discussion has been on space, not on aeronautics. Whether it is in one of the other agreements or not, I don't know.

Do you know, Mr. Frutkin?

Mr. Frutkin points out that, as part of the space agreement concerning meteorological soundings, we will obtain atmospheric profiles and better understanding of the atmosphere itself, which is remotely related to the subject you are asking about, but not directly.

Mr. SYMINGTON. Although NASA is interested in aeronautical as well as space technology development, I take it there is no aeronautical cooperation inherent in the Moscow space agreement.

Dr. Low. No, Mr. Chairman, there is not.

Mr. SYMINGTON. Mr. Frey, do you have any questions?

Mr. FREY. No, Mr. Chairman.

Mr. SYMINGTON. Mr. Price?

We may have additional questions which we would submit in writing to you, if that is convenient.

Dr. Low. Certainly, sir.

Mr. SYMINGTON. It has been stimulating to hear you today. There is a great deal for us yet to learn. We realize these programs are incipient and somewhat embryonic at the moment. We want you to know of our continuing interest both in the negotiations, as they become properly public, and in the implementation of these agreements.

I think we have heard a number of the caveats which can be legitimately raised in advance, and there may be others.

But at this time we want to thank you for a very forthright appearance and excellent statement. We are grateful to you for the work you are doing in this area.

The committee is adjourned until next Tuesday at 10 a.m.

(Whereupon, at 11:30 a.m., the subcommittee was adjourned, to reconvene sine die.)

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS ON SCIENCE AND TECHNOLOGY, SPACE, ENVIRONMENT, AND HEALTH AND MEDICINE

TUESDAY, JUNE 20, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON INTERNATIONAL
COOPERATION IN SCIENCE AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10:10 a.m. in room 2318, Rayburn House Office Building, Hon. James W. Symington (chairman of the subcommittee) presiding.

Mr. SYMINGTON. The committee will be in order.

This morning the Subcommittee on International Cooperation in Science and Space resumes its hearings on the four recently executed cooperative agreements between the United States and the Soviet Union on science and technology, medical science and public health, environmental protection, and space exploration.

Our witnesses today will discuss the Cooperative Agreement on Environmental Protection.

Both witnesses were instrumental in developing the terms of that agreement, and both have recently returned from Stockholm, Sweden, where they participated in the U.N. Conference on Human Environment. Thus, in addition to their testimony on the nature and scope of the Moscow agreement, they will be in a position to provide an assessment of the Stockholm conference as well.

Our first witness is Dr. Gordon J. F. MacDonald, who is a member of the Council on Environmental Quality, Executive Office of the President. Dr. MacDonald is a distinguished scientist and educator. He's served on the faculties of the Massachusetts Institute of Technology and the University of California at Los Angeles and Santa Barbara.

Dr. MacDonald is a member of the National Academy of Sciences and served on the President's Advisory Committee from 1965 through 1969.

We're mighty pleased to have you here this morning, Dr. MacDonald, and grateful for your having taken the time and care to put together a statement for the committee. You may proceed with it.

Dr. MACDONALD. Thank you, Mr. Chairman and Congressman Frey.

I would first like to introduce Mr. Hunt Janin, who is a staff member with the Council on Environmental Quality, with a special interest

in international environmental affairs. He has been working with me and other members of the Council on the U.S.-U.S.S.R. Agreements.

Mr. SYMINGTON. We welcome you here too, sir.

Mr. JANIN. Thank you, sir.

(The biographical sketch of Dr. MacDonald follows:)

GORDON J. F. MACDONALD

On leave from the University of California, Santa Barbara, where he was appointed Vice Chancellor for Research and Graduate Affairs in September 1968, Dr. MacDonald is serving as a member of the President's Council on Environmental Quality. While receiving his higher education at Harvard University, he was awarded his A.B. summa cum laude, M.A. and Ph.D. degrees and served as a Junior Fellow from 1952–54. Dr. MacDonald taught at MIT and did research at Carnegie Institute's Geophysical Laboratory before going to UCLA in 1958 as a professor of geophysics. At UCLA, he became Director of the Atmospheric Research Laboratory, Associate Director of the Institute of Geophysics and Planetary Physics, and Chairman of the new Department of Planetary and Space Science.

Dr. MacDonald was a member of the President's Science Advisory Committee from 1965 to 1969. He has served the Department of State as a member of the U.S.-Japan Committee on Scientific Cooperation and as a consultant; and the Department of Commerce as a member of the Commerce Technology Advisory Board. In addition to these responsibilities he has been most active as a consultant to NASA serving on the Lunar and Planetary Missions Board, the Science and Technology Advisory Committee for Manned Space Flight, and the Science Advisory Committee. For the National Academy of Sciences, Dr. MacDonald served on the Committee on Atmospheric Sciences from 1961 to 1970, the Space Science Board from 1962 to 1970, the Environmental Studies Board from 1968 to 1970, and he served as the Board's Chairman. He also was Chairman of the Executive Committee of the Earth Sciences Division of the National Research Council.

The earth's interior, the upper atmosphere, weather modification, and the origin of the moon and planets are subjects to which Dr. MacDonald has made important contributions. In 1960 he was awarded the American Academy of Arts and Sciences Monograph Prize in physics and biological sciences for his book ROTATION OF THE EARTH, coauthored with Walter Munk. He is the author of over a hundred articles on scientific subjects. He founded and was the first editor of the Reviews of Geophysics as well as co-editor of the Journal of the Atmospheric Sciences; he is now associate editor of six other journals.

Dr. MacDonald is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, Council on Foreign Relations, and thirteen other professional and scientific societies. He was elected an Associate of the Royal Astronomical Society in 1970.

STATEMENT OF DR. GORDON J. F. MacDONALD, MEMBER, COUNCIL ON ENVIRONMENTAL QUALITY, EXECUTIVE OFFICE OF THE PRESIDENT, ACCOMPANIED BY HUNT JANIN, STAFF MEMBER, COUNCIL ON ENVIRONMENTAL QUALITY FOR INTERNATIONAL AFFAIRS

Dr. MACDONALD. I welcome the opportunity to appear before you today to discuss the Agreement on Cooperation in the Field of Environmental Protection between the United States and the Soviet Union. A copy of the agreement is attached to my statement and I would request that it be made part of the record.

Mr. SYMINGTON. Without objection, so ordered.

(A copy of the agreement referred to is as follows:)

Agreement on Cooperation in the Field of Environmental Protection Between the United States of America and the Union of Soviet Socialist Republics

The Government of the United States of America and the Government of the Union of Soviet Socialist Republics:

Attaching great importance to the problems of environmental protection;

Proceeding on the assumption that the proper utilization of contemporary scientific, technical and managerial achievements can, with appropriate control of their undesirable consequences, make possible the improvement of the interrelationship between man and nature;

Considering that the development of mutual cooperation in the field of environmental protection, taking into account the experience of countries with different social and economic systems, will be beneficial to the United States of America and the Union of Soviet Socialist Republics, as well as to other countries;

Considering that economic and social development for the benefit of future generations requires the protection and enhancement of the human environment today;

Desiring to facilitate the establishment of closer and long-term cooperation between interested organizations of the two countries in this field.

In accordance with the Agreement between the United States of America and the Union of Soviet Socialist Republics on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural, and Other Fields in 1972–1973, signed April 11, 1972, and developing further the principles of mutually beneficial cooperation between the two countries; Have agreed as follows:

Article 1

The Parties will develop cooperation in the field of environmental protection on the basis of equality, reciprocity, and mutual benefit.

Article 2

This cooperation will be aimed at achieving the most important aspects of the problems of the environment and will be devoted to working out measures to prevent pollution, to study pollution and its effect on the environment, and to develop the basis for controlling the impact of human activities on nature.

It will be implemented, in particular, in the following areas: air pollution; water pollution; environmental pollution associated with agricultural production; enhancement of the urban environment; preservation of nature and the organization of preserves; marine pollution; biological and genetic consequences of environmental pollution; influence of environmental changes on climate; earthquake prediction; arctic and subarctic ecological systems; legal and administrative measures for protecting environmental quality.

In the course of this cooperation the Parties will devote special attention to joint efforts improving existing technologies and developing new technologies which do not pollute the environment, to the introduction of these new technologies into everyday use, and to the study of their economic aspects.

The Parties declare that, upon mutual agreement, they will share the results of such cooperation with other countries.

Article 3

The Parties will conduct cooperative activities in the field of environmental protection by the following means: exchange of scientists, experts and research scholars; organization of bilateral conferences, symposia and meetings of experts; exchange of scientific and technical information and documentation, and the results of research on environment; joint development and implementation of programs and projects in the field of basic and applied sciences; other forms of cooperation which may be agreed upon in the course of the implementation of this Agreement.

Article 4

Proceeding from the aims of this Agreement the Parties will encourage and facilitate, as appropriate, the establishment and development of direct contacts

and cooperation between institutions and organizations, governmental, public and private, of the two countries, and the conclusion, where appropriate, of separate agreements and contracts.

ARTICLE 5

For the implementation of this Agreement a US–USSR Joint Committee on Cooperation in the Field of Environmental Protection shall be established. As a rule this Joint Committee shall meet once a year in Washington and Moscow, alternately. The Joint Committee shall approve concrete measures and programs of cooperation, designate the participating organizations responsible for the realization of these programs and make recommendations, as appropriate, to the two Governments.

Each Party shall designate a coordinator. These coordinators, between sessions of the Joint Committee, shall maintain contact between the United States and Soviet parts, supervise the implementation of the pertinent cooperative programs, specify the individual sections of these programs and coordinate the activities of organizations participating in environmental cooperation in accordance with this Agreement.

ARTICLE 6

Nothing in this Agreement shall be construed to prejudice other agreements concluded between the two Parties.

ARTICLE 7

This Agreement shall enter into force upon signature and shall remain in force for five years after which it will be extended for successive five year periods unless one Party notifies the other of the termination thereof not less than six months prior to its expiration.

The termination of this Agreement shall not affect the validity of agreements and contracts between interested institutions and organizations of the two countries concluded on the basis of this Agreement.

Done on May 23, 1972 at Moscow in duplicate, in the English and Russian languages, both texts being equally authentic.

FOR THE UNITED STATES OF AMERICA:
RICHARD NIXON

FOR THE UNION OF SOVIET SOCIALIST REPUBLICS:
N. V. PODGORNY

Dr. MACDONALD. As you know, this unprecedented agreement was signed in Moscow on May 23, 1972, by President Nixon and President Podgorny; it is the first of its kind between the two countries and certainly the most comprehensive environmental agreement between major nations.

Before going into the details of this agreement, I think it would be useful to review, very briefly, some of the environmental problems the Soviet Union is facing, and which have undoubtedly contributed to its decision to cooperate with the United States in this respect.

It appears to us that the Soviet Union is experiencing, to some degree, nearly all the environmental problems found in the United States. This is a striking confirmation of the fact that nearly all of the developed countries, whether in Western Europe, North America or in Japan, have run into similar environmental problems at nearly the same time, regardless of their political or economic systems. The most pressing environmental problem in the U.S.S.R. is probably water pollution. The Soviet press has carried numerous articles reporting difficulties in efforts to clean up rivers, lakes, and shallow inland seas. You may have read accounts of Lake Baikal, the world's deepest body of fresh water, which is now subject to pollution from the lumber mills and cellulose plants located on its shores. Similarly, a recent U.S.S.R. Central Committee resolution concluded that significant quantities of untreated and

insufficiently treated wastes were still being discharged into the waterways of the Volga and Ural basins, and called for the construction of new waste treatment and sewage treatment facilities. Another example of Soviet interest in combating water pollution was a report from the Leningrad City Party Committee calling factory directors to task for failing to end the dumping of pollutants into the Neva River and the canals of Leningrad.

In some ways, perhaps the most discernable form, or evidence of water pollution, is the increasing scarcity of caviar within the Soviet country, and the fact that the price of caviar has increased rather substantially over the last few years.

Air pollution is a less serious problem in the U.S.S.R., except for some heavily industrialized areas, where atmospheric inversions can, as in Los Angeles, cause severe localized air pollution. In addition, the management of natural resources—minerals, timber, and land—has been recognized as an important environmental problem by the Soviet Government. Controlling urban sprawl, improving public urban transportation, and understanding the arctic and subarctic ecology are also areas of intense Soviet interest.

The U.S.-U.S.S.R. environmental agreement calls for cooperative efforts in eleven specific areas. These are: air pollution; water pollution; environmental pollution associated with agricultural production; enhancement of the urban environment; preservation of nature and the organization of national parks; marine pollution; biological and genetic consequences of environmental pollution; influence of environmental changes in climate; earthquake prediction; arctic and subarctic ecological systems; legal and administrative measures for protecting environmental quality.

Under the provisions of this agreement, the two countries will undertake bilateral programs involving the exchange of scientists, experts, and research scholars; the organization of bilateral conferences, symposia and meetings of experts; the exchange of information and research findings; and most importantly—and here is where we make a break with previous tradition—the joint planning, development and implementation of programs and projects.

Administratively, the agreement will establish a U.S.-U.S.S.R. Joint Committee on Cooperation in the Field of Environmental Protection, which will meet once a year in Washington and Moscow, alternately. Between these sessions, contact will be maintained by two coordinators—one on the Soviet side and one on the American side. It is expected that President Nixon will soon announce his choice of the individual who will lead the U.S. participation in the joint committee and who will, in turn, arrange for continuing coordination between the two governments. Once this decision is made. I expect that steps will be taken to quickly work out specific details of bilateral programs. Both countries wish to move promptly to activate action programs.

This agreement is unique not only because it marks the first time that two major countries have decided to work together on the full spectrum of environmental problems, but also because of the duration of the validity of the agreement. In the past, U.S.–U.S.S.R. bilateral environmental contacts, have usually involved only the exchanges

of scientists for fairly short periods of time. This new agreement, however, is open ended and will remain in force for 5 years; it can then be extended for successive 5-year periods unless either Government wants to end it. The agreement provides for action programs, not merely exchanges of scientists and information, although these of course, will continue to be of great value. Furthermore, it goes beyond former programs in that it will implement cooperative programs at a much higher level, and focuses on long-term problems of genuine concern to the people of both countries. Fishing in the Volga or the Potomac is not an abstract problem or a scientific question of interest to a few. It is a real and pressing concern for the people of both countries.

As a parenthetical thought, I think the agreement will also give us an unusual opportunity to weigh the relative effectiveness of legal and administrative measures to protect the environment as they are practiced by two radically different forms of government. It will be most interesting to see whether the U.S.S.R.'s mechanisms of direct state control are more or less effective than our own methods of legislative and regulatory measures. We may learn a great deal from the Soviet emphasis on long-range planning as related to environmental concerns.

I know you may be interested in how the environmental agreement was developed. It came about as a result of careful planning and private and governmental exchanges over the past few years. After the Council on Environmental Quality, working with the National Security Council, collected draft proposals from interested U.S. agencies, the White House in November, 1971, asked Chairman Train of the Council on Environmental Quality to head an interagency task force to study the possibility of a U.S.–U.S.S.R. environmental agreement.

Chairman Train met with Soviet Ambassador Dobrynin in March, 1972, to discuss the task force's suggestions for specific areas of bilateral cooperation, as well as possible forms the agreement might take. We also provided a preliminary draft agreement to Ambassador Dobrynin for his Government's consideration. In April the Soviet Union invited the United States to send a small technical delegation to Moscow to develop an agreement. In early May, a four-man team, which I had the honor of leading, went to Moscow and agreement was reached. The negotiations were conducted efficiently and successfully with no major substantive disagreements on either side.

Mr. Chairman, it is too early to judge the long-term significance of this new agreement; that will become evident as we work out specific undertakings with the Soviet Government and profit from each other's experiences. However, at the present time I think certain points are clear:

First, the agreement is a symbol of, and should contribute to, better overall relations between the two countries. In addition to the direct environmental benefits we may accrue, it may also help our trade relations since it could encourage the purchase of American environmental control technology by the Soviet Union.

Second, we stand to gain as much from the agreement as the Soviets. We are more advanced in certain areas, notably in dealing with air and water pollution, but they have made impressive progress in cold weather ecology, in urban planning, and in developing mass public transportation systems. Moreover, we will indirectly profit, as will the rest of mankind, by any advances made to cope with global en-

vironmental problems, such as marine pollution, the biological and genetic consequences of environmental pollution and the influence of environmental changes on climate.

Finally, this agreement underscores the importance that the two major powers place on environmental issues and may well encourage other countries to enter into similar arrangements with neighboring states or with states sharing comparable environmental problems.

Mr. Chairman, this concludes my prepared statement. I would be, of course, delighted to answer any questions that you might have.

Mr. SYMINGTON. Thank you very much, Dr. MacDonald, for a thoughtful and thorough statement, which will be of great help to us.

You mentioned that the benefits from this agreement would include benefits to our export situation.

Do I take it that our technology in environmental control is superior to that of the Soviet Union, and if so, in what respects?

Dr. MACDONALD. There are a number of areas where we believe that our technology has advanced to a greater degree than the technology in the Soviet Union—specifically in the area of the treatment of water pollution and in the control of atmospheric emissions from industrial plants.

The Soviets are very much interested in obtaining access to that technology. We are, of course, interested in entering into appropriate trade relationships with them. That is, we are interested in making sure that appropriate commercial arrangements can be made between the two countries.

With respect to this matter, I would like to draw your attention to article 4 of the agreement and the end of article 2. Let me read the appropriate paragraph in article 2:

> In the course of this cooperation the Parties will devote special attention to joint efforts improving existing technologies and developing new technologies which do not pollute the environment, to the introduction of these new technologies into everyday use, and to the study of their economic aspects.

This clearly underlines the interest on both sides of seeing the introduction of new technology and the employment of that technology.

Article 4 then talks to the point where the two Governments should encourage appropriate contacts between governmental and private and public organizations on both sides, and where appropriate, these private organizations entering into separate agreements and contracts. These are the provisions within this agreement that would make it possible for U.S. trade to develop in the area where we think we have very substantial advantages over the Soviets.

Mr. SYMINGTON. Do you have any anticipation of the likely magnitude of exchange of this kind?

Mr. MACDONALD. At the present time we don't. We do know that the Soviets face really massive problems, particularly in the area of water pollution. Water is a very precious resource to the Soviets, both in terms of their needs for agriculture, irrigation, water for cities, and so forth, but also for maintenance of their fishery resources. The Soviets depend upon fresh water fisheries to a far greater extent than we do as a source of protein. It's therefore in the Soviet interest to attempt to maintain a high level of water quality, and because of this I think they have a very significant interest in the technologies that we have developed here.

Mr. SYMINGTON. Which organization in the Soviet Union is responsible for environmental protection?

Dr. MACDONALD. There is no central ministry or organization with overall responsibility in the sense that we have it in this country. The discussions that I conducted were conducted with the State Committee on Science and Technology.

However, responsibility for environmental pollution control rests with the individual ministries. That is, the Ministry of Heavy Industry would have particular responsibility for the control of pollution associated with the manufacture of such heavy industry. It's a very diffuse responsibility, I would say, at the present time in the Soviet Government, and just the fact that this agreement has been concluded has focused attention within the Soviet Government of a need for bringing these diverse interests together, and we may see some moves for its reorganization within the Soviet Government.

Mr. SYMINGTON. I think the committee is curious along those lines, because you mentioned the cellulose plants and lumber mills along Lake Baikal. If those plants were in this country, they might really feel somewhat threatened by legislative and regulatory developments. One wonders what sensations run through the minds of the operators of the plants over there, and what pressures they exert to stay in business, and with whom.

Dr. MACDONALD. In theory, the pressures are exerted by the ministry responsible for, let's say paper production, and this pressure is then applied to the manager of the particular enterprise. The manager is in theory then responsible for instituting the appropriate pollution controls.

The Soviets, I think, are very much interested in how we have adopted or developed regulatory measures and monitoring, how we attack violations of our quality standards, and how we proceed in seeing to it that these water quality standards are maintained.

It's for that reason, I suspect, that they asked for, and were very much interested in, having the point on legal and administrative measures for protecting environmental quality included among the 11 points for further discussion.

Mr. SYMINGTON. I take it there is no agency or group, even informally organized, comparable to our Council on Environmental Quality.

Dr. MACDONALD. There is certainly no agency comparable to our Council on Environmental Quality, and certainly no agency similar to our Environmental Protection Agency. Their regulatory responsibilities, as I mentioned earlier, are diffused among the individual ministries with responsibility for specific industries.

Mr. SYMINGTON. The problem they have is quite different from ours in the sense that the consciousness at top government levels of the environmental problem here is fed, you might say, by underground springs of public need and frustration; whereas there, they have to make a decision from the top to begin with; and I would think that would be even more difficult for them to do, not having worked up any public resentment, or noticed any. They just have to decide at the top how to balance these conflicting interests between productivity and environment.

Were there any discussions along those lines, or were we properly diffident about bringing up something like that?

Dr. MacDonald. There was general discussion along these lines. As you know, it was considered improper to discuss pollution problems within the Soviet Union at one time. The dogma adhered to for a number of years was that the socialist system was such that pollution would be practically impossible since the individual ministries were directed to take into account all aspects of the public interest.

I believe there was a conscious decision made by the central committee to consider environmental quality as an issue that should deserve public attention and governmental attention, and it has been in just this past 2 or 3 years when greater public attention and greater governmental attention have been focused on these issues.

Mr. Symington. I would like now to defer to Mr. Frey.

Mr. Frey. Thank you, Mr. Chairman.

Welcome, Dr. MacDonald.

I think the thing that's running through the chairman's mind, and mine, is really the basic question of the environmental importance of the agreement for the United States and the Soviet Union.

Regarding the 11 specific areas, were there any particular ones that you pushed for that were left out?

Dr. MacDonald. No; all the areas that were in our initial list were agreed to by the Soviet Union. The precise form in which these were included changed during the course of the negotiations. For example, we had spelled out in detail solid waste and sewage as separate and distinguishable problems. The Soviets preferred to consider these as part of the overall urban environmental problem, looked at as a systems problem in which solid waste, sewage, and so forth, were all considered together. This seemed to us to make a great deal of sense, and in this case we went along with the Soviets.

Mr. Frey. One other thing, and since you were there maybe you can explain it. We talk about all the environmental projects that we're going to do together. But at the same time, the Soviets withdrew from the conference in Stockholm on Human Environment, and I believe some of the other countries who withdrew were Czechoslovakia and Hungary.

Could you comment on this as it reflects this particular agreement?

Secondly, maybe you could just briefly comment on the Stockholm agreement. It didn't receive the best of press over here, and yet I understand you are pretty optimistic about it.

Maybe you could talk to those two points.

Dr. MacDonald. First, we consider the U.S.-U.S.S.R. agreement and what happened at Stockholm as quite distinct and separate.

Our discussions with the Soviets with respect to a joint agreement started before their final decision was made not to participate at Stockholm. In our negotiations with the Soviets on the Joint Agreement their participation or nonparticipation in Stockholm was never raised. It did not come up in any form whatsoever.

As you know, the reason that the Soviets chose not to come to Stockholm involved the question of the participation of the German Democratic Republic in that conference—the degree of participation. We

and the Soviets differed as to the extent that the German Democratic Republic should participate in Stockholm, and as a result of that disagreement, the Soviets decided not to come to Stockholm.

Despite the fact that the U.N. conference began on this rather negative note in which a number of Eastern bloc countries did not participate, it wasn't all the Soviet bloc countries. Rumania was present and active at the conference.

We believe that the substantive accomplishments of the U.N. conference went well beyond our highest hopes. The number of areas in which we got agreement on specific recommendations to action were, I think, quite impressive. The press tended to play up the political byplay, and there was a great deal of political byplay: The decision of the Swedish Prime Minister to criticize U.S. Vietnam policies, the decision of the People's Republic of China to issue a vitriolic attack on the United States.

I think we were able to dampen these attacks and to divert the conference away from a political confrontation and into the substantive areas. I think the success of the conference was that it was in the end able to concentrate on the substantive subjects that had been prepared by the Secretary for consideration. While there was, as I say, a good deal of press coverage of the political disagreements, back in the working sessions of the committees we were able to achieve agreement in all major areas, with the exception of one or two.

Mr. FREY. Did you find over there any questions raised by some of the other countries about the United States-Soviet agreement itself? In other words, were some people worried about the fact that we were entering into this type of agreement with the Soviets?

Dr. MACDONALD. In all cases we found that countries praised the United States and the U.S.S.R. in taking this initiative and that it could be interpreted as a further step.

Mr. FREY. Even Red China?

Dr. MACDONALD. I did not have any conversations with the People's Republic of China. The arguments given were basically that this was a step taking environment out of politics, and out of the confrontation, or out of the areas of confrontation, between the two countries, that this was an area where the two countries could actively collaborate, work together and not be head to head, eyeball to eyeball worrying about political advantages or disadvantages, and it was because of this that we were praised both by our Western European friends, our African friends, and our Latin American friends for taking the steps that led to this agreement.

Mr. SYMINGTON. Would you yield on that?

Mr. FREY. Surely.

Mr. SYMINGTON. What other contributions do you know of that were made by the representatives of the People's Republic of China? Did they exhibit interest in other facets of the environmental problem?

Dr. MACDONALD. Yes. Their general statement, in addition to its attack on the United States and the U.S. policies in the capitalist system, included some positive elements. For example, they urged the conference to move ahead towards an ocean-dumping convention. They were very positive in that attitude. They also developed an argument that said that basically science and technology can solve many of the prob-

lems that we're facing today. They emphasized the role that science and technology could play in the future in dealing with some of the environmental problems.

So there was a substantive interest within the People's Republic delegation, as well as a political interest. They participated in almost all of the individual committee meetings and, even though they would occasionally sort of walk out while others—South Vietnam or Korea—would take the floor, I think this was just a matter of exercise rather than trying to disrupt the proceedings.

Mr. SYMINGTON. You said you had no conversations with them. Was that due to lack of initiative on your part, or theirs, or just simple chance?

Dr. MACDONALD. The chairman of our delegation, Mr. Train, did meet with the chaiman of the People's Republic of China's delegation. There were some conversations. These were of a general and, I would say, amicable sort. No attempt was made in these discussions to bring up disruptive political issues that the People's Republic had brought up in their formal statement.

Mr. SYMINGTON. I guess what I'm leading up to is I'm wondering if you feel that there might be arrangements with the Chinese along the lines of the agreements with Moscow at some point.

Dr. MACDONALD. We would hope that over the long term as appropriate governmental relations are established between the two countries—and, as you know, we do not have governmental relations as such today—that the area of environment would be an appropriate area for cooperation. It is certainly one where we feel that again we can learn a great deal from the Chinese experience, and one that we would welcome, at that time in which the two countries have developed a more normal relationship than exists today.

Mr. SYMINGTON. In the meantime, there could be exchanges of educators and academicians familiar with the problems.

Dr. MACDONALD. Yes. Again, we think this would be highly appropriate on an individual-to-individual basis or a private organization-to-private organization basis.

Mr. SYMINGTON. Thank you.

Mr. FREY. Do you think it would serve any useful purpose if this committee sponsored a sense of Congress resolution supporting this agreement and the other agreements?

Dr. MACDONALD. We would welcome a resolution on the part of Congress supporting the U.S.-U.S.S.R. Environmental Protection Agreement, and I think, of course, the other agreements although I'm not qualified to speak on these others. With regard to the one I'm interested in, I think it would be very helpful. We would be most appreciative of a congressional statement in support of these.

Mr. FREY. I have one last question. As you are aware, I have another meeting that I have to go to.

During the last 3 days last week we discussed all of these areas, and it became evident that there are problems, such as patents, national security problems, area of interests, et cetera.

Could you comment on any great problems that you see in the environmental area that come up, including the patent and security problems?

Dr. MacDonald. Yes. I think these are questions that will raise difficulties. When we speak of providing technologies to the Soviet Union there will be questions about patents: How that technology is to be provided, what commercial arrangements are to be made, what arrangements between specific industries and the Soviet Government would be appropriate.

In the area of security, I might just mention the fact that for the first time the two countries have agreed to work on arctic and subarctic ecological systems. In the past the Soviets have not been enthusiastic about working in this area, which in part was interpreted as a concern on their part with regard to security matters.

The agreement specifically states that we will be working together on arctic and subarctic ecological systems. Basically my answer is I don't see any of the areas coming in, in a major way, into the security area.

Mr. Frey. That was the question I was going to ask you.

Do you think in your area that it might be a little bit easier than in a couple of these other areas, especially the technology area where there's so much overlap?

Dr. MacDonald. Yes. I think that this is again one of the reasons we feel that the environment is an area in which the two countries can work together on action programs without impinging on potential security problems.

Mr. Frey. One of the things I think that both the chairman and I feel, after these meetings, is that it's going to be extremely important that in each of these areas we start on something positive that is not too controversial, and then take the tougher ones later. If we get into problems initially, I think you're going to find the sentiment which does exist against this type of agreement—I think it exists in the Congress—will find a place to coalesce, and we could have some real problems down the line.

So I would hope too in your area, although there appears to be little chance of this, that we do something positive, and as soon as we can.

Dr. MacDonald. I couldn't agree with you more, Congressman Frey. I think it's extremely important that we get some action programs underway very quickly.

I would suspect, for example, that in the area of earthquake prediction we might have a joint program underway within the next 2 or 3 months. If it would be possible to exchange information in this area, both in the Soviet Union and the United States, in a very short period of time, this would demonstrate that this agreement is much more than a piece of paper. It's something that can readily lead to action. It's certainly our attempt.

Mr. Frey. Thank you. I appreciate your answers to my questions.

Mr. Symington. I haven't seen it myself, but there was a New York Times dispatch on the Stockholm Conference, which indicated that the research and development recommendations of the conference were excluded from the arrangements entered into.

Does that have a familiar ring with you or not?

Perhaps if I can get hold of that. It did mention the Stockholm Conference.

Dr. MacDonald. I must say I'm not familiar in detail with all of the hundred or so recommendations, but I recall in several areas that

provisions were made not only for continued research, but for the dissemination of the research information collected by the cooperating countries, so I'm somewhat taken aback by that report.

Mr. SYMINGTON. I have not seen it. We will try to find it and perhaps get it to you for further comment.

Dr. MACDONALD. I would be delighted to submit something for the record on it.

Mr. SYMINGTON. Getting back to trade opportunities again, when you mentioned U.S. trade opportunities that may be opened up by environmental agreements with Moscow, did you have in mind actual hardware and hardware systems?

Dr. MACDONALD. Yes; for example, some of our electrostatic precipitators designed to control the emission of particulate matter is a potential candidate. Certainly some of our advanced water treatment facilities, actual hardware, as being another candidate. Some of the developments in desulfurization are still another candidate.

I think there are a great number of opportunities of specific hardware items where the Soviets would have an industry and a part in these, and in which specific trade arrangements could be entered into.

Mr. SYMINGTON. These would be substantial financial investments on their part.

Dr. MACDONALD. That's right.

Mr. SYMINGTON. This would require them to secure dollars in some fashion I suspect. I wonder how?

Dr. MACDONALD. I think this is, of course, a question where the environmental technology issue cannot be separated from the overall trade issues that the two countries face. The Soviets do face some problems with respect to obtaining hard currency, and capital.

But again, we feel it's an opportunity for American business in an area in which American business has made very important contributions.

Mr. SYMINGTON. If the President wishes to put the full force of his administration behind the implementation of these agreements, it's clearly indicated that he will have to move for some relaxation of controls of various kinds, and also encourage it, or at least give the Soviet Union the opportunity to show their wares in the best possible light here so they can develop a hard currency capability.

Dr. MACDONALD. Yes; and as you perhaps know, the Soviets are participating in the Seattle Trade Exhibit this year and are presenting to the Western World, or at least to the United States, a representative sample of what they have to offer in terms of heavy industry, and this is an area in which they have certainly made very substantial advances.

Mr. SYMINGTON. The Joint Committee on Cooperation, on our side, how do you expect this to be structured?

Dr. MACDONALD. I would expect it to include representatives, covering the 11 areas, preferably certainly at the policy level. For example, the Environmental Protection Agency would certainly be represented on the committee, as would be the Agriculture Department, the Department of Housing and Urban Development, HEW, the Department of Commerce, through its interest in earthquake prediction and other problems, the National Science Foundation, and the Department of State, and perhaps even the Department of Justice in

the sense that we will be picking up with the Soviets on some of these legal questions.

But it will be structured on the basis of participation by the interested agencies and hopefully participation at quite a high level from those agencies.

Mr. SYMINGTON. In the discussions in Moscow, inasmuch as the Stockholm conference was looming, was there any discussion concerning the hopes and aspirations of the Stockholm Conference and the international aspects of this effort?

Dr. MACDONALD. The discussions in Moscow were carried out, I think, in a very workmanlike fashion. At no time was any political issue raised. Neither the participation of East Germany in Stockholm nor the issue of Vietnam, nor any of the other devisive issues between our two countries, was mentioned, either at the formal negotiating sessions or at any informal contacts we had with members of the delegation.

Mr. SYMINGTON. What I'm asking is: Was it possible to discuss the more positive implications of the Stockholm Conference? Did that occur?

Dr. MACDONALD. We did touch on a number of questions that obviously would flow from the Stockholm Conference, marine pollution being an excellent example of that. The Soviets have had during the time they participated in the preparation for the Stockholm Conference, an interest in the whole question of prevention of marine pollution. They continued with that interest, and this was discussed.

But the specific issue as to Soviet participation in the Stockholm Conference, the reasons for the fact that they were not participating, never came up.

Mr. SYMINGTON. One issue at Stockholm was the rich versus the poor nations and their divergent approaches to the need for environmental controls as distinct from the need for development, and the question of compensation for the additional costs involved by the developing countries in pollution control efforts.

What was the resolution, if any, of these conflicting approaches to the issue?

Dr. MACDONALD. This was perhaps one of the most difficult issues that faced the Stockholm Conference. As you know, the conference was organized along six subject areas. One of the six subject areas was the area of development and environment.

I was responsible for this area on the U.S. side. The Secretary had prepared a series of recommendations, one of which involved the notion of compensation. Basically the notion of compensation is that if a developed country imposes certain environmental standards that put a developing country at a disadvantage in terms of its exports, the developed country should compensate the developing country for these higher standards.

We feel, and took the position, that environment is just one of the many factors that influence international trade. Differing labor standards, differing consumer tastes, differing developments and technology all have an influence on exports, imports and how they enter into international trade, so that we could not go along with the notion of compensation. For example, let's say a nation such as Brazil develops an automobile industry, and it develops automobiles that do not have

emission controls. Under the resolution that was adopted, they could export those automobiles to the United States. Either we would have to accept them or pay them for installation of the appropriate emission control devices.

We felt that this runs counter to all basic principles of international trade. We asserted that we would live up to all of our contractual obligations, including our obligations under article 21 of GATT, which deals with some of these issues, but that we could not accept the notion of compensation.

Mr. SYMINGTON. You say the resolution was adopted?

Dr. MACDONALD. The resolution was adopted. The United States made a statement, reserving its position on that resolution. It's a clear statement, saying that we do not wish to enter into further negotiations, whether they are multilateral or bilateral, with other countries taking the point of view that we have adopted the notion of compensation. We have not.

Mr. SYMINGTON. Were there any developed countries which did?

Dr. MACDONALD. I don't have a detailed record of the actual voting on some of these issues. There were a number of countries, developed countries, that sided with us, Switzerland and others, but then there were countries that abstained. I would say that most of the industrialized countries, members of OECD abstained, rather than taking a negative position. In the final vote it was a typical vote on U.S. amendments to the proposed Secretariat Doctorate. It would run something like 46 to 8 or 10, where the United States was one of the 8 or 10.

Mr. SYMINGTON. The precise effect of all of these resolutions is simply to convey a sense of the Stockholm Conference.

Dr. MACDONALD. That's right.

Mr. SYMINGTON. It's not binding on any nation, so you wonder why they would want to abstain. It's not binding anyway, so they might as well put themselves on record as to what they think. It's silly to go all the way to Stockholm and not express yourself on a subject of such importance, isn't it?

Dr. MACDONALD. That's precisely the point of view we took. We felt it very important to place the United States' position on the record so that it could not be thrown back to us in any future negotiations.

As you know, the whole report of the Stockholm Conference will go to the General Assembly this coming fall. The issue of compensation may be raised once again. We would hope that between now and then we can convince some of our major trading partners in the developed world to take a more positive attitude toward that issue than they took at Stockholm.

Mr. SYMINGTON. In the Moscow Conference did Andre Sakharov make his appearance?

Dr. MACDONALD. No, sir.

Mr. SYMINGTON. Was he referred to?

Dr. MACDONALD. He was never mentioned.

Mr. SYMINGTON. He, as you know, wrote a book on progress and peaceful coexistence in which he predicted rather solemnly that in 30 or 40 years the Soviet Union and the United States could poison each other peacefully with no hostile intent through emissions into the biosphere.

We've questioned various scientists on previous panels, and I felt although they were not prepared to accept a date for the finality of this mutual extinction program, nevertheless they said that there was some validity in the thinking that went into the prediction.

What I am wondering is, was there any discussion as to what things we were doing which the Soviets considered most dangerous to the world's environment, and vice versa? Did we have any ideas about what they might be doing, say with respect to the rivers flowing into the Arctic Zone?

Dr. MacDonald. There was a great deal of discussion, of course, about the whole question of what worldwide climatic changes might be brought about as a result of any large-scale program of river diversion. The Soviets do have under consideration such a large-scale program, and that is one of the reasons that influence on environmental changes on climate was one of the items specifically set out. There were other subitems under that, but one of the major items was what would happen to the climate if there were a diversion of the rivers.

We also had under consideration what effect do cities themselves have on the local climate, and under that heading a general consideration of what the effect of supersonic vehicles traveling in the stratosphere might have on climatic changes.

So it's an attempt to look at the actions taken on both sides on the international environment, and that was certainly the emphasis and the point of that particular area of agreement.

Mr. Symington. We have expressions of hope from the committee that there will be a mutuality of advantage here, and I'm speaking from the paper of one of my colleagues who is looking for the two-way street approach. You do mention in your paper a number of areas, such as studies of the cold water zones, where the Soviet Union is ahead of us, and you also mention urban planning and you say they're ahead of us there. That's an interesting thought.

How are they ahead of us there?

Dr. MacDonald. The Soviets have had a great deal of experience in the development of new cities. As you know, they have had a program of urbanization, building of new cities in the eastern part of their country. In this program they have developed rather advanced techniques of attempting to integrate overall urban services and systems; for example, their integration of sewage-solid waste, as well as taking into account public transportation. Their system of government, of course, is such that it lends itself far more readily to that kind of planning than does ours.

However, we feel that by examination of what successes and failures they're had we can learn a great deal. As you know, we have before the Congress proposals with regard to land use planning. I think the experience gained by the Soviets could help us in the implementation of some of these proposals with regard to land use planning programs.

Mr. Symington. Dr. MacDonald, we thank you very much for your testimony.

If there are no further questions, we want to express again our gratitude to you for coming and being with us today.

I'm sure we will think of further inquiries, which we may submit in writing, but for the time being, again thank you for a very fine appearance here today.

Dr. MACDONALD. Thank you, Mr. Chairman. It was a great pleasure. Thank you, Congressman Frey.

Mr. SYMINGTON. Now we will hear from our second witness today, Dr. Thomas F. Malone, dean of the Graduate School, University of Connecticut.

Dr. Malone is well known to our members. He served for many years on this committee's panel on Science and Technology. In that capacity he meets with the Science and Astronautics Committee in January of each year, together with the other distinguished members of the panel.

We're delighted to welcome you back on this occasion, Dr. Malone, and very much look forward to your testimony on the Environmental Protection Agreement and the Stockholm Conference.

(The biographical sketch of Dr. Malone follows:)

THOMAS F. MALONE

Dr. Thomas F. Malone, Dean of Graduate School, University of Connecticut, was born in Sioux City, Iowa, 1917. He was graduated in 1940 with a degree in general engineering from the South Dakota State School of Mines and Technology. In 1962, Dr. Malone received an honorary Doctor of Engineering degree from the South Dakota State School of Mines and Technology and in 1965, he received an honorary Doctor of Humane Letters degree from St. Joseph College. Married Rosalie A. Doran, December 30, 1942; children—John Harold, Thomas Francis, Mary Ellen, James Kevill, Richard Kevin, Dennis Patrick.

Upon completion of his engineering studies, Dr. Malone began his formal training in meteorology in the Graduate School of the Massachusetts Institute of Technology, where he received the degree of Doctor of Science in meterology in 1946. In 1941, he was appointed to the staff in the Department of Meteorology at M.I.T. and was promoted to assistant professor in 1943 and associate professor in 1951.

Between 1942 and 1945, Dr. Malone assisted in the training of groups of Air Force and Navy officers to be forecasters with the armed services. He was appointed a special consultant to the Air Weather Service in 1945 and served a tour of duty in North Africa where he gave lectures to Air Weather Service officers. In 1949, he was appointed editor to the Compendium of Meteorology, a thirteen hundred page volume devoted to an appraisal of scientific progress in meteorology.

In 1954, Dr. Malone was appointed Director of The Travelers Weather Service and the Travelers Weather Research Center for The Travelers Insurance Company. In 1956, he was named Director of Research; in 1964, was appointed Second Vice President; in 1966, he was appointed Vice President and Director of Research, and in 1968, was promoted to Senior Vice President and Director of Research. In 1971, went to University of Connecticut.

Dr. Malone is Past President of the American Geophysical Union and Past President of the American Meteorological Society. He was elected Secretary for International Participation for the American Geophysical Union in 1964. In October 1967, he was elected a Bureau Member of the International Union of Geodesy and Geophysics. He served as Chairman of the U.S. National Commission for UNESCO during 1965–1967; he served as Chairman of the Committee on Atmospheric Sciences of the National Academy of Sciences from 1962–1968, the American Association for the Advancement of Science, the American Geophysical Union and the American Meteorological Society. Dr. Malone is a member of the Econometric Society.

Fields: Applied meteorology, synoptic climatology, science, and public policy.

STATEMENT OF DR. THOMAS F. MALONE, DEAN, THE GRADUATE SCHOOL, UNIVERSITY OF CONNECTICUT

Dr. MALONE. Thank you, Mr. Chairman. May I say it's a pleasure to make my appearance before your committee and before you and Mr. Frey?

I do tender my apologies for not having a prepared statement, because I haven't been home since receiving your letter.

I thought that, with your permission, I would structure my formal remarks around four points, primarily related to the role of the private or nongovernmental sector in complementing the official actions of the kind that you are discussing here.

Let me say at the outset that I think this agreement is to be hailed as momentous; and secondly, I would contrast the relaxed attitude with which this important commitment has been reached to the circumspection that attended the first bilateral agreement between the Soviet Union and the United States in this area.

I have reference to the Meteorological Satellite Agreement, which is now known as the Dryden-Blagonravov Meeting. It was my privilege to attend those discussions in Rome in February of 1963, and I remember with what caution we talked with our Soviet counterparts. Over the intervening years the contacts have been built up so that there is almost a feeling of cordiality. At least there's a much greater trust and willingness to be free and relaxed in discussing these matters now. I think this is important, because it presages well for the future.

More recently, I would speak of the Dartmouth conference, which was one of the privately sponsored conversations that led to the official agreement between the governments. As you know, the Dartmouth conferences take their name from a meeting held at Dartmouth College in 1959, in which a small group of scientists, economists, and international relations people from the United States and the Soviet Union in the private sector met and discussed problems of mutual interest.

The sixth of these conferences was held in Kiev in July of 1971, and I was privileged to participate in that particular conference. It was a week-long meeting, addressed to three topics: (1) the environment, (2) trade, and (3) improving and strengthening the United Nations. It was led by David Rockefeller and Gen. James Gavin.

The environmental issue was one in which we found very quickly wide areas of agreement. A paper was prepared by academician Fedorov on their side and one by myself on the United States' side.

Fedorov's paper, I think, was important for six reasons:

First, he acknowledged—and this was the first time I had heard this recognition publicly stated—that the population problem was a real one and that ultimately there would have to be a regulation of world population.

He set down the four conditions for resolving what we agreed was an environmental crisis, that had a time dimension, not of years, or centuries, but of decades: First of all, that there be a common goal among nations; second, that there be a mechanism for planning to attain those goals and for carrying out their implementation; third, that there be the rather substantial material support to do the things which need to be done; and fourth, that these activities were incompatible with major world conflict.

Then the last thing he said, which I thought was significant, was that he felt that these conditions can be met in a society consisting of countries with varying social systems. This is a coexistence argument, if you will. He would prefer that things would be done best under a socialistic regime; however, he was quite willing to accept the fact that the entire world is not going to be that way.

If you would like, I would be happy to send for the record a copy of his remarks.

Mr. SYMINGTON. Yes, I would very much like that.

Dr. MALONE. Along with a copy of my own remarks, and the agreement which was reached that bore on environmental issues.

Mr. SYMINGTON. All three will be placed in the record.

(Information for the record follows:)

THE INTERACTION OF MAN AND THE ENVIRONMENT

THE SITUATION TODAY AND OUTLOOK FOR THE FUTURE

E. K. FEDOROV

The dimensions and the mass of the Earth create a limit for an optimum human population, but this limit cannot be determined now. The capacity of the Earth to support human life is of variable magnitude, depending on the use of living space, the use of resources . . . and man's ability to avoid war. This assessment of the Interaction of Man and the Natural Environment has been adapted by Academician Fedorov and the Bulletin from his address to the 1971 Dartmouth VI Conference in Kiev, USSR. The author is Chief of the Hydrometeorological Service of the USSR.

Public alarm has been aroused in many countries over the interaction of society and the natural environment. Scientists and prominent public figures have voiced the thought that technologically advanced society is destroying the very environment in which it exists and from which it draws the resources it requires. The problem has been the subject of numerous conferences and meetings, all the way up to the level of the U.N. General Assembly.

Every form of life interacts with its environment, is influenced by it and adapts to it in the course of biological evolution. It uses the resources of the environment for its existence, and the products and results of its life activity alter the environment. The emergence of human society changed the nature of this interaction between the life processes and the environment.

We know the immense part played by life processes in making our planet what it is now, especially its atmosphere, its water cover and the upper strata of its crust. We marvel at the great variety of life forms that evolution has produced over hundreds of millions of years and the adaptability of these forms to different, sometimes extreme, environmental conditions. Yet each species of flora or fauna exists only in a relatively narrow range of conditions, using the environmental resources and influencing the environment in one and the same definite and invariable manner according to its nature.

Man's appearance on the scene introduced a fundamental difference. With practically no change in man's biological nature, human society has constantly and at an ever increasing rate altered the manner of man's interaction with the environment. Man has broadened the range of conditions in which he exists, as well as extended the number of natural resources and the amount of them that he uses, vastly increasing society's impact on the natural environment.

These changes are apparent not over periods of millions of years, but in a span of centuries, and in recent times in decades. From Antiquity to the 16th and 17th centuries, low rates of growth of the productive forces and population accounted for relative stability in the interaction between man and his environment. Man used only a very small number of natural resources and only a small amount of each, and used them with low efficiency. His impact on the globe's environment as a whole was insignificant.

The situation changed sharply in the 16th and 17th centuries. The development of productive forces took on momentum. Exploitation of natural resources for profit arose, and rapaciousness toward nature spread quickly, especially with regard to the manpower and resources of colonial and dependent countries and those resources that "belonged to no one," such as the world oceans. As a result, the biosphere suffered the first considerable regional-scale damage. Some animal and plant species were exterminated, soil was exhausted and erosion set in.

This could not pass unnoticed. In the 18th century Malthus advanced his thesis that was to become so widespread concerning the discrepancy between unlimited population growth and limited and increasingly depleted natural resources, with the inevitable consequences of starvation and other calamities.

In the first half of our century, the question of chief concern was whether there were sufficient reserves of mineral resources, particularly oil; more recently, various forms of man's effect upon the natural environment, especially pollution, have roused the most alarm. Fears are expressed that the very surface of the globe will not accommodate the rapidly increasing population of the world, whose inhibited area extends over the land surface of the entire planet.

Many contemporary observers assert that the combination of the earth's finite resources and unrestricted growth of mankind's requirements will set a limit upon society's future development and is already, in fact, the chief cause of low living standards in the developing countries where population growth has not been accompanied by correspondingly rapid economic growth. In the view of these observers, the "population explosion" which we are witnessing poses one of the greatest dangers to mankind. As Lord Ritchie-Calder has stated ("Foreign Affairs," 1970):

"Always and everywhere we come back to the problem of population . . . It is appalling to hear people . . . talking about the population explosion as though it belonged to the future, or world hunger as though it were threatening, when hundreds of millions can testify that it is already here . . ."

Actually, however, all history shows that the increase in the possibility in principle of providing for mankind's needs has always outstripped and continues to outstrip the growth of those needs. This is true if one considers the requirements of the total world population as a whole and the possibilities of meeting these requirements with all the resources at man's disposal. For instance, the power that could be obtained per capita by existing means and from available resources is now approximately 20 times as much as the power that could be generated per capita 100 years ago with all the resources then known.

If modern farming methods which have already been applied successfully in many countries were applied on a global scale, we could completely meet the food requirements not only of the earth's present population but of a much larger population.

The prospected deposits of major mineral resources have increased steadily, both in absolute figures and per capita, while we have developed the ability to produce many substances from a great variety of available raw materials.

The fact that the needs of the majority of the earth's population are not being met when the possibilities to do so exist, that in many countries people are starving, or that in some developing countries population growth is outstripping economic growth—these facts are not by any means due to any natural law or shortage of natural resources.

This state of affairs has perfectly clear social-economic causes. In the developing countries, in particular, it has been brought about by prolonged colonial exploitation, during which these countries' natural wealth and manpower were used in the interests of colonialists. Although some developing countries are understandably resorting to family regulation in order to raise living standards, there can hardly be any doubt that the basic means of raising the standard of living is to increase the rate of economic development.

Back at the beginning of the century, V. I. Lenin put his finger on the fundamental error in all the talk of limited natural resources. In contending with the Malthusians of his day, he pointed out that the so-called "law of diminishing soil fertility" has only very relative and conditional application in instances in which technology remains constant, and is utterly inapplicable in cases in which technology advances and the production methods improve. This is the crux of the matter. Improvement in the mode of production (in the broadest sense of the term) increases the efficiency of utilization of nature as a whole, thus making it possible to outpace society's needs.

If it were not for this, limits to mankind's development would have arisen long ago. Even a much smaller population than today's could not survive by hunting, as did our distant ancestors.

HOW MANY PEOPLE?

Such limitations arise from time to time for animals or plants that improve their modes of interaction with the environment—their "modes of adaptation"—only by changing their biological nature extremely slowly. When a species multiplies beyond the optimal number in a given habitat, the environmental balance is upset and the final result is extinction of the surplus population, whereas the amount of earth's natural resources has not erected a barrier to man's development either in the past or now.

Nonetheless, no matter how efficiently we utilize the resources of our earth, its finite dimensions and mass set definite limits on the optimal population. I believe that we cannot determine those limits now. The "capacity" of our planet is a variable, constantly expanding in accordance with the methods of using its space and resources—depending, for instance, on whether people will find it expedient to live not merely on land, but on or in the ocean, underground, etc. The earth's capacity cannot, however, increase indefinitely. Therefore, we must assume that in the distant future it may become necessary to regulate the earth's population. We know that the rate of population growth is closely related to social and economic conditions, and there are no grounds for believing unchecked propagation to be a fundamental aim or basic property of the human race. We may, incidentally, face the problem of regulating not only society's numbers, but its qualitative composition, since advances in biology may enable us to give people definite traits of behavior or character. It is conceivable that regulation will be needed not to restrict population, but to increase it.

Finally, a definite optimum population on earth does not necessarily mean that the total number of mankind need be restricted. In all probability, long before we reach earth's optimum, it will become possible to construct large inhabited bodies in outer space or to use other planets for habitation.

We are already encountering the problem of natural resources now, long before their total amount could begin to retard society's development, because the potential sufficiency of natural resources for mankind's needs can be realized in practice only by optimal utilization of the entire wealth of the planet as a whole, and here we encounter serious hindrances.

Not optimal, but outright rapacious utilization occurs because of private ownership of natural resources and of the means of their exploitation, particularly when a foreign company exploits a country's resources. Hence, the nationalization of resources that is going on nowadays, especially their transfer to the ownership of a society that has a clear-cut goal and a long-range program for the society's development, has great positive significance not only politically, but for the protection of the earth's natural riches and their efficient utilization for the benefit of mankind as a whole.

Another very serious reason for inefficient utilization of natural resources is the fact that technologically lagging countries, holding the greater part of the world's population, lack the necessary equipment, capital and qualified specialists.

Many kinds of natural resources, such as the fish and minerals in the ocean, are now exploited on a global scale beyond the bounds of individual countries; yet there is no social-political machinery to ensure the use of these resources in such a manner as would be desirable and optimal from the viewpoint of all mankind. Indeed, such a "common viewpoint" of all mankind does not exist, nor can it be worked out as yet.

These circumstances stand in the way of optimal exploitation of our planet's natural resources. To an even greater extent they block the cultivation and modification of resources.

The task of cultivation applies chiefly to regenerative resources and relates closely to influence on the natural environment.

We now utilize almost every type of regenerative natural resource. The amount of the replenishment that we use ranges from less than 10 per cent to about 70 per cent. We use about 10 per cent of river flow, about 50 per cent of the forest growth, an insignificant part of marine biological resources, but a very substantial part—about 70 per cent—of the fish spawned, and we till approximately 70 per cent of all the land that is arable by present farming methods.

Man's requirements of regenerative natural resources are constantly increasing. The means of obtaining them from nature are becoming more and more efficient, the utilization of the extracted resources too is becoming more and more efficient, and all in all we are approaching the point at which we shall be using the total replenishment of each of these resources.

REVERSING RIVERS

Thereafter, as experience already has shown, either utilization must be curtailed, as has been the case with whales, or an equilibrium must be established between the replenishment and the utilization (some countries have achieved such an equilibrium with respect to forests), or we must turn to the cultivation of resources.

We are now experiencing a shortage of fresh water in some parts of the Soviet Union, despite the fact that our country has very large total water resources. The trouble is that most of our rivers flow through sparsely populated regions and empty into the Arctic Ocean. As a result, we must carefully plan the use of water resources and modify these resources in the interests of economic development. Plans have been drafted recently for an even more radical restructuring of the river system, first in the European part of the country and in the future in Siberia. The basic idea is to reverse part of the rivers which run north. Diverting the flow southward will enable us to improve the irrigation of vast arid lands and to increase the water supply of the Caspian and Aral Seas, which is a very important factor for many economic projects.

We are engaged in analogous cultivation and modifications of soil, forests and other natural resources.

Other countries are also taking such measures. At present these are mostly local programs, carried out within the framework of separate states, but regional programs are already being undertaken, such as the management of rivers flowing through several countries. Action on a global scale will be required in the near future.

The cultivation and modification of natural resources on a global scale are already feasible from a scientific and technical standpoint. We could, for instance, begin large-scale experimental work in the breeding of ocean fish. As everyone realizes, however, the existing social and political circumstances stand in the way.

RISING POLLUTION

The utilization of the regenerative natural resources and the activity of society as a whole increasingly affect the environment. We are changing its composition or, more precisely, the balance formed in the natural cycling of various substances. This change is effected by removing part of the substances from the natural cycle and, to an even greater extent, releasing added substances, chiefly pollutants from industrial enterprise, into the atmosphere and water. Air and water pollution is rightly regarded now as one of the major problems confronting mankind.

The pollution of rivers, lakes and reservoirs is a matter of the greatest concern. It has been going on for several hundred years. At first, industrial effluents did not play a big part in the natural balance. Pollution was local in character and was remedied by dilution of the effluents in pure water, but in the past century it became necessary to limit the discharge of pollutants.

For several decades such limitation met the requirements for keeping the rivers and lakes generally clean, since dilution served to eliminate the pollution within a comparatively short stretch of running water. Now the situation has changed radically. Industry discharges pollutants into rivers and lakes in amounts many hundreds and thousands of times greater than the natural concentration of the various components of pure water. We can no longer count on dilution to purify. For in a few decades from now it would require almost the entire flow of all the rivers on the Earth to dilute the amounts of pollutants that can be expected as a result of industrial expansion. It is obvious that major changes will be required in the technology of production and purification—a shift to closed technological cycles, recycling of water in industrial use and other similar measures, all technically feasible. In all countries, however, the regearing of industry will call for huge capital investments.

Although our country has relatively less water pollution than other developed countries and although we still have large untouched reserves of surface water, we are planning major measures for the purifying of effluents and for reorganizing the technology of production.

Nowadays new Soviet industrial enterprises are not opened without quite elaborate purification installations. For example, in erecting mills at Lake Baikal, which has been a subject of great concern to public opinion in the Soviet Union and other countries, we have planned and built very large and uniquely effective purification installations.

In our times water pollution is changing from a national to an international problem, particularly where rivers traverse several countries. It is even assuming global dimensions, since the seas and oceans are becoming seriously contaminated.

A similar situation is developing in the atmosphere. Serious local air pollution has been registered in many cities and industrial areas. There is no need to mention examples. They are common knowledge. Many of the cities of our country suffer air pollution, although not to the same extent as cities in the United States and other industrial nations. We have long planned industrial construction in such a way that the discharge into the atmosphere would not harm adjacent residential areas. We know that under some circumstances pollutants accumulate in the lower level of the atmosphere and at such times have a more harmful effect. Now we are embarking upon systematic regulation to reduce or prevent discharge into the atmosphere under unfavorable meteorological conditions.

If air pollution continues to increase at the present rate, the problem will confront us on a global scale in a few decades. Air and water pollution by industry has already reached tremendous proportions, is growing rapidly and, indeed, constitutes a serious threat to the welfare of mankind. Yet our present scientific knowledge and technological advances enable us to eliminate it, if only we use good will and make heavy investments for that purpose.

POLLUTION OF WAR

We should not forget that some of the present pollution of the environment is war-related. Military preparations have involved frequent accidents polluting the environment through nuclear weapons tests, the loss of nuclear bombs and leakage of toxic agents. Military operations have caused much greater damage. According to a committee of authoritative American scientists, the chemical agents employed by the U.S. army in Indochina have destroyed as much as 25 percent of the foliage of South Vietnam. Many civilians have suffered and hundreds have died from the effects of chemical warfare in Indochina. The results far exceed all the damage that industrial pollution could accomplish.

We are fully aware of the staggering effect that radioactive substances would have upon the environment and on all mankind if a thermonuclear world conflict were to occur.

Change in the planet's thermal balance is extremely important. Any industrial activity is accompanied by the emission of heat. At present the heat emitted by industry comes to approximately 0.01 per cent of the thermal energy that reaches the earth's surface from the sun; but if the amount of power used by man continues to grow at the same rate as in recent decades, it will add one percent or several per cent to the thermal balance that has formed on Earth in the course of centuries.

CHANGE IN ALDEBO

The thermal balance is also affected by change in the aldebo (reflective properties) of the earth's surface caused by urban growth, farming, irrigation, etc. The atmosphere is becoming darker because of dust suspended in it, because of changes in its chemical composition brought about by industrial discharge and products of combustion, mostly carbon dioxide, and finally because of the formation of manmade clouds, such as those from airplane exhaust fumes. These factors operate in quite complicated fashion, sometimes in contradictory ways, but the aggregate effect is to facilitate an increase in the temperature of the earth's surface and atmosphere. The temperature may rise several degrees centigrade in 50 to 100 years.

In principle, it is possible to prevent such "overheating," but it would require very large-scale concerted efforts on a global scale.

Changes in the moisture cycle constitute another form of interference with nature. Aside from the removal of part of the water from the cycle in order to produce man-made chemicals, we must reckon with the fact that industrial and agricultural development results in a redistribution of water resources, reducing the discharge of water into the oceans and increasing the evaporation from the continents. We can expect that irrigation and industry in the next century will require about 50 per cent of the present run-off of river water. How the increasing evaporation will affect the planet's moisture cycle is still unclear. We can expect more precipitation. The increased cloudiness also will affect the climate.

The total volume of fresh water in the hydrological cycle will increase in the future when, in addition to using river water, we shall have to tap much more ground water and then, depending upon progress in harnessing the thermonuclear power, go on to the desalination of large amounts of sea water.

Thus far we have spoken of the direct effects of man's activities on the environment, but we know that many extraordinarily complex and interrelated processes determining the state of the environment sometimes become unstable. Consider weather and climate. We are well aware that cloud systems become unstable. In spite of the tremendous forces involved in related processes, the direction of their development can be changed by relatively small forces. This fact underlies the methods employed in the Soviet Union to suppress hail and to disperse clouds as well as the attempts conducted by scientists of various countries to increase rain.

A WORD ON CLIMATE

The question of the unity and stability of climate is of great interest. The history of the Earth indicates that its climate has changed repeatedly and radically. There are many hypotheses to explain the changes in climate. It may be assumed that in the remote past they were brought about by changes in the direction of the axis of the earth's rotation, in the position of continents and oceans, and in other structural features of the planet. But the substantial climatic changes in the course of the past 10,000 years cannot be explained by these factors. Consequently the climate may be very different even when the structure of the planet remains constant, i.e., the totality of climate-forming processes in the atmosphere and ocean may assume not just one but several different states of relative equilibrium.

Research shows, however, that this equilibrium can sometimes be upset. (One of the trigger mechanisms may be the ice cap of the Arctic.) This has both positive and negative aspects—positive in so far as it allows us to hope to effect deliberate and purposeful changes in the climate by relatively modest means; negative in that such changes may come about independently of our will.

There is, thus, an indisputable need of careful study, prognosis and regulation of man's impact on nature. That this impact, both unintentional and purposeful, will grow is unavoidable.

We try to conserve nature, and we should of course maintain preserves in various geographical zones for recreation, tourism, etc. But the time will come to tolerate the continued existence of swamps, tundra, salt marshes and deserts over many million square miles of our planet. We must strive toward and prepare for not the conservation and stabilization of the environment, but deliberate and purposeful adaptation and cultivation of nature for mankind's constantly growing needs.

IS SCIENCE READY?

If technology will have to cope with such tasks in a few decades, science should be studying them right now, at least on the theoretical plane. Is science ready for this?

Scientists are working out the theory of interaction of all the atmospheric and oceanic global processes determining the climate and weather throughout the world. Until recently these researches were hampered by lack of sufficient data about the initial state of the environment, not to mention the tremendous volume of calculations required. Now it is evident that weather satellites and other systems for gathering global data, plus modern high-speed computers, will enable us to overcome these handicaps. At any rate, scientists in various countries are already working at the task. The World Meteorological Organization has launched an extensive program of study of global processes in the atmosphere. We can hope that in a few decades we shall obtain means of calculating the environment's equilibrium and its response to various influences.

The situation is not as good, in my opinion, in the study of processes in the biosphere. Here we are still very far from being able to calculate the laws of natural processes and to measure the effects of interference. Yet man needs such calculations of the environment's "sturdiness" and response before undertaking large-scale efforts to modify and cultivate nature, just as he has needed calculations of the resistance of materials and the strength of structural elements before setting out to build edifices or structures. There is no doubt, however, that he will meet this challenge, too, and in ample time. National and international scientific organizations are already focusing their attention on the subject.

There is another matter, nevertheless, that is cause for urgent concern.

I think that the entire problem under consideration should be treated somewhat more broadly. Man has now achieved the possibility of acting on a really large scale. His power systems control a huge flow of electricity, modern mass production can turn out a great quantity of any goods in a short time, and we all know what havoc a world thermonuclear conflict would wreak.

THE GREATEST DANGER

The heightened capacity for actions on a massive scale should, in general, be accompanied by a heightened guarantee of their wisdom and safety. In technology, we see to increased expediency and safety of operation as the scale of operation increases; we do so for any machinery within the framework of entire factories and industrial complexes. Socialist countries, which plan their economy, do so on a nationwide scale. But human society as a whole does not do so. I consider this the chief danger to the development of society.

Here I would like to quote an important statement from a report by the former U.N. Secretary-General U Thant, on "Problems of the Human Environment" (1969):

"The deterioration of the human environment may thus be related to three basic causes: accelerated population growth, increased urbanization, and an expanded and efficient new technology, with their associated increase in demands for space, food and natural resources. None of these need be damaging to the environment. However, the efforts to accommodate population, to integrate technology into complex environments, to plan and control industrialization and urbanization, and to properly manage land and resources, have fallen far short of those required. In consequence, all nations of the world face dangers which in some fields and in some areas have already achieved critical proportions."

That is the former U.N. Secretary-General's view. Now let us recall a principle formulated more than 100 years ago by Karl Marx. "If culture develops spontaneously and is not consciously directed, it leaves a wasteland behind it," he wrote in one of his letters. It is hard to find a more accurate and concise summation of the problem before us.

Whether the world will be turned into a wasteland depends upon the timely evolvement of social machinery to ensure the harmonious development of society in interaction with nature on a global scale.

Are we able to tell how much time society has within which to achieve unity in its interaction with nature? I think we are. We shall have to achieve it somewhat before the use of regenerative natural resources approaches the limit of their replenishment and before some factors of society's impact on nature have a pronounced effect on natural processes.

In 50 to 100 years, as pointed out above, we may come close to utilization of the full replenishment of river water, fish, forests and perhaps the soil. By the same time we may expect industrial heat emission and the increase in evaporation to exert a pronounced effect on the thermal balance and the hydrological cycle on a planetary scale. This is, of course, a very rough estimate. It can be narrowed down by more precise calculations and comparative studies of several processes that are not closely interdependent.

That will be a critical period which mankind can survive only on certain conditions. Let us try to estimate these conditions.

First, mankind must have a recognized and well-defined common goal and a long-range program for its further development. Only then will it be able to assess intelligently as generally favorable or unfavorable the features of the planet's natural environment at the time and those expected in the future.

Second, society must have a practical possibility of planning and regulating the development of all its industry, agriculture and other branches of productive activity for a long period ahead in accordance with its adopted goals. Only then will it be able to use all of the earth's natural resources economically and efficiently and to cultivate them.

Third, society must have a practical possibility of using immense material resources for concerted large projects, in various parts of the globe, that will yield results only in a distant future. Only then will it be able to effect rational changes in nature, even to the future creation of a "biotechnosphere," a harmonious synthesis of natural and man-made environment.

Fourth, major conflicts, any one of which would disrupt the other conditions, must be ruled out.

In my view, a single universal socialist society would possess all these characteristics. However, it is possible that the necessary conditions may be met also by a society consisting of countries with varying social systems, but only if they coexist peacefully and, moreover, work in close cooperation on a global scale.

Regardless of the structure that human society assumes several decades hence, concrete and serious action is already imperative now if, to use Marx's words, we are to turn from "spontaneous" to "consciously directed" culture.

Putting an end to the arms race would enable us to find the necessary resources for rapid reorganization of technological processes in industry and agriculture in order to reduce and subsequently prevent air and water pollution.

A ban on nuclear, chemical and bacteriological weapons would avert the danger of military pollution of the environment.

Disarmament and the assurance of firm and lasting peace would enable us to embark upon major projects for the conservation, transformation and cultivation of many natural resources on a global scale.

An understanding of the coming stage in the process of interaction between man and nature obliges us to fight with all our strength to establish the social machinery for regulation before spontaneous development of the productive forces can lead to irreversible dislocations in the interaction between society and the environment.

ENVIRONMENTAL ISSUES OF INTERNATIONAL CONCERN

It is timely that conversations on international aspects of the human environment be held during the summer of 1971. This matter has been thrust into a position of such prominence during the past year or two that there is an understandable tendency to turn away from the topic because of sheer weariness from listening to strident voices warning of impending disaster. We are *not* confronted with an "environmental crisis" that will come to a head within a few years. We *are* confronted, however, with a set of important environmental issues of sufficient gravity that they must be resolved within the next several decades if the human species is to achieve the quality of life to which it aspires—or even to survive and continue to be an integral and vital part of the natural world.

It is expected that many of these issues will come under intensive scrutiny at the United Nations Conference on the Human Environment to be held in Stockholm in June 1972. Thoughtful reflection on them, prior to the Conference, in an atmosphere conducive to an informal exchange of views, and with sufficient time to explore several in some depth, might well help to lay the groundwork for a productive Conference in spite of the constraints of time and formality at international conferences which often inhibit the convergence of widely varying views on a program of action that will command universal support.

The purpose of these notes is:

To provide a point of departure for the identification of environmental issues;

To place them in proper perspective; and

To suggest a few principles that might well be observed in the development of bilateral or multilateral programs.

One useful dimension of perspective is time. In this sense, it is helpful to recall:

That Spaceship Earth was launched, in a manner we do not yet fully understand, about five billion years ago.

A primitive form of living organism made its appearance a little more than three billion years ago when prebiological organic synthesis took place in a mixture of water vapor, methane, carbon monoxide, carbon dioxide, ammonia, nitrogen and other products of volcanic out-gassing, activated by an energy source such as lightning or ultra-violet radiation. These primitive organisms were incapable of manufacturing their own food by photosynthesis and depended on externally formed molecules and a process of fermentation for nourishment.

During the subsequent couple of billion years a critical stage in the evolution of living organisms was successfully passed by the acquisition of the capability by those organisms to nourish themselves, to generate oxygen through photosynthesis, and to fix nitrogen.

Then oxygen began to increase in the atmosphere, invertebrates made their appearance 500 million years ago, and vertebrates a little over 400 million years ago.

Land animals emerged three hundred million years ago.

The reign of the dinosaur began 200 million years ago and lasted for 140 million years.

The Age of Mammals began sixty million years ago.

Human life emerged, say, three million years ago.

What has come to be designated as Modern Man appeared something like fifty thousand years ago.

As recently as 20,000 years ago, the Wisconsin ice sheet covered North America with a layer up to two miles thick, only to recede during the "Climatic Optimum" from 4000–2000 B.C., with a substantial increase in sea level.

So much for perspective on the past.

What can be said of the future?

Informed conjecture on the usable solar energy yet remaining, and on the probability of cosmic accidents originating from natural causes, suggests that man's terrestrial home should be habitable for at least ten million years! One of the central issues in the problem of the human environment is the determination of those steps that will have to be taken over the next five or ten decades to insure the existence of the human species ten million years from now, given the present relationship between man and environment and current trends in that relationship. More than a defensive posture to insure sheer survival is at stake. In a positive sense, the really central issue is: Can the misused knowledge that threatens our survival be redirected to raise the quality of life to a level commensurate with the intrinsic dignity that should be the birthright of each individual?

Throughout most of man's existence on the earth, his relationship to the environment has been governed by three basic and interrelated processes:

The energy process; the nutrient process, and the reproductive process.

The sun is the principal driving force in the energy process. It provides the energy for photosynthesis and it is the prime mover in the atmospheric, oceanic and hydrologic systems. Something like one percent of the solar energy reaching the surface of the earth is "fixed" in green plants on land and in algae in water as carbon in the form of carbohydrates. This energy is passed up the successive levels in the food chain with decomposition and the release of waste heat to the environment as the final stage of the process (except for that which is preserved and accumulated in the form of fossil fuels).

The nutrient process provides the additional ingredients required for life by cycling nitrogen, phosphorus, sulfur, and trace minerals through the atmosphere and lithosphere and thence into plant and animal life in a mode of balanced equilibrium under natural conditions.

The reproduction process makes it possible for living things to produce more of their kind and thereby preserve the species. This may take many forms, varying from the fission process by which the simplest plants and animals reproduce by cell division to the sexual reproduction by which highly developed plants, animals and human beings perpetuate the species through the union of male and female reproduction cells.

These three global processes are actually the aggregate of the processes taking place in an array of ecosystems, each consisting of a biotic community and its physical habitat that make up the thin film or air, land, sunlight, water, mineral, and plant, animal and human life that envelop the earth and is known as the biosphere. In the natural world, each of the ecosystems is in more or less stable balance in the natural state and is the culmination of many millions of years of evolution. The number of human beings has been controlled by the operation of the energy and chemical processes and by the interaction of many with other species. Not only the number of men but the nature of man was determined, to a large extent, by the human environment.

This is now changing. Man has acquired a capability of altering each of the three processes and the near equilibrium of the biosphere is being replaced by a growing disequilibrium. The energy process has been affected in three ways:

Agricultural practice has channelized the process of photosynthesis by, for example, monoculture that enormously increases the carrying capacity of the environment for man.

Man has learned to draw down the accumulated solar energy stored in fossil reserves so that the rate at which solar energy could be made available through natural environmental processes is, for the time being, no restraint on meeting contemporary energy needs.

Man has discovered an alternative source of energy in nuclear fission and is probably within a few decades of being able to control nuclear fusion. The first accomplishment introduces a significant perturbation into the relationship between man and his environment and the second development, if realized, would alter that relationship in a revolutionary manner.

The nutrient process has also been altered in several ways:

A capability has been developed to find, extract and process chemicals and minerals and introduce them into the environment in a manner which, at man's option, natural life processes in the plant and animal world can be either enhanced or inhibited. Nearly a thousand chemicals are now used to formulate several tens of thousands of preparations in current use, with an annual growth rate in use of 10–20 percent in the United States.

Side effects from man's activity in utilizing energy and manipulating matter to meet his needs result in the introduction of substances into the environment that are deleterious to the natural functioning of the biosphere.

The reproductive process has been altered in ways that include the following:

Understanding of the processes of life, the ability to control disease, and to prolong life have sharply changed the relationship between birth rates and death rates with dramatic effects on the rate of world population growth.

A general understanding of genetic laws has made it possible to create a variety of genetically different strains of domesticated plants and animals, with very large effects on the productivity of ecosystems. More recently the elucidation of the chemical structures and mechanisms responsible for the gentic properties of living matter are beginning to bring within reach a degree of genetic control which could profoundly alter the future development of all forms of life.

There are beginning to emerge practical techniques for conscious interferences with the procreation process which make it possible to separate the sexual interaction of human males and females from the reproduction of offspring. By providing a means of controlling birth rates that would match the degree of influence we are exerting over death rates, the way is being opened to conscious control of population growth.

A necessary concomitant to mankind's growing capability to influence the global systems that relate the individual to the environment has been the creation of an economic system which permits men to act in concert in transforming the earth's natural resources into the goods and services needed to satisfy primitive human needs for food, clothing, shelter and health, as well as those amenities such as culture, recreation, etc., that give meaning to sheer existence. Important elements of the economic system are the technology concerned with the utilization of energy and with the transformation and utilization of materials.

In an oversimplified sense, there are two principal economic systems in operation today:

That of the western world in which the principal instrumentalities of production are in private hands and are deployed in response to the aggregate desires of individuals expressed in the market place.

That of the eastern world in which the principal means of production are in the hands of the government and are deployed according to a formal process by which societal objectives are translated into planned programs.

The development and evolution of these variants of the basic economic system have been very strongly influenced by mankind's access to stored energy sources and by a growing mastery in transforming and utilizing materials. An advance of recent decades that promises to exercise a strong influence on the performance of economic systems during the balance of this century is the capability of modern sensing, communications and computer technology to perceive, to transmit, to store, to utilize and to retrieve information. Just as access to stored energy has enormously multiplied the effective power of the human muscle to perform work, so is the emerging information science and technology extending the capability of the human mind to utilize information.

The energy technology coupled with the information technology and the materials technology places in the hands of man a tool of almost incredible potential for transforming the natural resources of the world into the goods and services that are required for the necessities and amenities of living. This enormous power, if used wisely, holds the possibility of elevating human life to heights of which

man has heretofore only dreamed; if used unwisely, little change in the human state can be foreseen in the short term (few decades)—and nothing but disaster in the long term (many decades). Mankind thus appears to be approaching a watershed in his development, at which the words Immanuel Kant wrote nearly two hundred years ago (in *The Critique of Pure Reason*) have a special relevance:

". . . the whole interest of reason, speculative as well as practical, is centered in the three following questions: (1) What *can* I know? (2) What *ought* I to do? (3) What *may* I hope?" (Emphasis added.)

There are five basic elements which, taken together, determine changes in the state of the human environment. They are:

The growth in population.

Changes in the distribution of population.

Changes in the per capita capability of converting natural resources into goods and services—economic productivity.

Structural changes in the per capita consumption of goods and services.

Changes in the technology by which natural resources are converted into goods and services—including agricultural practices—and the manner in which they are used, or "consumed."

Perhaps the most significant aspect of population growth is that we are now adding increments of one billion individuals over the order of a few decades—whereas the first billion required on the order of a million years. With a doubling time something like 30–40 years, world population is likely to lie between six and seven billion by the year 2000 and, given the age distribution that exists, even if a net reproduction rate of one were to be achieved by the middle of the next century, a steady-state population of 15–20 billion is about the lowest figure that can be anticipated.

Concentration of population in urban settlements is a phenomenon on a worldwide scale. The percentage of urban population in the more developed countries will rise from 66 to 88 percent by A.D. 2000: in the less developed countries, from 25 to 45 percent. Against a projected doubling in the world population by the year 2000, the world urban population will treble, with the number of urban residents in the developing world increasing from 600 million to 2.1 billion. A billion new urban and rural dwellings will be required, in addition to two billion new or modernized work areas, with accompanying public facilities and public service areas. A complicating factor is that the population in slums and uncontrolled settlements of migrants within human settlements in many countries is growing at twice the city population rate, which in turn is rising at a rate faster than industrialization.

Economic productivity has the potential of doubling within a matter of decades and should actually treble between now and the year 2000.

There are complex structural changes in the per capita consumption of goods and services taking place within nations, but on a global scale the most disturbing fact is the widening gap between the more-developed countries and the less-developed countries. Lord Blackett and Graham Jones (in *The Role of Science and Technology in Developing Countries*) have pointed out that:

"About two-thirds of the world's population have annual earnings of only $135 per head, while the remainder in the developed countries enjoy $1,800 per head.

"Over the period 1950–67, the less-developed countries succeeded in increasing their Gross Domestic Product . . . per head to 2.4 per cent per annum . . . the industrial nations . . . 3.1 per cent per annum."

Changes in the technology employed to convert natural resources into goods and services and in consumer-behavior can either ameliorate or exacerbate environmental degradation. It is possible to design processes in industry and agriculture that save or recycle materials and to contain or neutralize the discharge of pollutants to the environment. Only a bare beginning has been made, primarily because full access has been permitted to our common environmental property. Patterns of consumer behavior are slowly beginning to respond to a growing awareness of the hazards now endangering the human environment.

An understanding of these five elements is crucial for success in the task of either enhancing the quality of the human environment or preventing its further degradation. Very simply, our rapidly expanding fund of knowledge has made possible an exponential growth in population and an exponential economic growth which, if allowed to proceed for more than a few decades, threaten to exceed the carrying capacity of the biosphere. This problem is aggravated by

concentrations of human beings in urban settlements—a feature in which, at present, the environmental disadvantages appear to outweigh the advantages. The widening gap in individual consumption between the more developed and the less developed nations may well introduce facets of social and political instabilities into a prospective environmental disequilibrium which is already close enough in time to cause grave uneasiness. Finally, there exists the distinct possibility that the skillful application of technology and wise consumer behavior could provide a temporary offset and delay the day when the twin problems of population growth and economic growth must be forthrightly confronted and resolved.

The five elements listed above may be viewed as the variables in an equation that determines the quality of the human environment. Thus, one can see that, if a "steady-state" society is to be achieved, that is, one in which the relationship between man and environment eventually return to a state of near equilibrium, something like the following set of conditions must prevail:

Population growth must soon (within decades) be reduced and eventually (within, say, a century) be reduced to zero.

Economic productivity initially must be encouraged to rise—but only differentially until there will be some approximate equalization among the demands made by each individual on the environment at some level which provides the basic necessities of food, clothing, shelter, and health, and those amenities such as culture, recreation, etc. that give meaning to sheer existence—and then stabilized.

The tendency toward greater urbanization must be modulated by technological advances and restraints in consumer behavior that will bring into balance the advantages and disadvantages of increased concentration of population in human settlements.

During the period over which population growth and economic productivity are gradually being stabilized, considerable emphasis will have to be placed on technological improvements in converting natural resources into goods and services, and in ameliorating the waste load caused by increased consumption, as well as a thoughtful reappraisal of the consumptive patterns of the more affluent members of society.

Whether or not these are the long-term policy issues that must be resolved, and if they are, how society should go about addressing itself to them, would seem to be matters that merit serious scrutiny and discussion at this time. Some prospect for treating these issues in a quantitative fashion is found in the approach sponsored by the Club of Rome in which the societal response to matters such as world population trends, utilization of natural resources, capital investment, industrialization, agriculture, pollution, and the quality of life are analyzed by means of computerized, multi-loop, nonlinear, feed back, system models as a guide to the formulation of effective policies for consciously affecting the future.

There are, of course, many specific issues also demanding attention. They include:

The increasing concentration of long-lived chlorinated hydrocarbons (DDT, aldrin, dieldrin, etc.) which have proved to be highly efficacious in beneficial programs such as the control of malaria, but which also undergo successively greater concentration at every step up the food chain with catastrophic results for birds, fish, and marine invertebrates, deleterious consequences on laboratory animals, and as yet undertermined effects on man.

The accumulating presence in the environment of toxic heavy metals.

The steadily increasing carbon dioxide content in the atmosphere which has the effect of decreasing the outgoing long-wave radiation, thereby increasing the temperature of the earth. If present patterns in the usage of fossil fuels continue into the 21st century, this effect could produce significant climatic changes in several parts of the world.

The increasing particle load in the atmosphere which may well have an effect just opposite to the one produced by an increase in the carbon dioxide content.

The increasing heat from energy conversion which, at the present rate of growth (four per cent per year) would within 150 years constitute an input to the atmosphere equivalent to several per cent of the solar energy absorbed at the earth's surface.

Questions have arisen concerning the wisdom of using our petroleum resources for energy conversion, since they will be depleted within a few decades at present rates of growth in usage and they might better be preserved for future food conversion.

The problem of marine pollution is now reaching a level of serious impact on public health, ocean food productivity and esthetics. Dumping of wastes in coastal zones is aggravated by the release of two million tons of oil each year into the ocean, constituting a prodigal waste of resources, a threat to marine life, and a perturbing influence on the exchange of energy and matter between the ocean and atmosphere.

Biostimulation of inland lakes, estuaries and even some portions of the continental shelf is a result of the discharge of nutrients such as phosphates is beginning to affect marine life and promises to be an alteration of more than regional importance if present trends in nutrient use and loss continue.

The degradation of soils, particularly in the developing countries, by mechanical erosion, pollution, overgrazing, etc., threatens their productivity at a time when it should be sharply rising, not declining.

Future success in improving agricultural and industrial productivity depends to no small extent on the availability of a diversity of germ plasm (genetic pools) of plants, animals, and microrganisms. The trend toward a narrowing of the genetic base needs to be reversed by institutionalizing the conservation of the world's genetic resources.

A higher population density tends to accentuate the demand for the outdoor recreation that nourishes the human spirit. In the United States, attendance at national parks has been growing at a rate of 8 to 10 per cent annually and shows no signs of decreasing. This is but one manifestation of the increasing pressures that are being exerted on land use as one element of the human environment.

If the foregoing examples are indicative of the environmental issues confronting the world today, it is clear that profound societal changes will be required for their resolution. In particular, it will be necessary :

To fill the gaps in our knowledge and to generate new knowledge about matters on which we are ill informed.

To re-examine the array of human attitudes and human values that lie at the root of societal behavior.

To provide new or renewed institutions capable of dealing with both the supportive and the operational aspects of international cooperation.

With respect to knowledge :

We are woefully lacking in understanding of the "carrying capacity" of the world's biosphere.

Our understanding of the behavior of social systems is quite inadequate with respect to implementation of a policy which would seek to achieve balance between population and natural resources.

We have yet to explore the implications of disposing of the waste heat of a worldwide energy generating capacity that can be expected to grow something like 4% a year as far as one can see into the future. Of special interest here are the trade-offs in material recycling and energy requirements.

We lack adequate information on the rate at which pollutants enter the environment, their dispersion and residence time in ecosystems, and their ultimate disposition. The intrinsically international nature of the problem requires a global system of monitoring.

There are conspicuous gaps in our knowledge about toxicity levels, the economic cost of a contaminated environment, and the psychological effect of a physical milieu which offends one's esthetic sense.

In spite of considerable progress, we lack truly reliable and really accessible techniques for birth control.

There are major inadequacies in the technology of pollution control and in the economics of properly allocating the costs of such controls.

We need more refined and precise techniques (e.g., modelling and computer simulation) to assess the direct impact and the side effects of technological innovation or large-scale man-made modifications of ecosystems before that technology is introduced or those modifications are made. Promising progress has been made toward development of predictive ecosystem models in the International Biological Program and a solid foundation exists for early applications.

With respect to new attitudes :

We need to re-examine the fundamental relationship between man and the natural world in which he lives.

We need to re-think the matter of an equitable sharing of the resources of the world among all men.

We need to develop an ethic on the consumption of goods and services which will provide restraint on those who have an opportunity to exceed reasonable individual limits.

We must foster the acceptance of an accurate pricing system that will take into account external social costs.

The matter of institutional innovations are of more than casual interest because institutions constitute the framework within which international cooperation is achieved. At the outset it should be recognized that there are approximately two dozen intergovernmental organizations, most of which are in the UN system, currently engaged in activities and programs concerned with environmental problems. In addition, the International Council of Scientific Unions and the International Union for the Conservation of Nature carry on programs at the nongovernmental international level.

The importance of institutional innovation and renewal has been succinctly stated by Professor Eugene Skolnikoff, Chairman of the Department of Political Science, M.I.T. in the *Technology Review* for June, 1971:

"The nature of the issues emerging from advancing technology and its side effects is such as to emphasize the connectedness of things. Increasingly, issues cannot be neatly divided into boxes labelled "oceans," "agriculture," "health," and so forth. This is no less true domestically than internationally, and again raises the problem of integration of policy and activity. In the future, this interconnectedness will make current problems of international jurisdiction and coordination appear relatively simple."

"Another problem that complicates the issue of policy integration is the complexity and size of modern technological and organizational systems. This makes the task of innovation exceedingly difficult. The problems of innovation in existing international organizations and their activities are well known today. They can only be more difficult tomorrow. . . ."

"In fact, these new and intensified demands on international machinery will severely strain the international political system as we know it today. Serious questions arise as to the viability of existing patterns of international relationships. Whether man and his political systems are capable of coming to grips with these prosaic but politically demanding requirements will go a long way to determining whether we ever have to worry seriously about global catastrophes. . . ."

"In a different vein, we can point to what may be the hopeful beginning of increased public interest, in some countries, in the substantive issues that have been raised in this analysis, particularly environmental control and pollution. It will surely take such public interest, expressed in political activity, to bring about the kind of controls on man and his works, whether national or international, that will be required for survival."

"Accompanying this increased public interest in the protection of man's environment there seems to be, though much less clearly, a growing recognition that governments do not have the right to act unilaterally in technological areas when the effects may spread beyond national borders. It remains to be seen how this recognition will develop, but it would be a prerequisite for any substantial movement by governments in the direction of relying more heavily on international organizations in their own decision making. . . ."

". . . whatever the political developments of the next two decades, technologically related developments that are in some sense 'inevitable' will pose major new international requirements. What the preferred course of evolution of the international system should be to meet these new requirements must depend, in part, on an evaluation of existing international machinery. Clearly, as a minimum, a substantial amount of extremely difficult institution building and institution modification will be required internationally."

A logical starting point for a consideration of institutional arrangements is the kind of functions which these institutions might perform. In general, they are two: action functions and support functions.

Again functions would include:

Articulation and adoption of multi-lateral policies.

Formulation and adoption of international standards.

Operation of monitoring systems and archiving of data.

Implementation of multi-lateral regulatory and trade agreements.

Execution of multi-national action programs.

Funding environmental projects.

Adjudicating disputes.

Supporting functions would include:

Exchange of information.

Education and training.

Analytical and research activities intended to develop the body of knowledge required for decision making and to cast the results of these studies in a form that can be conveniently linked to the mechanism by which public policy decisions are made. An important attribute of this work is that it be completely objective and free from political influence yet readily accessible to the political instrumentalities concerned with decision making.

It seems clear that the institutional arrangements would include the following:

Vigorous national efforts in both the support and operational categories.

Strengthened and augmented activities of a coordinating nature carried on by the specialized agencies of the United Nations System.

Coordinating activities carried on by the non-governmental national institutions.

A small, high-level body within the United Nations, either within ECOSOC or at a level equivalent to ECOSOC. The functions of this instrumentality which might be called an Inter-governmental World Environmental Council would be of importance to provide coordination and cohesion to the diverse activities in the environmental arena within the U.N. System and among the U.N. Specialized Agencies.

A non-governmental instrumentality capable of carrying on sustained analytical research and planning activities of use and interest to inter-governmental agencies and national governments. This kind of entity has been variously referred to as an International Center for the Environmental (I.C.) and World Institution for the Environment (WEI).

The concept of a non-governmental international capability for environmental areas is sufficiently important to merit further discussion.

RATIONALE

Although, on purely intellectual grounds, a strong case could be made for an executive agency at the international level in order to develop and implement policies that would be universal around the world, it is highly unlikely that this will be possible within the forseeable future.

Public policy decisions will be for the most part decentralized among sovereign states, although international conventions and agreements will surely be made.

The most important step to be taken in the near future is to create an international mechanism for developing a body of knowledge which has universal credibility as well as constituencies of sufficient stature that their views are heeded in individual nations. This appears to be the most effective way of introducing rationality and coherence into a decentralized system of decision making.

CHARACTER

It must be international in staff, governance and funding.

It must be non-political, open to all the nations of the world, and carefully insulated from the political forces operative in inter-governmental organizations.

It must be advisory and analytical rather than possessing executive or administrative functions.

It must be in a position to cooperate closely with other non-governmental institutions at the international and national levels, as well as with inter-governmental organizations and national governments.

Its staff must be interdisciplinary.

It should have access to a large computer and be equipped with analytical laboratories and shops for instrumentation research and development.

It should be organically linked to several regional problem-solving institutes in areas where the environmental problems of developing countries can be vigorously addressed in situ.

It must have a permanent as well as a visiting staff of the highest competence.

FUNCTIONS

Comprehensive analysis of the impact of environment on man. This would include: (a) determination of levels of toxicity, (b) the psycho-social consequences of overcrowding, ugliness, frustration, etc., (c) the economic costs of environmental pollutants, and (d) offenses to human aesthetic sensibilities.

The impact of man on the environment. This would include the prediction of biome degradation or improvement through the use of biome modeling tech-

niques, the management of tropical forests, determination of the progression of soil erosion, technology assessment (e.g., climatic consequences of an increase of CO_2 or the possible depletion of O_3 by supersonic transports), environmental implications of man-made lakes, large-scale river diversion and ocean-to-ocean canals with special attention to the anticipation of the consequences of new technologies before they have started processes that will be difficult to reverse.

The analysis of the potential for ocean productivity of food and minerals with special attention to measures which will preserve the integrity of international waters and optimize the food yield from the seas.

The formulation of options for global public policy in the field of energy conversion with special attention to the most efficacious use of fossil fuels and the energy requirements for recycling materials, as well as an assessment of the threshold at which world energy production becomes a significant factor in the environmental energy balance.

The analyses of the sources and uses of materials and the substitution of one material for another and the policy that will be required to insure an adequate supply of materials for centuries to come.

The application of systems analyses to an understanding of the global social systems with the development of an hierarchy of computerized, multi-loop, feedback models that successively approximate the behavior of the real world.

Analysis of alternative processes for converting natural resources into goods and services and for disposing of the waste from consumers use with particular attention to technological controls that will minimize the deleterious effects of environmental pollutants and nuisances.

GOVERNANCE

It has been suggested that such a center be established within the framework of the International Council of Scientific Unions in a manner similar to that employed in establishing Special and Scientific Committees. Governance would be by a board on which would sit representatives of the adhering body (academies, research councils, royal societies) as well as governmental observers. A special advisory council would be made up of representatives of the U.N. System and U.N. Specialized Agencies.

FUNDING

To reach a critical size for effectiveness, the principal center should be staffed by about 300 physical scientists, life scientists, social scientists, engineers and humanists, and each of four regional institutions in the developing countries (South America, Africa, India and Southeast Asia) would be staffed by about 100 scientists and professionals. An approximation to the total cost including support personnel and facilities could be reached by estimating $50,000 for each scientist or professional. Funds would be provided by national governments through the adhering bodies to the International Council of Scientific Unions.

Finally, it is important to stress the role of the regional institutions in the developing countries that would be organically linked to the international center. These would be problem oriented with particular attention to the matters of immediate practical and environmental interest in the countries (water supply and sewage disposal, ecosystem management, urbanization, soil erosion, agricultural productivity, etc.). They would serve as catalysts in developing indigenous environmental scientists and engineers and in fostering environmental literacy and public awareness that economical developing and environmental enhancement are not antithetical but really constitute a single concept.

JOINT COMMUNIQUE OF THE VI DARTMOUTH CONFERENCE

The sixth regular meeting of the representatives to the Dartmouth Conference from the United States and the Soviet Union met in Kiev on the 12th to 16th of July. (These meetings are known as the Dartmouth Conference because the first meeting of this type took place at Dartmouth College in 1960. The four subsequent meetings have convened alternately in the USA and the USSR). Problems of Soviet-American trade relations were a principal subject of the exchanges at the meeting as well as other problems important to the maintenance of international peace and security.

The participants exchanged views and advanced proposals aimed at achieving a general lessening of international tensions and the improvement of the relations between the USSR and the USA. Both sides presented their ideas for working more effectively toward world peace. The Soviet participants informed their American colleagues on the contents of the peace programme advanced by the XXIV Congress of the CPSU, that, in the Soviet view, presents a sound basis for the improvement of international relations in this decade. The American participants presented proposals on ways of promoting international cooperation, particularly in the fields of international trade, the strengthening of the United Nations, and the protection of the human environment.

The participants were unanimous in considering that the improvement in Soviet-American relations would serve the vital interests of the Soviet and American peoples and recognized the utility of promoting beneficial relations of a permanent and stable nature.

The participants expressed their conviction that real possibilities exist for the promotion of a greater volume of Soviet-American trade, for cooperation in the field of industry and for more meaningful exchanges in the areas of science, technology and management. The preliminary meeting of minds which was reached on certain trade matters was, in their view, a welcome development. They expressed the hope that this understanding would open the way to further and more effective promotion of Soviet-American commerce.

The conference favored the normalization of trade relations, through the elimination of laws and practices which restrict the free flow of trade in non-strategic items, and felt confident that improvements in the conditions of trade can be achieved despite existing differences in institutions, laws and customs.

The conference expressed the conviction that the growth of Soviet-American commerce and other forms of economic cooperation would help to improve the political climate and contribute to the settlement of outstanding political issues.

In the course of the meeting, both sides stressed that the United Nations Organization is an instrument of great importance for keeping world peace and international security.

Both sides agreed that the effectiveness of the United Nations for this purpose should be strengthened. Both sides also agreed that this could be achieved if the member-states intensify their efforts to reinforce the authority of and use to the utmost the resources available to the United Nations for maintenance of international peace and security as well as for related purposes.

The participants reached firm agreement on the importance of the human environment and the necessity of cooperation in the rational development and utilization of natural resources and the enhancement of the quality of the environment. Unless attacked vigorously, they agreed, this matter will reach critical proportions within a matter of several decades.

The rapidly increasing effect of industry, agriculture and other types of human activity on the environment, including the atmosphere and water, may lead after several decades to dangerous disruptions in the natural processes of nature.

It was agreed that urgent measures are needed to prevent environmental pollution on a national and international scale and to broaden studies of the possible consequences to the world and to human life resulting from the release of heat and other influences.

The participants agreed that the rational utilization of the natural resources of our planet as a whole in the interests of mankind, as well as the healthy inter-action of human society with the environment, urgently require peaceful co-existence of states with different social systems. Close international cooperation is required, including the possibility of launching, by concerted efforts of different countries, important projects aimed at the conservation and rational transformation of the environment over long periods of time. The planning of these projects will require innovation in institutional arrangements by which the nations of the world may achieve appropriate cooperation. In this connection, the American participants proposed the establishment of a World Environmental Institute. It was agreed that the Dartmouth Conference would continue to consider and work on this matter.

It was felt that the foundations for future cooperation between the two countries exist in the coordination of efforts in the space program between the Soviet Union and the United States, as well as the active participation of scientists of both countries in international programs of oceanic and atmospheric

studies. The Conference also saw wide opportunities for developing mutually beneficial relationships in such fields as the prevention and elimination of disease.

The Conference agreed that the arms race must be brought to an end. As arms expenditures decrease, part of the resources released should be used to liquidate environmental pollution and for research into the impact of human activity on nature.

Much attention in the exchanges was concentrated on disarmament and reduction of armament problems. Conference participants agreed that the armaments race, both in the nuclear and conventional fields, endangers the cause of international peace and security and that the time is ripe for taking specific steps to put an end to the arms race. Each specific step in the direction of general and complete disarmament is a positive contribution to the improvement of the international climate. The Conference participants expressed hope that the agreement reached on the 20th of May on the further progress of Soviet-American talks on the limitation of strategic armaments will be instrumental in arriving at important decisions in the nearest future made in the interests of peace and international security. The participants noted the urgent need of ending as soon as possible the war in Vietnam. They expressed their support of an early and lasting peace in the Middle East. They also noted the importance of constructive agreements, designed to improve the situation in Europe.

The exchanges in Kiev were conducted in the spirit of good will and candor. The Conference participants are aware of the existence of contradictions and divergent interests between the USSR and the USA, countries with different social and economic systems and these differences were reflected in the discussions. This notwithstanding, the participants in the Conference recognize that, given good will and a desire to arrive at mutual understanding, real opportunities exist for the improvement of relations between our countries. They expressed the belief that the continuation on a regular basis of the Dartmouth Conferences will maintain contacts with each other for the good of the constructive goals these meetings have been called for.

Mr. SYMINGTON. What year was the latest Dartmouth Conference?

Dr. MALONE. That was July of 1971.

Mr. SYMINGTON. And it was David Rockefeller who went on that occasion?

Dr. MALONE. It was David Rockefeller, yes.

A particular noteworthy development of that conference was an invitation to the leaders on the American side to visit with Premier Kosygin. David Rockefeller and General Gavin, Ambassador Charles Yost, and Senator Church spent an hour and a half talking with Kosygin.

I think the fact that the environment was discussed at such length during that interview is auspicious.

Kosygin made four points. The first is that they had let the environmental problem get ahead of them; second, that it was "crucial," and I use that word as a direct quotation from the statement that appeared in the New York Times. It was "crucial" that the United States and the U.S.S.R. cooperate on environmental problems; third, that immense material resources would be required; and fourth, that the most likely way to obtain these resources would be by arms reduction.

I believe that this expression of opinion from someone in that position is important, and I believe that it was a factor that led to the agreement which you are discussing this week.

That is the recent background. I think that the lesson to be learned from this is that there is a role for private nongovernmental discussions in leading to official agreements.

Now, if I might turn to the Stockholm process, I would first of all comment on the appalling discrepancy between the press clippings I

have seen since returning and my own impressions of the conference as a representative, not of the United States in this case, but of the International Council of Scientific Unions. In my view, the Stockholm Conference on the Human Environment was a watershed in the forward progress of mankind. Perhaps too much was expected of it. I think much too much was made of controversy which prefaced the substantive discussions.

Our own delegation from the United States was led by Russ Train and Chris Herter, and I think of these six points I carried away with me as being significant about the Stockholm Conference:

The first was the clearcut recognition of the magnitude of the problem of an infinitely increasing population, an infinitely increasing capacity to convert natural resources into goods and services, pressing against the finite resources on our planet, Earth. We are going to have to learn to manage things in a different way, and we're going to have to learn how to divide up these finite resources in some equitable fashion.

The fact that the magnitude of this dilemma was clearly recognized was the first point of importance. The second was that there were actually modest but discreet steps taken, in spite of the political noise that was always in the background.

Third, the fact that more than 70 nations had made assessments of their own environment and submitted those in report form, some good, some bad, some indifferent, but each characterized by awareness of their environmental problems.

Fourth, the agreement to establish an Earth Watch which will monitor the changes in the human environment.

Fifth, an agreement to set in place in the United Nations system an institutional framework to carry this on in the Environmental Council. There were more members than I would have liked to have seen personally, but it looks to me like it's viable. The Executive Director has the proper authority. There is, as you know, a provision for an Environmental Fund which will give this unit in the United Nations some authority.

I think it was most important that it reports to the General Assembly through ECOSOC, and not to ECOSOC itself.

Sixth, I would say that the enormous interest of the nongovernmental organizations. While there were approximately 113 missions represented there, there were nearly 350 nongovernmental organizations. They have a very keen perception of the problem, and in view of the magnitude of that problem, we're going to have to use the multiplying power in nongovernmental organizations, and draw upon the resources they command in support of the task.

For those reasons, I think it was an important conference.

I might close by making a few remarks about the future plans of the worldwide nongovernmental scientific community, which has the opportunity of meeting and discussing these problems without the political debates that attend intergovernmental meetings.

Out of the Stockholm process, three things emerged:

One is the need for more knowledge. The second is a need for more interdisciplinary cooperation. And third, for a closer interaction between decisionmakers and the scientific community.

I think that I might comment on the question you raised about the New York Times report. That had to do, it is my understanding, with resolution 20, which proposed the establishment of a World Environ-

ment Institute, which was a mechanism to link together the nongovernmental scientific community with the intergovernmental organizations and provide this sort of input. This was rejected by the conference, but, through the skillful handling on the part of Christian Herter, it was not killed permanently but deferred for later, more thoughtful consideration, and there is opportunity for research and additional new knowledge, and I think it's a misinterpretation of the rejection of resolution 20 that led to the story that you cited in the New York Times.

We in the International Council of Scientific Unions, which is made up of the scientific communities such as our National Academy of Sciences, the Soviet Academy of Sciences, the National Research Councils, and the various inter-disciplinary units, have felt that we have a major responsibility to fill in these gaps of knowledge, to open up the dialog between disciplines and to encourage more interaction between policy makers and scientists. Here are the things that we propose to do:

We are having a General Assembly in Helsinki in September of this year. We are going to initiate there a planning process of undertaking to close gaps of knowledge during the period 1975 to 1980, which we're calling a global environmental period, or we call it the Long-term Investigation on the Future Environment (LIFE).

We expect to spend 2 years in sorting out the kinds of gaps that need to be filled. During those 2 years we expect to have about four major conferences which will bring together not only the scientific disciplines, but the policy decisionmakers, and at the end of those 2 years we expect to have a program which can be carried out, leading to filling some of those gaps by the year 1980.

To give you an idea of the kinds of problems which we think can be moved forward discreetly by 1980, there is an undertaking we have underway to determine the toxicological effects of various contaminants.

Mr. SYMINGTON. May I interrupt at this point, Dr. Malone, to give our chairman, Congressman George P. Miller, a chance to say hello to you? He has to get on his way.

Chairman MILLER. I'm only sorry that I could not be here for all of the hearings, but these days they're building lots of problems which must be solved immediately, and I must get out of here by 11:30. But I did want to come down here and pay my respects to you and to congratulate you on the great contribution you have made to this committee and to science generally, and to say that I subscribe to what you are doing.

I hope that the committee can be of service and assistance in bringing about the work that you are discussing now.

I believe that we've been shaken by environmental problems in this country. I'm not too sure that the rest of the world is quite as aware of them as we are.

I was particularly struck some years ago when I stopped over in Zurich enroute to a meeting of the scientific attachés, in Belgrade, to hear that they were experiencing at that time the same sort of thing with respect to Lake Zurich that we have had with Lake Erie. It's not limited to any place. It's a worldwide problem.

It's going to take a lot of patience, I believe, to get it started, but I think you are initiating this, you initiated it at Stockholm, and I thank you for your part in it, and I just want to say that I'm sorry I can't be with you in the future to help carry on some of this work, but I can assure you that the gentleman on my left is quite competent. He's well trained in the international field, and I'm certain that you will hear from him in the future as a great leader in this field.

Thank you. If you'll excuse me, I have to get to an 11:30 appointment.

Dr. MALONE. Thank you, Mr. Chairman.

I believe you know the place of affection you have won in the hearts and minds of the scientific community over the years for your labors on this committee.

Mr. SYMINGTON. Thank you, Mr. Chairman.

Dr. MALONE. Mr. Chairman, I have about 5 more minutes, or would you prefer to go directly to your questions?

Mr. SYMINGTON. Why don't you go ahead?

Dr. MALONE. I was listing the kinds of problems which we feel need to be tackled on an interdisciplinary basis and which can be moved forward significantly to close the knowledge gaps by 1980.

A second problem that we will probably undertake is the modeling of tropical forests. This is a development which is a method of analysis which grew out of the International Biological Program that your committee has long been familiar with and supported, and it permits one to answer on a computer the question: What if I do this to a tropic forest? As you know, a tropical forest embraces much of the developing world, and it's a crucial problem, They are being raped at the moment.

A third area is the management of coastal zones, which is the interface between the land and the water and the source of much protein development. Our knowledge here and our techniques of management are in very bad shape and need concentrated attention.

A fourth problem, to illustrate the kinds of things that will emerge, is the vexing question of what will happen to the global climate if the carbon dioxide increases by about 20 percent by the year 2000, which is the estimate that's now available. Today this cannot be answered.

With slight modification of the global atmospheric research program, which has been planned for about 1977, one should be able to give a pretty good answer to what will be the effect if CO_2 increases by 20 percent by using satellites to observe the atmosphere hydrodynamic models to run on computers, with the objective of ascertaining what would happen to the world circulation patterns.

Finally, we have the vexing problem, which can certainly be answered by 1980 if not before, of the possible consequences of an increase in the nitrous oxides at 60,000 feet because of SST travel by about 1990. It is now clear that this is a meaningful scientific problem and not a red herring. It may turn out to be a nonproblem. We think it's possible to ascertain the reality of this problem, and measures which might be considered as countermeasures, if it does turn out to be a problem by 1980.

Those are the kinds of programs with which we are involved. The CO_2 problem is a joint undertaking of the International Council of Sci-

tific Unions, a nongovernmental organization, and the World Meteorological Organization, a specialized agency of the U.N.

The tropical forest will be a joint undertaking of ICSU and UNESCO under the enlargement of their Man and the Biosphere program.

We expect the toxicology problem to be a joint undertaking of the World Health Organization and ICSU.

Those are the general comments that I have, Mr. Chairman.

I would remark that, with respect to the absence of the Soviet Union at Stockholm, it should be remembered that Stockholm only prepared recommendations which will be transmitted to the General Assembly, and the Soviet Union will participate in the decisions. No decisions were made. Only recommendations were made in Stockholm.

Mr. Kunin, who is the science adviser to Maurice Strong, was present in Stockholm and took an active part in the deliberations.

From my own conversations with Gvishiani and Academician Vinogvadov, I am persuaded that we can move ahead and that we can repair the slight damage which was done by the incompleteness of the representation.

Thank you, Mr. Chairman.

Mr. SYMINGTON. Is Dr. Gvishiani related to Premier Kosygin?

Dr. MALONE. Yes, I believe he is his son-in-law.

Mr. SYMINGTON. I remember meeting Mrs. Gvishiana when Premier Kosygin was here for the Moscow talks, and she served as his hostess, I think, while he was here.

Dr. MALONE. I was particularly pleased, in talking with Gvishiani, in that he felt that the proposed East-West Center that Dr. Handler discussed last week before this committee might be the vehicle for carrying on the sort of work which was not voted in under our resolution 20 in Stockholm.

Mr. SYMINGTON. You mentioned the problems of the tropical forests. What's happening to the tropical forests that we should be concerned about?

Dr. MALONE. They're being exploited. They are not being managed. They're not being renewed. The forestry practices are to treat them as a one-time resource, which once exploited is gone, and we simply can't do that any longer.

Mr. SYMINGTON. Who is doing this, and in what areas of the world is it the most serious?

Dr. MALONE. Brazil. All through Latin America you find this. We had a metting in Canberra, Australia last September of ecologists from the less developed countries, and their number one recommendation was that the less developed countries were not paying sufficient heed to the degradation of their ecosystems, and chief among those was the degradation of the tropical forests.

Mr. SYMINGTON. What is the result of the degradation of the tropical forests?

Dr. MALONE. The unavailability of wood.

Mr. SYMINGTON. Of wood?

Dr. MALONE. Yes.

Mr. SYMINGTON. Just for wood's sake, or for use in further production?

Dr. MALONE. Also the fact that as the delicate interrelationship among the many elements of the forest is interrupted, the soil loses its productivity and becomes hard and baked and not capable of nourishing plant life of any kind, a consequence of the slash burn technique as it's often referred to.

Mr. SYMINGTON. In other words, when you use the expression "tropical forest," you're not referring only to indigenous trees but to the potential they hold for agricultural development if properly used?

Dr. MALONE. Yes.

Mr. FREY. Will you yield, Mr. Chairman?

Mr. SYMINGTON. Yes.

Mr. FREY. I assume the problem that comes up is that the nations that are undeveloped, in essence, have said, "Well, you know you developing nations have done this anyway, and now you're just trying to hold us down." Is that true?

Dr. MALONE. Yes. It was not as great an issue as I had expected it to be, and I attribute the containment of this issue to the fact that Maurice Strong very early recognized that this would be a problem, convened a group of experts in Switzerland, read their report, and held four conferences among the less developed countries. So much of the steam was taken out of this issue. He, in fact, helped to support the conference on this problem we had in Canberra under the auspices of the International Council of Scientific Unions.

Mr. FREY. I was down in Brazil on another matter recently, and one of the things that really impressed me was the movement in the country, but also the complete lack of concern over any of the problems of the environment or pollution. They just really weren't concerned about it. I think it came up in the sewer question, and they indicated to me somewhat they weren't going to spend this money on all these waste processing plants and that they didn't have time to do it right now and that they didn't have the money to do it, and this was only the concern of a developed country, which they were on their way to becoming.

Dr. MALONE. That is the view of many of the Government people. The scientists in these countries are deeply concerned over these problems and they are looking for ways to communicate their concern to their own Governments. This is one of the needs that was expressed in Canberra, some mechanism by which the Governments could be made aware of these problems.

I think that in a small way Stockholm was a step toward developing that awareness.

Mr. FREY. But do you think it's a fair statement to say that this Government awareness, especially in the underdeveloped countries, outside the scientific community, just doesn't exist? Maybe awareness is a bad word. Maybe they're aware of it, but they don't care.

Dr. MALONE. I heard Madam Nehru talk in Stockholm, and I felt that she had a fair appreciation of the problem.

Mr. FREY. But again, is this general or just a specific instance?

Dr. MALONE. You're correct.

Mr. SYMINGTON. Can we consider the tropical forest, for example, as a resource of mankind, not simply of the nation where it exists, because of its relation, let's say, to the CO_2 problem? If we did that I

suspect we might be more willing to consider assisting in the preservation of it.

Is that a fair statement?

Dr. MALONE. That's a fair statement; yes, sir.

Mr. SYMINGTON. You mentioned the production of CO_2 and the out of balance with the needs of humanity.

How does this come about?

Dr. MALONE. Through the using up of fossil fuels to generate energy.

Mr. SYMINGTON. And CO_2 is consumed by plantlife?

Dr. MALONE. Yes, sir.

Mr. SYMINGTON. What percentage of the plantlife consuming CO_2 is terrestrial as distinct from oceanic?

Dr. MALONE. I can't give you the precise numbers on that, but the water is by far greater than the land, because the water covers about 70 percent of the earth's surface, as you know.

Mr. SYMINGTON. I had heard the figure as high as 70 percent attributed to the photosynthesis process in the ocean, and 30 percent on the land.

Is that the figure that is bruited about in scientific circles, or did some individual decide to suggest it?

Dr. MALONE. That turns out to be almost exactly the distribution of land versus water, so I would assume that the rate per square foot was equal.

Mr. SYMINGTON. One difference being we haven't exploited the ocean bottom the way we have our land surfaces, certainly. I am wondering if one could extrapolate the effect of the CO_2 problem of destroying the tropical forest in its entirety. I know people in Brazil are urged to go West and knock down the trees and set up industry.

Have any predictions been made on the effect that this would have there or in other parts of the world, Africa, Asia, where the tropical forest plays such an important ecological role?

Dr. MALONE. That is precisely why we think it's important to make a major research undertaking in constructing what they call ecosystem models of the tropical forest, so that you can answer the "what if" question by use of computerized models before it actually happens.

Mr. SYMINGTON. The Soviet Nation and the American Nation are not strong in tropical forests per se themselves, but they've entered into this Environmental Agreement. I'm wondering if any of their efforts will be exerted to assist other countries in the solution of their problems, especially as they impinge on the total world situation, or whether they will be confined, in large part, to problems that we directly share between us, the more immediate problems.

Dr. MALONE. From talking with Gvishiani, who is influential in this; Vinogradov, who is Vice President of the Soviet Academy and has a keen appreciation of these things; and Fedorov, I would say that I'm less optimistic that they would take more than a parochial interest in the kinds of problems you are talking about.

Mr. SYMINGTON. Mr. Frey, do you have another question?

Mr. FREY. Mr. Chairman, I would be happy to yield to the gentleman from Texas.

Mr. SYMINGTON. Mr. Price?

Mr. PRICE. I just wanted to, along the line of your questioning, bring up again for the record, that in my travels I've run into Lerner Labora-

tories down in the Bahamas. They are implanting strontium 90 in the brain of sharks at 10 times the lethal dose that would kill a human being, and they think if they can perfect a vaccine, we could vaccinate mankind so he wouldn't be subject to fallout.

But along this line of environment, what we're talking about, they're also doing experiments such as putting electrodes in various mammals of the sea, spreading them throughout the world, monitoring them by satellite, thence down to the computers, and you can tell immediately and spontaneously where this pollution of our environment is in relation to the water anyway, and I guess really that's our most necessary ingredient to live.

I think it's a fascinating and fantastic idea because it seems that the good Lord put in a detection system in all of these animals of the seas, so they can immediately detect when their environment is being tampered with, and at parts per billion instead of the parts per million mechanisms which mankind has been able to develop.

I think it's very fascinating and something that both countries could get involved in, with this already built-in device. Could more attention be put in this area?

Dr. MALONE. Let me say, sir, that I agree with you and that my own position is not so much of apprehension over environmental crises, but appreciation of the opportunity to take advantage of the increased capacity we have to do things, to elevate the lot of mankind by using energy to augment the work performing power of the human muscle, by using computers, telecommunications, to extend the logic performing information processing capabilities of human minds.

We are, for the first time in the history of mankind, coming within reach of being able to provide the primitive needs of food, clothing, shelter, and the amenities which give meaningful existence to everybody, regardless of the strength of their muscle or the astuteness of their mind. This is an awesome thought and it's an opportunity which, if we seize, can certainly elevate the lot of all mankind. It's that positive sort of approach rather than the one of protecting mankind from annihilation that I like to associate with the environmental problem.

Mr. PRICE. I have another question.

The United States and the U.S.S.R. environmental agreement contain a statement to the effect that the United States and the U.S.S.R. attach great importance to the problems of environmental protection. As long as I've ever been able to recall, the Soviet Union has emphasized that its resources are without limit. Furthermore, the pressures within the Soviet Union to meet even higher production quotas would tend to indicate that there is something less than great concern within the U.S.S.R. regarding their environmental problems.

I wonder if you could comment on whether the Environmental Protection Agreement in particular signals a Soviet willingness to compromise increased economic growth in the interest of fighting pollution and conserving resources?

Dr. MALONE. Yes, I think it does, and I would offer as a bit of evidence the fact that in the next Dartmouth Conference, which will be held in Dartmouth as a matter of fact in October of this year, the preliminary conversations with the Soviets have indicated a desire to have the participation of Dennis Meadows, who authored the book, with

which you're familiar, "*The Limits of Growth.*" So that to me is a signal that they recognize that resources are finite and cannot be infinitely exploited.

Mr. PRICE. The topic of environment, particularly protection of the environment within this country, is of major current interest as you know. Accordingly, a great deal of Federal, as well as private resources, are being made available to address the many problems.

Could you please make an attempt to compare the relative emphasis given the environment, and environmental protection in particular, in the Soviet Union? Do you have any feelings for the amount of money the Soviet Union is making available for the study of the environment?

Dr. MALONE. No. I don't have any sure estimates. My guess would be that at present their outlay, as a percentage of their gross national product, is smaller than ours. In both cases, it's on the order of a few percent. Except for that qualitative comparison, I don't have a precise figure.

Mr. PRICE. I want to thank you for appearing here this morning. I'm sorry I had to leave and testify in another committee awhile ago.

That's all I have, Mr. Chairman.

Mr. SYMINGTON. Thank you, Mr. Price.

Was the SST problem discussed in Moscow in those discussions of the agreements with the Soviet Union?

Dr. MALONE. I was not a participant in that, but in the press release that I did see, Dr. MacDonald referred to a discussion of that and it was identified as the kind of problem which can be worked upon.

Mr. SYMINGTON. You mentioned in your testimony today that it is a real problem, it's not a red herring. What exactly is the problem?

Dr. MALONE. The problem is that at 60,000 feet, which is the height at which SST's would operate, you are in the photochemically active portion of the atmosphere. The density is quite low and what one calls the residence time of a contaminate injected is on the order of weeks because of the stability of the atmosphere compared to the lower portion where it washes out in a matter of days.

The particular problem then is the nitrous oxides which are emitted as part of the combustion process in the SST, interacting with ozone, which is the three molecule form of oxygen, which tends to convert some of the ozone into oxygen. Ozone is important because it is a filter for ultraviolet, and if we get too much ultraviolet in that part of the spectrum, it could have deleterious effects on a rather delicate balance, which has been built up over the last 3 million years.

Mr. SYMINGTON. Could you describe those effects? What happens if you have too much ultraviolet? Is it dangerous to human systems here?

Dr. MALONE. The potential danger—and I want to stress that it's not possible today to provide categorical answers—for example, would be to increase the incidence of skin cancer, which is related to the ultraviolet light.

I wish to be perfectly clear that I am not saying this is going to happen. I say it is a problem which is a meaningful scientific problem, and a problem which we now think we can go about answering.

Mr. SYMINGTON. In what time frame?

Dr. MALONE. I think that we can answer it within 3 years.

Mr. SYMINGTON. The answer being whether or not it's a problem, right?

Dr. MALONE. Yes.

Mr. SYMINGTON. Not what to do about it, other than to stop flying?

Dr. MALONE. The Department of Transportation, I think, has budgeted $7 million, which is the largest single agency appropriation for any kind of conscious or inadvertent weather modification.

Mr. SYMINGTON. I'm interested in the Soviet sharing. I'm interested in the Soviet's willingness to discuss the problem, because they're trying to market their planes, especially while we haven't built our own yet.

Yes, Mr. Price.

Mr. PRICE. I had a little experience in this area recently in being privileged to fly an aircraft at 80,000 feet at 2,200 miles an hour, which is faster than the muzzle velocity of a 36 caliber bullet, and evidently I exposed myself to a lot of radiation.

We have this type plane, and so do the Soviets now, which are much faster and they're flying at higher altitudes than the SST, and they claim that it will sustain Mach 3, which it won't.

But anyway we have planes flying now at much greater altitudes. I'm quite interested in it, and I don't quite understand.

Are you saying that if we put up massive fleets of these planes, rather than a few, then there is where you run into the problem of the change of atmosphere?

Dr. MALONE. Precisely. There's where it becomes a problem, the answer to which we do not know.

Mr. PRICE. And the problem is the exhaust from these aircraft?

Dr. MALONE. Yes. If you postulate 400 SST's flying on an average of 9 hours a day at 60,000 feet, then you calculate the amount of NO_x, the nitrous oxides which are emitted. Then it is possible—and I stress only that it is possible—I'm not saying it's a foregone conclusion—happily it will turn out to be a nonproblem, but it is possible—that this many SST's would emit sufficient nitrous oxide to decrease the ozone content sufficiently to allow the ultraviolet light to come down to the ground.

Mr. SYMINGTON. The threat isn't so much to the pilot of the plane as it is to the people down below, if there is a threat?

Dr. MALONE. Yes, that's right.

Mr. SYMINGTON. Is there any way to compensate for that in some way by restoring the balance in an artificial fashion?

Dr. MALONE. I don't know. I suspect there is. There are all kinds of technological fixes which can be considered. I don't have a nice handy little proposal in my pocket.

Mr. SYMINGTON. Is anybody working on that?

Dr. MALONE. I'm sure there are people working on that.

Mr. SYMINGTON. I would like to find out.

Along those lines, on the CO_2 emission problem for the burning of fossil fuels and the destruction of plantlife, which could soak it up, do we have another artificial process for separating the oxygen out of CO_2 the way the plants do it?

Dr. MALONE. Not to my knowledge.

Mr. SYMINGTON. Is that something we've tried to do and failed?

Dr. MALONE. No. There is the possibility that you could counteract the warming effect of the increase of CO_2 by injecting into the environment particulates which would reflect back and hence cool the atmosphere. This is a hypothesis. This can be tested, and I'm sure it will be tested on mathematical models.

Mr. SYMINGTON. There's no way to capture the CO_2 as it leaves and to feed it to a plant at that point is there?

Dr. MALONE. No.

Mr. SYMINGTON. It just gets out before you can do that?

Dr. MALONE. Yes.

Mr. SYMINGTON. And then it goes up?

Dr. MALONE. Yes.

Mr. SYMINGTON. As a former English major, I'm afraid I can't dig too deeply into these scientific mysteries, but this suggests areas where we ought to be working with the Soviets. That is, for example, in the search for new energy sources that don't require the burning of fossil fuels and the emission of CO_2.

Mr. Price, do you have any further questions?

Mr. PRICE. Nothing other than that, as the chairman knows, I have great concern that we have accelerated, it seems to me, in this area and the United States feels that they should pay their full share in carrying out the environmental protection. You and other gentlemen who attended workshops, or agreements, or whatever you might want to call them, I feel that it's your duty as our representatives to see to it that we don't do all the work and they get the benefits from our efforts. I think it should be a mutually shared effort and see that it's adhered to in this area. Do you have any comments on that?

Dr. MALONE. That's an eminently reasonable position and one with which I would associate myself.

Mr. PRICE. That's all I have, Mr. Chairman.

Mr. SYMINGTON. Thank you, Mr. Price.

At Stockholm was there any discussion of the earth resources satellite as a monitoring device for preserving the environment and, if so, were there any apprehensions expressed concerning the use of this information, sharing of the cost of it, et cetera?

Dr. MALONE. Yes, there was some discussion of that. I did not sit on the particular committee. They broke down into various committees.

There is great interest all around the world in the potential of the earth resources satellite, and I think it's generally held to be a very powerful tool in our array of this technology to work on the environment.

Mr. SYMINGTON. I would be surprised if, particularly in Sweden, they didn't raise some serious question about the legality of using this device to secure information that might be considered the sovereign privilege of the host country. At the U.N. a couple of months ago when I went up there for a day to see what they were worried about, the Swedish Ambassador headed a small delegation of U.N. ambassadors strongly urging me to suggest that the State Department work out

some details of the international law implications of these flights before we fly them.

The State Department said, "Well, we don't really know enough about what we're going to learn to speak intelligently to the problem of how to share it."

Nevertheless, when NASA came before us to get the money, they seemed to have a very good idea of what they were going to learn, and so I would have thought that the subject would have come up; but as far as you know it didn't hit the fan, at least in that part of the world?

Dr. MALONE. No. You may recall at the Joint Symposium that was held last year by this committee and Senator Magnuson's committee, Bengt Lundholm from Sweden was one of the ardent advocates of the earth resources satellite.

Mr. SYMINGTON. It certainly may prove to be a very valuable device, won't it, in helping to solve some of the problems that we have?

Dr. MALONE. Yes.

Mr. SYMINGTON. At the moment I have no further questions, and if Mr. Price doesn't, we thank you very much, Dr. Malone, for an exceedingly interesting and stimulating conversation that we've had with you.

Dr. MALONE. It's been a privilege and a pleasure to visit with you, sir.

Mr. SYMINGTON. I hope to see you again soon.

Tomorrow is our final day of the hearings on the Moscow agreements. Our witness will be Dr. Roger Egeberg, Special Assistant for Health Policy of HEW, and he will testify on the medical science and health agreement.

This meeting is adjourned.

(Whereupon, the committee was adjourned at 12:05 p.m., to reconvene on Wednesday, June 21, 1972, at 10 a.m.)

U.S.-U.S.S.R. COOPERATIVE AGREEMENTS ON SCIENCE AND TECHNOLOGY, SPACE, ENVIRONMENT, AND HEALTH AND MEDICINE

WEDNESDAY, JUNE 21, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON INTERNATIONAL
COOPERATION IN SCIENCE AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10 a.m. in room 2318, Rayburn House Office Building, Hon. James W. Symington (chairman of the subcommittee) presiding.

Mr. SYMINGTON. The subcommittee will be in order.

This is the fifth and final day of the hearings before the Subcommittee on International Cooperation in Science and Space on the cooperative agreements between the United States and the Soviet Union on science and technology, medical science and public health, environmental protection, and space.

Our witness this morning is Dr. Roger O. Egeberg, Special Assistant for Health Policy, Department of Health, Education, and Welfare, who will discuss the cooperative agreement on medical science and public health. Dr. Egeberg was the chief architect of that agreement for the United States, he participated in the negotiations in Moscow, and he recently returned from Stockholm, Sweden, where he represented the Department of Health, Education, and Welfare at the U.N. Conference on the Human Environment.

Dr. Egeberg was visiting other countries in connection with his European efforts and cut that visit short to be with us today to give us the benefit of his reflections on these agreements. For that we are deeply grateful.

In addition to the position Dr. Egeberg holds in the Department of Health, Education, and Welfare, he also serves as special consultant to the President for health affairs.

We welcome you to the subcommittee, Dr. Egeberg, as well as your colleagues who accompany you this morning. Of course, John Zapp, our old friend, we know well. Perhaps you would give us the names of your other colleagues at the witness table. We welcome your statement.

Dr. EGEBERG. Yes, may I start by introducing the people at the table. On the extreme left, your right, is Dr. Theodore Cooper, who is the

Director of our Heart and Lung Institute at the National Institutes of Health.

Next is Dr. Kevan, pardon me, he insists he is "Mr.," but I will call him "Doctor." At this time he is Special Assistant to the Director, Office of International Affairs, Office of the Assistant Secretary for Health and Scientific Affairs, DHEW.

On my right, as you know, is Dr. John Zapp, who is Deputy Assistant Secretary for Legislation on Health, and on his right is Dr. Frank J. Rauscher, who is the Director of the National Cancer Institute, National Institutes of Health, and beyond him is Dr. David P. Rall, who is the Director of the National Institute of Environmental Health Sciences, National Institutes of Health.

(The biographical sketch of Dr. Egeberg follows:)

ROGER O. EGEBERG, M.D.

Dr. Roger O. Egeberg was designated July 1, 1971 by President Nixon to be Special Consultant to the President on Health Affairs and Special Assistant to the HEW Secretary for Health Policy.

In his dual role Dr. Egeberg's responsibilities focus upon presenting the Administration's health initiatives to the Nation and relating those to the long-term health requirements of the country.

Prior to his assumption of these duties Dr. Egeberg served as Assistant Secretary for Health and Scientific Affairs from July 18, 1969.

Dr. Egeberg was born in Chicago, Illinois, November 13, 1903. He attended elementary and secondary schools in Chicago, Oslo, Norway and Gary. He received his B.A. degree from Cornell University, Ithaca, New York in 1925, and his M.D. from Northwestern University, Evanston, Illinois, in 1929.

Dr. Egeberg served in the U.S. Army Medical Corps from 1942 to 1946 (Major-Colonel) and was personal physician and aide-de-camp to General of the Army Douglas MacArthur, 1944–45.

Following post-graduate training he practiced medicine, specializing in internal medicine in Cleveland, Ohio from 1932–42.

He was Chief of Medical Services, VA Hospital, Los Angeles, California 1946–56; and Medical Director, Los Angeles County Hospital 1956–58. Professor of Medicine, University of California at Los Angeles, 1948–64; and the College of Medical Evangelists (now Loma Linda University School of Medicine) Loma Linda, California 1956–64. He was a Professor of Medicine, University of Southern California, 1956–69 and Dean of the School of Medicine, USC, 1964–69.

Dr. Egeberg served as a member of the President's Advisory Commission on Narcotic and Drug Abuse. He was a member of the National Advisory Cancer Council, 1964–68; the Special Medical Advisory Group to the Veterans' Administration, 1965–69, and Chairman 1968–69; and the California Board of Public Health President 1963–68. He was Chairman of the Governor's Committee for the Study of Medical Care and Health in California from 1959–60, and Chairman of the California Committee on Regional Medical Programs, 1967–69.

He is a Diplomate, American Board of Internal Medicine; a Fellow of the American College of Physicians and member of the American Medical Association.

Dr. Egeberg has published numerous articles in professional medical and scientific journals, his particular field of interest being the deep mycoses.

He is married to the former Margaret McEchron Chahoon and they have three daughters, Dagny, Sarah, and Karen and one son Roger Olaf.

Mr. SYMINGTON. We welcome all you gentlemen here this morning. Thank you.

Dr. EGEBERG. Dr. Cooper and Dr. Rall were among those on our last trip to the Soviet Union. I have a prepared statement that I would like to read to you, if I may start off with that.

Mr. SYMINGTON. Yes.

STATEMENT OF ROGER O. EGEBERG, M.D., SPECIAL ASSISTANT TO THE SECRETARY FOR HEALTH POLICY, OFFICE OF THE SECRETARY, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE; ACCOMPANIED BY JOHN S. ZAPP, D.D.S., DEPUTY ASSISTANT SECRETARY FOR LEGISLATION (HEALTH), DHEW; THEODORE COOPER, M.D., DIRECTOR, NATIONAL HEART AND LUNG INSTITUTE, NATIONAL INSTITUTES OF HEALTH, DHEW; DAVID P. RALL, PH. D., DIRECTOR, NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES, NATIONAL INSTITUTES OF HEALTH, DHEW; FRANK J. RAUSCHER, JR., PH. D., DIRECTOR, NATIONAL CANCER INSTITUTE, NATIONAL INSTITUTES OF HEALTH, DHEW; AND ROBERT A. KEVAN, SPECIAL ASSISTANT TO THE DIRECTOR, OFFICE OF INTERNATIONAL AFFAIRS, OFFICE OF THE ASSISTANT SECETARY FOR HEALTH AND SCIENTIFIC AFFAIRS, DHEW

Dr. EGEBERG. Mr. Chairman, and members of the subcommittee, it is a pleasure for me to appear here today to have the opportunity to present to you what I believe to be a program which holds great promise, not only for the two great powers involved, but for all mankind: The United States-Soviet Union agreement on cooperation in the field of medical science and public health. It is a common effort toward a common goal: the end of human suffering and pain. A goal which I am convinced offers us a basis for world order, a sense of community among men, and ultimately a road to world peace.

I would like to emphasize how seriously the people we talked with in the U.S.S.R. felt about this as a mechanism toward peace. We had been there twice, and on the first trip we spoke with many people on health, health research, delivery of health care, and teaching of health sciences. Emotionally and sometimes with tears in their eyes, they kept saying health is the neutral communication medium. Health is the neutral subject that we can talk about and through which we can keep the doors open for others. They frequently said: "We must keep communicating in the field of health."

The health cooperation agreement is the only one of those signed at the President's summit meeting with the Soviet officials that is based on a long history of exchanges of information and scientists between the United States and the Soviet Union, all of which have been accompanied by strong feelings of mutual understanding and respect. I would like to take a few minutes here to review for you the events that brought us to the signing of this new and significant agreement.

For many years, there have been informal contacts between American and Soviet biomedical scientists, especially at international professional meetings, as is traditional in the medical profession. A hiatus occurred in these relationships when the Soviet Union withdrew from the World Health Organization in 1950. They did not return to that organization until 1957. However, this isolation of Soviet medicine

was broken with the establishment of a direct informal relationship between U.S. and U.S.S.R. medical scientists which first developed in 1955.

Then in January 1956, a severe outbreak of poliomyelitis in the U.S.S.R. prompted the Soviet Government to request permission to send a group of specialists to the United States to study our progress in the control of this disease. The Soviet visitors were impressed with our research on poliomyelitis and the vaccine work of Dr. Albert B. Sabin and Dr. Jonas Salk. As a result of this visit, over 12 million children of the Soviet Union received the Salk vaccine between 1957 and 1960.

In 1958, Soviet authorities started using the Sabin attenuated live vaccine and inoculated over 91 million persons between 1959 and 1963, experiencing the same success as we did in the elimination of poliomyelitis as a major disease threat. Incidentally, two of the Soviet medical scientists on the team that initially visited the United States were awarded the coveted Lenin Prize in 1963 for their part in this cooperative effort.

In February 1956, a U.S. microbiology and epidemiology group spent 30 days in the Soviet Union visiting 25 medical institutions and organizations in Moscow, Leningrad, Kiev, Kharkov, and Sukhumi. With this visit, the first reciprocal exchange had been completed, and it was considered mutually beneficial by all parties concerned. As a result, many others subsequently followed.

In June of 1956, the State Department proposed a formal program of exchanges and the Soviet Government agreed, resulting in a meeting in Washington in October 1957. In response to an initiative by the Soviet Embassy, agreement was reached early in January 1958 to include a health section in the official overall exchange document. The first U.S.-U.S.S.R. general agreement for exchanges in selected fields was signed on January 27, 1958. This launched the formal basic U.S.-U.S.S.R. exchange program with responsibility for the administration of the health section of the agreement delegated to our Department and its counterpart, the Soviet Ministry of Health. There have now been 38 American delegations to the Soviet Union and 32 Soviet groups to the United States. In addition to these exchanges of delegations, a total of 194 individual American and Soviet medical scientists have participated in the program, conducting personally planned studies and research in their special fields of interest with their counterparts in the other country.

But this is enough of past history, Mr. Chairman. I have taken the time to review our early experience in this program for one extremely important reason. It is significant to note that in 1956 with the informal exchanges beginning with the polio group and again when health was included in the official overall U.S.-U.S.S.R. agreement signed in 1958, the Soviets took the initiative in proposing cooperation in health. Since that time, the exchange program in health has gone on despite serious foreign policy differences between the two countries and periods of strained relations with respect to other exchanges under the overall agreement. The direct line of communication authorized between the Department of Health, Education, and Welfare and the Soviet Ministry of Health has remained constant

and cordial over the years which supports the thesis that health has the capacity to transcend political and cultural barriers between nations.

Based on our experience in health exchanges with the Soviets, we were encouraged to explore possibilities for broadening these activities. The program that was being carried on, useful as it was, had several deficiencies. The exchanges, both of delegations and of individual scientists, were unrelated and not a part of an organized plan of cooperation, they were generally of short duration, and they were more informative and orientation-oriented than conducive to a continuing in-depth examination of a particular disease or public health problem.

It was decided therefore that the Department of Health, Education, and Welfare should take the initiative and propose to the Soviets a revision of the program to make it a planned long-range continuing collaboration on health problems of mutual concern. Under this concept, health subject areas of interest to both countries would be selected and a jointly developed work plan would be prepared for a coordinated research effort. A key factor in our thinking was that the overall planning and direction of new programs should be at a high level. Accordingly, the establishment of a U.S.-U.S.S.R. Joint Committee on Health Cooperation, composed of senior health officials, was included in our proposal.

As you may know, Mr. Chairman, a U.S. Delegation of Health Services Research visited the Soviet Union in October 1970. I had the privilege of serving as chairman of this delegation. It was decided that in my capacity at that time of Assistant Secretary for Health and Scientific Affairs, I should personally deliver to the Soviet Minister of Health, Dr. Boris V. Petrovsky, a letter over my signature proposing this new approach to the health exchange program. Our delegation was warmly received, and Dr. Petrovsky expressed interest in our proposal. Subsequently, we received a favorable response, and negotiations were undertaken to jointly develop the necessary details. Following extensive discussions, it was agreed that Secretary Richardson and Minister of Health Petrovsky would exchange letters expressing agreement to restructure and to expand the exchange program to a more long-range truly collaborative effort on common problems in the field of health. These letters were exchanged on February 11, 1972, and provided for the establishment of a U.S.-U.S.S.R. Joint Committee for Health Cooperation to develop and plan the new program. The letters also confirmed an earlier consensus that the initial three areas of cooperation would be in cancer, heart diseases, and environmental health.

The first meeting of the joint committee took place in Moscow during the week of March 27, 1972. The designated members of the committee on the U.S. side were myself as the American cochairman; Dr. S. Paul Ehrlich, Jr., Director of the Office of International Health, as the alternate cochairman; and the Directors of those Institutes of the National Institutes of Health responsible for the three fields selected for the initial programs of cooperation: The National Cancer Institute, the National Heart and Lung Institute, and the National Institute for Environmental Health Science. Dr. Cooper and Dr. Rall were there.

On the Soviet side, Deputy Minister of Health Dmitri Venediktov was designated to be cochairman; Dr. Oleg Shchepin, Director, Foreign Affairs Section, Ministry of Health, as the alternate cochairman; and the directors of the three principal Soviet counterpart Institutes concerned with research in cancer, heart diseases, and environmental health.

The meeting took place in a very friendly and cooperative atmosphere, and excellent rapport quickly developed among the members of the committee. The counterpart Institute directors held separate meetings and identified specific areas for collaborative research in the three agreed-upon specialized medical scientific fields. There was no niggling, there was a good attitude on both sides, we would discuss it frankly and do our giving and taking. It became apparent in these discussions that there was much to be learned by both sides since the Soviets are strong in some areas and we are more advanced in others. By sharing experience, data, and resources, unnecessary duplication of expensive research will be avoided, and there is the prospect of achieving more rapid progress as a result of combined and coordinated research efforts.

The results of this first meeting of the joint committee provided a sound foundation for the preparation of a higher level agreement which would formalize the commitment of both governments to the proposed program of cooperation in medical science and public health. A mutually acceptable text of an agreement was completed and signed, as you know, on May 23 during the President's summit meeting with the Soviet officials.

I would like to emphasize a highly important element in this agreement which did not exist before the exchange of letters between Secretary Richardson and Minister Petrovsky: the planning and the execution of joint research activities according to an organized work plan. The earlier exchanges of delegations were for relatively brief visits, usually for about 3 weeks, touring various medical institutions in the specialized field previously agreed upon for the exchange. Likewise, the individual American and Soviet scientists who participated in the program prepared their own research plans according to their own interests and totally unrelated to other activities in the program. However, it is abundantly clear that all of these exchanges had a broader value beyond the vested interests of the individuals involved. They provided a firm base of mutual understanding and friendship between the American and Soviet medical communities. These people were often taken into the homes of such people we visited. They were in our home and were taken to our laboratories when I was with the University of Southern California. They began to see our way of life. They began to see in many ways we were not so different from them.

These contracts over the years made it possible for the door to be opened to the new program of collaboration in a genuine spirit of cooperation.

Under the agreement of May 23, a new wide range of cooperative activities are authorized. In addition to the carrying out of joint studies, there will be exchanges of information, techniques, and research protocols; the organization of symposia, conferences, and lectures; invitations for participation in national scientific forums;

the development of direct contacts and cooperation between individual scientists, scientific medical societies, and editorial boards of medical journals; the exchange of reagents, biological material, drugs, et cetera; and possibly even the joint development of new medical scientific equipment. In recognition of the worldwide implications of this cooperation, it is agreed that the results will be shared with international health organizations, and in particular the World Health Organization.

As you can see, these activities provide the program with the broadest possible parameters and encourage the free flow of medical information and health professionals between the two countries. Considerable progress has already been achieved in the initial three areas of collaboration: Malignant neoplasms, cardiovascular diseases, and the effects of the environment on man's health. Preliminary work plans have been prepared in each of the three areas, and arrangements for implementation are now underway. For instance, a group of five outstanding American oncologists leave this weekend (June 24) for a week's consultation in the Soviet Union on the definitive planning for collaborative research in this area.

Others of us here can tell you what is going on in other Institutes.

Mr. Chairman, these remarks reflect the enthusiasm of myself and my colleagues for this new bilateral venture. It is our view that this program has the potential to be of vast importance to the health and well-being of all people and may well prove to be a major step forward in improving health conditions throughout the world.

Mr. Chairman, my colleagues and I would be pleased to answer any questions you or other members of the subcommittee may have, and I thank you.

Mr. SYMINGTON. Thank you very much, Dr. Egeberg, for a very wide-ranging and thorough statement, and one that is full of hope. I am confident we all share this hope, and it is good to hear expressions of this kind from one who has been eminently connected with negotiations.

The polio problem that the Soviet Union had some years ago you described as an "outbreak." Can you give any further details on the magnitude of their polio outbreak?

Dr. EGEBERG. No, I think there were many thousands involved, and it frightened them badly. I don't know whether any of you here go back that far in your experience. I am afraid not. I just heard from them when I was over there that they were frightened, and they were very grateful to come over here and get help.

Mr. SYMINGTON. I asked it for a number of reasons. I was wondering what the extrapolation of possible illness and debilitation there would have been had there been no Salk vaccine provided. Could it have been a national disaster?

Dr. EGEBERG. Yes, it would well have been for them. A polio patient who lives and is paralyzed is a national problem. Based on our experience, there might have been upward of thousands of people in iron lungs or they would have died. That is from our experience.

Mr. SYMINGTON. I don't recall any publicity about this. I would have thought that would have been headline material. Can you recall that the people of the Soviet Union were notified of where the assistance came from?

Dr. EGEBERG. I don't know whether they knew where it came from. There was some modest notice of it in our scientific journals at the time. I don't think it was in the papers.

Mr. SYMINGTON. One would think when 90 million people are protected from the spread of disease, that that would be national news.

Dr. EGEBERG. Yes, the 90 million, and then diluting the susceptible group.

Mr. SYMINGTON. I visited the Soviet Union in 1968. It is difficult for the officials there to acknowledge anything but their own attainments. The people generally accept or don't accept what they read in the papers. I am hoping that the agreements that have been entered into this time and which will provide mutual assistance, we trust will be aired properly in both countries. Do you have confidence that this will be so on their side?

Dr. EGEBERG. Yes. They seemed very happy about this at all levels. It was not publicized in the beginning because further negotiations preparatory for the final signing might have changed a few things, and it was thought wiser to keep it unaired. The exception to this was an almost cryptic announcement made by the Soviets and ourselves at the time in Moscow, but really no newspaper interviews. However, I understand now that Dr. Cooper and others are getting quite a bit of correspondence both from the U.S.S.R. and this country, wondering about this, and we certainly are getting many offers of people who would like to participate in some way.

Mr. SYMINGTON. My feeling is, and I am sure that you would share it, that while the implications of these agreements go far beyond simple scientific exchanges because they carry the hope of increased mutual trust and respect between the peoples, this is only likely to occur if people know it is going on. That is true here, and it will inevitably be true there. I hope that without eliciting any embarrassment, they can be encouraged to spread the word a little bit, not only as to the signing of these agreements, but their implementation, so that we aren't just playing games with the hierarchy and then selling the American people on the success of it.

Dr. EGEBERG. Well, Doctor—Mr. Kevan, pardon me—tells me right now Minister Petrovsky has had a lot of radio, TV, and there have been interviews about it in the paper. They want this as a solid thing.

We were there when our two American gentlemen landed in Armenia and caused quite a ruckus. The papers weren't very kind. It was interesting to be at the airport and see the television stories where we were always the villains. But the people on the streets or in stores or in restaurants or hospitals showed every desire to be friendly. They were polite. They wanted to touch us and shake hands with us. We feel that there was a reaching out of many, many people for contact. They think we are the ones who want the war.

Mr. SYMINGTON. I experienced the same things when I was there. We must give the people hard facts to justify confidence on their part, but we are not in a position to give them the facts. They have to get facts from their own publicists.

Dr. EGEBERG. I listened to the President's broadcast from Moscow, and in view of the fact he was being translated for the entire nation, I think he was giving them a solemn promise. He was saying important things for them. We take it for granted.

Mr. SYMINGTON. I thought it was an excellent statement he made. I hope they were listening; I am sure a lot of them were.

On our side, while I don't think there is very much resistance particularly to this agreement, nevertheless I am sure the American people would like to be reassured that we are gaining something of scientific value as well as political and public relations value from the health agreement. I wonder if there are any illustrations you could give us where U.S. medicine might be advanced by this cooperative venture?

Dr. EGEBERG. Yes, if I may. I think this would be a good opportunity to begin with Dr. Cooper and go right on down the line and discuss the position of Russian medical science and what we expect to gain for our country from cooperation.

Dr. COOPER. The problems that we have identified with the Soviet scientists in the cardiovascular field are areas in which the American people can expect some benefit from the advances made in recent Soviet technology. The main areas of cooperation that we will begin with relate to a problem which we and they acknowledge is the No. 1 public health problem in the country, which is arteriosclerotic heart disease or its main manifestation, a heart attack. That is their No. 1 because of fatality. Deputy Minister Chazov, the ranking cardiologist, indicated this accounted for the majority number of deaths in that country just as it does in this country, and that a large fraction of that has to do with the deaths from premature heart attacks.

Among the things that we can expect to gain from this cooperation is their experience with their recently developed emergency care system. We had the opportunity not only of discussing this problem with them, but of visiting the system and seeing how, in the jurisdiction of Moscow, their emergency medical system and their echelons of "triage" were able to deal with emergency situations such as those which occur: pain in the chest or heart attack.

Mr. SYMINGTON. That is an interesting point because, in the Public Health Subcommittee, we are considering an emergency medical assistance bill. Perhaps you could give us a few more details, especially with respect to the Soviet manner of bringing quick assistance to the heart patient and whether or not they follow a high-risk patient with any special attention?

Dr. COOPER. Yes; I would be pleased to do that. The way they approach the problem is that there is direct access for any citizen by dialing a special number on the telephone. The response to the call is then directed from a central source through their organized system which serves the whole jurisdiction with a level of emergency response that seems appropriate to the triage officer, given the nature of the call. There are several of these emergency ambulance teams available for distribution to any site in the city.

Mr. SYMINGTON. Triage? Is that the word?

Dr. COOPER. The person who answers the call.

Mr. SYMINGTON. I was interested in getting the definition of that word. Is that a Russian word?

Dr. COOPER. No; it is a military word. T-r-i-a-g-e. It is sort of a sorting process that is used in organized medical care in the medical field to determine who goes for a bandage, who goes for an amublance, and who goes for an operation. It is a sorting process.

Mr. SYMINGTON. I was in the Marines. I never heard that term.

Dr. EGEBERG. You were probably too badly wounded.

Dr. COOPER. Too ill to need care.

Mr. SYMINGTON. A message center?

Dr. COOPER. Yes. And they dispatch a team in an ambulance with all expected necessary emergency and resuscitative capability on the ambulance.

Mr. SYMINGTON. Let us take Moscow, for instance, where they have this I am sure to the *n*th degree, they have a number of different centers for dispatching?

Dr. COOPER. Yes.

Mr. SYMINGTON. Do they ever use air ambulance helicopters?

Dr. COOPER. I don't know.

Mr. SYMINGTON. They don't have the traffic problem we have.

Dr. EGEBERG. In Siberia they use both planes and helicopters, but that is where they have long distances.

Dr. COOPER. On the arrival at the scene, which they believe they can accomplish within 10 or 15 minutes of any locus, they assess the situation. If a more specialized group is needed, the team that has arrived sends for additional aid.

Mr. SYMINGTON. How well trained are those ambulance attendants? Are they paramedical?

Dr. COOPER. They are well trained. They are paramedical largely.

The second level is medical, they man the more elegantly equipped vehicles which can be adapted immediately for use as a coronary care unit, mobile coronary care unit, or an operating room.

Mr. SYMINGTON. Do they use Russian-produced vehicles designed by themselves?

Dr. COOPER. They were designed by themselves. They can immediately adapt a stretcher to a hydraulic system on the bottom of the ambulance which can then be activated and becomes an operating table at proper height. The center section of the vehicle is activated and it increases in height so that the attending physicians and nurses can work around the operating table. There is a light that is useful as an operating room light, respiratory equipment, anesthetist, defibrillation, and surgical technology are available. The unit can function as a coronary care unit, respiratory assistance unit for acute respiratory failure, or for any situation requiring the control of hemorrhage or the administration of oxygen to provide respiratory support.

When the need arises, the central section of the ambulance is activated and the roof goes up to accommodate individuals of Dr. Egeberg's size rather than mine. I was able to stand in the basic vehicle without difficulty, but Dr. Egeberg would have difficulty.

Mr. SYMINGTON. Did they experiment with self-administered drugs?

Dr. COOPER. This is a topic we have discussed. They have had experience with antiarrhythmic drugs in acute myocardial infarction. Their experience is the same as ours and they recognize the value of antiarrhythmic treatment. They have no program, as I understand it, for the self-administration at this point in time.

Mr. SYMINGTON. Nor do we.

Dr. COOPER. No, we do not have such a program, although there are plans being proposed by Dr. Stanley Sarnoff and others who think that in high-risk patients it might be a good process.

Mr. SYMINGTON. He demonstrated his apparatus before the Public Health Committee and the committee was extremely interested in what he had to show us. I am sure if it gains acceptance in your jurisdiction, the Soviets might be interested in it, too. I am sure we don't want to share any devices or systems that we haven't yet approved here.

Dr. COOPER. I think on the four main problems which we agreed to approach in the first year, the work that will be undertaken as joint objectives will be on things that are not already proven. It is truly an effort, at this point in time, for the solution of common problems, the pathogenesis of arteriosclerosis and the classification of the the patients and risks in the free-living population by various biological and chemical techniques. The assessment of the value of medical as opposed to surgical therapy of coronary artery disease which would include the capability of antiarrhythmic therapy as well as a coronary bypass surgery, is a job that needs to be done in this country as well as theirs. The study of the metabolism of the heart as it is affected by disease is of interest in both countries and, Russian scientists have a great deal to offer in the understanding of mechanisms of what we call cardiac hypertrophy or a form of enlargement of the heart and nitrogen metabolism of the heart.

These are areas where they have had exciting developments. Finally, in the area of congenital heart disease where they recognize, as do we, the importance of finding better ways to diagnose and treat congenital heart disease in the newborn or the infant there is going to be a collaboration program.

In the second year we will go on, if we can get our protocols working, into other very important common issues including high blood pressure and shock.

Mr. SYMINGTON. The way you describe these cooperative programs to us makes us forget that there must be some linguistic problems to overcome, especially in dealing with scientific terms. How will this occur?

Dr. COOPER. This is a very good point, Mr. Chairman, because during the course of the meeting we had one issue that arose in an area of misunderstanding that could underscore your concern about clarification of nomenclature and facility of communication. During the course of discussions, Professor Chazov told me of some recent new findings in his laboratory and told me that he learned that the heart could make urine which would be a remarkable finding, I thought, and I had to seek clarification. What he was talking about is a form of nitrogen metabolism in which the heart could convert amino acid into urea.

Mr. SYMINGTON. In other words, you experienced misunderstanding through misinterpretation?

Dr. COOPER. Through direct communication. Dr. Chazov could speak English to some extent but I could speak no Russian. Therefore, this interpretation is much more a failing on my part than his. With the aid, further aid of our interpreters, we were able to resolve this rapidly. This has been a point of some difficulty in exchanges previously. We hope that we can get more American scientists trained in the use of the Russian language. Recognizing that this would take some time, Dr. Chazov and his colleagues assured me that when American scien-

tists are available to work in their laboratories on these projects, there will be assigned to them some specific scientists who, as part of their required language training, will have training in scientific English. This language would no longer be a barrier. On their visits here, their scientists will also be so trained. I was not able to give them this assurance.

Mr. SYMINGTON. In the joint statement of the President which he made on the 26th, he said he would encourage the study of Russian in our school systems, not simply to prepare people for these agreements, but to get along. I think that is a good idea.

Does the U.S.S.R. suffer a doctor shortage the way we do?

Dr. COOPER. In our field I think yes, they do. They recognize the difficulty of having different levels of medical care coverage. They try to cover it by the first thing Dr. Egeberg went over to explore—a means of providing health care service to the entire population.

Dr. EGEBERG. In the overall members, they have about twice as many physicians as we do. But in their various specialties which Dr. Cooper is talking about, they are short on some of them and are trying to increase their numbers. But they have 1.8 or 1.9 as many physicians as we do, according to the population.

Mr. SYMINGTON. Over 50 percent are women?

Dr. EGEBERG. About 70 percent or 80. The men's lib is out doing something about it, and they are now admitting at least 50 percent men in the medical schools. They are trying to get it down to about 50–50.

Mr. SYMINGTON. What was the cause of this phenomenon?

Dr. EGEBERG. I don't know, many men went—well, the women went into engineering, too—the fact is that many women who would normally decide to go into nursing, said: Why not go into medicine? They could and were able and did.

Mr. SYMINGTON. Do they have male nurses?

Dr. EGEBERG. They have a shortage of nurses, but I don't think I saw a male there.

Mr. SYMINGTON. How about the paramedical personnel?

Dr. EGEBERG. The feldscher would be their main example of paramedical. His training varies from 2 to 3 months to 9 or 10 months. In distant places, such as Siberia, he may be the main source of medical aid. They told us in Novosibirsk, some of the feldschers who run their punkts could handle about 80 percent of the instances that brought patients to them.

Mr. SYMINGTON. Are these generally women as well?

Dr. EGEBERG. It is a German term. It was used in the old Austrian Army, I think, and it means "the man in the field".

Mr. SYMINGTON. He would be like a medic in the military?

Dr. EGEBERG. Yes, but many of them, I think, had less training than many of our medics. It is difficult to say how much training they did have. They had great prestige in the villages where we saw them, and were respected and became important people in the community.

Mr. SYMINGTON. This is something quite foreign to our way, isn't it?

Dr. EGEBERG. For most of this country, but not in Alaska. There, they have the native health aide in each village, maybe the village is only 120 people like the one I visited, and because of these native health

aides who are chosen the same way they are chosen in Russia, sort of elected from the people and then sent into—they are sent in to get training maybe only 1 month or 2 months, so that the hospitals of the native health service up there are only half full. The main thing is that there has been this native health aide that can take care of things right away.

Mr. SYMINGTON. As to the medical profession in the United States, don't we have a similar need in some rural areas that are without doctors and in the inner city at times where there is also a shortage of doctors? Whether this feldscher idea would work, would it be accepted by the medical community? To what extent would they countenance such a system?

Dr. EGEBERG. We have begun to do this in connection with neighborhood health centers and training neighborhood health aides. We could make great strides in our slums if we realize only one such person should have the responsibility for 200 or 300 people and that he would belong in that area. He wouldn't have any fear of entering the area. The people wouldn't have to leave the area to make their first contact with the health professions. It has great possibility. It is being explored to a degree in the neighborhood health efforts.

Mr. SYMINGTON. Is this something the Department is already exploring and financing the study of?

Dr. EGEBERG. Yes, I think we are exploring every possibility.

Mr. SYMINGTON. We might be safe in saying that this could receive some impetus from what you have seen in the Soviet Union?

Dr. EGEBERG. Yes, it has.

Mr. SYMINGTON. Mr. Frey?

Mr. FREY. I was interested in the list of accomplishments. Are you going to continue?

Dr. EGEBERG. Yes.

Mr. SYMINGTON. I think that would be great.

Mr. FREY. I was hoping someone was going to hit on the drug problem.

Dr. EGEBERG. We will talk about that generally.

Mr. SYMINGTON. Let us see if you can move on to the area of drugs and alcoholism, which is in the news, in the Soviet Union. How they propose to deal with that.

Dr. RAUSCHER. Thank you for the privilege of being here. My field of responsibility and interest is in the prevention and treatment of cancer. As in this country, cancer in the Soviet Union in many age groups is the leading cause of death and is the cause of great anguish, morbidity, and mortality. There are ways that my Soviet and U.S. colleagues feel that cancer research itself would benefit from this kind of international cooperation.

Since Dr. Egeberg led the team to the Soviet Union, we have already started exchanging information and specific materials. For instance, in this country, the physician now has some 40 different drugs that are quite effective, in some cases exceedingly effective, in combating acute lymphocytic leukemia of children. There are 10 cancers that have shown not only a long-term remission, but in fact cure. These drugs are being sent to the Soviet Union, and, in turn, we are receiving some that they used in the last 5 or 10 years. They have used drugs that

we have not had general access to in this country. My colleague, Dr. Zubrod, head of chemotherapy at the National Cancer Institute, is leading a group to further exchange these materials as well as information.

In addition to that, we have already arranged to exchange viruses as well as specific other kinds of antibodies that can be used to determine exposure to different agents that cause disease.

Some of these agents have not been isolated in this country, but have been isolated in the Soviet Union. We feel quite confident that this exchange can occur quite soon. In aiding our physicians and public health people to determine exposures of people to particular kinds of diseases, specifically of cancer, one of the things that we have been trying to get aid on from Soviet scientists, for many years has been what we call incidence and mortality data. We are able to say now that up to 80% of people's cancers do not occur simply because we happen to be people. This means it is not our intrinsic or inherent right to develop cancer, it means that something in the environment causes cancer. This is an exceedingly important concept. The way we have gotten information to say this is by studying different population groups all over the world. The Japanese male living in Japan has the highest risk to stomach cancer of any male in the world. When the Japanese male moves to this country, by the end of the third generation, his risk falls to yours and mine, and your risk is the lowest, Mr. Chairman, of any group of males in the world to stomach cancer. This means that something he is doing in Japan or eating or is being exposed to is causing that cancer. This is an example of the kind of things that are coming in that allow us to say that most of the cancers are caused by something we do or are exposed to.

In identifying these sources of trauma and exposure, we ought to be able to prevent these cancers and, in fact, we have already identified some 22 different chemicals known to cause cancer in man. Knowing this, we have taken steps to prevent it. By understanding what the Soviet Union risks are, by understanding how many of their population are expected to develop breast cancer and when, we will be able to determine the things they are exposed to and that we are not exposed to or, conversely, what we are not exposed to which they are exposed to. This is the biolological detective way of determining causative factors which will then hopefully lead to prevention.

I met with the Minister of Health Petrovsky earlier this month in Lyon where I represented the Secretary in dedicating the new building for International Agency for Research on Cancer. We met with President Pompideau and arranged with substantial enthusiasm on the part of the Soviet delegation to begin to use the international agency in Lyon as a means of implementing the means of cooperation between the Soviet Union and the United States. I think this went very well indeed. In point of fact, he brought volumes of the kind of data we are talking about regarding cancer experience in the Soviet Union. This is the first time we have been able to get these kinds of data. We think they are very important.

One other example of how the United States will benefit by Soviet participation: In addition to our sending delegations to the USSR early in September, Dr. Boris Lapin, who is head of the largest primate center in the world located in Sukheemi, will visit the United

States. We are good friends and he will bring a delegation with him to help us in using monkeys for leukemia research, and will help us plan various facilities and experiments at Fort Detrick, which was recently turned over to cancer research. Dr. Lapin and myself, together with our colleagues, will go to Detrick for these discussions.

Mr. FREY. May I interrupt? In the June issue of Fortune, they talked about something that was going to revolutionize the whole pharmaceutical industry. If my pronunciation is good, I think they called it prostoglandins. What is it?

Dr. RAUSCHER. They are hormonelike substances which if present in imbalanced situations, can lead to various diseases. They can also lead to the control of specific diseases. We are excited about this potential in the cancer field as well.

Mr. FREY. Are the Russians doing any research with that?

Dr. RAUSCHER. It is a new area. We do not know what the Soviets are doing in this field.

Mr. FREY. You don't have a good idea of the recovery rate?

Dr. RAUSCHER. No, not yet. We have an idea of recovery rate in terms of leukemia and other forms of childhood cancer. It isn't as good as in this country. With other types of cancer, it seems to be as good or perhaps better. Such as in breast cancer, for example.

Mr. SYMINGTON. Why haven't we had such a good idea of what they were doing since, as Dr. Egeberg pointed out, we were exchanging information frequently over the past decade?

Dr. RAUSCHER. It is a very good question. The issue that you raise is one that has just developed very recently. It is very likely that the Soviet scientists are working on this as well. You must remember that even in this country, it can take 8 to 9 months before a piece of scientific work is published. This is further complicated in relating to the Soviets, by the issue of journal translations, by the issue of our people not traveling there or their people not traveling here perhaps as frequently as they now can. In terms of what they have done in the last 5 years, we have a good idea of the published literature, or at least those things that are talked about when scientists from different countries get together. In specific answer, this is just too new for us to have gotten a feel for what they are doing over there. Delayed communication is not unusual even in this country.

Mr. FREY. There is one other thing I was thinking about. It strikes me, it always has, that they have proportionately a great many more doctors than we do. I assume that is also true of specialists? Is that true?

Dr. RAUSCHER. I don't think it follows in terms of scientists in cancer. As was pointed out by my colleagues, they have a very good level of paramedical people. But in terms of specialists for cancer surgery, cancer chemotherapy, their manpower staff is woefully inadequate.

Mr. FREY. Why are they able to produce so many more doctors? Is their training different?

Dr. EGEBERG. When we returned from our first trip from the Soviet Union, we wrote a report which was published in the *New England Journal of Medicine* and has quite a bit to do with how they train their physicians.

Mr. SYMINGTON. Without objection, we will make it a part of the record.

SPECIAL ARTICLE

THE SOVIET HEALTH SYSTEM – ASPECTS OF RELEVANCE FOR MEDICINE IN THE UNITED STATES

JAMES E. MULLER, M.D., FAYE G. ABDELLAH, R.N., ED.D., F. T. BILLINGS, M.D., ARTHUR E. HESS, LL.B., DONALD PETIT, M.D., AND ROGER O. EGEBERG, M.D.

Abstract A survey of the delivery of health care in the Soviet Union was carried out during a period of three weeks. Health services in the USSR are governmentally controlled, activities are planned and centrally directed, prevention is stressed, and no fees are charged. Medical education consists of six years of training past secondary school and at least a one-year internship. Continuing education is encouraged and can increase a physician's low pay. Hospital midwives are numerous, but there is a shortage of nurses; rural feldshers will be retained only in isolated areas.

The basic unit of health service is the uchastok (district), containing about 4000 adults. In cities, health care is readily accessible from polyclinics; care is less accessible in rural areas. Specialized emergency care is available within 10 minutes in large cities. Elaborate health statistics are compiled for planning.

> Since it is generally accepted . . . that we should know how other countries handle their health problems, what methods they use, and what results they obtain, how can we ignore the country that has made the boldest departure in the medical field? This health program is especially absorbing and significant because it is applied not in a small territory with a homogeneous population but throughout one-sixth of the inhabited earth against the greatest possible odds. [Henry Sigerist.[1]]

AS members of an official United States Health Delegation, we spent three weeks in October, 1970, studying the Soviet system for the delivery of health care. Two distinct but related objectives led to our trip to the Soviet Union. In the first place, although major social, political and economic differences exist, the size, the population and the major disease problems of the Soviet Union are quite similar to those of the United States; we wished to study the Soviet approach to their health problems. Secondly, we sought to increase Soviet-American health co-operation as a possible contribution to the reduction of tensions between the nuclear superpowers.

Before leaving the United States we stated our preference to the Ministry of Health of the USSR for a program that would provide an overview of the Soviet Health Service and include Moscow, Novosibirsk, Akademgorodok and Tashkent – cities in various regions of the country. On our arrival in

Address reprint requests to Dr. Muller at the National Center for Health Services Research and Development, Room 15A-54 Parklawn Building, 5600 Fishers Lane, Rockville, Md. 20852 (the authors are members of the 32d Official United States Health Delegation to the USSR).

Moscow, Dr. Dmitri Venediktov, Deputy Minister of Health of the USSR, confirmed this itinerary. He suggested that we also visit Minsk, to see a city in the European part of the USSR, and Sochi, to meet Dr. Petrovsky, the Minister of Health. Throughout our trip we were accompanied by a Soviet specialist in health-care organization and by a young microbiologist who speaks English. Most of the translation was provided by a Soviet interpreter. On rare occasions she was assisted in technical matters by a member of the American delegation who had lived in the Soviet Union for five months as a medical exchange student and who speaks Russian.

In each region of the country our hosts selected institutions representative of that particular setting for us to visit: the Ministry of Health of the USSR and the Academy of Medical Sciences in Moscow, a republic ministry of health and a polyclinic in Minsk, a health resort in Sochi, a cardiovascular research institute in the Siberian city of Akademgorodok, and a referral hospital and a rural-health facility in Tashkent. By the completion of our trip we had visited most of the major components of the Soviet Health Service, from a centralized and complex ministry to the feldsher-midwife station — often the farthest extension of the health service to the people.

The Philosophy of the Soviet Health Service

The basic principles of the Soviet Health Service are explicit and provide the foundation for all health activities. Dr. Venediktov outlined these principles as follows: health care is a responsibility of the government; no direct charges should be made to the patient for health care; health services should be unified, centrally directed and accessible to all; science should be the foundation for health care; prevention of disease should receive major emphasis; and efforts should be made to improve the health knowledge of the population.

These guiding principles are widely accepted by the Soviet people. Mark Field, a leading contributor to American knowledge of Soviet medicine, came to the following conclusion on the basis of information from 1650 Soviet émigrés:

> Soviet socialized medicine has been one of the more impressive and positive achievements of the Soviet regime and has probably met with the approval of the great majority of the population. If the population has any complaints, they certainly do not seem to deal with the concept or the blueprint of socialized medicine, but rather with the execution of the program at the local, personal level.[2]

Dr. Venediktov, who worked for four years in New York with the USSR Mission to the United Nations, remarked that Americans studying the Soviet Health Service often comment on the outdated health facilities and unusual clinical practices that they encounter in the Soviet Union. "Here is the difference between our countries," he explained. "We know that the components of our health service must be strengthened, but we are satisfied with the general relationships among these components. In the United States your components are of extremely high quality, but the proper relationships are not established. We must improve our pieces; you must collect yours. We also know that you will not use the Soviet plan or the British plan or the Swedish plan, but one molded to your own unique situation."

Health Manpower

Physician Training

Soviet physicians are educated in 96 medical schools, most of which are not affiliated with universities. Republic Ministries of Health have the chief responsibility for these institutions, but the schools are also accountable to Republic Ministries of Education. Admission to the more prestigious schools, such as the First Moscow Medical School, is highly competitive, with over 10 applicants per position. Oral examinations and, to a lesser degree, secondary school grades form the basis for selection. Special preference is given to allied health personnel who have demonstrated aptitude by the quality of their work.

Although almost 70 per cent of Soviet physicians are women, this predominance will decrease since only 50 per cent of all medical students are women. In contrast to the small number of allied health personnel who become physicians in the United States, in some Soviet schools 20 per cent of all medical students are ex-feldshers.[3]

Soviet physicians usually receive their degree four years before their American counterparts (Fig. 1). The training for physicians who were previously

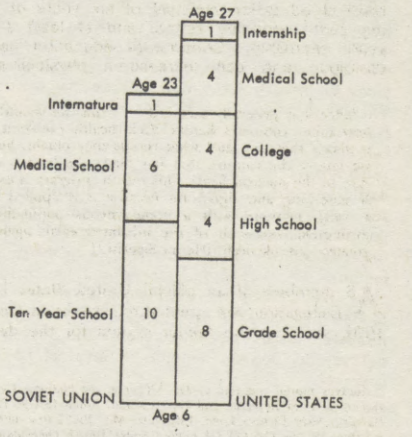

Figure 1. Comparison of the Soviet and American Systems for the Minimum Education of a General Practitioner.

allied health personnel is 1.5 to 2.5 years longer (depending on the type of primary school attended) than the standard 17-year educational program for Soviet physicians.

The first unit of the Soviet educational system, the 10-year school, offers an education similar to that of an American grade school plus a college preparatory high school. During the first two years of the six-year medical curriculum, a student studies chemistry, anatomy, political economics and other courses similar to those in the American pre-medical curriculum. In the third year, subjects such as pathophysiology and pharmacology are introduced, together with the first exposure to clinical medicine. In the fourth year, specialization starts with students interested in pediatrics beginning a separate curriculum.[4] In the sixth year, the remaining students choose a curriculum in surgery, general medicine or obstetrics and gynecology. Upon completion of the sixth year the students receive the title "vrach" or Soviet "physician."*

An additional year of supervised clinical practice, the Internatura, has recently been added as a requirement for all new physicians. After the Internatura, approximately the top 15 per cent of medical students are enrolled in training programs similar to our residencies or fellowships that lead to careers as specialists, teachers or researchers. Students with high grades, who in addition have often displayed an aptitude for academic medicine, generally obtain these coveted positions. The remainder are assigned service for three years in areas of need to repay the state for the education that they received without tuition. Upon completion of their obligatory service these physicians may apply for assignment to a post of their own choosing. Many then begin a rather long, intermittent course of training to become specialists through continuing education.

The large enrollments of the Soviet medical schools (about 2000 medical students per school, or 330 per class), together with the relatively short training period, result in a large supply of physicians for the Soviet Union.[5] There are more than 630,000 physicians, or 266 for each 100,000 Soviet citizens, compared with 158 per 100,000 Americans. The Soviet need for physicians is increased to some extent by practices that, by American standards, would be termed excessive utilization of free services, by the small number of allied health workers per physician, and by the 6½-hour work day, which necessitates two shifts of physicians in many health facilities. It is planned, therefore, by increasing class size, to raise the number of physicians to 320 to 340 per 100,000 over the next 10 years.[6] The number remains uncertain because the Soviets have not yet decided on an optimal level of physician coverage.

*The title "Doctor of Medicine" is reserved for distinguished researchers or teachers who have made major contributions to their field.

The Soviets also train a large number of foreign physicians for other countries, in contrast to the American practice of importing foreign physicians. In 1970 there were 1800 foreign students receiving undergraduate medical and nursing education in the Soviet Union.[7] Some of these students are educated in Lumumba University in Moscow, an institution operated primarily for students from less developed countries.

Soviet medical schools use several interesting technics to manage their large enrollments. Some divide classes between duplicate faculties. Small groups of 10 to 12 students are kept relatively intact over a period of three or four years to relieve some of the anonymity of classes with 300 students. Demonstrations often supplant individual laboratory projects.

The fourth year of training consists of one-month rotations through the major clinical departments. The students have . . . one lecture a day on clinical subjects and work in the wards for three to four hours in groups of six or seven. Each student has one bed assigned for the month, but he also studies to a lesser extent the patients of other members of his group. Twice a week the students have rounds with the professor, and once a week they attend a lecture in the clinical speciality areas to which they are assigned."[8]

At present, Soviet medical schools depend heavily on affiliations with nearby hospitals and polyclinics for clinical training for their students. Some Soviet medical educators, dissatisfied with this situation, now seek formation of additional clinical facilities controlled by the medical schools. However, most educators and health leaders are opposed to any attempt to separate medical education from practical health-care activities.

Although the Soviets plan to increase the quantity of physicians, Dr. Petrovsky, the Minister of Health, told us that the major emphasis of Soviet medical educators in the future will be on upgrading the quality of the educational process. Dr. John Cooper, president of the Association of American Medical Colleges, who visited the USSR in June, 1970, reported additional information about this shift in emphasis:

> There is general recognition that the main effort should now be directed at improving the quality of education and the quality of care. By lengthening the medical school curriculum, expanding the opportunities for research in medical schools and the participation of students in advancing knowledge and strengthening speciality training . . . the Soviets give indication of a real concern for improving quality.[8]

Continuing Education for Physicians

The recent article in this journal by Storey[9] provides details on continuing medical education in the Soviet Union. Storey comments that the Soviet system of medical education is "particularly noteworthy for its commitment of personnel, financial

and organizational resources to the lifelong improvement of a physician's knowledge and skills."

Numerous incentives encourage a Soviet physician to seek continuing education. A substitute is found for his position while he is away, his salary continues to accumulate, he receives an additional stipend, and his professional stature and pay are related to his examination grade and the number of courses that he has taken. In the rare cases in which a physician does not wish to participate in continuing education, he is not required to do so.

Although it is the policy of the health service for rural physicians to receive a six-month continuing education course every three years and for urban physicians to do so every five years, educational facilities are currently able to supply only about 60 per cent of the positions needed to meet this goal. Preparatory correspondence courses have recently been introduced to increase opportunities for continuing education and to shorten the time that physicians must spend away from their homes and practices. Preference for course enrollment is given to local health-service leaders, who are expected to teach the physicians subordinate to them when they return to their positions.

Curricula for continuing education and teaching methods for the entire country are determined by the Central Institute for Continuing Education in Moscow. In addition, with its own facilities, the Institute annually provides continuing education for 12,000 physicians in over 70 specialities.

Physician Activities

Physicians occupy all major positions in the Soviet Health Service; there are no separate professional hierarchies for health personnel such as nurses or hospital administrators. Physicians who hold administrative posts usually participate directly in clinical activities. For example, Dr. Boris Petrovsky, Minister of Health of the USSR, continues his work as a leading cardiovascular surgeon.

Most Soviet physicians work in polyclinics, organizations quite similar to multispeciality group practices. A primary-care physician in a polyclinic is responsible for the preventive and therapeutic care of about 2500 adults who reside within his uchastok (district). Such a physician is commonly called an uchastok physician. Specialists also work in these polyclinics.

Polyclinic physicians often rotate for work in an affiliated hospital to maintain their familiarity with inpatient problems. The duration of this hospital rotation varies with speciality, location and the work-load of the polyclinic and hospital. A polyclinic surgeon might spend ½ of each year doing inpatient work, whereas an uchastok physician might spend only three months each year in a hospital.

In sharp contrast to current American practices, uchastok physicians spend ½ of their 6½-hour day making house calls. However, in both polyclinic and home care, the work of the uchastok physician is limited to relatively minor problems. When questions regarding treatment or diagnosis arise, referral to a specialist is immediate and not considered a sign of professional incompetence. For example, an 18-year-old girl who had come to the polyclinic for a cold and mild bronchitis was referred by her uchastok physician to three specialists because of a Grade 1 systolic pulmonic murmur, a few coarse rales at the lung bases and a very early tendency to bunion formation. Although extensive referral is on the whole probably beneficial, the uchastok physicians' seven years of medical education may equip them for more responsibility than they are allowed to carry. Their role is restricted to such an extent that an American nurse visiting the USSR commented: "The nurse clinician in the U.S., with little additional preparation, would be competent to carry out the responsibilities of the uchastok doctors."[10] As the training of nurse clinicians is begun, the relation of this new type of health professional to the uchastok physician should be carefully studied.

Some common clinical practices of the uchastok physicians are quite different from those of American physicians. The most notable difference is the extensive use of physical medicine by the Soviets.[11] Paraffin therapy and mud therapy are used for various forms of arthritis, ultraviolet light for sinusitis, and infrared radiation and hydrotherapy for somatic disorders. In each polyclinic there is a large, well lighted room, often adorned with numerous plants, where this physiotherapy is offered. It is our impression that minor psychosomatic disorders, for which tranquilizers are often prescribed in the United States, are treated in these units in the Soviet Union.

The most obvious differences in hospital care are the comparatively long periods of hospitalization in the USSR. Patients are kept for two or three months after a myocardial infarction and seven to 10 days for childbirth. Tuberculous patients are hospitalized for as long as a year after their health is no longer in danger and their sputum is not infectious.

Therapeutic regimens also vary. For example, during a myocardial infarction nitrous oxide, rather than morphine, is used for analgesia. Anticoagulants and fibrinolytic preparations are more frequently employed for an acute myocardial infarction. Controlled clinical comparisons of these and other differences could yield valuable and otherwise unobtainable information.

Physican Compensation

The wages of Soviet physicians are determined by a complex system combining a monthly base pay with supplements and increments.[12] The base pay varies with the type of position and increases with the number of years of service. In general medical educators, administrators and medical researchers

receive a higher base pay than practicing physicians. For example, the chief physician of an urban hospital with a staff of 200 physicians receives a base pay of 225* rubles per month, whereas a physician practicing in the hospital for less than five years receives a base pay of 90 rubles per month. With 30 years of professional service the chief physician's base pay would increase only to 230 rubles, whereas the practicing physician's base pay would increase to 165 rubles per month.

Supplements to the base pay are given on the basis of level of professional advancement, the difficulties or hazards of working conditions and territorial location. Physicians who are certified to be in the "higher-qualification" category on the basis of their continuing education progress receive an additional 30 rubles per month. A "Doctor of Medicine" receives a 20-ruble supplement, whereas an "Honored Physician of the Republic" receives a 10-ruble supplement. Base pays are increased by 20 per cent for night work and 15 per cent to 30 per cent for work with radiologic equipment or patients with tuberculosis. Physicians who work in isolated rural areas or the far North receive 30 per cent to 100 per cent increases in their base pay. The holding of as many as two full-time positions is sometimes permitted in cities and often occurs in sparsely staffed rural areas.

Physicians are not highly paid in relation to other professionals in the Soviet Union. The urban hospital physician with less than five years' service and a base pay of 90 rubles per month receives the same compensation as a librarian with a college education but less than five years' service,[13] a secondary school instructor with between five and 10 years of service, or the principal of a secondary school with less than 280 students and less than five years' experience. The dean of a university with more than 3500 students who is a professor receives 600 rubles per month as base pay.

A direct comparison of a wage of 200 rubles per month ($222) of a Soviet physician with a $2,000 monthly income of an American physician does not give a completely valid impression of relative personal finances. Taxes on these 200 rubles are minimal, health care and education are not direct expenses, rents are heavily subsidized, and insurance costs are small. In addition, working hours of Soviet physicians are generally short, and at least 15 work days of paid vacation are granted annually.

Allied Health Training and Roles

The three main types of Soviet allied health workers — nurse, feldsher and midwife — are trained in allied health schools that are independent of medical schools. Their curricula contain common core courses that facilitate transfers or progression to medical training. Graduates of allied health schools are given preferential admission to medical schools but receive no advance credit for previous course work.

Both the course content and teaching methods of Soviet allied health schools vary considerably from American practice. Procedures such as cupping and the use of leeches are taught. Classes are didactic, and primary emphasis is on the practical, rather than theoretical, aspects of health care. Final examinations are oral and are given by physicians.

The duties of the Soviet nurse are often not equivalent to those of an American registered nurse.[14] Owing to shortages of clerical and service personnel, the Soviet nurse is frequently needed to register patients and perform housekeeping tasks. Opportunities within the nursing field for advanced training and responsibilities appear limited. As in the United States, there is a shortage of personnel for bedside nursing. We were told that many of the young women interested in the health field want to become doctors. Some allied health schools are accepting more applicants from eight-year schools to alleviate the shortage of nurses.

Graduates of eight-year schools who enter nursing training must complete 3½ years of education, whereas graduates of 10-year schools need complete only 2½ years. The nursing curriculum includes courses such as history, social science, basic and scientific atheism, physics, chemistry, Latin, biology, anatomy, physiology, microbiology, pharmacy, hygiene and organization of health services.[15] Emphasis is placed on practical experience through a program in which students begin work in health facilities as auxiliary personnel and gradually progress to their professional role in parallel with their formal education.

A complete description of the training and role of feldshers in the Soviet Union has been provided by Sidel in his article "Feldshers and Feldsherism."[16] Our major interest was not in the laboratory feldshers or the ambulance feldshers but in the rural feldshers who assist with the provision of health care in isolated areas.

In Tashkent, we asked to visit a feldsher-midwife punkt (station). After a 48-km drive past cottonfields surrounding the city, we reached a rectangular three-room cottage surrounded by a neatly trimmed hedge. Feldsher Ergash, speaking in Russian with an Uzbek accent, graciously invited our delegation inside for a discussion of his work. He explained that his duties are confined to four areas: as the most highly trained health worker in his village of 1700 people, he administers uncomplicated first aid in emergency situations before an ambulance, based 3 km away, arrives to transport the patient to a nearby uchastok hospital; he carries on health education; he vaccinates and inoculates people in his village in accordance with the policy of the health service; and, finally, he carries out orders from the uchastok physicians for

*Figures are for 1967, when 1 ruble equaled $1.11.

patients who still require treatment after returning to the village. Feldsher Ergash estimated that 70 per cent of the health-care visits for his village are handled without referral to the uchastok hospital.

The nature of a rural feldsher's activity indicates that he is not comparable to the physician's assistant currently being trained in the United States to work under the close supervision of a physician. Rural feldshers are comparable to American public-health nurses and nurse-midwives who extend health services to isolated areas.

At present, there is a debate over the future of the feldsher in the Soviet Union. Critics claim that many step beyond the areas of first aid, prevention and health education and function as second-class physicians. Others assert that a properly trained feldsher is a great asset to a small, isolated community that does not warrant the services of, or attract, a physician. Although the Soviets plan to train a fixed number of feldshers to function in settings not requiring physicians, there are no plans to expand the roles or number of rural feldshers.

Unlike feldshers, midwives are almost universally accepted as adequately trained health personnel who provide valued services of high quality. Their training is similar to that of nurses and feldshers, but in addition they receive 475 hours of obstetrics and 820 hours of practical work in a maternity hospital.[15]

Graduate midwives who work in maternity hospitals in the cities and in rayon (regional) hospitals, uchastok hospitals, or feldsher-midwife stations in the countryside, provide prenatal and postnatal care in uncomplicated cases. Midwives, under the supervision of an obstetrician, have major responsibility for about 90 per cent of both urban and rural deliveries; the remaining 10 per cent are sufficiently complex to require primary management by an obstetrician. Midwives commonly participate in the delivery of babies of women physicians and physicians' wives and are well accepted by patients.

Organization and Delivery of Health Services

Administrative Structure and Finance of the Soviet Health Service

The Soviet Health Service has a strict pyramidal organizational structure with geographically defined units (Fig. 2).

Dr. Venediktov stressed the system of dual control over health services, explaining that each health unit is subordinate to the health agency above it and to the general governmental structure in its own area.

The relation of central control to local initiative is difficult to determine. The Minister of Health of the USSR and the Ministers of Health of each Union Republic have great authority over health-service activities. The details of all planning and budgeting

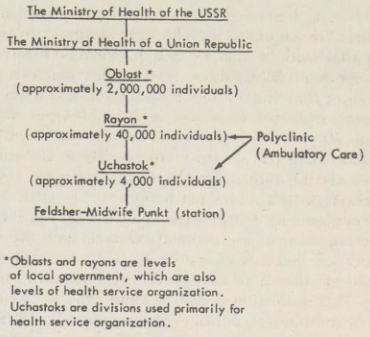

Figure 2. Administrative Structure of the Soviet Health Service.

proposals, however, are formulated by local health officials and sent to progressively higher levels, indicating a degree of local control. Consumer advice and participation are achieved through governmental, Party and trade-union channels. The Soviets describe their Health Service as organized ". . . on the principle of democratic centralism, combining single leadership with broad initiative of local organizations."[17]

The budget of the Ministry of Health, which covers the majority of the health expenditures in the Soviet Union, approximates 3.2 per cent of the Soviet gross national product (GNP). Various local governmental units such as republics, oblasts, cities and individual collective farms are encouraged to supplement this official health budget from their own funds. It is estimated that these local sources raise the total direct Soviet expenditures for health to 3.5 per cent of the GNP. Many health services, however, are not financed directly through the health agencies. For example, physicians and medical services in old-age homes are under the jurisdiction of the Ministry of Social Security, whereas sanitoria and rest homes providing some health services are under the jurisdiction of trade unions.

Although a rough measure of national resources directed to health care might be made by comparison of the Soviets' 3.5 per cent of their GNP with the current US level of 7.5 per cent, the value of this comparison is limited by differences in methods for calculating the GNP, uncertainty over the magnitude of health activities supported by sources outside the Soviet health budget, and the low pay of health personnel in the USSR in relation to other Soviet professionals.

Health Planning and the Semashko Institute

Planning is an essential part of the Soviet health system. A description of the intricacies of Soviet

health planning is given by G. A. Popov,[18] formerly of the Division of Finance and Planning of the Ministry of Health of the USSR. Dr. Popov states that an important characteristic of economic plans in the USSR is that they are not merely predictions or prognoses but have a directive nature and must be followed.

Dr. Golovteyev, Director of the Division of Finance and Planning of the Ministry of Health of the USSR, explained that health planning originates at the national level with general norms indicating expected values for certain indexes, such as the supply of beds, the supply of physicians or the number of new beds that should be built in a given year. This outline of a plan is then sent to the Union Republics for further elaboration. Dr. Popov states that in recent years, there has been a definite increase in the responsibility taken by the Councils of Ministers of the Union Republics for the direction and planning of the economy. For example, in the area of health, the Councils of Ministers of the Union Republics have been given the right to determine and state the indexes of the health-services plan, to train allied health personnel, to supervise the plan for the training of physicians and pharmacists, to plan the goals of labor, to establish the volume of capital investment, and to approve proposed construction projects and plans for supply of materials.

From the Union Republic level the plan goes to municipalities and local institutions, where the most detailed planning occurs. It then travels a return route up the health-service hierarchy for approval by higher agencies and legislative bodies.

The leaders of a highly planned health service have a great need for information on which to base decision making. In addition, documentation of health needs is necessary for competition for funds with other sectors of the economy. The Semashko Institute for the Organization of Health Services and Social Hygiene was formed more than 40 years ago to provide scientific advice on health-services organization. The Institute conducts intramural research and funds health-services research projects throughout the country. Dr. Bogatiryev, the director of the Institute, is also editor of Sovetskoe Zdravookhranenie, the Soviet journal of health-services research.

In conjunction with the 1970 census, the Institute conducted a study of seven million Soviet citizens to determine the health status of the nation. To assure a balanced sample of the entire country, the Institute selected 140 sites representing the geographic, economic and cultural characteristics of the Soviet Union. In each of these sites health data were collected on 50,000 persons randomly selected from the general population. Abstracts were made from polyclinic records, hospital records, vital statistics and work records to determine the health status of each person studied. In addition, subjects in a random sample of 200,000 of the total 7,000,000 were examined by a team of 12 medical specialists to detect morbidity not found in health-service records. The results of this study will be used to plan hospital construction, guide training activities, set research priorities and justify budgetary allocations. The use of morbidity data for health planning has been described by Popov[18] and by Navarro.[19]

Regarding the widely discussed health statistic of infant mortality, it is interesting that although the Soviet index has been reduced from 269 in 1913 to 25.7 in 1970, it remains above the 19.8 reported for the United States in 1970.[20]

Health Care for the Urban Population

Soviet citizens in urban areas have little difficulty obtaining medical care.[21] We noted that the large number of physicians, the territorial organization scheme that assures relatively even distribution, the short waiting times and the absence of direct charges for care contribute to the ease of access. In rural areas, access to qualified medical care is more difficult, and patients must often visit a feldsher for assistance.

In the cities, uchastok physicians provide comprehensive primary care for most of the adult population, whereas children are cared for by specialized pediatric uchastok physicians. Workers and several other groups are also covered by a separate occupational or restricted network of health facilities. In addition, numerous programs directed toward specific diseases, such as tuberculosis, carry on their own preventive and therapeutic activities. With this array of health services, it is not only easy to enter, but sometimes difficult to leave the health system.

We noted a fragmentation of health services that does not appear to be a matter of concern for Soviet health planners. There is no attempt to consolidate services on the basis of a family's health needs. A mother may attend a maternity clinic, the father the polyclinic, the son the pediatric polyclinic, and the grandfather, living with the family, the diabetic specialty clinic. Even the services for a single patient may be geographically scattered. This dispersion not only produces inconvenience but in some cases leads to duplication of health efforts. The Soviets are aware of the problem of inadequate communication between these scattered clinics.

Health Care for the Rural Population

The broad expanses of the Soviet Union make the delivery of health care to the rural population a particularly difficult problem. The first link of the Soviet Health Service to this segment of the population is often the feldsher-midwife punkt. When necessary, patients are referred to the nearest uchastok hospital. These uchastok hospitals of 10 to 20 beds are manned by two or three physicians who manage only common disorders. They are strongly encouraged to refer problem cases to rayon (regional) hos-

pitals. There is a plan to phase out the inpatient facilities of most of these small uchastok hospitals because of their inefficiency.

Our trip to a rayon hospital 80 km from Minsk illustrated the highly developed nature of the Soviet rural health system in relation to the general level of development of the countryside. After arriving in a village with no paved streets and probably little plumbing or central heating in the homes, we visited a 200-bed rayon hospital providing 15 types of specialized medical care for a local area of about 40,000 inhabitants. Relatively complicated surgical procedures, such as a cholecystectomy, are performed in the two operating rooms of this hospital.

Patients requiring still more specialized care are directed to oblast or city hospitals, where most medical and surgical specialities are represented. Some complicated cases are referred to one of the 30 scientific research institutes under the Academy of Medical Sciences or to specialized republic institutions. This overall system for rural health care is noteworthy for its centralization of expensive facilities and ease of referral.

Throughout the system, hospital design and construction reflect an earlier era.[22,23] Small wards with no running water regularly contain six beds, closely crowded together. Several institutes have been formed to improve the architecture and construction of hospitals.

In spite of the efforts of the Ministry of Health, the volume of health care delivered to the rural population has been consistently smaller than the volume of care given to the urban population. "In 1961, while the ratio of doctors to population was 19.9 per 10,000 for the Soviet Union as a whole, it was 27.6 for the urban population but only 9.8 for rural inhabitants."[24] The maldistribution is counterbalanced but not corrected by the provision of health care to rural inhabitants in urban institutions, the assignment of young physicians to rural positions for their 3-year obligatory service and increased wages for service in otherwise unpopular locations. The dearth of health personnel in rural areas is primarily due to their reluctance to live in the more isolated areas of the country.

Emergency Health Services

The Soviet system for emergency medical care is an outstanding feature of the Soviet Health Service.[25] Major efforts are expended to bring highly trained medical personnel to the site of an accident or illness.[26] By dialing 03 in any city in the Soviet Union, a citizen with a request for emergency health care is connected to a switchboard manned by a trained operator with a physician available for consultation. The operator or the physician evaluates the request and dispatches appropriate aid to the patient from stations located throughout the city. A general, obstetric, pediatric, orthopedic or cardiac ambulance manned by a physician and an ambulance feldsher will usually reach the patient within 10 minutes of his call. Emergency care in the extensive rural areas of the Soviet Union is provided by helicopters and air ambulances operated by the health service. The medical specialty of traumatology considers the organization and operation of emergency services as part of its responsibility and is the prime contributor to progress in this area.

Prevention

"Profilaktika" or "prevention" was repeatedly described to us as a major activity of the Soviet Health Service. This emphasis can be traced to the epidemics that ravaged the Soviet Union immediately after the 1917 revolution. The danger posed to the Soviet state by these epidemics was great enough to prompt Lenin's statement to the Seventh All-Russian Congress of Soviets on December 5, 1919, that ". . . either the lice will conquer socialism, or socialism will conquer the lice!"[27] From 1918 to 1922, more than 6.5 million cases of epidemic typhus and 3.2 million cases of relapsing fever were reported.[27] In 1920, almost 2 million cases of malaria were registered. Since prevention was the most effective way to combat these diseases, the Soviet Health Service from its very beginning adopted as its major tenet ". . . the principle of the unity of preventive and therapeutic activities."[27]

The emphasis on prevention has continued despite the decline of infectious diseases as the leading health problem. In addition to a constant "preventive" attitude in clinical practices, several major programs and institutions are designed specifically for preventive purposes.

Under the "dispensarization" program certain healthy persons such as children, workers in hazardous jobs, athletes and pregnant women are required to report for periodic health care. Dispensarization is also applied to patients with chronic diseases such as tuberculosis, hypertension, cancer and diabetes.

During our visit to an institute of medical-physical culture in Siberia, we observed the extremes to which preventive dispensarization can be carried. About 20 young athletes, experts in the sport of shooting with rifles while on skis, were being given physical examinations complete with electrocardiograms. These examinations are given each six months, or even sooner after a strenuous contest. Later, we observed a group of children with barely detectable scoliosis attending a twice-weekly corrective-exercise class.

Primarily for preventive purposes, the trade unions and the Ministry of Health operate an extensive network of 2200 sanatoriums and 500 health resorts that can accommodate about 7 million people per year. Many Soviet citizens, with the advice of a physician and the consent of the trade union, travel to the Black Sea area for several weeks of rest and treatment in specialized sanatoriums. For

example, patients with mild hypertension would attend a sanatorium providing a regimen of salt restriction, weight reduction, a relaxed atmosphere and undoubtedly several types of physiotherapy designed to combat the disease. Recently, overnight sanatoriums have been constructed in wooded areas near cities to enable workers with diseases in their early stages to undergo treatment without leaving their jobs.

Health Care for the Aged

Many times our delegation requested to see health-care facilities for the aged, expecting to find numerous institutions similar to our nursing homes in the United States. Although we eventually visited a home for invalids and the aged, we were told that only 1 per cent of those over 65 reside in such homes, as compared with 4 per cent of the population over 65 who are institutionalized in this country. A law that assigns responsibility to the children for care of their aged parents may account for part of this difference, but other factors are also important.

Several aspects of Soviet life tend to encourage activity by the elderly. A shortage of labor in many fields, particularly unskilled labor, permits certain classes of pensioners to receive full retirement income in addition to full pay for work. Others are needed by families with working mothers for assistance with the care of their grandchildren. Grandparents often have major responsibilities for running a household. This may involve many hours of strenuous shopping under conditions much more physically taxing than in the United States. These tasks, as well as the general rigor of Soviet life, support a relatively high level of activity for the elderly.

A final reason for the absence of large numbers of the aged in nursing homes may be related to a direct function of the Soviet Health Service. The uchastok physicians make numerous house calls to the disabled elderly. It is probable that without this service, many aged who are now cared for in the home would need institutional care.

Conclusions

The hazards that accompany a comparative study of health-care systems are magnified for the Soviet Union and the United States. Because of ideologic differences between the two countries, observers must make a judgment of the validity of their observations. It is our belief that the statements in this article reflect the true condition of the institutions of the Soviet Health Service that we visited. We found the Soviet health officals candid in describing their successes and failures and quite responsive to our requests to visit various types of health-care institutions.

We are considerably less satisfied with the breadth of our observations. Primarily because of limitations of time, we did not examine all the facilities in a single local health-care system, nor did we always visit more than one institution of a given type. We did not study mental-health services or biomedical research. Furthermore, the observations that we made were limited primarily to the structure of the Soviet Health Service – we did not directly participate in the delivery of health care. Finally, a cost-benefit analysis, which is accomplished only with difficulty for a limited type of health care in one's own country, was not attempted for the Soviet Health Service.

Although the utility of American observations is limited by the problem of transferability, the Soviet Health Service does provide a wealth of data for Americans interested in various forms of health-care organization. The study of these data will require extended projects in the Soviet Union by Americans skilled in health-services research. These studies should be directed toward a critical evaluation of the Soviet Health Service with special emphasis on areas in which progress appears to have been made, such as continuing medical education, routine and emergency access to health care and health planning. The newly formed US–USSR Joint Committee for Health Cooperation provides an opportunity for this work. Further studies, which themselves may generate increased co-operation, should benefit the health services and the people of both the Soviet Union and the United States.

We are indebted to Dr. Verne G. Robinson, co-ordinator of the Soviet-American Health Exchange, Department of Health, Education, and Welfare, for his skillful planning of our trip, to our numerous Soviet hosts for their hospitality and their efforts to acquaint us with their health system (particularly Dr. O. P. Shchepin, of the Ministry of Health of the USSR, Dr. Alexandrov and Dr. Shakovsky, who traveled with us, and Mrs. Eva Kipiani, our interpreter), to Dr. Patrick Storey for comments on the initial manuscript and to Mr. Kenneth Flieger for editorial assistance.

References

1. Sigerist HE: Medicine and Health in the Soviet Union. Binghamton, New York, Vail-Ballou Press, 1947, p 8
2. Field MG: Soviet Socialized Medicine. New York, Free Press, 1967, pp 202-203
3. Fry J: Medicine in Three Societies: A comparison of medical care in the USSR, USA and UK. New York, Elsevier Publishing Company, 1970, p 214
4. Sokolova-Ponamareva O: Professional training for pediatricians in the USSR. Pediatrics 38:508-510, 1966
5. United States Department of Health, Education, and Welfare. Medical Education in the Soviet Union: Report of the delegation on medical education under the US-USSR cultural exchange agreement, October 20-November 8, 1963. Washington, DC, Government Printing Office, 1964
6. Cooper JAD: Education for the health professions in the Soviet Union. J Med Educ 46:412-418, 1971
7. Petrovsky BV: Zdrovia Naroda (Health of the People). Moscow, Meditsina, 1971
8. Cooper JA: Health Planning and Education of Health Professionals in the Soviet Union. Washington, DC, Association of American Medical Colleges, 1970, p 31
9. Storey PB: Continuing medical education in the Soviet Union. N Engl J Med 285:437-442, 1971
10. Ingles T: An American nurse visits the Soviet Union. Am J Nurs 70:754-762, 1970

11. Forster S, Benton JG: Spas in the Soviet Union. Arch Phys Med Rehabil 47:62-66, 1966
12. United States Department of Commerce, Bureau of the Census, Foreign Demographic Analysis Division. Wages in the USSR, 1950-66: Health services (International Population Reports, Series P-95, No 64). Washington, DC, Government Printing Office, April, 1968
13. *Idem:* Wages in the USSR, 1950-67: Education (International Population Reports, Series P-95, No 66). Washington, DC, Government Printing Office, April, 1969
14. Norris KH: Profile of a Russian nurse. Am J Nurs 66:549-551, 1966
15. Sbornik Uchebnyk Planov Srednikh Meditsinskikh i Farmatsevticheskikh Uchebnikh Zavedenii (Curricula for Allied Health and Pharmaceutical Institutions). Moscow, Ministry of Health of the USSR, 1966, pp 4-27
16. Sidel VW: Feldshers and "feldsherism": the role and training of the feldsher in the U.S.S.R. N Engl J Med 278:934-939, 987-992, 1968
17. 50 Let Sovetskogo Zdravookhraneniia (50 Years of Soviet Health Services). Moscow, Medical Publishing House, 1967, p 19
18. Popov GA: Principles of Health Planning in the USSR (Public Health Papers No 43). Geneva, World Health Organization, 1971
19. Navarro V: Planning for the distribution of personal health services. Public Health Rep 84:573-581, 1969
20. United Nations. Population and Vital Statistics Report: Series A. 23 (1): January, 1971
21. Field MG: Doctor and Patient in Soviet Russia. Cambridge, Harvard University Press, 1957, p 191
22. A day's work in a Soviet hospital. Mod Hosp 111 (10):79-81, 1968
23. United States Department of Health, Education, and Welfare, Public Health Service. Hospital Services in the USSR: Report of the US Delegation on Hospital Systems Planning, June 26-July 16, 1965 (Publication No 930-F-10). Washington, DC, Government Printing Office, 1966
24. Field MG: Health personnel in the Soviet Union: achievements and problems. Am J Public Health 56:1904-1920, 1966
25. Barton WE: Impressions of Soviet psychiatry: admissions into the treatment system. Am J Psychiatry 125:644-649, 1968
26. Storey PB, Roth RB: Emergency medical care in the Soviet Union: a study of the Skoraya. JAMA 217:588-592, 1971
27. Potulov BM: V.I. Lenin i Okrana Zdrovia Sovetskogo Naroda (Lenin and the Protection of the Health of the Soviet People). Leningrad, Medical Publishing House, 1967, pp 112-123

80-787 O - 72 - 14

Mr. FREY. Is there anything we can learn from that?

Dr. EGEBERG. They begin much earlier than we do. Their vratsch is the man most comparable to our general practitioner, and this is the largest single category of physicians in the Soviet Union. I would say his training is similar to that given our general practitioner, but it is hard to make general comparisons.

Mr. SYMINGTON. You call him a man, but it is more likely to be a woman?

Dr. EGEBERG. Yes. The vratsch, she is. They start after high school, and they divide very soon into pediatrics and medicine.

Mr. FREY. They combine their undergraduate and medical schools?

Dr. EGEBERG. Yes, they combine it with medicine. They divide pediatrics early, then after a year and a half, they divide surgery, OB, GYN, and surgery.

Mr. FREY. How about internships?

Dr. EGEBERG. They have recently initiated a program which they call internatura. They also have the ability to send their physicians, as soon as they finish their internship, to where they are needed unless they are in the top 10 percent of the class. So if you are not too hot, you could end up somewhere in Siberia.

Mr. FREY. Getting back to the question of what we are going to gain and what they are going to gain, despite their lack of specialists compared to ours and this lack of emphasis, you still feel that there is no question that we are going to get our money's worth?

Dr. RAUSCHER. Yes. Without question. The incidence data alone will be well worth the first year's effort. The exchange of drugs and viruses that they have isolated from children with an acute lymphocytic leukemia we have tried to do for 10 years.

One other point which addresses itself to your question. Cancer research not only in this country, but in the world, can be visualized essentially in three components; that is, early diagnosis, prevention, and treatment. One of the most important opportunities we have now is to push this frontier to the left by trying to identify people as risks even before early disease. We call these "risk profiles." We have to look at many different people in many parts of the world. Because of the data we can get from Soviet scientists, we can cut down the time it takes to accomplish this. As an example, for breast cancer.

Mr. FREY. Like ballplayers, using the computers for study.

Dr. RAUSCHER. Exactly. We have identified some five or six factors which, if all are present in a woman during her peak age period, enormously increases her risk. By comparing their data with ours, we ought to have a good profile for the women who may develop breast cancer.

Mr. SYMINGTON. May I interrupt to welcome Congressman Burt Talcott from California. Tell us who you brought with you today.

Mr. TALCOTT. These are students from the central coast of California, 36 high school seniors from various small towns in central California. They are spending a week in our Capital or places near our Capital to see how the Government works. Ladies and gentlemen, this is Jim Symington from Missouri, Louis Frey from Florida, and Larry Winn from Kansas, members of this committee.

Mr. SYMINGTON. We certainly welcome them all here and are thankful to you for bringing them.

We are hearing testimony from Dr. Roger Egeberg and his colleagues, from the Department of Health, Education, and Welfare, on the President's agreement in Moscow covering the subject of health and medicine. We have had a very interesting day so far, and we are still at it. I will give it back to you, sir.

Dr. RAUSCHER. I have attempted to present three or four examples as to how we think the American people can benefit by these cooperative agreements with the Soviets in cancer research. I would stop here by reiterating what Dr. Egeberg said, and that is I am thoroughly convinced that they are sincere in trying to work with us.

Mr. FREY. We heard testimony last week that one of the problems was when you would want to work with a Soviet scientist or doctor, a specified person, there was trouble in getting that person. In the past, they would pick out who they wanted you to work with, and you could take it or leave it. Do you think this problem will still exist or that you will have a little more freedom?

Dr. RAUSCHER. First of all, I agree that this problem has existed. I can say I think it will be greatly diminished in the sense of scientific exchanges.

Dr. EGEBERG. Tell Mr. Frey how quickly they accepted this team that is going on Saturday.

Dr. RAUSCHER. About the time it took to exchange telegrams.

Dr. EGEBERG. Did you hear that?

Mr. FREY. That is quicker than mail gets back and forth from Florida.

Dr. RAUSCHER. We anticipated going in July. It turns out that most Soviet scientists take July and August off for semivacations, so they suggested we come over immediately, and we are doing that this Saturday.

Mr. SYMINGTON. What is a "semivacation"? [Laughter.]

Dr. EGEBERG. I think I can tell you. A one-month vacation; and if your blood pressure is elevated—say it is 140, which we don't really consider too elevated—you probably get a month in a sanitarium, so between the two, you have had a semivacation.

Mr. SYMINGTON. Every Soviet doctor needs that?

Dr. RAUSCHER. It is traditional in France, in Paris, that they take the month of July off; and in the Soviet Union it is July and part of August.

Mr. SYMINGTON. I meant the month in the sanitarium.

I think it is interesting to see how through leisure and free time they manage to keep the maximum pace to their professional activities. It is something that we have never learned how to do here. Men here are run into the ground and then leave us when they have a number of years of useful service in them.

The old adage is, you can do a year's work in 11 months, but you can't do it in 12 months. This is not unrelated to health generally, too. This is something that I take it that the regime there finds useful. How many days a week is a Russian doctor on duty?

Dr. EGEBERG. Thirty-six and a half hours a week is his official duty. He is allowed to moonlight usually in an official position and may do that for another 20. Dentists, on the other hand, have private practices along with their official 36½ hours, so their hours may be quite similar to ours.

Mr. SYMINGTON. The mention of moonlighting, that is private practice as well for the doctor?

Dr. EGEBERG. Except if you work for the Government, you may turn around and work a separate 20 hours for the union. The unions use a lot of doctors.

Mr. SYMINGTON. They have their own doctors as distinct from doctors that work for the Government?

Dr. EGEBERG. Yes, and they have many privileges and compensations as distinct from what the overall state gives.

Mr. SYMINGTON. I think it would be very interesting to the committee and useful to have a memorandum prepared as an addendum to the testimony here as to the structure of the Soviet medical community, the number of doctors, sex ratio, the paramedical people——

Dr. EGEBERG. I think most of it is in here [indicating].

Mr. SYMINGTON. All right, then I will add any further questions to it if there are any.

Did you have anything more?

Mr. FREY. I had just one further question. Would you support in Congress a resolution endorsing this particular agreement?

Dr. EGEBERG. If you are talking to me, I feel that health is in a very peculiar situation with respect to our dealing with a country such as the U.S.S.R. It is a thoroughly neutral subject which when times are tough, diplomatically, the health relationship continues, As I said just before you came in, when we spoke with Russian scientists and physicians, they said very emotionally—many of them with tears in their eyes thinking of 15 million that Russia lost in the last world war—we have got to keep this communication open. One got the feeling that the implications were broader than health alone. We feel that the health possibilities and potentials are very, very great.

May I at this point add one more thing in line with what Dr. Rauscher was saying? The Soviets have not begun to move around quite as much as we have. They have many ethnic groups and many social groups that have been living in the same place under the same circumstances, eating the same foods for many, many years and they are still doing it, which is no longer true in our country. In an exchange of epidemiological data and trying to determine the relationship of background and disease, we have a great opportunity to work with them. They are, I think, very cognizant of this, and in their last census they gave a whole host of extra health questions to about 5 million people on whom they took the census, and then, by random selection they identified 500,000 whom they were going to subject to a very thorough chemical, physical and historical examination. They are trying to get information which I am sure we will need and find useful.

Mr. FREY. You have hit on the head one of the things that we feel is so important, the tangibles that will result. What we have emphasized is that we think it is extremely important that something positive be done immediately. This is one of the easier areas. There will be areas where we can't do things, and we will have problems figuring out how to do it because of security. In this area, we don't have it. We should establish these important areas now because if we don't, we will be bogged down. I am delighted they will take off in July, and you have got to do it now. I hope we can continue this.

Do you have anything for the record about how they handle their drug problem? And if they have it, the extent of it:

Dr. EGEBERG. I can tell you on the record they don't apparently have much of a drug problem in the U.S.S.R. We hear there is only the beginning of one, unless you want to include alcohol, and they certainly have an alcohol problem. We suggested cooperation in research on the treatment of alcoholics or anything to do with alcoholism, about which I feel very strongly. They feel at the present time that this is a social problem. You may have read the papers recently which took a rather—not exactly punitive, but a somewhat different approach to alcoholism than we have. People who were alcoholics or who behaved asocially would not be allowed to go to certain resorts or take vacations or go to places where other people might have a good time. They are apparently beginning some such a program on alcoholism. We could learn a lot from each other in this area, and will watch what they do carefully.

Mr. SYMINGTON. I am interested in the suggestion that this would be a deterrent for alcoholism. Many people feel if they have a good drink, there is no need to go to a resort.

Dr. EGEBERG. Maybe they will learn something with the experiment. I think we have been through something like that ourselves. If we keep after them, I hope one of these days they will feel they would like to work with us on this problem.

Mr. SYMINGTON. It certainly is a very serious problem, and we have a lot to learn, too.

Dr. EGEBERG. Yes.

Mr. SYMINGTON. How many alcoholics is your estimate the United States has?

Dr. EGEBERG. About 8 or 9 million.

Mr. SYMINGTON. A great number of tragedies.

Dr. EGEBERG. We have one man left, Dr. Rall, who is in environment.

Mr. SYMINGTON. We will be happy to yield to him. We had some testimony yesterday on environmental protection. Undoubtedly this will complement it.

Dr. RALL. Thank you. The National Institute of Environmental Health Sciences is small, we speak after the heart and cancer institute people have talked. We tend sometimes to be forgotten. I think many of our problems in the future are going to be related to the environment. Deputy Minister Burgasov of the Ministry of Health of the U.S.S.R., who is primarily in charge of this, pointed out as Drs. Cooper and Rauscher did, that many of the causes of heart and cancer disease are related to environmental problems.

Now, our efforts in establishing a cooperative program with our Soviet counterparts in environmental health are somewhat more difficult than with heart and cancer, mostly because the field is new and there is not this history of a 10- or 15-year low level, informal exchange between the U.S. and U.S.S.R. scientists. My counterparts in environmental health research had never visited the United States. Almost none of them spoke English. They had very little feeling for what we were doing, how we were organized. They read our litera-

ture, they knew the science of the field, but we just did not have this background of a friendly history of exchange.

Mr. SYMINGTON. By the same token, very few of our people spoke Russian?

Dr. RALL. Absolutely. There are a number of medical students now, interns and residents, who were in high school during Sputnik and resolved to take Russian in college and have taken it and are fairly good at speaking Russian. One of them accompanied us in our trip to Moscow and he was just very useful. He could not speak Russian elegantly, but, well, he knew enough and knew the science and he was a great pleasure. Our program will be decided at a meeting we are having in North Carolina. Our Institute is the only one of the NIH Institutes located outside the research campus in Bethesda. Six Russian scientists will visit us for a week long, giving them a fairly unhurried chance to explore our various research interests in depth. We will cooperate on the importance of assessing toxic effects of pollutants. Russians have been active in determining central nervous system behavior effects of toxic chemicals. They are much ahead. We tend to study tissue damage or changes in clinical chemistry.

Mr. SYMINGTON. If I may interrupt, do they have agricultural pollutants, such the DDT problem?

Dr. RALL. Yes; they do. There is some feeling that the DDT levels in the fat of the Russian people are higher than what we carry in the United States. One of the Russians who will be with the group visiting us is concerned with the toxicology of agricultural chemicals.

The Russian central nervous system studies, the so-called Pavlovian techniques, may be very much better than what we have, or we may have a better method than they do. One of our major efforts will be to compare these two and work together.

We will also be interested in other problems, the possibility that two chemicals, each nontoxic alone, when man is exposed to both together may be very much more toxic. This so-called joint synergistic toxicity is a real concern. The Russians have done some very good work in this area. They were the first to show, for instance, that the red dye, F, D, and C No. 2 is teratogenic and can cause birth defects. They have developed good methods for assaying pollutants and for eliciting subtle contral nervous system effects.

Mr. SYMINGTON. Is that dye the so-called red 2 used in making jellies and jams?

Dr. RALL. Yes, and in making Maraschino cherries.

Mr. SYMINGTON. I thought HEW had not corroborated the carcinogenic impact.

Dr. RALL. This is teratogenesis, birth defects rather than carcinogenesis. It has been corroborated both in-house and outside that the pure compound is foetotoxic.

The Russians used a crude preparation, a plant extract, and there was some question as to what its exact composition was, HEW found that the pure compound was definitely foetotoxic.

Mr. SYMINGTON. Are we talking about the same experiment? Was this made with mice?

Dr. RALL. It is not the same experiment. I will provide the details for the record.

(Information for the record follows:)

Amaranth, a crude material, was reported to be teratogenic, foetotoxic (Bajguseva Vop. Pitan. 27, p 46, 1968), and more recently carcinogenic (Shlenderg and Gaurilenko. Vop. Pitan. 29, p 66, 1970) by the Russians. Studies in the U.S. with the pure F D & C #2 Red Dye have not demonstrated teratogenicity but have confirmed the foetotoxicity. Only one U.S. carcinogenicity study was performed with F D & C Red #2 (in 1953) in 18 rats and it was negative. The U.S.S.R. report showed a moderate incidence of mixed tumors in the animals treated with a high dose of amaranth and no tumors in the controls. A recent NAS-NRC study is reported to indicate that there is no hazard from ordinary use.

Mr. SYMINGTON. I can discuss that later because another finding was reached.

Dr. RALL. I, too, was impressed by their sincere interest in a collaboration. I look forward to seeing them and visiting with them when they come in October and to developing very substantial cooperative efforts.

Mr. SYMINGTON. Thank you very much for the testimony.

Mr. Winn?

Mr. WINN. Thank you, Mr. Chairman.

Dr. Egeberg, the medical and health agreement spells out 100 man-hours per month for specialists to dedicate to pursue joint research for a period over 2 years. Can you tell us how such a program will be financed and what will be the source of the funding in this country?

Dr. EGEBERG. Yes; I can. At least I can start and maybe Mr. Kevan, can finish. Our present agreement is that the country who sends the scientist to the other country pays all of his transportation from the home to that country. The country to which he comes pays for his keep and then a certain modest honorarium per day and rather modest expenses per day for food and so forth, I think $12. Beside the $12, they get a room to stay in or whatever is needed. Arrangements have been made so that we can reciprocate standard social services our people would receive in most other countries, such as health care. We have outside arrangements for insuring them in case they get sick while they are here. Of course, some of them have found almost tragic circumstances when they got sick here and weren't insured. As far as this country is concerned, if it is research in any of the fields that they are interested in that belong to the National Institutes of Health, it will bear the cost of the Russian investigator when he is here.

Mr. SYMINGTON. May I interrupt there, sir? You mentioned that some have suffered tragic circumstances for the want of health insurance while they were our guests?

Dr. EGEBERG. Yes, not just the U.S.S.R., but other countries have had people over here. When they got out of the hospital they had bills they could never hope to pay on the basis of what they have been earning at home. While some have been forgiven, it is a pretty sad circumstance.

Mr. KEVAN. There was one specific instance in the case of a Polish scientist that was here in one of our exchange programs who was involved in a mugging incident in Baltimore which required hospitalization. While he was here in the hospital, he had no physician's cost but the hospital care came up to a very sizable bill for his admission. We had no legal authority to handle this. Because it happened to be in the State of Maryland that has this provision in law of taking care of expenses for people who are injured as a result of this kind of incident. His bill was taken care of that way.

Mr. FREY. If you will yield. I would sure hate to be a lawyer trying to collect. As a practical matter, if someone like that did run up a bill,

you would have a devil of a time trying to collect it unless they had a lot of assets——

Mr. KEVAN. The real problem is what it does to the relations in the program.

Mr. SYMINGTON. Yes, it is cold comfort for a gentleman to know he can abscond and not pay the doctor bill.

Dr. EGEBERG. Does that answer your question adequately?

Mr. WINN. Yes, I am interested in knowing from the space agreement, and medical science and public health, how can the United States expand this effort to take advantage of the enormous capability possessed by the Soviet satellite nations? Was this discussed or considered?

Dr. EGEBERG. I personally visited several of the Soviet satellite nations and they would like to do the same thing.

Mr. WINN. They would not be included?

Dr. EGEBERG. Rumania would not be included. We have a separate agreement with Rumania. I don't know about Poland.

Mr. KEVAN. Cooperation with Poland is under Public Law 480, the special currency program.

Mr. WINN. Have they shown interest? Have they shown an interest?

Mr. KEVAN. Yes, there is an extremely active interest in Poland primarily with some of the institutes involved with the Soviet program and we also have the same program in Yugoslavia. There is a separate exchange agreement similar to the Soviet with Rumania which is just beginning to develop. Again the language problem creates the difficulty.

Mr. WINN. Maybe there hasn't been enough time to fully develop the agreement between ourselves and the U.S.S.R.

We are probably off the subject a little bit, like we seem to have been a couple of times today, but is acupuncture widely practiced in the U.S.S.R., in the United States, as it is in China?

Dr. EGEBERG. With our foreign expert here, I understand there has been some acupuncture used in the U.S.S.R. On the other hand, it is not a customary thing in such wide spread use as in China.

Mr. KEVAN. It has also been used in Rumania and we just received last week some reports from them that we asked for when it was reported in their press that acupuncture was being used. We asked the Embassy to get us some information and it just came in.

Mr. WINN. But it is not used to the extent that we think it is in China?

Dr. EGEBERG. It is being used a little bit in the United States on the west coast.

Mr. WINN. I have read a few articles. I don't know what it is percentagewise. I don't think it would mount up very high.

Dr. EGEBERG. Percentagewise, no.

Mr. WINN. I don't think it would even register at the polls.

Mr. SYMINGTON. If the gentlemen will yield, let us put a question that is of interest to at least two members of our committee. With the interest the Soviet people are giving to tennis, and inasmuch as Mr. Frey and I both have tennis elbows, do you know if any progress has been made in that field?

Dr. EGEBERG. I will write the Minister and ask him. We had a man who had a very bad eye disease in which they seem to be ahead of us

and they took him in over there even though he is a lousy capitalist.

Mr. WINN. I thought tennis elbows fell in the same category as alcoholic elbows.

Dr. EGEBERG. I don't know.

Mr. WINN. Back to the recently signed agreement, it spells out a number of specific diseases in which joint efforts are recommended and I think that is certainly very important and you mentioned quite a few of them. In addition, within this country, further health priorities include certain chronic degenerative diseases, infectious hepatitis, various mental disorders, alcoholism would come into that category, possibly drugs. I had a note along the same line. I am on the Select Committee on Crime. We are halfway through 2 days of hearings in New York involving the use of drugs in the high schools up there—in the schools. We had testimony yesterday that as high as 90 percent of the kids in one junior high school were either drug users or drug addicts, which just sets you back. You just sit there with your mouth open. You can hardly think of a question. Would you comment on the possibility, then, for pursuing certain of these other areas within the context of the new agreements? How broadly do you think we can approach these things?

Dr. EGEBERG. It is broadening all the time.

Mr. WINN. You stated this earlier. Are we all too anxious to cover too wide a field?

Dr. EGEBERG. No, I think each one takes time. We went over in the fall of 1970, I guess it was, and it wasn't until this March that we had a real agreement. Both countries were working about as quickly as they could in trying to accomplish this. When we went back we wanted to broaden from cancer, heart disease, and environment to other fields. We suggested alcoholism, occupational health, the chemistry of schizophrenia in which they have shown great interest and in which they are doing very important work, and a number of others.

Mr. WINN. Did you discuss venereal diseases?

Dr. EGEBERG. No, but at that time we went into the question of distribution of health care which would be a very important one, as far as venereal disease is concerned.

Mr. WINN. Have they had an increase as we have because of their problem on alcoholism?

Dr. EGEBERG. I don't know how much they had. The people with whom we spoke didn't really want to talk about it, and I don't think they were well versed with respect to what the situation is there.

Mr. WINN. I understand.

Dr. EGEBERG. They didn't want to start working on alcoholism as a health measure because they called it a social affair. On industrial or occupational health, they very very gladly said let us do it, but we didn't have an expert in that field with us at that time. So the next time we come around, we will have one in occupational health.

Mr. WINN. These specialty subjects are going to take a little time to develop and explore with the Russians to see if they want to sit down and exchange ideas and teams and things?

Dr. EGEBERG. There will be a little lag just as you said. We would like very much to work with them in the area of circumpolar health,

specifically on diseases, and environmental problems, epidemiology of people who live North and near the Arctic Circle. I was up in Iromsö, Norway, the other day at a meeting at which attempts were made to interest the Soviets in joining such efforts. We have had informal relations with them on such things, but so far no formal relations. We feel we would have much to gain from them on this score.

Mr. WINN. I agree with my colleague from Missouri in that I doubt that we have been able to tell not only their people, because we don't have access to their news media, but we haven't been able to tell our own people what we have been doing—using the polio example, but I would hope that HEW, because they certainly have got the methods down there, you have got a whole staff of public relations and information people that can certainly at least make these team visits, make the people of this Nation aware of the team visits and certainly through HEW, but I don't think you would have any trouble at all securing positions for say at least your counterpart, I forgot his name, if he comes over here and visits, on something like the "Today Show." I am not putting in a plug of "Today," but for some of the nationally famous talk shows. This is the way to do it. I get the idea from the way it was handled when the President was over there, that they are ready for this now, not only in their country, but our own. I may be wrong.

Dr. EGEBERG. No; I think they are. I have been on the Voice of America. I don't know where it was beamed, to talk about this subject.

Mr. WINN. It does pretty well.

Dr. EGEBERG. We are.

Mr. WINN. We would need their cooperation.

Mr. SYMINGTON. Wouldn't it be far better for the Soviet citizen to hear from their own radio broadcasts about these arrangements, than through the Voice of America which, after all, is considered by their Government to be somewhat antagonistic?

Dr. EGEBERG. Yes, as I said, Minister Petrovsky has been on television and radio and written articles about it in the Soviet Union.

Mr. WINN. I am talking about the two of you as an exchange which, to me, if he is on some of our nationwide shows bringing up the same information that you did, this is obvious that both countries are working together, not just you saying in the United States we are working with the Russians and in Russia with him saying we are working with the Americans. It is a little more public relations. This is what gets down to the people to realize how important some of these steps are. Here you have this week this team going to visit. How many are on the team?

Dr. EGEBERG. Five.

Mr. WINN. I am sorry, you did say that. That should be publicized. The chairman of the team should be interviewed before he leaves.

Dr. EGEBERG. He is right in Washington, he could be.

Mr. WINN. I am talking about HEW. Wake up your public relation guys down there.

Dr. EGEBERG. I will take your message myself.

Mr. WINN. You are probably the best carrier we have had in this room for a long time.

Mr. SYMINGTON. Thank you. I think the Soviets have indicated a sensitivity in these matters. In their reluctance to attend any of our space launchings, they let us know it was awkward to invite us back. This is changing. Perhaps the acceptance by your counterpart of an invitation to appear on a U.S. talk show would mean a subsequent invitation to you to go on somethink over there. I think we should be able to do a great deal better than we did in the case of the polio exchange where it would appear that neither country knew what was going on. There was in fact an investment of American medical technology in the lives of the Soviet people which may have saved thousands and thousands of lives, and this at a time roughly parallel to the U–2 incident. It would have been interesting and helpful to offset some of the problems that we had.

Again, on the question of the dominent role that women play in the Soviet medical system—I know that you have already attempted to explain why that is the case. Perhaps you could restate that and then let the committee know if we in the United States are ignoring a potential national resource in failing to educate more women for medical careers?

Dr. EGEBERG. I think we are. A lot of people still feel if you invest money in educating a woman, you lose her through the childbearing period, but we now have statistics to indicate that she lives longer than the male doctor and gives just as many years of service as the male. This helps. This is one of the arguments that often has been used when you think of the very expensive medical education. Woman has many of the qualities one wants to see in a physician, tenderness and ability to give of love—I don't mean that men don't have that. In our school, we had perhaps the biggest women's group in our medical classes than any not purely women's school.

Mr. SYMINGTON. Do the Soviet women doctors marry and have children and live happily ever after?

Dr. EGEBERG. If they work 36½ hours a week, even if they do some moonlighting—when they have a child, they get a year off.

Mr. SYMINGTON. So at the age of 2 he is put in a nursery?

Dr. EGEBERG. Then comes the question of his exposure to their schools, and that is where the older people in Russian society play an important role. They come back into the home and become the foster parents, in a sense, where the parents work.

Mr. SYMINGTON. They may not have left the home in many cases because many families with aunts and uncles live together in somewhat limited accommodations, which has this peripheral value for the working age people. I think there is a lot for us to learn there, not so much in a whole family living under one roof, but in the opportunities for children to be cared for in the absence of the parents. I think the Senate has just voted on it. We are considering it.

Mr. WINN. Mr. Chairman?

Mr. SYMINGTON. Yes?

Mr. WINN. I have one question, if I may. We were talking about the various fields, and I think two that we—we may have covered one when we talked about it. Dr. Cooper—is that your name—when Dr. Cooper talked about the heart attacks and he touched earlier on the average life expectancy, what do their studies over there find?

Is their average life expectancy longer or shorter than ours? How would it compare?

Dr. COOPER. This is the type of epidemiological data which we have not gotten prior.

Mr. WINN. These are some of the things you will be able to discuss?

Dr. COOPER. Yes, and the characterizations of the population as Dr. Rauscher previously described, which is our No. 1 problem in arteriosclerosis for that purpose.

Mr. WINN. Do you have any indication of their record of infant mortality?

Dr. COOPER. I do not, Mr. Winn.

Mr. WINN. We haven't touched on that at all. But if we are going to go to the far end, let us start at the first end.

Mr. COOPER. I do not have any.

Mr. WINN. Do you think that will be one of the subject matters to be discussed in these conversations, or should it be? I think it should be.

Dr. EGEBERG. It could well be. They are in somewhat the same region as far as infant mortality. They use midwives very much, so they have very few people who aren't seen before delivery.

Mr. WINN. Through that midwife system, do you feel that there would probably be the records available?

Dr. EGEBERG. To our surprise, a very large proportion of their people are having their babies in hospitals except far out in the country where they have them at the Punct. They have excellent obstetrical hospitals with, I believe, good survival statistics. The midwives deliver frequently, often delivering some of the doctors' wives, but under the supervision of obstetricians.

Mr. WINN. Would that hamper the recordkeeping system we would normally have through the hospital deliveries?

Dr. EGEBERG. No, they do it in the hospital as part of a team.

Mr. WINN. If that is discussed, it should be pretty comparable?

Dr. EGEBERG. Yes, their records now should be getting good.

Mr. WINN. I had one more question. I think you pretty well covered that about the specific new advantages or benefits you foresee flowing from this new agreement in medical science and public health; as the Chairman mentioned and we are all aware, we have now 20-some-odd public health bills being considered in Congress. Do you see any new advantages in these discussions coming up in the public health field? Are they more advanced than we are in the public health field?

Dr. EGEBERG. I think they have done many things that are well advanced in the field of public health, but I think we still have to explore this whole thing. For instance, even though they are a socialistic nation, they apparently have a great deal of pollution on the western end of Lake Bykol which they said is almost dead. They have problems very much like ours. They have solved many of the problems. For instance, they recently had an epidemic of what—cholera—cholera, just before we went there on one of our visits. They handled that very quickly, very decisively, and with a very small spread.

Mr. WINN. What about in the medical sciences, since this is a Science and Astronautics Committee and we may be entering more in the science field than astronautics, I think all the members of this committee would be interested in the medical science field.

Dr. EGEBERG. Well, that, of course, is what we took our three Institute directors along for this last time. That was very basic scientific information that they were trying to establish together.

Mr. WINN. As I understand your testimony, it worked real well. It was very successful for both sides?

Dr. EGEBERG. We felt it was productive and as far as rapport was concerned, it was very warm.

Mr. WINN. What is the next stage after the top three?

Dr. EGEBERG. We might gain a year from the last time at which time we can introduce new fields we would like to work together on. At that time we will have already——

Mr. WINN. Does a year seem like a long time?

Dr. EGEBERG. It does, except this time we are trying to get started. We would have willingly met a little bit sooner. They wondered if we shouldn't have met a little bit later. The way things are going along, we are going to get an awful lot done by next year.

Mr. WINN. In between?

Dr. EGEBERG. Yes.

Mr. WINN. Particularly with these teams visiting, they are having a team coming over here?

Dr. EGEBERG. Yes, I think one is coming to Rall's Institute, Dr. Rauscher has one, and I have one coming.

Dr. COOPER. Yes.

Mr. WINN. At least three other teams of Russians are visiting us over the next year?

Dr. EGEBERG. On these subjects in the overall pattern.

Mr. WINN. We have an additional team going over and no shortage of volunteering?

Dr. EGEBERG. A lot of our people would like to go. We have individuals who have done some very good work with the Russians.

Mr. SYMINGTON. The Joint Committee which is to be established, we haven't discussed that today. On our side, how would that be made up?

Dr. EGEBERG. So far, I have been the cochairman for the United States and Dr. Venedictov has been the cochairman for the Soviet Union. Dr. Paul Ehrlich has been the alternate cochairman, he is the head of our International Office in the Secretary's office and Dr. Schepin has been his counterpart in the Russian group.

Mr. SYMINGTON. It is interesting because we didn't receive any testimony from the other spokesmen for the other three agreements, any enlightenment on when such a committee would be established, and who would be on it.

Dr. EGEBERG. May we give you that?

Mr. SYMINGTON. Yes.

Dr. EGEBERG. We have it here and we will be happy to see that you are given all this information.

(Information requested for the record follows:)

List of participants in the 1st session of the U.S.-U.S.S.R. Joint Committee for Health Cooperation

FOR THE U.S.A.

1. Roger O. Egeberg	Co-chairman, Counsellor for Health Affairs to President of the U.S.A.
2. S. Paul Ehrlich, Jr	Deputy Co-chairman, Director of the Office of International Health, Department of HEW of the U.S.A.
3. Robert Q. Marston	Member of Committee, Director of the National Institutes of Health, U.S.A.
4. Carl G. Baker	Member of Committee, Director of the National Cancer Institute, National Institutes of Health, U.S.A.
5. Theodore Cooper	Member of Committee, Director of the National Heart and Lung Institute, National Institutes of Health, U.S.A.
6. David P. Rall	Member of Committee, Director of the National Institute of Environmental Health Sciences, National Institutes of Health, U.S.A.
7. James E. Muller	Adviser, Coordinator, Office of International Health, Department of HEW, U.S.A.
8. Jack L. Tech	Adviser, Scientific Attaché of the Embassy of the U.S.A.-Moscow.

FOR THE U.S.S.R.

1. D. D. Venedictov	Co-chairman, Deputy Minister of Health of the U.S.S.R.
2. P. N. Burgasov	Deputy Minister of Health of the U.S.S.R., Chief Sanitary Physician of the U.S.S.R.
3. E. I. Chazov	Deputy Minister of Health of the U.S.S.R., Chairman of the Scientific Council on Cardiology of the U.S.S.R. Academy of Medical Sciences.
4. O. P. Schepin	Deputy Co-chairman, Chief of the External Relations Department of the U.S.S.R. Ministry of Health.
5. N. N. Blokhin	Member of the Committee, Director of the Institute of Experimental and Clinical Oncology of the U.S.S.R. Academy of Medical Sciences.
6. I. K. Shkhvatsabaya	Member of the Committee, Director of the A.L. Myasnikov Institute of Cardiology of the U.S.S.R. Academy of Medical Sciences.
7. G. I. Sidorenko	Member of the Committee, Director of the A. N. Sysin Institute of General and Communal Hygiene of the U.S.S.R. Academy of Medical Sciences.
8. G. I. Avdeev	Adviser, Chief of the Laboratory, Moscow P. A. Herzen Research Institute of Oncology.
9. O. A. Alexandrov	Adviser, Chief of Section, Department of International Health, All-Union N. A. Semashko Research Institute of Social Hygiene and Public Health Organization.
10. M. N. Savelyev	Adviser, Deputy Chief of the External Relations Board of the U.S.S.R. Ministry of Health.

Mr. SYMINGTON. I notice that this agreement remains in force for 5 years after which it is extended an additional 5-year period unless one of the parties decides against it. A couple of the other agreements have to be extended by mutual agreement. Is there any significance to attach to the difference in approaches?

Dr. EGEBERG. I don't think so. Most of us wanted the strongest thing we could get. The 5 years was apparently a very good advance. We just chose that language.

Mr. SYMINGTON. I didn't think there was any significance myself.

Dr. EGEBERG. No.

Mr. SYMINGTON. If you could submit for the record, sir, a general statement concerning major medical areas where the United States might have something to offer through its leadership to the Soviet Union and vice versa, I would appreciate it.

(When received this document will be placed in the committee files.)

There was mention earlier of the stomach cancer rate as between the Japanese in Japan and the Japanese here. It raises the desirability of a multilateral approach of some of these studies. I think that would bring answers sooner than simply a bilateral approach. Would that be so?

Dr. RAUSCHER. Yes, sir, Mr. Chairman. Much of this is ongoing now in some cases informally and in some cases formally. Specifically with Japan, we do have a formal agreement. We have intense interest from Australia and from other countries of Europe, and so forth. In fact, the United States is providing specific dollars in some of these instances.

Mr. SYMINGTON. I am interested in a particular area of medicine, because of the purpose for which Soviet mental institutions have been used in the last decade or so. Is psychotherapy an advanced art there and do many people seek it and do they get it?

Dr. EGEBERG. According to Dr. Bertram S. Brown, who is the head of our National Institute of Mental Health, when they talk to scientists in the field of schizophrenia and other psychiatric diseases, they are very much on a par and would like to work together. I know that Dr. Brown would like to achieve a closer working relationship with the Soviets. As to the use of institutions, I don't know what to say.

In California, there were 10 times as many people put in psychiatric institutions in northern California than southern California and everyone thinks Los Angeles is crazy. It wasn't because of the difference in the population, it was the economics and patterns—it was tragic, it has been stopped. That was the pattern just a few years ago.

Mr. SYMINGTON. That is very interesting. Is there a difference in the criteria that was used?

Dr. EGEBERG. Yes, in the north an older person who has broken a leg and perhaps needs a small operation, might be moved from his home and put into an institution. If he was subsequently confused, he might be sent to one of the big psychiatric hospitals. In the south, we sent them home or near their home and they lost their confusion.

Mr. SYMINGTON. I think that the American people would register some concern at least at the thought that people were sent to mental institutions for any other reason than their inability to cope with their environment. Stories have come out of the Soviet Union that dissident writers and poets sometimes end up there. I hope that we will find increasing reassurance that this isn't happening because that isn't something we want to learn from people on any side of the world.

Dr. EGEBERG. We spoke to people on both sides. A lot of human qualities enter that problem.

Mr. SYMINGTON. Well, you want a doctor to make that decision and not an official of the Government?

Dr. EGEBERG. Yes.

Mr. SYMINGTON. Mr. Price, do you have any questions?

Mr. PRICE. No, Mr. Chairman.

Mr. SYMINGTON. Dr. Egeberg, this has been a stimulating day for us. There was a caucus this morning, as you may know. I can assure you that this testimony will be read thoroughly and with great interest. As I recall the words of a sometime poet, "There was a tide in the affairs of men which, taken at the flood, leads on to peace." I have only changed one word. I think your work has contributed greatly to that tide. Thank you very much.

Dr. EGEBERG. Thank you for your interest. We have enjoyed being here.

Mr. SYMINGTON. The meeting is adjourned.

(Whereupon, at 12 o'clock noon, the hearing was closed.)

○