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A busy week for science in Moscow

In a week in Moscow culminated by the signing of the historic strategic arms limitation agreement by President Nixon and Soviet Communist party leader Leonid I. Brezhnev, U.S. and Soviet leaders also signed agreements on space, science and technology, health, and the environment. All were products of a series of negotiations between officials of the two countries during the months prior to the Moscow meeting. Reports on the four agreements follow, starting with the one that involves a joint U.S.-Soviet manned space mission in 1975:

Space: A joint manned mission in 1975

The space agreement signed by President Nixon and Premier Aleksei N. Kosygin May 24 cements ten years of general efforts toward U. S. and Soviet cooperation in space and two years of specific and active pursuit of such cooperation (SN: 5/1/71, p. 303).

The document outlines plans for cooperation in fields such as meteorology, study of the natural environment, planetary exploration and space biology. But clearly the most visible will be the joint docking mission scheduled for 1975: The whole world will be able to watch and listen via television and voice communications as Russians and Americans work together in space, according to James C. Fletcher, administrator of NASA.

The purpose of the mission as outlined in Article 3 of the agreement is "to enhance the safety of manned flights in space and to provide the opportunity for conducting joint scientific experiments in the future." It will involve the rendezvous and docking of an Apollo command and service module (CSM) and a new docking module with a Soyuz spacecraft. The decision by the Soviets to use the Soyuz instead of the more complicated and sophisticated Salyut space station (SN: 9/11/71, p. 167) was revealed to NASA officials only in April and came somewhat as a surprise. The 24-foot-long Soyuz is about one-fourth the size of Salyut. It can house comfortably only two or three men. Salyut is said to be able to house 24 (SN: 5/1/71, p. 298). Accordingly, the Soviets also announced they would be using only two cosmonauts for the mission.

The Apollo CSM will be launched first from Cape Kennedy by a Saturn 1-B rocket. It will carry two or three astronauts into a low earth orbit of 110 nautical miles. The plane of the orbit will be inclined 51.6 degrees to the equator in order to pass over the U.S.S.R. launch site. After the CSM separates from the second Saturn stage, it will extract the docking module in much the same way the lunar module is extracted on a moon mission. The CSM will then turn around and dock with the docking module.

Then, according to Fletcher, the Soyuz spacecraft will be launched into an orbit of about 145 nautical miles. The Apollo craft will then begin an active rendezvous sequence using Apollo radio and optical guidance systems to maneuver and dock with the Soyuz.

The actual docking of the two craft is the prime objective of the mission. They will remain docked for up to two days. During this time, one or two astronauts will pass through the docking module into Soyuz, carrying voice and communications equipment and an additional television camera with them. Then later a cosmonaut will accompany an astronaut back through the module to the CSM. While docked the two crews will perform numerous tests of the systems. It is not clear what, if any, scientific experiments will be done.

The docking module, which will be built by the United States at an estimated cost of $50 million, is a cylindrical shaped structure, approximately five feet in diameter and ten feet in length. It will serve as an airlock for the internal transfer of crew between the different atmospheres of the two craft. The new androgynous docking collar (which will be placed on all next generation spacecraft of both nations) is located at the free end of the docking module. Instead of the male-female plug-in system now used, the new system has interlocking fingers. Inside are stored the necessary gases, a thermal control loop, and the displays and controls necessary

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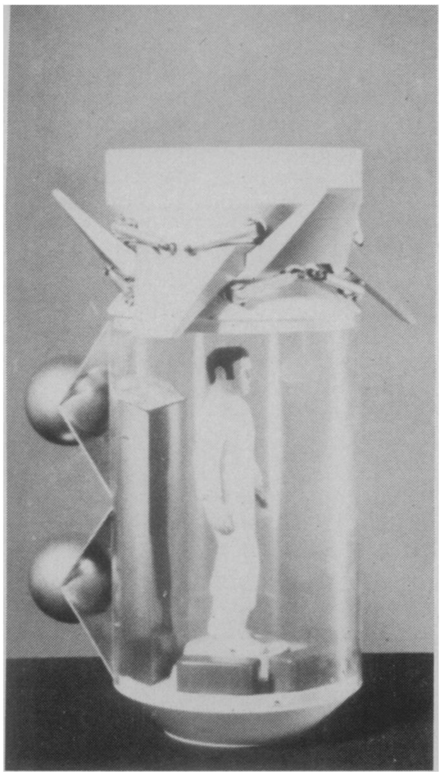

NASA
Docking module will unite two craft.

for safe operation of two different pressure levels. The Soyuz craft uses a mixture of nitrogen and oxygen at a cabin pressure of 14.7 pounds per square inch (psi). The CSM uses pure oxygen at 5 psi. Consequently, the return visit from the Soyuz back to the CSM will require an intermediate stop of approximately two hours in the docking module for the two men to perform the necessary oxygen-prebreathing exercises before they can go safely back to the lower operating pressure of the CSM.

Most of the technical aspects of the mission have already been ironed out by joint working groups that have been meeting during the last year in Houston and in Moscow. Now will begin the astronauts' and flight controllers' training. Controllers and crews of both nations will have to be thoroughly familiar with both spacecraft and systems, and be able to speak both English and Russian. Training will take place at Houston and in the Soviet Union.

Now that the mission is firm, a flurry of activity has begun at Houston involving a little game of Russian roulette to determine who will get to fly on the mission. Astronauts who have not studied Russian in the past are now doing so. Others have been eliminated from the race. They have been fired. (After Apollo 17 in December, there remain only three approved Skylab missions, for which nine astronauts have been selected, plus the joint docking mission.)

The total U.S. investment in the joint mission will be about $250 million. Glynn S. Lunney of NASA's Manned Spacecraft Center and K. D. Bushuyev of the Soviet Union have been named directors of the joint program.

Science: Possible joint research projects

The agreement on cooperation in science and technology augments and expands previous scientific exchange agreements between the United States and the Soviet Union. Some exchange of scholars and information was provided by the regular 1971-1972 agreement on exchanges in scientific, educational and cultural fields, signed April 11, but last week's action is expected to broaden both participation by U.S. and Soviet scientists and the range of areas in which cooperation may ensue.

American officials express hope that stepped-up cooperation between the two countries will accelerate scientific and technological progress. Edward E. David, President Nixon's science adviser, lists several research areas where the effect should be more vigorous activity in the United States: new sources of energy (especially thermonuclear fusion), management and systems science, wise use of natural resources, weather modification, superconductivity and high-energy physics.

For the past 14 years, U.S. and Soviet scientists have engaged in limited cooperation as a result of the regular exchange agreements. But, David points out, there have been few joint research activities.

The new agreement sets up for the first time a high-level commission to establish cooperative projects and see that they are carried out satisfactorily for both countries. In the United States, the White House Office of Science and Technology, which David directs, will be the executive agent for the U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation; in the Soviet Union, the State Committee of the U.S.S.R. Council of Ministers for Science and Technology will be the agent.

David expects the U.S. side to have four or five core members, with an additional three or four members selected for specific meetings. The commission will meet at least once a year, in Moscow and Washington alternately. Secretariats will be established to maintain contacts between meetings. David expects to meet soon with his Soviet counterpart to agree on guidelines and procedures for the commission.

In some ways, the agreement seems merely a confirmation and expansion of previously agreed-upon principles of cooperation. But the establishment of the joint commission should greatly ease the frequent bureaucratic obstacles to freer exchange and cooperation. And the concrete possibility of actual joint research projects adds a new twist. By this David means dividing up the amount of research to be done on some complex problem, assigning one portion to one country and one to the other, then pooling the results. This kind of division of labor is not really done now, in a formal, policy-level sense. David also points to the future possibility that the United States and the Soviet Union will establish some joint research facilities.

Of course, all this is words until the new commission is operating and a bolstered program of scientific cooopera-tion is under way. One unknown factor is to what degree the Soviet Union, which has frequently made difficult or impossible the travel of certain of its own scientists to Western countries, intends to modify such actions. But to the many scientists in both countries who have hoped for expanded opportunities for cooperation, the agreement is a good sign.

Health: Focus on cancer and heart disease

Since the United States and the Soviet Union have been cooperating in medical research for 14 years, the new agreement on medical science and public health is not a new concept. Nonetheless the contract is unprecedented in its focus of attack, and in the scope and intensity of cooperation that can be expected to ensue among scientists from the two countries.

For the first time, themes of research have been singled out. Cancer, heart disease and environmental health were chosen because both Soviets and Americans are particularly concerned about them at this time. Within each theme, three or four areas for concentrated research have also been cited. The areas for cancer research, for example, are: chemotherapy, immunotherapy of human tumors, viruses of leukemia tumors in monkeys and humans and the genetics of tumor cells.

In the past, exchanges of scientists between the Soviet Union and the United States have been brief and sporadic. Under the May 23 agreement, scientists will be pursuing "common objectives over longer periods of time with operations of common protocols and methodologies, including joint operations where appropriate," Theodore Cooper, director of the National Heart and Lung Institute, points out. During the next several months, the first American teams of medical researchers will be going to the Soviet Union to talk with their counterparts there, to visit their laboratories and to decide how collaboration in their specific research areas might be improved.

Under the new agreement, exchanges of scientific conferences and lectures between the Soviet Union and the United States are also in prospect. There will be direct contact between scientific medical societies and the editorial boards of medical journals, joint development of new types of medical equipment and drugs and an exchange of laboratory specimens. Frank J. Rauscher Jr., the new director of the National Cancer Institute, says the United States is getting ready to send to the Soviet Union samples of some hundred cancer viruses, including several suspected of causing human cancer. American scientists are anxious to receive samples of a virus that Soviet scientists say they discovered in patients suffering from leukemia and that proved capable of causing cancer in monkeys and baboons.

Environment: Sharing different approaches

Gordon J. F. MacDonald, a member of the President's Council on Environmental Quality and a major architect of the new U.S.-Soviet environmental agreement, told SCIENCE NEWS there is no doubt that both countries have a great deal to gain by it.

Envisioned in the agreement are actual joint studies, as well as the more usual information exchanges, in a variety of environment-related areas, including air and water pollution, agricultural pollution, urban problems, preservation of natural areas, climatological and genetic effects of pollution, earthquake prediction, arctic and subarctic ecology and legal and administrative approaches to environmental problems.

"Soviet approaches to technology, to population problems, to urban planning are very different from ours," MacDonald said. In one area, arctic and subarctic ecology, "by virtue of their geography, they have done a great deal more than we have."

The Soviets have also moved much further along than the United States in dispersing population into new cities in previously unsettled areas. MacDonald believes this was not accomplished through blunt coercion of Soviet citizens, but rather through incentives, such as better housing, which might work equally well in the United States.

Although U.S. and Soviet actions in pesticide regulation appear to be similar, it is possible, suggests MacDonald, that Soviets may have done more about water pollution from agricultural runoff. Air pollution from stationary fuel burning is not serious in the Soviet Union because of its abundant natural gas, but auto-caused air-pollution is growing there and the United States has valuable expertise to share regarding that complex problem.

In addition to the new cities studies, there will be unprecedented joint social scientific studies of urban problems, including mass transit needs, open space, suburban sprawl and others. □

Stockholm: Toward an ecologically aware world

The United Nations Conference on the Human Environment, which starts in Stockholm June 5, is, in a way, an anticlimax. Simply because the conference was scheduled, a great deal of environmental action has already occurred. Some 70 nations, for instance, are submitting reports on domestic environmental problems. In many cases, these reports are first efforts by these nations to assess the state of their environments.

The special agencies of the United Nations have also prepared reports on subjects of international interest, ranging from deforestation to marine ecology. Other groups have written reports on environmentally significant institutional problems, running the gamut from environmental aspects of industrial growth to proposed organizations for an international environmental effort. British economist Barbara Ward Jackson has drafted a broad conceptual paper called "Report on the State of the Environment" with the guidance of an international group of scientists headed by microbiologist René Dubos of the United States.

As pointed out in earlier SCIENCE NEWS articles and in another article in this issue (p. 364), the main benefit of much of this preparation may lie more in creating public awareness of

Astronomy: The next 10 years

From time to time, the National Academy of Sciences empanels boards of specialists in one field of science or another to draw up a comprehensive report of the state of their art with recommendations for the next 10 years' progress. This week the Astronomy Survey Committee made public volume I of their report, *Astronomy and Astrophysics for the 1970's*, the first such consideration of astronomy since 1963.

Astronomy has developed rapidly in the intervening decade. There are branches of astronomy that did not exist or had only begun to exist in the early 1960's, and the report recommends new specialized equipment for them. It also appears to mark the beginning of the end of the centuries-old trend toward larger and larger single telescopes and the beginning of the beginning of the end of optical astronomy's century-old reliance on photographic plates.

For centuries optical astronomers and for decades radio astronomers have sought telescopes with larger and larger mirrors because the larger collecting area increases both resolution and sensitivity. Now it appears that the technological limit on size of fully steerable mirrors is being reached. The report does recommend two large radio mirrors. One would be rather colossal: a 440-foot dish for observations at one centimeter and longer wavelengths. The other would be a 215-foot reflector for millimeter waves, specifically to serve the new field of molecular astronomy. But these two are numbers 5 and 10 on the list of 11 priorities.

The success of other methods of acheiving high resolution, notably aperture synthesis, in which signals from a number of small mirrors are combined to simulate the aperture of a much larger one, is reflected by the report's giving first priority to the very large radio telescope array that has already been approved by the Government (SN: 3/25/72, p. 196).

A shadow no bigger than the image of a twentieth-magnitude star lies over the use of photographic plates to record data in optical astronomy. Emulsions just do not give reliable data from faint sources. A number of electronic devices similar to television cameras are under development to do the job (SN: 5/6/72, p. 300). The report gives second priority to development of these devices. If they are successful it may become possible to import aperture synthesis into optical astronomy, combining outputs from an array of small mirrors to simulate a large one. The report recommends ultimately an equivalent aperture in the 400-to-600-inch range. Failing this, another 200-inch conventional mirror should be built.

The new field of infrared astronomy should have a large ground-based telescope (three to four meters), says the report. Continued pursuit of space and high-altitude programs for X-ray, infrared, ultraviolet, radio and optical wavelengths is urged, as well as more support for theoretical studies, and, in eleventh place, a number of new astrometric instruments for better determining the positions of stars.

The committee estimates the whole high-priority program would cost $884 million over 10 years, less than the cost of one new aircraft carrier.