truth under these circumstances is open to question. Parker, in his majority report, argued that the techniques must have been effective because the information gained from internees led to the identification of an additional 700 members of the IRA and the discovery of a significant number of hidden arms. Gardiner, in the minority report, opines that the same information could have been obtained by the methods proved effective in World War II.

Whatever the efficiency of the brainwashing methods, Prime Minister Heath stated in March, after publication of the Parker report, that the techniques described by Compton would not be used in the future, and in fact had not been used since November. Interrogation in Northern Ireland, he said, would be continued by other methods.

What those other methods might be he did not specify, but there continue to pour from prisoners of the Royal Ulster Constabulary allegations of beatings, electric shock, and administration of "truth drugs." Some of these allegations are supported by local doctors. (Last month, for example, a Newry practitioner, Dr. Seamus McAteer, stated that amphetamines had been found in the urine of a suspect interrogated by the RUC. He inferred that the man had been given 30 milligrams of amphetamines on three or four separate occasions, McAteer told *Science*.) Whether or not these particular allegations are well-founded, the psychological techniques are no longer in evidence. The British government deserves some credit for renouncing them, at least in comparison with the record of the French government, say, in Algiers. Only recently, General Jacques Massu calmly admitted that torture, including electric shock, was regularly used against the rebels.¶ And having taken root in Algiers, torture soon spread to metropolitan France. Brainwashing, which probably contributed in significant measure to the revulsion of the Catholic population against internment and the subsequent downfall of the Stormont government, seems to have enjoyed only an Indian summer on British soil.

—NICHOLAS WADE

¶ Jacques Massu, *La vraie bataille d'Alger* (Plon, Paris, 1972), 33.60 F.

Soviet-U.S. Summit: Science Accords Open the Way to Joint Projects

The strategic arms limitation agreement was the crowning public achievement of the Russian-American summit meeting, but several other accords, for which quiet preparations had been months in the making, promise to supply a coherent framework for cooperation in the areas of health, space, the environment, and science and technology. Taken together, they represent not only a significant expansion of programs already in existence, but forays into areas hitherto unexplored—the environment agreement being a prime example. The agreements, all of which call for the establishment of new, joint Russian-American commissions, are designed to insulate cooperative scientific endeavors from the stresses of international politics by putting authority into the hands of appropriate government agencies rather than the foreign ministries of the respective countries. All the pacts are open-ended—that is, automatically renewable after 5 years—and all take scientific interchange beyond the traditional exchange of ideas and scientists and into the realm of joint research on specific projects.

Of most immediate interest to the scientific community is the agreement on science and technology, which goes considerably beyond the renewed 2-year scientific and cultural exchange agreement signed in April.

Edward E. David, Jr., director of the Office of Science and Technology (OST), has been named the U.S. executive agent for the agreement. The joint committee, which will meet once a year, alternating between Washington and Moscow, will draw members from various layers of the scientific community, including industry, government, universities, and private foundations.

"In the past we have looked upon international science and technology as based primarily on the camaraderie of scientists and engineers," said David, explaining that now each cooperative venture will be formally overseen by the pertinent Soviet and American agencies.

According to OST, prime areas of interest will be new energy sources—particularly nuclear fusion power generators—management and systems science, efficient use of natural resources, weather modification, superconductivity, high energy physics, and basic science.

There has already been considerable effort made toward cooperation in high energy physics with American and Soviet scientists planning experiments on each others' machines at Serpukhov and Batavia, Illinois. But the other areas need cultivation. The Americans, for example, are interested in Soviet work on magnetohydrodynamics—a system of converting fuel plasma directly into electricity. The Soviets are interested in computer technology, electronics, materials research, and the application of systems analysis and management techniques to major problems.

The agreement is expected to be a stimulus to international industrial cooperation, and David expressed confidence that the pooling of the two countries' scientific knowledge will help speed new technologies out of the R & D stage and into commercial markets.

Another agreement that came under the President's pen was an environmental pact—a totally new departure for the Soviets and the first one the United States has signed covering a wide range of issues (the April pact arranged with Canada covered only one area: the Great Lakes). The Council on Environmental Quality (CEQ) thought this pact up last fall, and negotiations with the Soviets were begun in March.

Eleven areas of specific interest are outlined. Prime among these will be joint work on sewage and industrial waste treatment. Other areas readily amenable to cooperation are the urban environment, earthquake prediction, and the problem of agricultural wastes. The Soviets have also expressed somewhat surprising interest in investigating the comparative legal and administrative procedures of the two countries for

promoting environmental protection. Under the Soviet structure, the ministry in charge of a given field, such as agriculture, is also responsible for promulgating relevant environmental strictures. This puts the ministries in a position similar to that of the U.S. Atomic Energy Commission, which both fosters and regulates atomic energy uses. However, this structure has allowed the Soviets to put their foot down in some areas. They are beginning to phase out hard pesticides in agriculture, says CEQ member Gordon MacDonald, and leaded gasoline is not permitted to be sold in cities.

The environment agreement is expected to stimulate Soviet-American trade in antipollution technology, and could also lead to a form of international technology assessment, such as did not occur with reference to the supersonic transport.

MacDonald points out that both countries have much to gain: while the United States has an edge on air and water pollution control technology, the Russians know a lot about urban mass transit and Arctic ecology. They also have first-hand experience in putting a hot-oil pipeline through Arctic tundra, a circumstance that some observers believe will give Nixon persuasive data to back up the Administration's desire for an Alaskan pipeline.

The health agreement, too, regularizes and formalizes activities that have previously been included in general agreements negotiated at the foreign ministry level and whose aims have frequently tended to serve political rather than scientific interests. For the first time, cooperation in medical areas is put under the direction of the ministries involved [the U.S. Department of Health, Education, and Welfare (HEW) and the Soviet Ministry of Health]. The substance of the accord was agreed upon by the two ministries last February; it has now been elevated to an intergovernmental accord supervised by a joint committee whose American head is Roger Egeberg, the President's special consultant on health.

Three major fields have been singled out for cooperative research projects: cardiovascular diseases, cancer, and diseases associated with the environment. The agreement also provides for unprecedented exchanges of drugs, as well as medical equipment and technology. Frank Rauscher, director of the National Cancer Institute (NCI), has already announced that NCI plans to send samples of about 100 assorted cancer viruses to Soviet scientists and that, in return, the Soviets are expected to give NCI a number of anticancer, particularly leukemia, drugs to test for potential application here. Officials of HEW say they hope the agreement, which runs for 5 years, will open the way for broader exchanges, covering areas such as health care delivery, occupational health, viral diseases, and schizophrenia.

Fellowship in Space

The new space accord, in addition to spelling out areas of mutually profitable research, puts the final stamp on a scheme that has been in the works since 1969: the linking up of a Soviet and an American space vehicle in orbit sometime in 1975. An Apollo command and service module with two or three astronauts and a Soviet Soyuz with two cosmonauts will perform the operation —a rather spectacular departure from the usual cooperation, which has not amounted to much more than the exchange of moon samples. Until a couple of months ago, the Soviets were planning to use their Salyut space station as a dock for both vehicles, but plans were changed at the last minute because the Soviets decided it would be too complicated. The primary goal of the maneuver will be to test rescue capabilities in outer space, but, as NASA head James Fletcher said, the flight maneuvers "will be but the highly visible tip of a large iceberg of solid cooperative effort among government officials, engineers, operations personnel, and astronauts and cosmonauts of both countries." Not only does the iceberg consist of an unprecedented peek into each others' space technologies—astronauts will be trained in running each others' vehicles and personnel will receive training in each others' countries —but it also provides needed work for NASA. The $250 million docking project will allow the Apollo team of 1000 to 2000 persons to be kept intact; some lucky California aerospace firm will get a $50 million contract for building the docking module, which is to be carried by Apollo; and some 4400 new jobs will be created, mostly in industry, during peak preparation activities in 1974. The project also amounts to a program of guaranteed national appeal for a NASA that can expect no more than a relatively stable budget for the remainder of this decade; it also gives NASA something to do between its other two big projects—Skylab, which will be launched next May, and the space shuttle scheduled to go into operation at the end of the decade.

NASA is operating on the assumption that the joint docking is only the first in a series of increasingly ambitious mutual experiments—serving both the causes of economy and international understanding—which could conceivably lead to something as grandiose as a joint landing on Mars 20 years hence.

All of these agreements are, of course, overshadowed by the SALT (strategic arms limitation talks) pact, since, in order to cooperate, both parties must be alive. The SALT agreements, 2½ years in the making, are basically designed to forestall aggression by assuring that each side could destroy the other even after absorbing a first strike. The package comes in two parts: a treaty limiting defensive antiballistic missile (ABM) installations and an executive agreement freezing the number of offensive strategic weapons at the number extant or under construction as of 1 July.

The treaty permits each country two ABM installations to protect its intercontinental ballistic missile sites—one at the national capital and one somewhere else. One hundred ABM's are allowed at each site. The United States already has its ABM site prepared around its Minutemen missiles at Grand Forks, North Dakota. Work on another installation in Malmstrom, Montana, will be halted, although $22 million has already been spent on it. A proposal to ring Washington, D.C., with ABM's has met with a good deal of opposition; presumably there will now be more pressure to go ahead with it. The Russians, for their part, already have 64 ABM's in place around Moscow and are planning another site 780 miles from the capital, east of the Ural Mountains. The most significant aspect of the defensive agreement is that both countries have agreed to abandon any idea of putting most of their land and population under ABM umbrellas. The agreement also limits radar installations, which are crucial to the operation of ABM systems.

The agreement on offensive weapons, which provided considerably more difficulties in negotiating, is in the form of a 5-year executive understanding, whose provisions may be expanded and hardened into treaty form during future SALT talks.

The agreement leaves the Russians with an edge both in land-based missiles and missile-launching submarines, a

fact that causes rumbles of concern among congressional hawks. This edge is offset, according to the Administration, by the qualitative superiority in U.S. weaponry, including computer technology. The U.S. lead in the development of MIRV (multiple independently targeted reentry vehicles) warheads is regarded as particularly significant. The Russians have larger, but less accurate, warheads and are not expected to have a good supply of MIRV's for another 5 to 8 years.

The matter of inspection—which, because of the Soviets' abhorrence of on-site inspection, provided obstacles to the consummation of the 1963 treaty barring atmospheric testing—has been solved because both countries now have spy satellites adequate for the job.

Two other agreements were signed at the summit: one to reduce mutual harrassment by Soviet and American navies, the other a joint commission to talk about trade. A joint trade agreement was anticipated at the summit, but apparently it will take longer to straighten out such issues as long-term credits for wheat transactions, settlement of the U.S.S.R.'s World War II Lend-Lease debt, and Russia's desire to get on a "most favored nation" trade basis.

From what President Nixon told Congress on his return, the two countries are indeed heading toward a practical and businesslike, if not affectionate, relationship. The effect of the summit agreements, if they are followed, will be to involve many layers of the scientific community in stable, long-term, cooperative projects. Presumably such a welter of ties, joint committees, and mutually dependent projects will spring up that neither country will let third-party aggravations, such as in Vietnam and the Middle East, jeopardize an increasingly productive relationship.

Everything is at the budding stage now—by the end of the summer, after initial meetings have taken place, the significance of the autographing marathon in Moscow will be clearer.

—CONSTANCE HOLDEN

Smart Bombs: Air Warfare Undergoes a Reluctant Revolution

As military authorities tell it, Richard Nixon's Operation Linebacker —the code name for the renewed bombing of North Vietnam—is turning out to be considerably more devastating than Lyndon Johnson's Rolling Thunder of 1965–68. One major reason for the air war's deadly new efficacy is said to be the introduction of laser- and television-guided "smart bombs" in the campaign against the North. According to Columbia University physicist Richard Garwin, a former science adviser to the Department of Defense, these new guided weapons have brought about a "revolution in bombing accuracy"—one that permits the destruction of bridges, petroleum tanks, and other targets with surgical neatness, while greatly reducing "collateral" or inadvertent damage to civilian populations.

It happens, however, that the revolution in bombing and its presumed benefits for the hapless residents of Hanoi and Haiphong have been waiting on the arsenal shelves a lot longer than most people thought. Last week, Alexander Flax, a former assistant secretary of the Air Force, revealed that the laser-guided bombs were made available to the Air Force as long ago as 1967, but that high military officials evidently were not sufficiently impressed with these exotic new weapons to use them at the time.

"We had the bombs in 1967, but we couldn't find any customers," Flax said in a brief interview in Washington. Asked if laser-guided bombs might have helped reduce losses o pilots and aircraft as well as civilian casualties during the height of the bombing campaign in 1967, he replied that they probably would have.

Flax, who is now president of the Institute for Defense Analyses, dropped his revelation during a 2-day seminar on "science and public policy" sponsored by the Council for the Advancement of Science Writing and the Alfred P. Sloan Foundation. His remarks caught no apparent notice by the press, probably because competing news conferences in Washington that day drew away most of the reporters who had attended earlier.

He said it was difficult to pin down precisely who resisted the use of the laser weapons in 1967 or why, although he indicated that some Pentagon officials and field commanders may have felt that the complex new bombs were inconvenient for bomber crews to use. He did say, "We had a production capacity of 100 [laser-guidance units] per month in 1967, and we couldn't find any takers."

The bombs aroused "wild enthusiasm" after the bombing halt of March 1968. As the focus of the air war shifted to the network of supply trails meandering down through Laos and Cambodia, Flax said, pilots found during late 1969 and early 1970 that the new "smart bombs" were superbly adept at hitting trucks and other small targets.

In principle, the laser guidance system is simple, and it makes for one of the cheapest guided weapons in the American arsenal. Devised in 1966 as a "kit" that could be affixed to conventional bombs weighing anywhere from 500 to 3000 pounds, each unit costs about $3500 to install on one bomb. This involves mounting a laser-light sensor on the bomb's nose and some movable steering vanes on its body. The vanes adjust the bomb's ballistic path as it falls toward the target.

An attacking aircraft—not necessarily the one that drops the bomb—aims a laser beam at the intended target and the bomb simply homes in on the reflected light. The guiding plane may twist and turn in any evasive action necessary, so long as it keeps its laser beam pointed at the target.

Air Force spokesmen at the Pentagon indicate that the laser-guided bombs now being used are mostly in the 2000- to 3000-pound range and are routinely directed at "priority, heavily defended, point targets" in both North and South Vietnam. One of the weapon's more widely publicized accomplishments is the reported destruction of the Thanh Hoa bridge in North Vietnam, which stood intact under repeated bombing raids from 1965–68. *Aviation Week* reports that a single, 3000-pound, laser-