grow up to 6 feet tall and put down roots as deep. If the plant is heavily grazed, its roots make a shallower penetration and, in dry periods, may fail to strike water. The perennial grasses are replaced by coarse annual grasses, but these, under heavy grazing and trampling, give way to leguminous plants that dry up quickly and cannot hold the soil together. Pulverized by the cattles' hooves, the earth is eroded by the wind, and the finer particles collect and are washed by rains to the bottom of slopes where they dry out into an impermeable cement.

Desertification has been hastened by the heavy cutting of trees for firewood. Trees recycle nutrients from deep in the soil and hold the soil together. Slash-and-burn techniques—the only practical method available to the poor farmer for clearing land—are the cause of numerous fires which, according to a World Bank estimate, kill off 50 percent of the range grass each year.

Under these abuses, the Sahel by the end of the 1960's was gripped by a massive land sickness which left it without the resilience to resist the drought. A whole vast area which might with appropriate management have become a breadbasket providing beef for half of Africa instead became a basket case needing more than $100 million worth of imported food just to survive.

The future prospects for the Sahel and its people are not very bright. Sahelian governments and the various donors have not reached any kind of agreement on long-term strategy for rehabilitation. Some donors—AID excepted—are still digging boreholes. Most of the development projects now under consideration were drawn up before the drought struck and are based on the unlikely assumption that when the rains return everything can go on as before. (A recent meeting of American climatologists concluded that planners should assume drought conditions in 2 years out of every 3.)

Much of the development money for the Sahel will have to come from the United States and France, but there seems to be little coordination or exchange of ideas between the two countries. Nor is there any general agreement on how the Sahel can be restored to self-sufficiency. Optimists, such as William W. Seifert of MIT, who heads a $1 million long-term development study for AID, believe that the Sahel could support its present human population provided that cattle numbers were reduced by a half or more. Unfortunately, there is no way, short of a major social upheaval, that the nomads will consent to reduce their herds. Projects involving controlled grazing, such as in the Ekrafane ranch, are impractical because there is not enough land to go around. AID plans to open up the lands to the south of the Sahel by clearing them of tsetse fly, but this would benefit only 10 percent of the population. Others are not so hopeful. "I don't think there is much optimism that significant improvements can be expected in the short term. All you can do is to try to increase their margin for survival and hope that something turns up," says an agricultural specialist conversant with both the AID and MIT development plans.

"Neither the leverage of modern science and technology," concludes an in-house AID report on the Sahel, "nor the talents and resources of large numbers of individuals and institutions currently being applied to relevant problems has occasioned more than minor progress in combatting the natural resource problems and exploiting the undeveloped potential." Which is another way of saying that Western ideas for developing the Sahel have not proved to be a spectacular success. Its ecological fragility and the vagaries of its climate make the Sahel a special case. But there are many other areas in the world where unchecked populations are overloading environments of limited resilience. The Sahel may have come to grief so soon only because mistakes made there show up quickly. Other Western development strategies, such as the Green Revolution, are, one may hope, more soundly based in ecological and social realities. If not, the message of the Sahel is that the penalty for error is the same Malthusian check which it is the purpose of development to avoid, except that the crash is from a greater height.

—NICHOLAS WADE

U.S.—Soviet Summit: Make Science, Not War

It was a summit of modest expectations, and it more or less lived down to its prior billing. Six days of meetings between President Nixon and Soviet leaders produced an aura of restrained diplomatic camaraderie and several small, though not trivial, movements in relatively noncritical areas of arms control that added up to the minimum progress U.S. officials had hoped to achieve.

There were also small elaborations of science and technology agreements signed in the two previous summits in 1972 and 1973. Along with a bundle of similar but less specific accords reached by the President on his June swing through the Middle East, these agreements seemed to reaffirm what has evolved as an unwritten tenet of Nixonian summitry: Science and technology are the handiest instruments of détente.

Following is a summary of arms control and research agreements reached from 27 June to 3 July, and earlier in June in the Middle East.

Threshold Nuclear Test Treaty. As expected, the two sides agreed to limit the size of nuclear weapons tests underground, but the limitation agreed upon was significantly less restrictive than anticipated (*Science*, 17 May). The treaty, subject to ratification by the Senate, would ban weapons tests larger than 150 kilotons and would take effect on 31 March 1976. In the meantime, the two sides would agree to hold the number of weapons tests to an unspecified "minimum."

Testing in the atmosphere, in space, and undersea is already prohibited by the 1963 Limited Test Ban Treaty.

The agreement marks an important precedent: Under a separate protocol, the United States and the Soviet Union will exchange detailed geophysical information about their respective nuclear test sites and about the explosive yield, date, time, and depth of two nuclear "calibration" shots in the test

areas. All of this is intended to facilitate seismic monitoring of nuclear testing to verify adherence to the threshold limit of 150 kilotons. Information of this kind has never previously been exchanged.

At the same time, however, the Soviet Union has refused to apply the threshold limit to so-called "peaceful" nuclear explosives; these are to be governed by a separate agreement that is still to be worked out. Reportedly, an understanding was reached under which on-site inspections would be permitted in order to verify the peaceful nature of such explosions. This represents a return by the Soviet Union to a position it last expressed in 1963.

Briefing

Moscow Scientists Protest with Hunger Strike, Seminar

Whatever it may have accomplished for international relations (see page 237), the Nixon visit to Moscow this month both helped and hindered the cause of civil liberties within the Soviet Union.

While the President and Soviet Party leader Leonid Brezhnev toasted one another in the Kremlin, the most prominent dissident in Russia, physicist Andrei D. Sakharov went on a hunger strike. Sakharov wanted to dramatize the cases of 83 "political prisoners" who have been deprived of their rights—a list of whom he submitted in a public appeal to Nixon and Brezhnev on the eve of the summit. Some of the Western television crews who tried to cover the Sakharov protest were able to film him, but others found that their electronic equipment simply went dead. After Nixon left Moscow, Sakharov gave up the hunger strike on the orders of doctors, he said, who were alarmed by his loss of 18 pounds.

Russia's most prominent would-be Jewish emigré is Veniamin G. Levich, a corresponding member of the Soviet Academy of Sciences. When Levich made known his wish to emigrate to Israel in 1972, the authorities deprived him of his scientific jobs, harassed his family, and made him a nonperson in the scientific literature.

However, the end of this persecution was signaled when, the day after the President's arrival in Moscow, Levich was told that he would be permitted to go to Israel after all by the end of next year. His sons will be able to leave by the end of 1974. Knowledgeable sources in Washington speculated that private diplomacy in advance of the President's trip by Secretary of State Henry Kissinger could have been a factor in the Soviet government's turnaround on the Levich case.

High on the list of Western objections to Soviet internal policy has been the alleged practice of committing dissenters to mental hospitals. The most celebrated case of this type is that of former Red Army hero Major General Pytor Grigorenko, who fell from official grace when he criticized Nikita Khrushchev in 1961; Grigorenko has been committed, released, and recommitted to mental hospitals on and off since 1964. The day Nixon arrived in Moscow, Grigorenko was told that he would be released from his mental institution within hours; that afternoon he was drinking port in his home and talking with Western newsmen about his release. Whether the Nixon visit or pressure from American diplomats had anything to do with Grigorenko's release is unknown; he was, however, one of the 83 cases whom Sakharov wanted the authorities to reconsider.

Sakharov's hunger strike left him too weak to attend another major dissident event planned for the summit—an unofficial, scientific seminar to help Jewish scientists who had lost their jobs keep up to date in their work. But the authorities obviously thought the meeting was a potential political bombshell that could embarrass them while Nixon was in Moscow. Seminar leaders, including its principal, Alexander Voronel, were all arrested and held during the President's visit. Police agents gathered outside Voronel's apartment building at the hour the meeting was to start to stop anyone from going in. According to the *New York Times*, three Soviet scientists appeared at 10 a.m. and tried to enter, including one who "sprinted from hiding in a clump of bushes into the building . . . clutching a bundle of papers under his arm." After Nixon left, the activists were reported to have been released.

Some 120 papers had been submitted for the Voronel seminar from scientists in Israel, Western Europe, the United Kingdom, and the United States, and these will be published anyway. On the eve of Nixon's arrival in Moscow, however, a delegation of American organizers of the seminar met Acting Secretary of State Joseph J. Sisco to express their disillusionment with détente. Soviet authorities, they said they told Sisco, "may not be aware of the intensity and magnitude of American scientific disenchantment." Two members of the group, Christian Anfinson and Julius Axelrod, both Nobel laureates at the National Institutes of Health, announced on the same day they would not welcome in their laboratories any Russian scientists "who cooperate in the persecution of other scientists."

Anfinson later explained, "I've had a lot of Russian visitors whom I consider working friends. But some of these have . . . signed letters denouncing Sakharov, to name the most recent instance. I would be reluctant to accept them or their junior colleagues as visiting scientists to spend time working in my lab."—DEBORAH SHAPLEY

Maryland Scientists' Hunger Strike Averted

Four researchers at the Maryland Psychiatric Research Center were abruptly fired last month after they publicly lambasted the center for its management, research, and personnel policies. The group promptly announced it would start a hunger strike on the center's premises, but was talked out of this action by the Federation of American Scientists, which instead fixed them up with civil rights lawyer Leonard Boudin. The case is now before the federal district court in Baltimore.

The four researchers say they were fired in malicious retaliation for having exercised their right of free speech. Center director Albert A. Kurland, whose decision was backed by Neil Solomon, Secretary of the Maryland Department of Health and Mental Hygiene, says the scientists were most definitely fired "for cause" and their

The agreed-upon limit of 150 kilotons may have more of an effect on the Soviet testing program than on the U.S. program. The United States has detonated one device that large in 2½ years, whereas the Soviet Union has exploded six, including some of megaton and multimegaton yield in the past year. The 21-month delay in the limitation, however, is expected to allow the Soviets to finish proof-testing their new multiple warheads, or MIRV's.

One of the clear disappointments of the summit was its failure to limit deployment of multiple warheads.

Before the meeting, U.S. arms control authorities had expressed hope that nonnuclear nations might interpret a threshold test accord as a gesture of good faith. Such a gesture, they said, might encourage nations like Japan, Brazil, Argentina, India, and Pakistan to become parties to the 1968 Non-Proliferation Treaty.

Privately, however, some U.S. officials conceded before the summit that a limit as high as 50 to 100 kilotons would be hard to defend as a gesture of good faith.

Anti-Ballistic Missiles. The two sides have agreed to give up one of the two ABM installations permitted under the interim limit on ABM's signed in 1972. For the United States, this means agreeing not to build an ABM site near Washington, D.C., which Congress has already refused to pay for. The interim ABM agreement, which expires in 1977, remains one of the Nixon Administration's signal achievements in arms control.

Environmental and Chemical Warfare. U.S. and Soviet representatives will hold talks later this year on possible means of limiting the use of "environmental modification techniques" in warfare. This agreement comes 6 weeks after the Pentagon's first public acknowledgement that it had conducted rainmaking experiments in Indochina during the Vietnam war.

In the summit meeting's final communiqué, the two sides also agreed to consider a "joint initiative" this year in the multination Geneva disarmament talks aimed at limiting "the most dangerous, lethal means of chemical warfare."

The communiqué also committed the two sides to negotiate a new interim agreement on strategic offensive weapons that would extend to 1985; the present accord expires in 1977.

Scientific Exchange Agreements. Building on the broad 1972 agreement to cooperate in fields of science and technology, this year's summit produced a few additional projects but no major expansion of U.S.–Soviet scientific ties.

An agreement to exchange information on energy R & D may focus on natural gas and geothermal steam development as a start (nuclear power is covered by a long-standing agreement between the U.S. Atomic Energy Commission and its Soviet counterpart). There will also be exchanges of data

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public utterances had nothing to do with it. He noted that two of the scientists had been sacked last year and provisionally reinstated. In the letter dismissing the scientists, though, they were accused not only of "lack of positive performance" but of "having seriously breached expected employee conduct by taking public actions which were not in the best interest of the center."

The researchers' complaints are legion: they accuse the management of corrupt and wasteful practices, and say that they were passed over for promotion although they were the only ones doing any real work around the place. They also say the center, a state facility, has been losing money doing research for private drug companies on over-the-counter drugs such as Sominex and Tums, which have little bearing on mental health.

The scientists' complaints, initially made by the two researchers who were temporarily fired last year, have received considerable local attention. The state, in its biennial audit of the center completed last March, said that it did look as though the center was losing money on private research contracts and suggested that health officials find out whether the state was receiving benefits to justify the costs. Then the state legislature, prompted by this concern, held 2 days of hearings on the center's relationship to industry and to a private organization that has been acting as a conduit for public and private funds to the center. Meanwhile, Secretary Solomon has appointed a panel of independent research scientists to evaluate the research center. Finally, Maryland's Department of Fiscal Services is conducting reviews covering the center's organizational structure, policies, plans, and research programs.

So whether the four sacked scientists are finally judged to be malcontents or heroes, they seem to have set in motion activities that could significantly affect the future of the research center.—C.H.

NAS Denies Photo to Columbia Journalism Review

The National Academy of Sciences (NAS) has refused to provide the *Columbia Journalism Review* with a photograph of NAS President Philip Handler. The photo was to have illustrated an article prepared for the *Review* by Daniel S. Greenberg, the former news editor of *Science*, who now publishes *Science & Government Report*.

The refusal, which Handler says he knew of in advance, was explained by Howard J. Lewis, director of the NAS Office of Information, in a letter to Elie Abel, dean of the Columbia University Graduate School of Journalism which publishes the *Review*. Lewis said:

"Phil Handler's secretary passed on to me a request from the *Review* for a photograph of Phil to illustrate an article by Dan Greenberg on 'Science and the Media.' As you may know, Greenberg covers the Academy fairly regularly in his newsletter. His treatment of Phil in those pages has been, in my view, so offensive (except when the Academy has criticized some other part of the establishment) that I must decline the request. There are times when one's obligation to the media conflicts with a respect for personal dignity, and this is one of them.

"Greenberg is unquestionably a key figure in the journalism of science and public affairs. It is unfortunate that he so dominates that sparse terrain, many mistake him to have a central view."

Lewis later explained that he refused to send off the photo as "my own, tiny boycott . . . a small gesture of defiance against the fact that institutions have to respond like cows being led to slaughter while people like Greenberg get to go free."

Greenberg, commenting on the fact that his piece in the *Review* would not be illustrated said: "For years, people have been saying I wasn't getting the picture. Now they're right."—D.S.

on artificial heart devices, the behavior of prefabricated homes during earthquakes, and high-speed transportation of the future, including a cooperative look at a "magnetically activated train," according to the summit's final communiqué.

Under the rubric of the 1972 environmental agreement, both sides have now agreed to designate certain areas as "biosphere reserves" where baseline data on ecosystems will be collected and shared in cooperation with the Man and Biosphere Program of Unesco. This could lead to consideration of a biological preserve in the Bering Sea, straddling the U.S.–Soviet boundary line.

No new cooperative projects in space were worked out beyond the Apollo-Soyuz earth-orbiting mission scheduled for next July.

The Middle East. All but lost in the furor that surrounded the President's decision to sell nuclear power plants to Egypt and Israel was a series of broadly worded statements committing the United States to cooperate in science and technology with Egypt, Israel, Jordan, Syria, and Saudi Arabia. These accords merely say that joint committees will be set up in the future to work out specific projects. The Egyptian agreement, for example, calls for cooperation in medical research and training, agricultural technology, and general research and development, including space research—the last, one State Department official notes, "because everyone's interested in space."

For Israel and Egypt, the new accord is mainly diplomatic frosting on a long-standing precedent of cooperative research. (In Egypt, the United States already supports about $2 million worth of civilian research.) The statements, though, are expected to grease the bureaucratic skids for new projects on both sides.

For Saudi Arabia, which has no well defined R & D infrastructure, substantive projects may take longer to develop.

—ROBERT GILLETTE

Agriculture: FDA Seeks to Regulate Genetic Manipulation of Food Crops

Not so long ago tomatoes were soft, juicy, and tasted of tomato. Several varieties available in today's supermarkets are rubbery gobs of cellulose that taste of nothing. They are bred that way for mechanical picking. So far most genetic manipulation of crops has been for the benefit of the producer and, in the process, qualities of interest to the consumer, such as nutrients, have fallen by the wayside. The federal government has now moved to intervene, but from an unusual quarter and in a way that has stirred up considerable alarm within the plant-breeding community.

The government agent in this case is the Food and Drug Administration (FDA), and the legal basis for its intervention is its claim that food crops fall within the purview of the law governing GRAS substances, food additives that are "generally regarded as safe." President Nixon in his 1969 Consumer Message directed the FDA to review the safety of all substances on the GRAS list. The plant-breeding community was astonished when a year later the FDA made clear that the review would cover food products as well as food additives, including any products whose composition had been significantly altered through breeding or selection, provided that the alteration might "reasonably" be expected to change either the nutritive value or the amount of a toxic constituent of the plant in question.

The new regulation raised more questions than it answered. Which of the hundreds of new varieties of plants developed each year would be monitored for nutrients and which of the thousands of toxic substances in food products would have to be checked? How did the FDA define a "significant" alteration in the nutrient or toxic composition of a food crop variety? Would it be necessary to monitor every single new variety of chick pea, Brazil nut, and rutabaga?

To calm the sea of uncertainty raised by its action, the FDA sent out letters to industry officials to clarify its position further. For the purpose of the regulation, a 20 percent decrease in the content of a nutrient and a 10 percent increase in a toxic substance caused by breeding or selection would be considered significant, and would, therefore, have to be reported to the FDA.

A familiar pattern of government regulatory action was beginning to emerge, one which served unintentionally to exacerbate industry suspicions. The FDA would issue a regulation without a careful examination of the regulation's impact. Industry would react with alarm. The FDA would respond with a clarification which only raised additional concerns.

The letter defining a "significant" alteration in nutrient or toxic content left untouched the crucial question of which crops should be monitored and which particular substances should be measured.

The resulting confusion led to the formation of a joint industry-government task force in October 1972, 2 years after the FDA had first announced its radical regulation. According to members, the FDA task force has been plagued, since its inception, with an overly broad mandate and inadequate data upon which to base its recommendations. The group was told to develop criteria for choosing which products should be monitored. Frederic R. Senti, who retired as a senior administrator in the Agricultural Research Service last week after serving 2 years as chairman of the task force, called the mandate "prodigious." An industry member labeled the group's task "herculean," in view of the lack of knowledge in the field.

The task force was asked to consider the issue of toxic substances in food crops because of the FDA's concern over several recent incidents. According to task force member Alan Spiher, Jr., chief of the FDA's GRAS Review Branch, the practice of irradiating potato seed tubers to enhance yield had been found to cause a 60 percent increase in the toxic alkaloid solanine. A few years ago, another new potato