budget approximately 31 departmental programs have been supported with approximately 169 trainees enrolled at any one time. It is my estimate that this program should be doubled and that, with this doubling, each department so supported will produce a small but continuing supply of scientists for this most demanding, widely applied, and, at times, most empirical of the medical professions.

Notes

1. An additional estimate of the number of surgeons devoting their postresidency years to scientific training and research is provided by the Society of University Surgeons, which currently has 250 active members (with 300 senior or inactive members) and 160 candidates for membership. The sum of these numbers (about 400 men under age 40) is particularly significant because active membership ceases at the age of 45, and this society, plus its candidates, would represent a reasonable majority of those in the country who consider themselves surgical scientists.
2. Fields of surgery that become separated from a biosciences mission have shown a pernicious tendency to revert to a service-oriented craft—inflexible and misapplied. After 50 years of criticism, routine tonsillectomy in children bewilders the onlooker.
3. The concept that no funding support need be given during postgraduate education because such trainees will all earn large clinical incomes at a later time is particularly self-defeating in this area. Most medical students enter their internship and residency period with a considerable debt. The temptation to leave the laboratory and earn enough money to repay these debts is already strong enough (and sufficiently destructive of academic careers) without adding to it an additional debt incurred during scientific training.

NEWS AND COMMENT

Technology in Ulster: Rubber Bullets Hit Home, Brainwashing Backfires

Belfast. The disorders in Northern Ireland, now in their fourth year, may not amount to a civil war but are making the country a dangerous place to live. In 1971, 173 people on all sides were killed, somewhat more than half the number of homicides that occurred in Washington, D.C., during the same period. Modern science has not contributed importantly to this tally. Unlike the Vietnam war, which has spawned major technological gadgetry such as the electronic battlefield, Ulster's principal gift to mankind's arsenal has been the rubber bullet. Like much of recent British policy in Northern Ireland, the bullet is an ad hoc development—blunt, soft-headed, and pacific in intent but liable to cause severe damage when discharged not according to rules.

A less successful application of science to war has been the psychological interrogation techniques used in the early days of internment last year. As devised by the British army, the techniques are probably unmessy. Unfortunately, in the hands of the Royal Ulster Constabulary, they were applied with sufficient brutality to ensure wide attention. British citizens who had believed that brainwashing was the exclusive prerogative of totalitarian nations learned otherwise. Those who objected to such techniques argued that they were in the first place immoral, in the second illegal, by British, Northern Irish, and international law, and in the third place inefficient, compared with other, incidentally humane, methods of interrogation. The British government, while denying that any brainwashing had occurred in Ulster, promised last March that no more would be countenanced in that or any future war. In its own way, this decision is as notable a fallout of the Ulster war as the rubber bullet.

The organization which has followed most closely the use of technology in Northern Ireland is the British Society for Social Responsibility in Science (BSSRS). In a recent statement, the society warned that the efficacy of new weapons resided in their novelty and that the British army was introducing one new weapon after another in order to maintain the deterrent element of surprise. In fact, the army has been if anything conservative in its choice of weapons. In policing the 270-mile border between Northern Ireland and the Irish Republic, the army has apparently eschewed the sensing devices developed for use in Vietnam and presumably available through exchange agreements with the United States; the most advanced piece of equipment applied to this chore is a backpack ground surveillance radar made by a British manufacturer. In the cities, the principal nonlethal weapons used for crowd control have been water cannon, CS gas, and rubber bullets. No use has been made of the many fancy gadgets developed for crowd control in the United States.

This conservatism is presumably a deliberate policy; an infatuation with technology is notably absent from the theoretical tract on urban warfare published recently by one of Britain's leading counterinsurgency experts, Brigadier Frank Kitson. With experience in the successful campaigns in Kenya and Malaya, Kitson stresses development of information as the key to counterinsurgency. New weapons should only be introduced after full consideration of their impact on public and world opinion. An officer who understands the importance of information gathering "is more use to his government and to his men then one who has spent years learning how to use the latest devices produced by modern technology."* The Irish Republican Army (IRA) is said to be among the closer students of Kitson's book; until last month, Kitson was commander of the brigade covering Belfast.

Kitson's advice was not heeded with CS gas. Although developed for antiriot use by British chemists in the late 1950's, the first use of CS gas† in the United Kingdom was in the Bogside at Londonderry in August 1969. Used indiscriminately in the narrow city streets by the Royal Ulster Constabulary and later by the British army, the gas can have done little harm to the IRA recruiting campaign, and in any event aroused such protest after its first appearance in the Bogside that the government set up an inquiry, the Himsworth committee, to study its use and safety. Spokesmen at Porton Down, where the gas was developed, continued to insist on its harmlessness for use against crowds—"no more toxic than bonfire smoke" was the homely line given out at one time. In fact, CS is somewhat more poisonous than chlorine, according to the only British scientist outside Porton to have studied

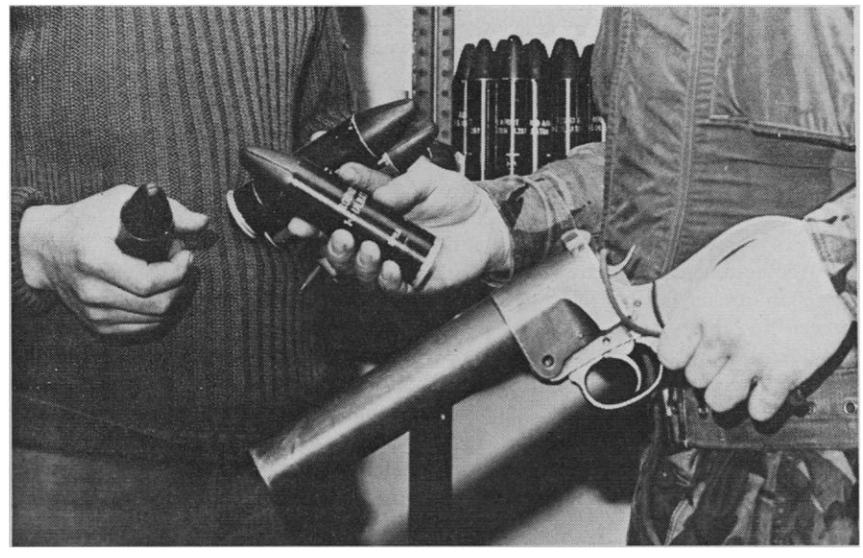
* F. Kitson, *Low Intensity Operations* (Faber and Faber, London, 1971).
† The chemical formula of CS gas is 2-chlorobenzylidene-malononitrile.

the gas. The Himsworth committee, when it finally reported last November, confirmed the potential lethality of CS but said the army could go on using the gas provided that the charge in each grenade was reduced (the old grenades, when they penetrated a room, were capable of filling it with dangerously high concentrations of gas). Himsworth and his colleagues also recommended, with every apparent seriousness, that before the soldiers fired gas grenades into a crowd they should instruct people to close their eyes.

Having refrained from deploying CS during the early half of last year, the army has since made sporadic and fairly discriminating use of the gas. To a large extent the rubber bullet has replaced CS as the standard nonlethal weapon in Ulster. In concept, the bullet derives from the wooden projectiles used to disperse crowds in places such as Hong Kong. Whether or not the wooden bullets were considered too injurious to use on populations nearer home, the rubber equivalent was developed in 9 months by army scientists, specifically for the Ulster situation. From the public relations viewpoint, the bullet's chief advantage is that it harms fewer innocent bystanders than does CS gas. It is also about the only weapon that can be used against one of the chief vexations of a soldier's life in Ulster—a troupe of small boys throwing stones.

As the Porton chemists compare CS to bonfire smoke, so army spokesmen claim that the rubber bullet "is intended, at a range of 25 meters, to deliver the equivalent of a hard punch with a fist." The two statements are equally accurate. Soldiers are in fact instructed not to fire directly but to aim their hard-punching bullets at the ground so that they will strike only on ricochet. On occasions when this instruction has been disobeyed, the bullets have inflicted serious wounds. On 7 November last year, a rubber bullet was fired at a Mrs. Emily Groves from a range of 24 feet. Aimed directly, the bullet traversed her face, breaking the bridge of the nose and collapsing both eyeballs. This "hard punch" has left her sightless. In two more recent cases, one child has been blinded and another killed by rubber bullets. Despite massive use, CS gas seems to have caused no permanent injuries.

Permanence of damage is one of the salient issues arising from the use of brainwashing techniques in Northern Ireland. When the dust had settled in the wake of the predictable—but apparently unpredicted—outcry, it was clear that the British army had developed a formidable set of psychological techniques for inducing mental breakdown in suspects and undermining their resistance to questioning. In April 1971, a team from the army center where these techniques are developed and taught visited Northern Ireland to instruct the Royal Ulster Constabulary (RUC) in their use. The RUC did not practice their newly gained skills until internment, the operation in which suspected IRA members were taken from houses and detained without trial. Beginning at 4:30 a.m. on 9 August 1971, the army arrested and handed over to the RUC more than 1500 suspects by mid-December.



Rubber bullets.

Soon after 9 August, stories became current in Belfast of how the interned men had been subjected to beatings and other maltreatment. Statements smuggled out of prison were distributed by the Association for Legal Justice, a Catholic civil rights organization in Belfast. The authorities dismissed these allegations as IRA propaganda. But some of the statements contained details bizarre enough to strain the imagination of the most inventive propagandist. Several internees alleged that they had been dressed in loose-fitting coveralls with a thick black hood over the head that prevented vision and made breathing difficult. In this garb they had been made to stand spread-eagled against a wall for hours on end, were deprived of food and sleep, and made to listen to loud, ceaseless, monotonous noise. The men reported that under this regimen they lost all sense of time, suffered delusions and hallucinations, forgot even their children's names, and became convinced of their impending death. In between sessions at the wall, they were interrogated under bright lights and subjected to beatings, threats of being injected with a "truth" drug, and mock executions.

Such at least were the allegations. They were ventilated in the press, and eventually the British government appointed a commission of inquiry, headed by Sir Edmund Compton, the government ombudsman. Future history books, whether of government or the music hall, should reserve at least a footnote for mention of Sir Edmund's report. Compton's terms of reference were to investigate the allegations of *physical* brutality. To him, physical did not mean, indeed excluded, psychological. His commission afforded a perfect parallel to the blind men examining an elephant. Yes, the internees had been dressed in hoods, the Compton commission concluded, but this was to prevent prisoners from recognizing others in transit. Yes, they had been made to stand against a wall, for up to 43 hours in one case. But the standing was for periods of only 4 to 6 hours at a time. Yes, the men were subjected "to a continuous and monotonous noise of a volume calculated to isolate them from communication." Yes, it was the policy to deprive them of sleep. Yes, all the men had lost weight, but the commission found it "difficult to give credence" to the allegation that they had been denied food and water.

So what did these various treatments

add up to? Each of them constituted "physical ill-treatment," the Compton commission ruled. But in sum, did they not amount to something graver than that? No, said Compton and his two colleagues, because ill-treatment only becomes brutality if there is a deliberate intent to commit cruelty in the mind of those inflicting the treatment, and the commission believed there was no such intent in the instances concerned. In other words, an act can only be defined as brutal if the agent of the act is deemed to be a sadist. Torquemada and every Grand Inquisitor could ask for no more. The exact phrasing of this extraordinary doctrine is as follows:‡

> Where we have concluded that physical ill-treatment took place, we are not making a finding of brutality on the part of those who handled these complainants. We consider that brutality is an inhuman or savage form of cruelty, and that cruelty implies a disposition to inflict suffering, coupled with indifference to, or pleasure in, the victim's pain. We do not think that happened here.

It did not take long for others to name the animal whose individual parts the Compton commission had described. The techniques concerned, although some may be individually innocuous, are components of a method for inducing sensory deprivation. The brain is dependent on receiving a constant stream of messages from outside. When this stream is significantly curtailed, an artificial psychosis or episode of insanity may occur. This psychological phenomenon was widely exploited in the 1930's by the Soviet police, who probably inherited the method from their czarist predecessors. A common KGB technique was simply to keep a prisoner standing angainst a wall on tiptoe for hours on end. A day or two of this was said to be enough to break anyone. Other methods included confinement in a featureless room, inadequate diet, and permission to sleep only at certain times and always in a fixed position facing a light. The KGB (or NKVD as it was then known) used the techniques to acquire the false confessions needed for the treason trials of Old Bolsheviks.

Various attempts to understand the KGB's sensory deprivation methods have been reported in the open literature. In an experiment in England by S. Smith and L. Lewty [*Lancet* **1959-II** 342 (1959)], volunteers were made to wear gloves and translucent goggles, placed in a soundproof room, and asked to stay there as long as they could. The hardiest remained for periods of 48 to 92 hours, but 14 of the 20 volunteers gave up after 48 hours (two after only 5 hours), the usual causes being unbearable anxiety and attacks of panic.

Soundproof rooms are expensive to construct, but the hoods and noise machines used in Northern Ireland are a very adequate alternative method of halting visual input and curtailing auditory perception. The loose-fitting clothes would reduce sensation from the skin, and the fixed posture against the wall would limit the normal flow of positional information from the limbs. Besides sensory deprivation, the internees were also denied sleep and food, both of which deprivations would impair brain function. The severity of the treatment undergone by the internees and its length—considerably greater than the periods tolerable to volunteers —raise the possibility that they may have suffered some degree of lasting psychological damage.

Of the men to whom these techniques were applied—in fact, a total of only 14—some were allowed last month to receive a visit from a solicitor. The solicitor told the press that one man, McKenna, "shakes continually and finds it hard to articulate sentences." According to other visitors, McKenna "broke into tears after every sentence he managed to utter" and "could not bear to be alone at any time." Auld, another internee, was reported to "shudder spasmodically and complain of violent headaches, insomnia, and nightmares when he does get to sleep." Both Auld and McKenna are receiving psychiatric care. It is not possible to determine to what extent their symptoms are due to the effects of their long internment and to what extent the treatment they underwent. Three internees, however, were interviewed in prison only 10 days after their interrogation by a civilian psychiatrist, P. Pearse O'Malley of the Mater Infirmorum Hospital in Belfast. O'Malley told *Science* he estimated that all three men had developed a psychosis within 24 hours after the start of interrogation. The psychosis consisted of loss of sense of time, perceptual disturbances leading to visual and auditory hallucinations, profound apprehension and depression, and delusional beliefs. As an example of the latter, one man said he heard voices singing evangelistic hymns and saw it was a choir conducted by Ian Paisley (an extreme Protestant leader). He believed Paisley was about to lead a general slaughter of the Catholics. All three men, O'Malley said, felt they were going to die.

O'Malley diagnosed that one man would make a complete psychological recovery and a second would probably recover. For the third, who seemed to have been beaten before interrogation, there is a chance of permanent mental damage. According to Compton, these three men stood at the wall for total periods of 29, 23, and 35 hours, respectively.

In the wake of the fury produced by the Compton report, the British government was obliged to endure two more inquiries before the matter was ended—one by Amnesty International, the other by an official committee set up to consider acceptable methods for interrogating terrorists in the future. The Amnesty committee, consisting of a Swedish chairman, a Dutch doctor, and a Norwegian lawyer, interviewed four of the internees whose cases were examined by Compton, concluded that their treatment "clearly amounted to brutality," and remarked that the techniques used were "dangerous both to the immediate mental health of the individual subjected to this treatment and to the long-term health of some subjects, especially those with a family history of mental illness."

The three-man committee on interrogation, chaired by a former chief justice, Lord Parker, completed its work this March. A majority report by Parker and a colleague said that the government could continue using its psychological interrogation methods in future emergencies, provided some safeguards were built into the procedure—such as having a psychiatrist present.

The minority report gave ministers less pleasant reading. In it Lord Gardiner, a former Labour Lord Chancellor, opined that the specific interrogation techniques—said to have been used in every British colonial emergency since the last war—had never specifically been authorized by any British minister. Even if any document or minister had purported to authorize them, it would have been invalid because the techniques are illegal by English law, by the laws of most of the countries concerned, and probably by international law.

More surprising than the illegality of the brainwashing methods was the debate that emerged over their efficiency or otherwise in extracting information. The official view, given by Lord Parker, was that the techniques had contributed

‡ "Report of the enquiry into allegations against the security forces of physical brutality in Northern Ireland arising out of events on the 9th August 1971." Cmnd. 4823, (Her Majesty's Stationery Office, London, 1971), 52½p.

to the successful counterinsurgency operations conducted by the British in Malaya, Kenya, and elsewhere. This argument, not dissimilar to an apprehended burglar justifying his methods by saying he had committed many excellent burglaries in the past, was a curious one for the former chief justice to propound. A government minister questioned in Parliament in December had admitted to use of the interrogation techniques by British forces on only two occasions in the past—in Brunei in February to March 1963 and in Aden between 1964 and 1967. The chief architect of the security operations in Malaya, Sir Robert Thompson, is on record as denying the efficacy of torture: "[A suspect] . . . can be interrogated on the basis of a mass of information already available to the intelligence organization. This shocks the truth out of him far more effectively than torture."§

The efficacy of the techniques used in Northern Ireland was disputed even more directly by the British government's former senior psychologist for prisoner of war intelligence from 1951 to 1961, Cyril Cunningham. "If the Royal Ulster Constabulary, or indeed the Army, is using the methods reported," Cunningham wrote in the London *Times* after the appearance of the Compton report, "they are being singularly stupid and unimaginative. Interrogation by overt verbal examination backed by fear is a blunt, mediaeval and extremely inefficient technique." Since Cunningham's tenure of office overlapped several of the emergencies in which Parker claimed the techniques were used, it seems possible that the Parker committee was misinformed by official witnesses.

Finally, the commandant of Britain's interrogation center during World War II explained in a letter to the London *Times* that the methods used on German prisoners were "processes of 'painless extraction' seasoned with legitimate guile. . . . It is the simple truth to say that if one of our interrogators had suggested submitting any prisoner to *any* form of physical duress (which would certainly not have been permitted) he would have been a laughingstock among his colleagues."

What was the expectation of those who permitted the brainwashing techniques to be tried in Ireland? And how did the British army get into the business of developing such techniques in the first place? Apologists stress that British soldiers need to be trained in resistance to these techniques in event of war with, for example, the Soviet Union. Maybe the hooding and the noise machines were developed at the army intelligence center in the expectation that the Soviet Army would have made some improvements in the crude sensory deprivation techniques used by the NKVD in the 1930's. With the techniques in existence, the temptation to use them presumably became irresistible. Yet, as was pointed out by a group of psychologists who gave evidence to the Parker committee, the brainwashing techniques may break down a man's resistance to talk, but they also make him highly suggestible. Whether he is more likely to speak the

§ Sir Robert Thompson, *Defeating Communist Insurgency* (Chatto & Windus, London, 1966), p. 87.

Katchalsky Killed in Tel Aviv

On Tuesday evening, 30 May, Aharon Katzir-Katchalsky was in Tel Aviv's Lod airport on his way home to the Weizmann Institute of Science in Rehovot. He never made it. Katchalsky, a scientist of the highest repute, was gunned down in the terrorist attack that took the lives of more than two dozen other persons.

Katchalsky, described as a citizen of the world by his many friends and admirers in the American scientific community, was an eminent biologist who devoted his career to understanding life at the molecular level. Educated in biology (he received his undergraduate and Ph.D. degrees from Hebrew University), he moved on to physical chemistry and the study of protein and protein-like polymers, specializing in the electrolytic properties of chain molecules. His colleagues credit him with opening the field of polyelectrolyte research in the late 1940's. A theoretician who had a profound understanding of thermodynamics, Katchalsky is also known for his contributions to our knowledge of the transport of molecules through biological membranes.

Most recently, the 58-year-old Polish-born scientist, who spent his professional life in Israel, turned his attention to neurobiology. According to Francis O. Schmitt of the American Academy of Arts and Sciences in Boston, Katchalsky was an active participant in that organization's neurosciences research program and had been in Boston for a couple of weeks in May. An authority on "irreversible thermodynamics," Katchalsky was trying to understand the functioning of the brain and the molecular basis of memory. Says Schmitt, "Nucleic acid chains come apart on electrical stimulation and do not come together again as before. Katchalsky considered this a model of memory."

A frequent visitor to the United States, he was a visiting professor at the University of California at Berkeley in 1967–1968 and was elected a foreign associate by the National Academy of Sciences in 1971.

As much as he will be remembered for his scientific achievements, Katchalsky, known in Israel as Katzir, will also be remembered for the strength and vitality of his personality and for the brillance of his teaching. "Nobody who ever met Katzir-Katchalsky ever forgot him," says Gary Felsenfeld, of the National Institutes of Health, who visited Katchalsky's lab a couple of months ago. Typical of his passion for knowledge and his desire to create a fertile environment in which scientists could work was a trip he organized for his colleagues—a stimulating respite from the lab. As Felsenfeld recalls the day, they went first to Jerusalem where they toured the obscure quarters of the city with a guide Katchalsky had found, seeing neighborhoods that otherwise would have escaped their ken. From Jerusalem, they journeyed to the Dead Sea where Katchalsky, a "natural lecturer," told them about the biology of the place as well as about its history.

Says Schmitt, who was with him on the day before his death, "He inspired everyone who knew him by both his great learning and his great enthusiasm, even though not everyone understood some of the esoteric aspects of his science. His murder is a very terrible loss."

—BARBARA J. CULLITON

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