PHOENIX

EDITORIAL COMMENT

We are an occasional people, prone to observe anniversaries, to mark events, when some round number of years have passed. 1965 is an available occasion. It marks twenty years since the end of World War II, since the use of the first and the second nuclear bombs in war. Since 1945, drastic changes have occurred in our concept of the conditions of life. We still debate the use of nuclear explosives but assume that their use is likely in some future war. We are still appalled by the thought that a city could be eradicated in seconds but see such destruction as likely should a nuclear attack occur. We still protest the annihilation of civilian populations but with the grotesque awareness that there may be a qualitative difference between 50 million dead and 100 million dead in an afternoon of nuclear exchange. Imperceptibly, we have slid over a line to where a bizarre holocaust, a replica of Judgement Day, is an inherent part of our vision.

Detail of a tombstone in St. Sebastian's Cemetery, Salzburg, Austria, 1635—plaque 11 inches high

The atomic bomb alone did not change our concept of the condition of life. Concentration camps, gas ovens, strategic bombing, fire-raids, rocket bombs have all shaped the twentieth century. Civilization, riding on technology, has expanded death's possibilities. The value of being uncivilized is that it takes an afternoon to kill a few hundred people. There is time to sate one's passions, to consider one's acts, to change one's mind, before the world is wiped out.

The absurdity of contemporary reality should be self-evident. Given the task of designing a world for human beings, no rational person would design the one in which we live—a sphere divided in two halves, each equipped with posed rockets awaiting only a human thought, or unthought, to launch them on their destructive trajectories.

Because the imminence of death is not part of the modern American tradition, it is difficult for us to acknowledge its role in our lives. World War II left us relatively unscathed. Death happened abroad, not in Boston or New Orleans or Ann Arbor. The Cuban Crisis of 1962 revealed reality, but only momentarily. It has been easy to forget the nights of waiting for something to happen, of listening to the flights of planes, unseen high overhead, immobilized by a sense of no-shelter and the questioning looks of children who wondered how their parents had allowed them to be placed in such a frightening situation. The Cuban Crisis is gone, with only sardonic remnants. During the telecast of the 1964 Army-Navy football game, the announcer periodically repeated that the President would address the nation at 4:30 p.m. The game, already dull, became pointless. What was President Johnson going to say? Were

we going to war? Were we confronting the Russians in the Congo? The Chinese in Viet Nam? Or had the Gross National Product risen?

Even when confronted by physical reminders we can get attuned to reality to the point of not seeing it. In class one day, a student, whose father was stationed at a SAC base in Michigan's Upper Peninsula, responded to another student's question—"what's an atomic bomb look like?" The student from the Upper Peninsula told how it was common on the country road that cut through the SAC base to see large trucks carrying bombs shaped like aluminum cigar containers. They were ten megaton weapons, he said matter-of-factly, and then in answer to another question added, yes, he had seen *Dr. Strangelove* at the base movie theater and had thought the film funny.

A more direct form of grappling with the reality of atomic bombs is to build a family shelter, immune from fire and the pressures of blast, a hardened home at home, stocked with guns, with oxygen, with Metrecal. Technically, this is feasible, and at a cost of only a few thousand dollars.

With these extremes lies a third alternative, an attempt to seek a more rational pattern for existence. This may prove an impossible task, but the effort is more in keeping with our sense of the meaning of human life.

There has been a large research effort in recent years on arms control and disarmament. Originally, the impetus came from individuals, many of whom were scientists, and from interdisciplinary seminars at universities. Eventually, as national policy recognized the legitimacy of such research, the Federal government took an active role. The Arms Control and Disarmament Agency was established to develop and sponsor research in this area. An arms control unit also has been created within the Defense Department. Around the nation a number of research firms that work on more traditional defense projects have sought and received contracts to study arms control. And there are university research groups, principle among them the University's Center for Research on Conflict Resolution, formed in 1959.

Primarily because of the climate established by the Conflict Resolution Center, The University of Michigan, in conjunction with the Bendix Corporation, has sponsored two conferences on Arms Control. Papers delivered at these conferences indicate the scope of research in this area—"Effects of Arms Control on Industry," "Public Attitudes toward Disarmament," "Game Theory as a Tool for Investigating Behavior motivated by Fear and Suspicion," "Zonal Inspection Systems." The primary difficulty in assessing this research is that its ultimate payoff lies in historical events where politics and science are mixed under extreme pressures. The limited test ban treaty signed in Moscow in August of 1963 is such an event.

Professor Hans Bethe, one of the world's leading physicists, was an American delegate in the negotiations leading to the treaty. Under the sponsorship of the Phoenix Project, Professor Bethe delivered the fourth annual Dewey F. Fagerburg Memorial Lecture. His address, printed on the following pages, is an analysis of the gains and losses of the Test Ban Treaty. It is also an explanation of the strategic status of our country and the relative stability afforded by hardened missiles and Polaris-type submarines. Professor Bethe contends that our nation has time and room in which to move. His speech leaves two questions unanswered:

1) How do we progress beyond the current Test Ban Treaty into arms control and eventual disarmament?
2) How do we maintain the peace and with it freedom in a disarmed world?

Both questions are the type that tend to be answered with poems and panaceas. They are also the two basic subjects of research on arms control and disarmament.

This issue of PHOENIX also contains two articles based on research supported by the Phoenix Project. The first, a critique of the test ban negotiations in which Professor Bethe participated, illuminates the difficulty of negotiating political treaties whose terms are determined by technical considerations. The second, a summary of the French decision to build atomic bombs, reveals the nationalistic concerns that work toward a proliferation of nuclear weapons.

The French story told here predates the reign of Charles de Gaulle and covers the period in which France formally decided to explode its first nuclear bomb. Since then the decisions about which the French vacillated have become technical realities. France has a nuclear testing ground near Tahiti. An isotope separation plant is in operation. A gaseous diffusion plant has begun to concentrate Uranium 235. A force of atomic bombers is under construction. And in the planning stage are polaris-style submarines and intermediate range missiles. The French nuclear force is rapidly becoming a serious factor in the world power picture. The Chinese will undoubtedly follow the pattern, as well may other nations, convinced that it is their only means of ensuring national sovereignty.

1965 is an occasion. It is the 20th year since the use of the atomic bomb. It is not the event, however, that is worth celebrating, it is the distance from it that we have reached.

THE DEWEY F. FAGERBURG MEMORIAL LECTURE, 1964

DISARMAMENT AND STRATEGIC STABILITY

HANS A. BETHE

Dr. Bethe, Professor of Physics at Cornell University, was a United States delegate to the disarmament negotiations at Geneva. This speech expresses his opinions only and does not necessarily reflect the views of the Government of the United States.

A little over a year ago, in August of 1963, the United States, Russia and Great Britain concluded a treaty banning atomic weapons tests in the atmosphere, under water and in space. This test ban was the culmination of nearly six years of diplomatic effort. It was difficult to achieve and is only a partial ban since it does not prohibit underground testing. However, its conclusion was a great success for the three countries involved. The treaty has since been joined by over a hundred nations.

Underground tests are permitted by the treaty. The United States is conducting an extensive and well publicized program of underground tests in Nevada and Mississippi. We have announced one British test in Nevada. No Soviet tests have been announced.

The treaty has achieved its primary purpose of providing relaxation of political tensions. Undoubtedly, it was not the only cause of this relaxation. The major cause, presumably, was President Kennedy's brilliant diplomatic victory in the Cuba crisis of 1962. Apparently, this victory made the Russians more inclined to seek an understanding with the West. Other agreements have been concluded, notably the establishment of the "Hot Line" between Moscow and Washington, but the test ban itself has contributed to the relaxation of political tension far beyond anything I had hoped for during our negotiations.

The ban has several technical shortcomings and some advantages.

1. Both countries, presumably, are continuing their weapons development. The ban, therefore, has only partially fulfilled its intended purpose of slowing down the arms race. It is effective in preventing the testing of multimegaton weapons, and this is a great achievement. But it permits the further development of fission weapons and also, presumably, of thermonuclear weapons below one megaton. This may be a disadvantage for us, because we have reason to believe that Russia is as yet deficient in low-yield nuclear weapons.

2. Due to the delay in concluding the treaty, the United States did not succeed in preserving the great technical superiority in megaton weapons which it had in 1958. A major cause for the long delay was the United States' insistence on extensive safeguards against violations of the treaty. We were concerned with possible Russian clandestine tests of weapons of a few kilotons. I repeatedly warned, especially in an article in the *Atlantic Monthly* in 1960, that this insistence on perfection would make conclusion of a treaty difficult and that the absence of a treaty would make it likely that the Russians would test megaton weapons. This is exactly what happened. Nobody can tell whether a treaty could have been concluded if we had been less difficult. It certainly would have been worth-while to have avoided the Russian test series of 1961 and 1962.

3. Since testing must now be underground, we can not get any information on the technical progress of weapon development in the Soviet Union. This information, when it could be obtained from the debris collected from atmospheric testing, was useful to us.

4. On the positive side, the existing treaty makes it difficult for non-nuclear countries that have signed the treaty to develop effective nuclear weapons. Testing underground is difficult, and assessing the results of such tests is especially difficult. The radioactive fission products get mixed up with the soil in a complicated manner so that even the yield of the weapon is hard to determine. These problems are easy to overcome for countries which already have nuclear weapon experience and which can use previously tested models for calibration of their underground test measurements.

However, even for new countries underground weapons tests are not impossible. If a country is satisfied with a Yes or No answer, i.e., simply with the knowledge that its device has worked, this answer can easily be obtained from underground testing. But I consider it very encouraging that over a hundred countries have signed the Test Ban Treaty. I do not believe that they did so in order to start underground testing.

Two important countries, France and Communist China, have not signed the treaty. France is pursuing her own program to develop nuclear weapons. This is annoying but probably not dangerous. When I wrote this speech, Secretary of State Rusk warned that China appeared ready to test her first nuclear weapon. In the meantime, this test has taken place. President Johnson discussed this event and its implications on October 18, 1964. He pointed out that there is a long way from one nuclear weapon to an arsenal of nuclear weapons and an even longer way to the capability to deliver them by planes or missiles. A full nuclear delivery capability costs billions of dollars. China has not suddenly become a great military power but she may use her possession of nuclear weapons to exert pressure on her Asian neighbors. President Johnson assured our support to any nation which might be threatened.

5. Many neutral countries consider it important to extend the ban to underground tests. President Johnson also declared this to be one of the aims of the United States. I would certainly welcome such an extension of the ban, but I do not consider this urgent. The partial ban has already accomplished the most desired effect, relaxation of tensions.

Sept. 1949 On the news of the first Russian explosion

"VERY SIMPLE—WE WON'T RECOGNIZE THEIR BOMBS"

Of course, if a complete ban would induce France and China to join the treaty, then I would consider it important to take such a step.

The methods for detecting underground explosions and distinguishing them from earthquakes have improved greatly in the last few years. They will never be perfect, but there is now a much better technical basis than there was five years ago for the extension of the ban to underground tests.

6. The test ban treaty did not give us any inspection system. Many neutral observers believe that this is a serious defect. They argue that it would have been worth-while to accept the Russian proposal to have three inspections per year, both in Russia and the United States. This, the neutrals say, would at least have established the principle of inspection and would have broken the Russians reluctance to accept inspections in future disarmament treaties. I am inclined to agree with them but I am impressed with the charming simplicity of the treaty as concluded.

PROLIFERATION

I believe the most important task in disarmament now is the proliferation of atomic weapons. President Johnson, in his speech on China's atomic bomb, pointed out that the four older atomic powers, the U.S.A., the Soviet Union, Great Britain and France, were countries of proven responsibility and experience in international affairs that could be trusted to use every restraint. By contrast, China has followed an adventurous foreign policy in the past 15 years, although it must be said in fairness that she has not rattled her atomic bomb since the test. Other countries which might join the nuclear club in the future will also be lesser powers than the first four. Although none of them appear potentially as dangerous as China, some of them might be inclined to use nuclear weapons for attacks on their private enemies. There is the danger that the great powers would take sides and that the war would escalate.

Therefore, it was most welcome news when Sir Alec Douglas-Home, in the 1964 British election campaign, announced that the United States and the United Kingdom had prepared a working paper on the prevention of proliferation of nuclear weapons. The Soviet Union is also on record against proliferation. They will, however, hardly sign a treaty on this subject unless we give up the plans for a multilateral nuclear force in Europe. According to this plan, we would equip some surface ships with Polaris missiles and man the ships with sailors from NATO countries, including some American officers who would have veto power over the use of the missiles. I presume there would also be an electronic lock which could only be opened by the President of the United States. In my opinion, it would be worth-while to give up this plan for the sake of obtaining a good treaty prohibiting the proliferation of nuclear weapons. I want to state emphatically that this is my own opinion and does not in any way reflect the views of the United States Government. The multilateral force was supposed to satisfy the Europeans' desire for nuclear weapons. But the most important countries, Britain and France, are not at all interested in this force. To have such a force in

the hands of Germany, Greece and Turkey does not seem to me wise.

A difficult point concerning proliferation is the increasing availability of fissionable material. Nuclear reactors for the production of power are being built in large numbers in many countries. The Atomic Energy Commission has estimated that by 1980 about 50 million kilowatts of electric power will be generated from nuclear reactors. This means that about 10,000 kilograms of plutonium or uranium-233, more than 1000 times the critical mass, will be produced every year in nuclear power reactors. This plutonium will have a high percentage of PU^{240} and will be more difficult to use in weapons than plutonium from special production reactors, but it can hardly be considered as useless. I believe that it is essential to have strict safeguards against the diversion of such material to military purposes. Such safeguards are provided in the regulations of the International Atomic Energy Agency, but very few reactors are built under the auspices of IAEA. The United States, the United Kingdom and Canada maintain similar safeguards, under bilateral agreements, when they give fissionable materials to countries for power reactors and other peaceful purposes. But I am concerned that nuclear reactors will appear more and more commonplace and that countries may forget about safeguards. It would be better to have a general treaty in which countries pledge themselves to adopt safeguards, like those of the IAEA, for all their nuclear operations. Such an agreement might be concluded between the Western nations first with an invitation to the Eastern block to join later.

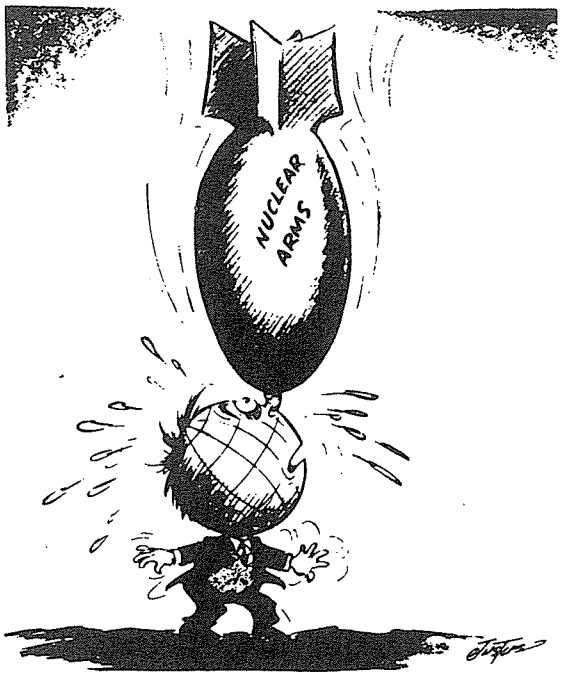
STRATEGIC DELIVERY VEHICLES

For many years, I have believed that the most important sphere of disarmament is strategic delivery vehicles. Without these vehicles, the possession of nuclear weapons has little military significance.

During the present election campaign, figures on our strategic delivery systems were published by Secretary McNamara. We have well over 500 B-52 heavy bombers and an even larger number of B-47 medium bombers, which are gradually being retired from service. There are about 100 B-58 bombers, which are capable of supersonic speed. We have about 600 Minute Man missiles installed in hardened silos, with more to come, and over 100 of the larger, but older, Atlas and Titan missiles, of which only a fraction is in hard sites. We are building a fleet of Polaris submarines which will ultimately carry over 600 missiles. Eighteen of these submarines, each carrying 16 missiles, are already operational.

In a speech responding to Secretary McNamara's announcement, Senator Goldwater estimated our present total delivery capability at about 20,000 megatons and expressed concern that this figure might be reduced to about one-tenth if we gave up bomber planes and shifted our entire force to missiles. Secretary McNamara answered that there are no plans to abandon planes. We have become so accustomed to large numbers that 20,000 megatons does not seem large to us any more. But we must remember that this is 100,000 times the size of the Hiroshima bomb. One megaton is equal to the total force of explosives dropped on Germany during the Second World War. True, this com-

"POPULATION CONTROL?
I'LL GIVE YOU POPULATION CONTROL"



CRUCIAL SUMMIT

parison is not fair, because one weapon of a million tons of TNT destroys less area than a million bombs of one ton each. But still, one megaton gives a blast pressure of 3 pounds per square inch at a distance of 4 miles, and such pressure would severely damage brick buildings and wooden frame houses. This means the destruction of an area of 50 square miles by a single megaton weapon. There are less than ten cities in the Soviet Union which have a larger area. American cities are more spread out, but even most American cities would be destroyed by a megaton explosion. Why, then, do we have so many megatons? What would one do with them even if there were a nuclear war?

There are two answers to this. First, there are military targets other than cities. Secretary McNamara, in 1962, in a speech at The University of Michigan, said that in case of war we would plan to use our force against military targets and not against cities, unless the enemy attacked our cities. I presume the Secretary meant that part of our strategic force is to be used against the Soviet strategic force, and I imagine the Soviets have similar war plans. The degree of our security force, then depends largely on the ratio of our forces to the Soviet forces rather than on their absolute size.

A second and more important reason for the large number of strategic delivery vehicles is the fear that some of these vehicles might be destroyed by an enemy surprise attack. There was ample ground for such fear in the days when our main strength consisted of bomber planes deployed on relatively few airfields. A determined enemy might then have penetrated our air defenses and attacked these airfields. A single bomb on an airfield destroys all the planes on it. Thus a surprise attack would have been very profitable for the aggressor. A vulnerable strategic force is a direct invitation to the enemy to make the first strike. Each side has to live in deadly fear that the other side may strike first, and from fear each side may precipitate a war. Thus we had a thoroughly unstable situation which made war more likely.

Of course, in the time of the bomber plane there existed safeguards against surprise attack. Many years ago, we constructed a radar warning system known as the DEW line, Distant Early Warning, which is strung out along the northern edge of the North American continent. It was designed to give a two or three hour warning of approaching enemy planes. Our bombers have now been put on ground alert so that half of them are able to take off within 15 minutes, the warning time we now have in case of enemy attack by missiles. In addition, our planes have been dispersed over many airfields. But, 5 or 10 years ago, we had to expect that only a small percentage of our air force would survive an initial enemy attack and then be able to penetrate into enemy territory and deliver its bombs. Therefore, it was prudent to build several times the force we expected to actually require for military missions. The fear of attrition by possible enemy attack was an important reason for the large size of our force.

The situation has changed in the age of the hardened missile. The Minute Man silos are built to withstand very high blast pressures. They are so far apart that even a large enemy bomb cannot destroy two or more silos. To destroy a single Minute Man requires extremely accurate

aiming of an enemy missile. The exchange ratio is favorable. More than one enemy missile is usually necessary to destroy one of ours. Therefore, our Minute Man silos are not attractive targets for an enemy attack and may be considered essentially invulnerable at this time.

Even more invulnerable is the Polaris. Submarines are notoriously difficult to find, and it is inconceivable that an enemy bent on surprise attack could find a large fraction of our Polaris fleet. Many Polaris submarines would survive and, therefore, constitute a strong insurance against surprise attack by the enemy. They and the hardened Minute Men are truly weapons which stabilize the military situation. Because we no longer need to be afraid of surprise attack, we need never start a war from fear. The vicious circle—in which A fears B, B fears A, neither can allow the other to shoot first, and hence A or B starts the war which they both dread—has been broken.

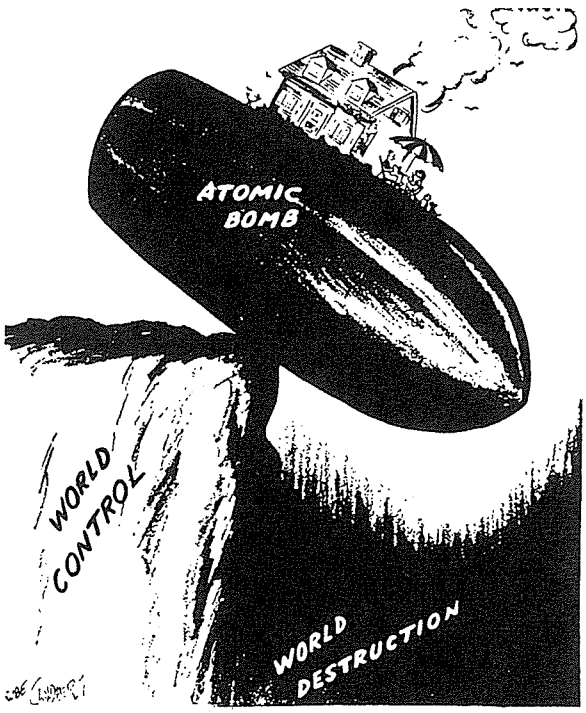
The Soviet Union has followed our lead. They have announced that they have submarines carrying missiles. I believe we should welcome this because it gives them an invulnerable deterrent. They also need not start a war from fear.

The Russian forces are numerically smaller than ours. Secretary McNamara has stated that the number of the Soviet ICBMs is about one quarter of our force. They also have much fewer bomber planes than we. Their ICBMs, however, seem to be bigger than our Minute Men. In addition, they have many older, intermediate range ballistic missiles directed against Western Europe. This does not change the fact that their forces are smaller. The Russians have continued the policy which they have adopted ever since World War II, to provide only a minimum deterrent against an attack by the U. S. There is a slightly ominous note from Russia now, after their change of government. Their new leaders announced their intention to strengthen Russian defenses. We have to wait and see what this means. I would be very unhappy if they would start yet another round of the arms race. This puts renewed urgency on attempts to control armaments.

Let me reemphasize the importance of a stable deterrent force. By hardening missile sites and by deploying Polaris submarines, we have almost eliminated the danger of surprise attack. Whatever disarmament measures may be adopted, they must not interfere with this strategic stability.

ARMS CONTROL

The large numbers of planes and missiles were conceived in a time when we needed to be afraid of surprise attack. If our missiles are essentially invulnerable, we need much fewer of them to have an effective deterrent. Therefore, there is now an excellent opportunity to reduce the strategic forces on both sides without endangering the security of either. Of course, I do not advocate doing this unilaterally. However, it is possible to have so-called reciprocal disarmament. For example, the U. S. phases out some of its medium bombers, then the Soviet Union does the same. If this can be ascertained by the U. S., the U. S. may feel encouraged to continue reducing the bomber force. The U.S.S.R. may reciprocate by eliminating some of its medium range



"PEACE TODAY"

missiles, which would reduce the threat to Europe. This reduction could continue as long as both sides felt fairly certain that the other side had no hostile intentions and was actually reducing its force as advertised. Reduction of military budgets would be another way to control the arms race.

Reciprocal arms reduction is attractive because it does not require treaty negotiations and leaves us freedom of action. On the other hand, most of us would be happier with a visible demonstration of disarmament. The U. S. has proposed, in the Geneva disarmament negotiations, to scrap a specified number of medium bombers each month in a bonfire under international supervision. This would be a step in the right direction. More desirable still would be a treaty limiting the number of planes and missiles on each side.

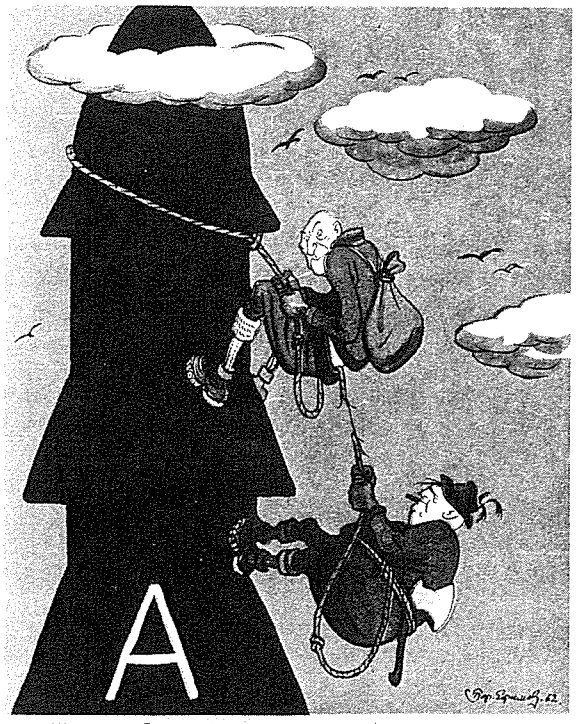
Once missiles are invulnerable, it seems entirely safe to reduce the strategic force to a few hundred missiles, each carrying perhaps one megaton, in contrast to the 10 or 20 megatons now carried by our planes. This would be an enormous reduction of the total destructive force. But this drastic reduction will only be possible if we can be sure that the other side has made a similar reduction.

This brings us to the all-important problem in disarmament: inspection. On this subject the Soviets and we still disagree. Both officially and unofficially, we have made many proposals which we consider quite equitable, but the Russians are fundamentally opposed to inspection of their country. We have also done a lot of research, publicly and privately, on methods of inspection, some important contributions having been made here at Michigan. An idea which I like very much is that first proposed by Professor Louis Sohn of Harvard, and elaborated by many others, of inspecting selected areas of the country by some sampling procedure. At the latest informal meeting, the Pugwash meeting in Prague, the Russians were apparently opposed to sampling. Rather, they favored spot checks which we would make in Russia on the basis of our intelligence information, and vice versa. Presumably, they envisage a treaty providing for very few spot checks.

No matter how good the inspection, it will never be 100% effective. A small number of missiles can probably always be hidden. For this reason alone, it would not be safe to have complete disarmament. But it would be very difficult to hide 50 missiles from an inspection system. Therefore, it seems safe to agree on a force of, let us say, 200 missiles and planes on each side.

Further disarmament would be dangerous from two other points of view. A country may abrogate the treaty and start producing planes and missiles quite openly. Such abrogation may be prepared in advance, as was the Russian test series of 1961. But large-scale production of weapons takes time and preparations for it are difficult to hide. Small-scale production, which could occur secretly or could be started suddenly after abrogation of the treaty, would not change the balance of power if enough missiles and planes were available to each side.

The other reason against complete disarmament is the existence of ambitious, smaller nuclear powers, such as Communist China. Confronted with overwhelming force in the hands of Russia and the United



Штраус: — Я, кажется, падаю, герр Аденауэр, но и вам не удержаться!

The Russian view

States, China can hardly be dangerous on a world scale, but if we were disarmed she might be. Complete disarmament will be possible only when we know how to keep the peace in a disarmed world. At present, we are very far from this.

Arms reduction also has its difficulties. First, it would have to be carried out without disturbing the present stable deterrent. We must keep the invulnerable missiles on both sides. This is possible. Second, we have the Russian objection to inspection and our need for it. Third, there is the most difficult question of the intermediate steps in the approach to the final state of reduced armaments. The United States, possessing a vastly superior force, is understandably reluctant to agree to the idea of parity, i.e., to having the same number of missiles on both sides. Accordingly, we have proposed in the Geneva negotiations to reduce the forces on both sides by a given percentage. This in turn is not acceptable to the Soviets because it gives them a permanently inferior position. Probably a compromise is necessary.

If we cannot agree on arms reduction, perhaps we can at least agree on keeping the armaments at their present level. Even this would be a great improvement over the unlimited arms race.

AICBM AND SHELTERS

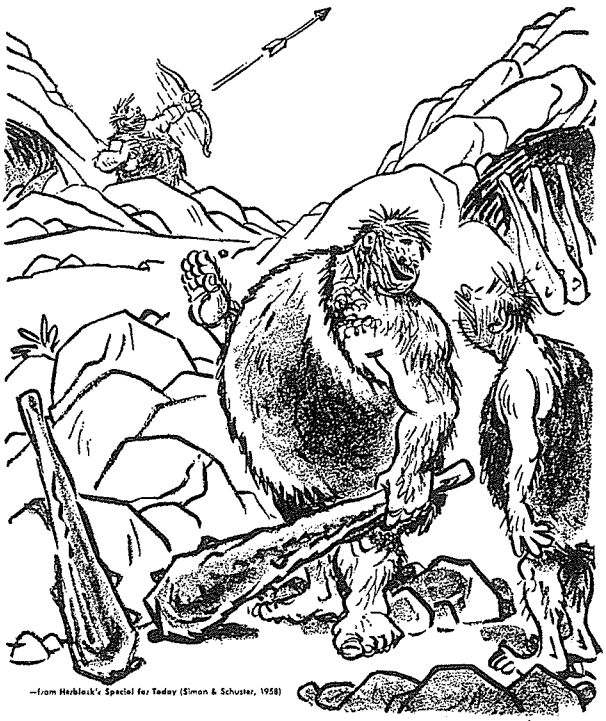
I have emphasized the great improvement of our security when our deterrent became invulnerable and thereby stable. This removed (or at least greatly reduced) the premium which previously existed for striking first, for starting the war. It is obviously most important that our deterrent be actually stable. New inventions may disturb its stability, and the one which has been mentioned most often is the anti-missile. If Country A develops an effective anti-missile (AICBM), so the argument goes, it may attack Country B with its own missiles. If Country B then counter-attacks, Country A will destroy all of Country B's missiles by AICBM. So Country B's deterrent fails to work.

I do not believe that we need to be afraid of such a development. It is quite likely that an AICBM system of some kind can be developed. But its effectiveness will always be moderate. It will never be the decisive weapon contemplated in the argument I just mentioned. As long as Country A makes a rational analysis of the effectiveness of its AICBM, it can never be confident that this system can really stop all the enemy's missiles.

There are many problems in an anti-missile system. At first sight, one might think it most difficult to intercept a fast ICBM, but this is possible. One needs fast-reacting anti-missiles, a good radar which can follow the incoming ICBM early enough, and a fast computer which calculates the future trajectory of the incoming missile. There has to be excellent guidance of the anti-missile, and the anti-missile must carry a nuclear warhead so that a near-miss is sufficient to destroy the incoming ICBM. Sufficiently close intercepts have been achieved by our experimental Nike-Zeus missiles.

The difficulty begins when the offense uses special tactics to facilitate penetration of its ICBM. One of these is to send over decoys together with the warhead. To the radar, these decoys resemble the warhead

The Russian view



—from Herblock's Special for Today (Simon & Schuster, 1958)

"IT'S A NICE TRICK BUT IT HAS NO SIGNIFICANCE"

very closely, especially in outer space. The defense then has two choices. It may attempt to discriminate between warheads and decoys, which is very difficult. If it cannot do this, the defense must send up one or more anti-missiles for each decoy. An offensive missile may carry a very large number of decoys, which may make anti-missile defense prohibitively expensive. Another method which the offense can use is to cause radar blackout. Before the actual attack, the offense launches a precursor atomic weapon which is exploded at high altitude above the anti-missile battery. This nuclear explosion, which must have considerable yield, leaves radioactive debris behind. The radioactive rays will cause ionization of the high atmosphere, which in turn will absorb the radar waves. This will hide from the radar any missiles which may enter behind the radioactive cloud. There are many other methods, and they all add up to making AICBM extremely difficult and very expensive.

Even if the defense copes with all these difficulties, the offense still has another tactic available. It may simply send so many missiles against the defended target that it exhausts the available anti-missiles. It is usually less expensive for the offense to increase its attacking force than it is for the defense to make more anti-missiles. The best the defense can hope to accomplish is to protect certain targets to a limited extent. But this would increase the danger for other cities. For instance, in this country, having a limited budget, we might choose to protect Washington and the three largest cities, New York, Chicago, and Los Angeles by AICBM. Knowing this, the enemy might then shift his attack to Detroit, Boston, and San Francisco. Wherever we drew the line, the next group of cities would be more exposed than it is now. Even the cities which are protected by AICBM could be destroyed by a determined enemy if he were willing to use enough of his missiles to exhaust the supply of anti-missiles defending that city.

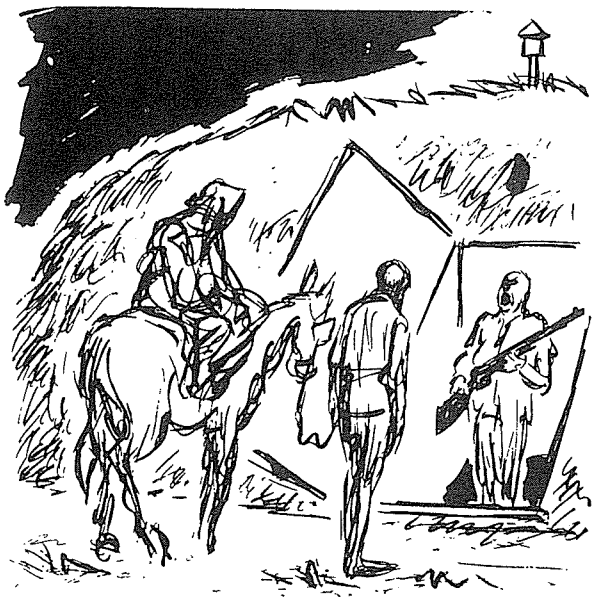
For these reasons, even if we were to develop a good AICBM system and even if we were to deploy it around some of our cities, we could never feel that we had made the country safe against enemy ICBM attack. AICBM will not change the balance of power in any decisive way, and its impact cannot be compared with that of the atomic bomb or the missile or the invulnerable deployment of missiles. It is an unpleasant feature that to overcome a possible AICBM defense of Country A, Country B will be inclined to increase the number of its offensive missiles. Therefore, AICBM tends to accelerate the arms race. But I do not believe that it would bring back the danger of surprise attack.

There is another way for the offense to circumvent AICBM defense which deserves special consideration. If a potential enemy desires to put New York out of action and knows that New York is strongly defended by AICBM, he may simply choose to place one or several missiles on points outside the defense perimeter of New York. These missiles will not destroy any particular target but they will release radioactivity. At least one of the radioactive clouds will be carried by the winds to New York City and produce fallout. Therefore, if AICBM is to be deployed, it is essential that fallout shelters be provided in the protected city at the same time.

I have reached this conclusion with great reluctance. I remember vividly the discussion of 1961 on fallout shelters, which stirred up the emotions of the population in a highly undesirable way. Nevertheless, if the country wants to provide some protection for its citizens in the unlikely event of an enemy attack, fallout shelters are probably the single, most effective and cheapest measure. Of course, one must realize their limitation. They do not protect against blast. Blast shelters would be enormously more expensive. In general, they do not protect against fire, and in case of a firestorm the inmates may die from lack of oxygen. Some shelters will be overcrowded while others are empty, and in the overcrowded shelters people may starve or even kill each other. When the survivors leave the shelter, it will be most difficult to provide food, transportation and new housing for them.

The worst point about shelters is that they change the psychology of the population. In contrast to planes and missiles, radar and anti-missiles, they intimately involve the civilian population. Indeed, shelters are useless unless every citizen is aware of them and knows the shelter to which he is supposed to go. This is a tremendous change from the carefree life of the American people, a change I do not want to see. To make people take shelters seriously, one probably would have to picture war as more likely than it actually is. And this change of attitude, especially when reacted to in Russia, will in fact make war more likely.

We are in a quandary. In case of war, shelters would undoubtedly save many lives. But if they make war more likely, we have lost on balance. It is far better to pursue a policy which avoids nuclear war.



"THERE'S NO ROOM IN THE SHELTER"

THE COST OF ARMAMENTS

Our analysis of the AICBM has shown that there is an interplay between offense and defense. If Country A spends money on defensive weapons like anti-missiles, Country B may penetrate and overcome these defenses by spending more money on offensive weapons like ICBM. The material damage and the casualties which Country A will suffer in case of war are not really determined by the amount it spends on military preparations. Both the U. S. and Russia have spent enormous amounts on weapons since World War II, and neither has bought any real security. In the event of war, the casualties in either country would be greater than in any previous war in history. The survival of each country depends entirely on the good sense of the other to avoid war for self-preservation. This is the essence of the deterrent philosophy.

All-out nuclear war would be an unmitigated catastrophe for all countries involved. Of course, as Herman Kahn has pointed out, it *would* make a great difference whether 50 million Americans die or 100 million. But even this depends little on the actual amount of money this country spends on armaments. In the arms race, where each move of the U. S. causes a countermove by Russia, it is much rather the *ratio* of the expenditures of the two countries that matters. The damage and casualties in our country, in case of war, will be essentially the same whether we spend a lot or little on war preparations, provided only that

The Russian view

the USSR follows suit. Security is not bought by increased spending on armaments. We can choose the level of armaments within wide limits and achieve about the same security for this country as long as there is a reasonable balance between our expenditures and those of the Soviet Union.

All this is true as long as nobody makes a mistake in his war preparations, as long as both countries distribute their defense money between different types of armament as intelligently as possible. If there are errors or miscalculations, it is likely that the higher level of armaments will be the more dangerous. Assume for instance that both sides have AICBM and both sides then incease their missile force to overcome the enemy's AICBM. Suppose then that AICBM does not work as well as predicted—and this indeed is very likely—then the damage to both countries in a war will be worse than it would have been without AICBM and with a smaller missile force. In any case, the amount of radioactivity would be worse. A controlled reduction of armaments would diminish the danger.

Barring miscalculations, the level of armaments (within certain limits) probably does not matter much to our security as long as there is a given ratio in the levels of armaments on both sides. Within these wide limits, setting levels is not a technical or military decision but a political and economic decision. Our economy can probably sustain, without much dislocation, either half our present level of arms production or twice that level. In the Soviet economy, change makes a much greater difference. So our choice is essentially whether we wish to put a strain on the Soviet economy by forcing them to a high level of arms production or whether we wish to encourage their development toward a prosperous bougeois society by keeping the armaments expenditure low. This is a question that I cannot answer and which has no technical answer. In any case, the initiative is ours.

It is also possible to outbuild the Soviet Union. We have done so in the past. Having a vast superiority in missiles and planes, the United States is understandably reluctant to accept an arms control agreement which would eliminate that superiority. But we must always remember that 100 missiles placed in American cities will make us just as dead as a thousand.

ARMS CONTROL IN A MULTILATERAL WORLD

The problem of arms control seemed simple when there were two well defined power blocks. The treaty on arms control would specify the number of planes and missiles for the Eastern and Western blocks. It might permit a larger navy for the West and a larger army for the East. Each country would get the best and most invulnerable forces permitted by the treaty. This would lead presumably to a stable deterrent because the missiles of one country could not be destroyed by the other.

But we see at present the disintegration of the power blocks. China is clearly going her own way. France, while still having fundamentally similar aims as the rest of the Western alliance, is developing her own nuclear establishment. The danger of a major conflict between East and

West has diminished, and many countries therefore see less reason to keep the block unified. People can think again in other terms than the overshadowing conflict between East and West and the possibility of thermonuclear war. Outstanding political problems have become less acute. For instance, a showdown over Berlin has become much less likely. Russia no longer seems to desire it, and East Germany by herself has little chance to disturb the peace. Perhaps the whole problem of East Germany and Berlin can be settled in this calmer atmosphere in a few years. Individual countries in the East may now have relations to countries in the West. Western tourists are travelling in the satellite states and in the U.S.S.R. and are getting better acquainted with the other side. A war over the boundary between eastern and western Europe has become quite unlikely. DeGaulle's opinions, while often differing from ours and often uncomfortable for us, are nevertheless often valuable because they start us thinking in different directions which may, in some instances, prove fruitful. All these are good aspects of the loosening of the power blocks.

On the other hand, the disintegration of the power blocks will make an agreement about arms control much more difficult. If China and France have to be given their own quotas of strategic missiles, and other countries follow, how can these quotas be determined? With only two potential antagonists it is easy to insure that each country feels safe from attack by the other. But with many countries possessing weapons, no country could feel safe from attack by a coalition of all the others. The coalition might easily have enough missiles to destroy the hardened missile sites of any single country.

In this difficult situation there is some hope. The single country would still have its Polaris-type missiles which are highly invulnerable, even to a vastly superior force, and which would remain a deterrent against the coalition starting a war. A coalition is very unlikely to act quickly and to stage a surprise attack. The invulnerable deterrent is designed to take the premium out of surprise attack. Finally, it is unlikely that a large coalition would be so devoid of moral scruples that it would act as an aggressor in this manner.

In spite of these hopeful points, I still regard the proliferation of strategic weapons as a serious factor of instability. Moreover, it is possible that some technical development may change the present stability of the deterrent. The AICBM, as I have discussed, is not likely to do so but other developments may. Military technology usually goes in waves and while the last few years have favored stability, one must be prepared that some time in the future the reverse may be the case.

Therefore, it is important that we conclude a treaty on arms control in the next few years. At present we have a stable and invulnerable deterrent. Who knows how long this will continue? At present we have only two countries with missile forces. If we wait there will be proliferation. In the last two years, we have had a relaxed relationship between East and West. This may not continue forever. I should like to see a treaty stabilizing the desirable state of affairs of the last two years rather than wait until aroused passions or fear make agreement impossible.

—from Herblock's Special for Today (Simon & Schuster, 1958)

"WANT TO KNOW HOW IT ENDS?"

....When you see that which the prophet
desolation, set up in the holy place (let him
then those who are in Judaea must take ref
to carry away anything from the house,
to pick up a cloak, if they are in the fields. It
or have children at the breast, in those days
not be in the winter, or on the sabbath day,
been since the beginning of the world, an

niel called the abomination of
o reads this, recognize what it means),
e in the mountains, not going down
they are on the housetop; not going back
ll go hard with women who are with child,
nd you must pray that your flight may
r there will be distress then such has not
an never be again. **Matt. 24. 15–35**

PHOENIX PROJECT 211

THE ROAD TO REGGANE*

LAWRENCE SCHEINMAN

In 1956, France debated joining Euratom, a proposed organization of Western European nations for the development of peaceful uses of nuclear energy. An important dimension of this debate was the issue of the renunciation of nuclear weapons. Under Prime Minister Guy Mollet, leader of the Socialist Party, France proposed to join Euratom but to reserve the right to develop atomic bombs. Though Mollet did not believe France should necessarily build atomic weapons, it was during his term of office that France committed itself to being a nuclear power.

Mollet's Minister of National Defense, Maurice Bourges-Maunoury, strongly supported the position that France, in joining the Euratom community, retain its right to an atomic military capacity. Bourges-Maunoury stressed that within a decade an army without atomic weapons would have little more effect than a police force, for atomic weapons were not only weapons of mass destruction but also tactical devices, useful in situations less than total war. He also considered atomic weapons a necessity for acquiring allied technological aid. To him the question was not whether France would or would not make atomic weapons, but whether or not she would establish an effective national defense.

In the early summer of 1956, Bourges-Maunoury invited one of the leading military advocates of French atomic weapons to address a meeting of armed service officers, ministers, and chief administrators of governmental agencies concerned with armaments. The tenor of the meeting was non-commital and many of the military officers appeared to be seeking truth in the old books of the Napoleonic campaigns. The line of argument pursued, however, was that France would not always be able to rely on American nuclear capacity within the NATO framework, for an American decision to use its retaliatory capacity was directly linked with American vulnerability to Soviet long-range bombers. There was a reluctant admission on the part of most of the military officers that eventually an atomic defense policy would have to be considered.

Pressure for a decision increased in June, 1956, when the upper chamber of the French Parliament adopted a proposal by Senator Pisani calling for the creation of a military division in the CEA (Commissariat a l'Energie Atomique, the French AEC). The Pisani proposal, a reaction to the proposition that France renounce the right to manufacture atomic weapons, focused public attention on the relationship between atomic development and national defense. The proposal was based on assumptions common among proponents of a French military program: there is no national independence without a national defense; there is no effective national defense without an atomic army; France is technically, economically and financially capable

* *This is a condensed version of a chapter from* Atomic Energy Policy in France Under the Fourth Republic *to be published in 1965 by Princeton University Press. The author is an Assistant Professor of Political Science at the University of California, Los Angeles.*

of creating an atomic military capacity; atomic weapons are not costly and investments made toward military ends would benefit peaceful atomic development. Finally, it was stressed that any future war would be an atomic war wherein atomic weapons would be used on a tactical if not a strategic basis. An army which lacked such weapons would be defeated *ab initio*.

SUEZ

A crucial event in the evolution of the French A-bomb was the Suez crisis in the fall of 1956. France, abandoned by the British and subjected to pressure by the United States in the face of Soviet rocket-rattling, concluded that the only true means of national defense was an autonomous nuclear capacity. It was not a question of Suez alone, for Great Britain, itself a nuclear power, also had to retreat. Rather, it was a question of what the future held for France if she would constantly have to bend when French and American interests were not the same. French commitments were not confined to the European continent, but extended throughout Africa. Except for Algeria, the North Atlantic Organization did not cover the African continent, nor did France wish it to do so on a military basis. Consequently national nuclear capacity would serve as an acceptable alternative and guarantee France the ability to meet its extra-European commitments.

The Suez incident, therefore, brought forth diplomatic as well as military rationalizations for vesting France with atomic weapons. The Gaullist journal *Carrefour* wrote:

> The first lesson of Suez is that only possession of the atomic bomb confers power. If France again wishes to intervene in international competition in an effective manner, her essential task is to establish her strategic and tactical nuclear potential so as to weigh in the balance of the destiny of the world.

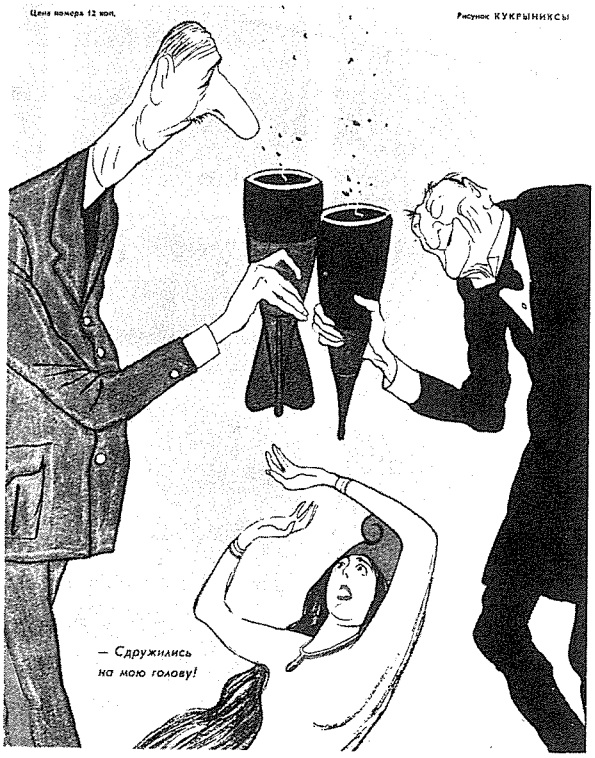
Felix Gaillard, one of the key figures in French atomic development, concluded in an article on atomic policy that:

> The political evolution and in particular the Soviet ultimatum and threats . . . prove the necessity of not excluding the eventuality of a military atomic program. It should even lead us to decide to carry on, without delay, all preliminary studies for the first explosion.

Action was not long in coming. On November 30, 1956, a protocol, significantly expanding an earlier agreement, was signed between the CEA and the Ministry of National Defense. It established a program for the succeeding four years in which it would be the Commissariat's responsibility to prepare the preliminary studies for a nuclear explosion, to supply the necessary plutonium and to be ready to make experimental prototypes if requested. The CEA was also charged with the responsibility of preparing studies for the creation of an isotope separation plant to provide France with Uranium-235. The actual experiments were to be left to the armed services. In December, 1956, a Committee of Military Applications of Atomic Energy was created, which included military personnel and both the Administrator-General and High

КРАСНАЯ ШАПОЧКА: — А почему у тебя такие острые зубы?

The Russian view



The Russian view

Commissioner of the CEA. This organization, under the presidency of the *Chef d'Etat-Major General des Armees,* reviewed the allocation of funds to research groups.

Though more and more officials were reaching the conclusion that a national defense program had to be built on an atomic basis, the public position of the Mollet Government was that a weapons program would not be underwritten at that time. Consequently, the military development plan went forward at a slower pace than it would have if consensus had been reached in the cabinet.

THE U235 PROBLEM

An important aspect of French atomic development, for both peaceful and military purposes, was the decision to construct an isotope separation plant. Enriched uranium was needed for electric power reactors, propulsion reactors, and nuclear weapons. Isotope separation studies had been started as early as 1952 by the *Service de Poudres,* a military group, under agreement with the CEA. It was possible, as of 1955, to acquire U^{235} from the United States under the "Atoms-for-Peace" proposal of President Eisenhower, but under stringent conditions and limitations. It could be used only for peaceful research, which precluded even propulsion studies, and the receiving nation was obliged to submit to controls and inspection by American teams.

France sought to acquire U^{235} free of any restrictions. It asked Great Britain for technological aid. Great Britain refused because of limitations imposed by Anglo-American agreements. France then unsuccessfully tried to conclude an agreement with West Germany. Finally it proposed an isotope separation plant on a European scale. From the inception of the Euratom idea to the conclusion of the Treaty in March, 1957, France sought acquiescence in the development of a European plant. General interest was at first high but steadily decreased until, finally, France alone deemed it necessary.

Several factors contributed to the declining interest of France's future Euratom partners. In February, 1956, the United States offered twenty tons of U^{235} for foreign industrial use at a price which unit for unit was at least one-half the cost of a European undertaking. In November, 1956, the United States reduced the selling price even further. Obviously, the United States was attempting to prevent the establishment of a European enriched uranium plant by offering an economically appealing alternative.

The French reaction to the American offer was summed up in *Le Monde:*

> . . . however generous this offer may be it is not really important from the qualitative point of view of technical progress . . . .
>
> Unquestionably we think that serious arguments militate in favor of the pursuit of European efforts in this area. If Europe wishes to achieve independence in the atomic sphere . . . she cannot rely on a single supplier for a material which may remain essential for certain applications such as propulsion . . . .

> We also think that even if we must produce U^{235} at an increased price ... which is higher than that which can be bought from the United States, it is worth the effort ....

The other nations of the future Euratom community considered the alternative of purchasing American enriched uranium attractive. The cost factor may have accounted for their attitude but a more probable explanation is that none of the other Euratom nations were contemplating the manufacture of atomic weapons and consequently were not concerned about the limitations which the United States would place on U^{235} that it sold to Euratom.

In France, however, there was strong consensus among scientists, technicians, military and political personnel that France undertake the construction of an isotope separation plant. This decision was presented to Parliament in July, 1957, and approved.

COMMANDEMENT DES ARMES SPECIALES

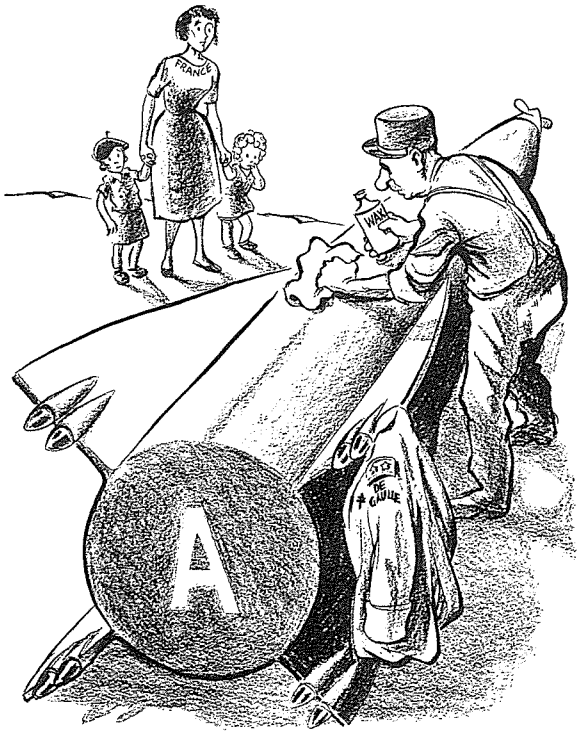
In 1956, Colonel Charles Ailleret, the most outspoken military officer in favor of atomic weapons, had been elevated to the rank of General and put in charge of the *Commandement des Armes Speciales*. This unit was given the task of overseeing the problems related to an eventual atomic test and the study of the organization of these tests. General Ailleret proceeded, in November, 1956, to outline a national military atomic program. Arguing that only the military uses of atomic energy were immediately practical and that nuclear electricity was still a long way off in terms of need and technology, General Ailleret defined what he considered to be the essential elements of a minimum French program: the completion of the Marcoule power plants; the fabrication of explosive atomic devices based on plutonium; the building of an isotope separation plant and the construction of power reactors from which a plutonium by-product could be taken. The end result, he concluded, would be the production of sufficient plutonium to produce one bomb in 1958, two in 1959, six in 1960 and twenty in 1961.

In May, 1957, Defense Minister Bourges-Maunoury announced a new military policy based on the premise that:

> ... the new conditions of war, our adversary's possession of a substantial stock of atomic weapons ... require that on the list of studies to be undertaken, the strategic reprisal weapon must have priority ....

The general staff, in late 1957, established a national plan for experimentation with atomic bombs that provided forty billion francs for a three year period. The plan complied fully with General Ailleret's. The only things lacking were a formal government decision and the appropriation of funds to prepare for a test.

The direction in which France was moving was indicated by Jules Moch, French representative for disarmament negotiations. In July, 1957, and again in October, 1957, Moch publicly stated that in the absence of a disarmament agreement between East and West, France would push ahead with her atomic bomb research for which she was already preparing the fissionable material.



STATUS SYMBOL

"PARLEZ VOUS NATO—I SAY, PARLEZ VOUS NATO?"

A GOVERNMENT ACTS

What turned an agreement in principle into a firm Government decision to vest France with an atomic weapon was the development of the nuclear balance between East and West and the deterioration of French-NATO relations. An assessment of these two factors by military and political personnel led the new Prime Minister Felix Gaillard to sign an order on April 11, 1958, calling for the detonation of the first French Atomic bomb in 1960.

Until 1957 the Soviet Union was not in a position to match the United States in nuclear armaments. The Soviet long-range bombers had an effect on the credibility of American statements that she would defend Europe against Soviet attack in Europe with nuclear reprisal, but it was the launching of Sputnik, in October, 1957, that seriously raised the question of the validity of the American promise. The United States was visibly shaken by this event. At the December, 1957, NATO meeting, the United States proposed the installation of missile emplacements on the soil of NATO countries. The United States, at that time lacking an Intercontinental Ballistic Missile, sought to compensate for this lack with the Intermediate-range Ballistic Missile. From the French point of view, the massive retaliation concept was valid when the West controlled "the launching of strategic reprisal" and held an edge over the Soviet Union. But, as one French writer commented, "from the day when this superiority disappears, when American territory tends to become as vulnerable as Soviet territory, the menace of this reprisal becomes less convincing for the adversary."

A number of French military authorities noted this advance of the Soviets in the missile field and contended that the United States was not working quickly enough to catch up. In reviewing this situation, General Paul Gerardot concluded that:

> Our only defense essentially resides ... in the possession of reprisal weapons, the development of which depends on us and on us alone ....
>
> France must, therefore, if she wishes to remain a great power and to enter into the 'club of the greats' in order to make her civilizing action felt, build atomic weapons as soon as possible.

Parallel with this, the French had long been impressed by the American and British decisions in October, 1956, to reduce their conventional troops. Furthermore, the British, in the spring of 1957, issued a White Paper which stated that there was no way to defend Great Britain except through a deterrent capacity. By the fall of 1957, French military thinking had become impregnated with the idea that military structure and equipment must adapt to the new possibilities offered by science and technology. As an observer concluded, whether France makes her own atomic weapons or receives them from the United States, one thing was certain: "the French army will have them."

On April 11, 1958, Prime Minister Gaillard signed the crucial order. His decision, influenced by military and diplomatic factors, may also

have been facilitated by the fact that the political groups supporting the Government had reached consensus on the need for atomic weapons. Aside from the Communist Party, all political groups had publicly acknowledged the need for French atomic weapons. It appears probable that if the Gaillard Government had presented to the National Assembly the question of whether France should make an atomic bomb it would have received a favorable response. The Gaullist policy of *grandeur* and prestige was in play—and it preceded its mentor.

THE BOMB

Possession of the A-bomb by France became official public policy under General de Gaulle. Although the decision to test the bomb by 1960 was taken under the Gaillard administration shortly before the end of the Fourth Republic, it was characteristic of that Republic that Governments vacillated, hesitated and were unwilling to shoulder the responsibility of underwriting an atomic military program for France. The Algerian yoke and the economic stresses of the Fourth Republic go far toward explaining this hesitation. In the Fifth Republic there was never any question but that France would provide herself with the atomic bomb. Added under the Gaullist regime was the concept of a national nuclear striking force, a panoply of strategic and tactical atomic weapons complete with a delivery system.

Official spokesmen for the Fifth Republic have gone to great lengths to justify France's development into a military atomic power. These justifications have extended from the narrow need to consider the strategic importance of French positions in the Mediterranean to the broader consideration of France's proper role in the defense of the free world. Prime Minister Michel Debre contended that:

> . . . to avoid being crushed by agreements between very great powers a nation like France must have the power to make herself heard and understood.

What this entailed in terms of French policy was highlighted by Jacques Soustelle, former Minister-Delegate for Atomic Research:

> I regret that for a nation such as ours possession of such a weapon is still necessary for entry into a sort of world "Jockey-club." But in the present state of affairs we must devote part of our research to [atomic] weapons which constitute an admission card among the truly Great Powers.

Gaullist leadership, which had long been convinced that those nations which did not possess atomic military capacity would be little more than satellites of the possessor nations, and that access to the nuclear club, and supposedly to American atomic secrets, depended upon possession of the bomb, forged the reluctant preparations of the Fourth Republic into the political and military banner of the Fifth. There was, therefore, no shift in the basic military atomic policy of France when the Gaullist Republic was formed. But the continuity which prevailed was given effective leadership by a Government which stated what it needed and was courageous and audacious enough to pursue the ends decided upon. On February 13, 1960, the first French atomic bomb was detonated.

"THE DOOR WAS TOO SMALL—I HAD TO BLAST"

PHOENIX PROJECT 268

THE TEST-BAN NEGOTIATIONS*

HAROLD KARAN JACOBSON

The prohibition or restriction of nuclear weapons tests became the subject of serious political discussion soon after the United States detonated a fifteen-megaton thermonuclear device in the Bikini Atoll on March 1, 1954. The techniques used in this detonation demonstrated that nuclear weapons could be much cheaper per megaton of yield than they had been previously and implied that their destructive capacities were almost limitless. The Bikini test also dramatized the danger of fallout when radioactive debris unexpectedly fell on adjoining islands, injuring the Marshallese inhabitants, and on a Japanese fishing boat, injuring the fishermen. As a consequence, pressures against testing nuclear weapons increased, but not until 1957, during the London meetings of the United Nations disarmament subcommittee, did the great powers seriously discuss the issue.

Negotiations did not begin until 1958. They were triggered by the Soviet decision to cease testing nuclear weapons and not to resume unless others engaged in testing. The decision was announced on March 31, 1958, immediately after the completion of a test series by the Soviet Union and shortly before the start of an American series. The United States response was to request a meeting of technical experts from East and West to examine the question of whether a test ban could be adequately monitored. Meanwhile, the American test series went on as scheduled.

AN OLD, OLD PROBLEM

THE CONFERENCE OF EXPERTS

The so-called Geneva Conference of Experts met from July 1 to August 21, 1958. After examining existing techniques of detection, the Conference concluded that it was "technically feasible to set up a workable and effective control system for the cessation of nuclear weapons tests." The Conference suggested a control system of 160 to 170 land-based posts and about ten ships. Such a system was estimated to have a "good probability" of detecting nuclear explosions of yields down to one kiloton in the atmosphere, in the open oceans and underground.

The Conference recognized that it would be difficult to distinguish the seismic signals generated by underground explosions from those generated by earthquakes and that this difficulty would increase signifi-

* *A slightly enlarged version of this article appeared in* The Annals of the American Academy of Political and Social Science, *January, 1964. The author, an Associate Professor of Political Science at The University of Michigan, is preparing a book on the same subject in collaboration with Professor Eric Stein of the Law School, entitled* Diplomats, Scientists and Politicians, *which will be published in 1965.*

cantly as the strength of the weapons being tested moved from five kilotons to one kiloton. It also felt that the only positive proof of an underground nuclear explosion would be the collection of radioactive debris at the site. For both reasons, on-site inspections were considered necessary. Although the Conference of Experts discussed the detection of nuclear explosions at high altitudes and in outer space, it did not suggest any control apparatus for this environment.

THE GENEVA CONFERENCE

On the basis of these conclusions, President Eisenhower proposed that the nuclear powers negotiate a test-ban agreement and offered to withhold testing for a period of one year from the beginning of negotiation. Thus began a moratorium which lasted almost three years and the negotiations which ultimately resulted in the Moscow Treaty of 1963.

The course of the negotiations was jagged rather than smooth, though, from surface appearances, they, and American policy within them, followed a logical and coherent pattern. Shortly after the Geneva Conference on the Discontinuance of Nuclear Weapon Tests opened on October 31, 1958, American scientists evaluated the United States 1958 test series and concluded that there were serious deficiencies in the control system outlined in the report of the Conference of Experts. In August and early September, the United States had fired—for the first time—several shots at high altitudes, one at a height of nearly twenty-seven miles, another at nearly fifty miles, and three at approximately three hundred miles. These tests made obvious the need for apparatus to detect nuclear explosions at high altitudes and in outer space.

The analysis of a series of underground explosions conducted in Nevada in September and October of 1958 created an even more serious problem. The scientists concluded that the seismic magnitude of the one previous underground explosion—the September 1957 Rainier shot —which had formed the principal basis for the calculations of the Conference of Experts, had been estimated incorrectly, and that discriminating between earthquakes and clandestine explosions would be more difficult than anticipated. More importantly, the scientists discovered that the background noise normally recorded by seismographs might obscure the direction of the first motion of a signal generated by an underground detonation. The direction had been assumed to be the most important criterion for discriminating between underground explosions and earthquakes. Scientists now thought that the threshold for detecting underground nuclear explosions was nineteen rather than five kilotons. At the same time, it was postulated that by detonating a nuclear explosion in a large underground cavity it might be possible to "decouple" or muffle its signal by a factor of three hundred.

TECHNICAL WORKING GROUPS I AND II

The United States response to these developments was a research program to see if improved methods could be found for detecting

—from Herblock's Special for Today (Simon & Schuster, 1958)

"LET ME KNOW WHEN YOU DECIDE SOMETHING"

"THE TIME HAS COME," THE WALRUS SAID,
"TO TALK TO MANY LANDS;
OF ATOM TESTS—AND ALL THE REST—
AND UNINSPECTED BANS"

nuclear explosions. Simultaneously, the United States requested further technical talks. At first, the Soviet Union refused, asserting that the report of the Conference of Experts was, and had to be taken as, the basis for negotiations. Eventually, in May, 1959, the Soviet Union agreed that there should be a technical discussion of the problems of detecting nuclear explosions at high altitudes and in outer space. Technical Working Group I, as it was called, met in June and July of 1959. During these talks, the Soviet scientists accepted all but one of the control devices suggested by their American counterparts. They refused to accept backscatter radar on the ground that it could also be used to detect rocket launchings. Group I recommended additions to the control system to extend its capabilities to high altitudes and outer space.

The problem of detecting underground nuclear explosions remained, and the United States continued to press for technical talks to discuss this. In early November, 1959, the Soviet Union acquiesced, and Technical Working Group II met from November 25 to December 18, 1959. Unlike the preceding meetings of scientists, this session ended in sharp disagreement. The Soviet scientists contested the American data. The capability of the control system recommended by the Conference of Experts remained in dispute.

In February, 1960, the United States proposed a phased treaty which would initially outlaw nuclear testing in environments where American scientists felt adequate control could be established and which could be extended as warranted by improvements in control capabilities. The United States had suggested the possibility of a partial ban as early as April, 1959, but the Soviet Union had rejected this almost out of hand. In addition, the United States suggested a joint research program with the United Kingdom and the Soviet Union to improve control capabilities. After some sparring, the Soviet Union accepted these suggestions on the condition that there be a moratorium on testing in the environments not covered by the initial phase. Agreement seemed to be in sight, and a fourth meeting of scientists from East and West was scheduled to plan a research program.

SEISMIC RESEARCH PROGRAM ADVISORY GROUP

The Seismic Research Program Advisory Group met in May, 1960, just prior to a planned meeting of the heads of state in Paris. At first, the talks proceeded smoothly. The Soviet scientists agreed that the problem of detecting underground nuclear explosions was more difficult than had originally been thought. There were, however, deep differences on low-yield nuclear explosions and the decoupling theory. The Soviet scientists implied that these problems were beyond solution, at least in politically acceptable terms, and ought not to be examined.

As it was, these differences became irrelevant. The Paris Summit Meeting between President Eisenhower and Premier Khrushchev collapsed over the U-2 incident, and the test-ban negotiations took a radical turn for the worse. From that point on, virtually no progress was made until December, 1962. Several significant concessions offered by the West after President Kennedy assumed office met only Soviet rebuffs.

THE END OF THE MORATORIUM

The Soviet Union unilaterally broke the moratorium on nuclear testing on September 1, 1961, despite pledges that it would not resume testing unless the West did. Earlier in 1961, the Soviet Union had rejected United States suggestions for reciprocal inspection of American and Soviet test sites to ensure that neither side was preparing to test nuclear weapons. The Soviet tests, which required extensive preparations, yielded significant results, and the United States and the United Kingdom felt compelled to conduct tests of their own.

These new tests provided more information on detecting underground nuclear explosions. On the basis of these tests and research which had been conducted in the interim, American scientists concluded that detecting underground explosions was even easier than had been thought by the Conference of Experts, thus reversing their previous pessimistic reappraisal.

THE MOSCOW TREATY

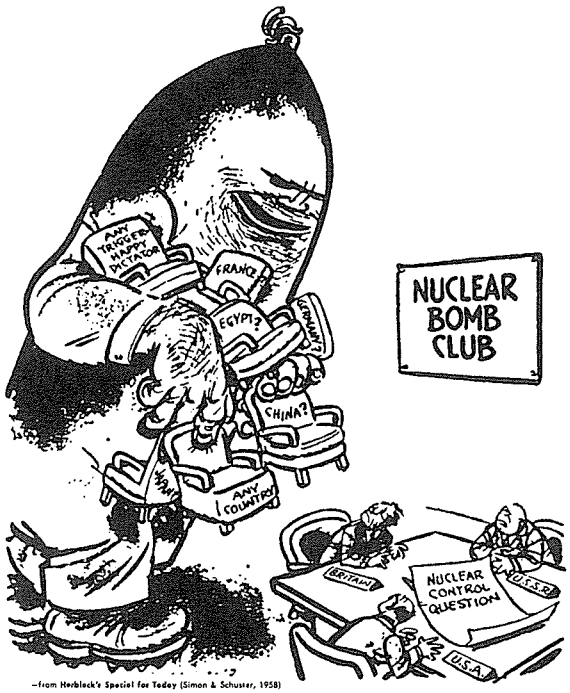
It is impossible to know what would have happened had not the Cuban crisis occurred in the fall of 1962. There is some evidence that both the United States and the Soviet Union felt only marginal gains could be made in weapons development through further atmospheric testing. Thus, even without a test ban, there might have been a sharp decline in testing in that environment. However, the threat of nuclear war implicit in the Cuban crisis seemed to compel both sides to seek some accord. In late 1962 and early 1963, the question of a comprehensive test ban was again seriously explored, but the Soviet Union was unwilling to accept even the greatly simplified international control mechanisms that the United States proposed. The next and final move, the acceptance in the summer of 1963 of a partial test ban policed by each nation's own detection systems, came in the context of a serious deterioration of Sino-Soviet relations.

AN EVALUATION OF AMERICAN POLICY

Although the record can be read as a tribute to American patience and as a triumph for the American concept that arms-control agreements should only cover aspects that can be controlled, it also reveals basic weaknesses in American policy.

INADEQUATE TECHNICAL PREPARATION

Throughout the negotiations, the level of United States technical preparation left much to be desired. During the Conference of Experts, the United States based its calculations for elaborate control measues over underground nuclear explosions on one experiment. Subsequent experience proved that this base was too narrow. Several times American scientists discussed and agreed to control devices which did not exist and whose operational capacities could not be known fully. A prototype of the control station recommended by the Conference of Experts in 1958 was not operating until October, 1960. The satellites recommended by Technical Working Group I for the detection of nuclear explosions



—from Herblock's Special for Today (Simon & Schuster, 1958)

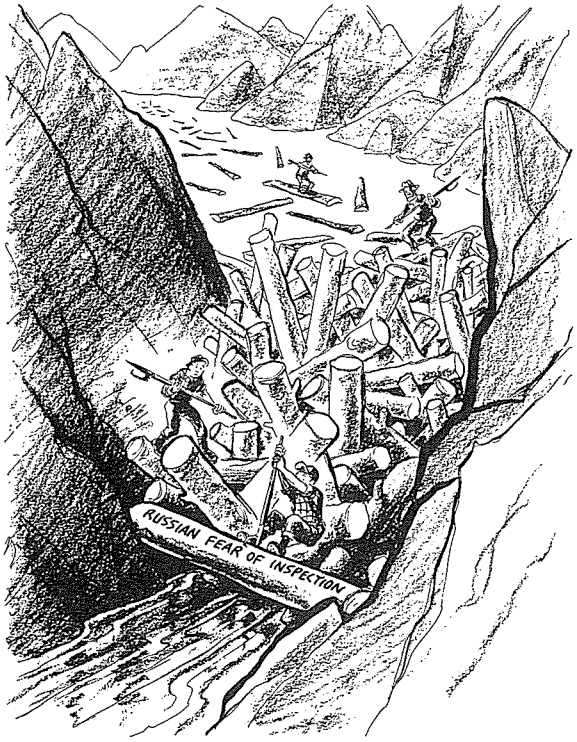
"WHILE YOU'RE TALKING, I'LL BRING SOME MORE CHAIRS"

in outer space were not put into orbit until the fall of 1963, and an entire system was not operational for another three years. Twice during the negotiations, the United States attempted to settle technical issues despite the knowledge that relevant experiments would be conducted during the technical discussions or after their conclusion. This occurred during the Conference of Experts. It also occurred during the meeting of Technical Working Group II. The first major experiment in Operation Cowboy, a series of chemical explosions designed to test the decoupling theory, was conducted on December 17, 1959, the day before the Working Group recessed. The tests in this series would continue until mid-March, 1960.

This is not to argue that the level of American technical preparation was inferior to that of the Soviet Union. On the contrary, the United States scientists provided the largest proportion of the technical data. Given the asymmetrical interest in control—which, regardless of whether or not it is desirable, will probably continue as long as Western societies maintain a higher degree of openness than Communist regimes—the situation requires that the West be better prepared technically than the East.

In part, technical preparation is a function of administrative and financial support. The United States position in 1958 reflected the low priority accorded to arms control and disarmament matters within the government. Presumably, the situation has improved with the establishment of the Arms Control and Disarmament Agency. More human and physical resources are now devoted to this area. Whether or not they are sufficient is an unanswered question.

Technical preparation is also a function of the linkage between political intelligence and technical research. Technical issues have to be defined far enough in advance so that scientists have time to probe their complexities. Again, the establishment of the Arms Control and Disarmament Agency should help to create this linkage. Moreover, the Office of the Special Assistant to the President for Science and Technology and the President's Science Advisory Committee—both created as responses to the sputnik crisis of 1957—are more firmly established as parts of the governmental structure than they were in 1958. Representatives of the scientific community now have an unquestioned place in the nation's highest policy councils. Perhaps as much has been done as is possible in terms of institutional arrangements. The questions which remain—and which by their nature are presently unanswerable—center on whether sufficient thought is given to future problems.



GENEVA LOG JAM

LACK OF POLITICAL DECISIONS

A second weakness in the American position is that until 1961 the United States was politically unprepared for nuclear test-ban negotiations. Crucial decisions were ignored, postponed, or settled ambiguously. The United States called for the Conference of Experts without any clear notion of what function it would serve other than to delay matters while the 1958 test series could be carried out. The American scientists went to the Conference of Experts without firm instructions on the minimum requirements that a control system would have to meet—

especially on the matter of the threshold of detectability—to be consistent with United States security interests. Despite the fact that Technical Working Group I accepted all but one of the detection systems proposed by American scientists, a month and a half elapsed before the United States accepted "the report as a correct technical assessment ... in the light of presently available scientific knowledge." Almost two years passed before the United States submitted a proposal based on the report of the Working Group for the incorporation of detection devices for high altitude and outer space in the control mechanism.

At no time prior to 1961 did the United States present an entire draft treaty. The basic reason for this was the deep division within the Eisenhower Administration on the wisdom of attempting to negotiate a test-ban treaty. The United States seemed not to know what it wanted and to be unwilling to accept what its scientists proposed. Moreover, depending on estimates of Soviet intentions, it might have been possible to achieve an agreement earlier than 1963, one that would have been more comprehensive than the present treaty and would have included some international control features.

FAILURE TO MAINTAIN A DETERRENT

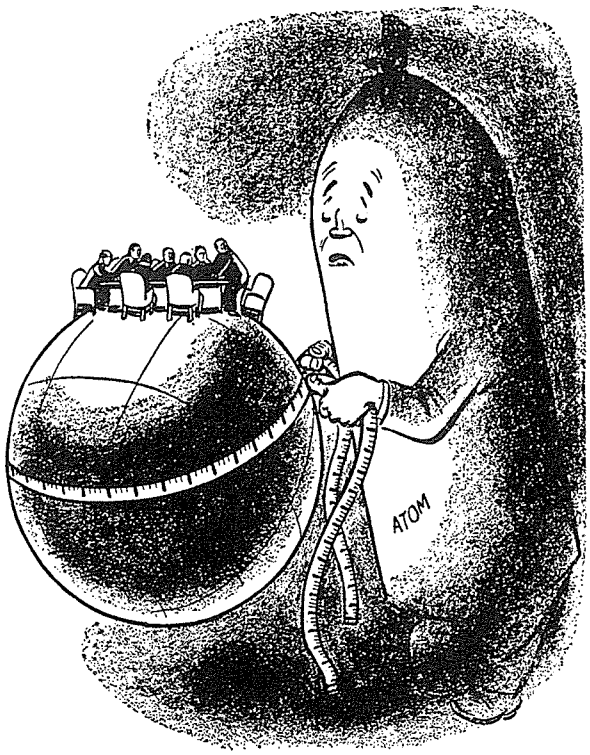
Starting with fiscal year 1960, no funds had been budgeted for testing nuclear weapons, and test sites were maintained on a minimal basis. There was some construction at the Nevada site in connection with proposed detonations in the Plowshare program for peaceful uses of nuclear explosions, but at the Pacific test site, the only objective was to retard the inevitable deterioration from the climate. In addition, American scientists appear to have been reluctant to plan weapon tests during the moratorium. Because of the openness of the procedures of American government, such as congressional hearings on budgetary requests, the lack of preparation was a matter of public knowledge. Thus, the Soviet Union knew in the fall of 1961 that it could break the moratorium without fear of immediate United States tests. Administration leaders in support of the Moscow Treaty, pledged that this situation would not be repeated. Some participants in the negotiations have even questioned the wisdom of engaging in a moratorium before an agreement had been completed. They argue that the moratorium eliminated an incentive to reach agreement.

BROADER IMPLICATIONS

It is sobering to realize that it took five years to achieve the limited accord of the Moscow Treaty and to consider that even this might not have been gained had it not been for the Cuban crisis and heightened Sino-Soviet tensions.

THE NECESSITY FOR BALANCE

One explanation for the tedious pace of the negotiations is that both United States and Soviet leaders from time to time appear to have had serious doubts about whether or not stopping tests would actually serve their security interests. Common sense suggests that in any technological race neither side will be willing to stop if it feels that it is behind and



—from The Herblock Book (Beacon Press, 1952).

"DON'T MIND ME—JUST GO RIGHT ON TALKING"

has a chance of catching up. Relative parity, therefore, may be a useful criterion in selecting other areas in which to negotiate arms-control agreements.

PROBLEMS RELATING TO CONTROL

The slow progress of the negotiations can also be attributed to the different concepts of control. The statement that the United States wanted an international control system while the Soviet Union did not is partially true. The negotiations set in bold relief the Soviet Union's reluctance to allow incursions into its territory and distrust of international organizations that it does not control. At the same time, the United States was unwilling to countenance the establishment of an international control system in which the Soviet Union's consent would be a necessary condition of most actions. The negotiations thus reaffirmed the common understanding that, in these matters, the international position of the two states and their strategic interests are significantly different.

Another difficult issue was that of creating a control mechanism in an area where relatively little was known and the state of knowledge was rapidly changing. The American approach was to frame control measures on the basis of knowledge as of that moment, in as legally precise terms as possible. For example, the American scientists generally insisted that any agreement detail the characteristics of instruments in the contol system. When the understanding of the technical situation changed during the negotiations, difficulties arose.

The position of the American scientists has justification. The negotiations themselves contained a record of disputes about the meanings of agreements, and certainly this has been a prominent pattern in East-West relations since the Second World War. Moreover, early in the negotiations, it was agreed that any basic changes in the proposed international control system would require the consent of the original parties—that is, of the Soviet Union, the United Kingdom, and the United States. Thus, the American scientists felt that they had to include everything they might conceivably think of in any agreement.

The difficulty with the American position was that it could not accommodate technological change. The nuclear test-ban negotiations illustrate clearly how much these matters are subject to change, and the failure of Technical Working Group II shows how difficult it would be to obtain agreement on changing a control system.

The Moscow Treaty of 1963 avoids many of these problems by relying primarily on national control systems. Administration officials cited as one of the Treaty's virtues the fact that most of the elements to ensure control were within the sovereign jurisdiction of the United States and that, therefore, improvements could be made readily and as needed. In the past, American policy concerning arms control has stressed the necessity of international control. Perhaps this experience suggests the wisdom of placing greater emphasis on what can be called reciprocal or adversary control. This might simplify the problem of obtaining agreement and also that of accommodating technological change.

ALMOST RIPE

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