AN ACCOUNT OF THE RETURN TO NUCLEAR WEAPONS TESTING BY THE UNITED STATES AFTER THE TEST MORATORIUM 1958-1961

PROLOGUE

In order to understand the steps taken immediately before the moratorium, during the moratorium, and at the end of the moratorium that affected the United States' capability to resume nuclear weapon testing, it is pertinent to review our status, from both the political and technical points of view, before the moratorium.

In the period of the moratorium, 1958 to 1961 and immediately afterwards, there was strong interaction between the testing activity details and the political situation in the United States. That interaction was perhaps not so strong in the period of 1946 to 1958, but nevertheless was occasionally noticeable.

Thus, there are several subjects that need to be discussed in this background: the political history of testing, which, of course, is largely the history of test ban activities; the tests themselves and their aims; the methods of testing; and the safety problems, specifically the question of worldwide fallout.

Negotiations

Perhaps it is best to remind ourselves first of the political history prior to early 1958. The period of 1943 through July of 1945 hardly belongs in this story since, on the part of the United States, it was largely a problem of active material procurement and device design, all conducted in great secrecy and, hence, discouraging external political problems were not particularly notable to the test organization. Furthermore, the story has been told in great detail elsewhere. For instance, the first volume of the official history of the U.S. Atomic Energy Commission (AEC), *The New World, 1939/1946*, by R. G. Hewlett and O. E. Anderson, Jr., covers these years in detail. Also, there are a variety of other books on this subject in those years such as Stephane Groueff's *Manhattan Project, the Untold Story of the Making of the Atomic Bomb*, John Purcell's *The Best-Kept Secret*, and recently, Martin Sherwin's *A World Destroyed*.

However, a few specific points should be made. The development of nuclear weapons in the United States* was hand in glove with the British and Canadians, and it is clear that even before the testing of the first nuclear weapon in July 1945, there was appreciable concern in these circles as to how this awesome weapon would be controlled. Roosevelt and Churchill had discussed the subject during 1943-1944. When

*In Britain, there were members of the French technical community involved.

Truman disclosed to Stalin at the Potsdam Conference that the United States was about to produce such a weapon, the subject was apparently not really new to Stalin. Kissinger* states:

> Against the background of the later disclosures of Soviet espionage there can be no doubt that Stalin was well aware of the impact of what he was being told. It is almost certain, in fact, that Stalin learned of the possibility of nuclear explosions well before Truman, who was not informed of the existence of our atomic energy program until he became President, in April of 1945.

Within a month after the Hiroshima detonation, the Soviet press was taking the attitude that the atomic bomb was not a decisive weapon, that it did not confer a basic advantage in warfare, and that all progressive forces should unite against its use. Stalin publicly ratified this view within a year, and maintained it up until the Soviets produced their own nuclear weapons.

The British and Canadian Prime Ministers, Clement R. Attlee and Mackenzie King, arrived in Washington, D.C. on November 10, 1945, for meetings with the President on the subject of a joint stand and communique on atomic energy matters. After several days of high-level discussions and detailed work on a joint draft, at which two of the American principals were Vannevar Bush and Ben Cohen of the State Department, the three nations agreed to a proposal and communique read by President Truman at a press conference on Thursday morning, November 15, 1945. Having decided not to disclose any information on the details of atomic energy, even as far as industrial applications go, for the present:

> The Anglo-American chiefs believed the United Nations should set up a commission to make specific proposals for (a) extending between all nations the exchange of basic scientific information for peaceful ends, (b) controlling atomic energy to the extent necessary to ensure its use only for peaceful purposes, (c) eliminating from national armaments atomic weapons and all other major weapons adaptable to mass destruction and (d) setting up safeguards to protect complying states from the hazards of violations and evasions.

The plan would proceed in stages, overseen by a commission, with each stage following upon the successful completion of the previous stage. This communique was followed within a month by a decision to solicit the Soviets' agreement on the basic guidelines and to seek their support of a joint proposal which would be brought before the United Nations for implementation. The details** of this concept were carried by Secretary of State Byrnes to Moscow for a meeting of the foreign ministers in mid-December (1945).

On January 7, 1946, less than six months after the testing of the first nuclear weapon, Secretary of State James F. Byrnes set up a Committee on Atomic Energy with Dean Acheson as Chairman. Other members of the Committee were Vannevar Bush, James B. Conant, Leslie R. Groves, and John J. McCloy. The major aim of the Committee was to consider controls and safeguards having to do with the development of atomic energy, with specific emphasis on the control of nuclear weapons. The Committee appointed a Board of Consultants including, among others, David E. Lillienthal, soon to become Chairman of the Atomic Energy Commission, and J. Robert Oppenheimer, who had been the wartime head of Project Y, later to become the Los Alamos Scientific Laboratory (LASL), the designers of the first nuclear weapons.

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*Henry A. Kissinger, *Nuclear Weapons and Foreign Policy*, Harper & Bros., New York, 1957, page 364.

**These details are covered comprehensively in the *The New World*, the AEC's history, especially Chapters 14 and 15.

After several months of intensive study beginning in January of 1946, the Lillienthal Board of Consultants, and then the Acheson Committee, formed several conclusions and recommendations which they transmitted to the Secretary of State on March 17.

The Committee started with the statements made by the President and Prime Ministers that we now had a revolutionary weapon establishing means of destruction hitherto unknown, that there was no adequate military defense against atomic weapons, that no single nation could, in fact, have a monopoly of these weapons, and that the only complete protection for the civilized world from the destructive use of scientific knowledge lay in the prevention of war. Thus, the United States had already made a political commitment to seek, by all reasonable means, to bring about international arrangements to prevent the use of atomic energy for destructive purposes and to promote its use for the benefit of society. The Committee concluded that there was no prospect of security against atomic warfare in a system of international agreements to outlaw such weapons controlled only by *inspection* and similar policelike methods. In other words, there could not be a successful scheme of inspection in a real world. Here inspection had not only to do with nuclear weapon testing, but also with the control of the production of nuclear weapons. This was the philosophical framework in which atomic energy would be developed around the world for peaceful purposes. The Committee further concluded that if nations or their citizens carried on intrinsically dangerous activities, the chances for safeguarding the future were hopeless. "Intrinsically dangerous activities" meant the mining, production, and separation of uranium, the operation of reactors, hence producing plutonium, and the use of the product materials for the production of atomic weapons. They therefore proposed that an international agency be given sole responsibility for these dangerous activities, with individual nations giving up their sovereignty to that extent. To put it differently, nuclear energy, including weapons, should be in the hands of an international agency or there would be no hope of preventing nuclear war.

This study became the basis for the so-called "Baruch Plan" presented to the United Nations Atomic Energy Commission at their first meeting on June 14, 1946. The plan, in essence, proposed the establishment of an International Atomic Development Authority (IADA), to which all phases of the development and uses of atomic energy would be entrusted. It would own all mines and plants producing atomic fuel. It would manage these operations, it would have the exclusive capacity to carry on research on atomic weapons, and it would license nations to conduct their own atomic research. It would have the authority to inspect all declared and legal national activities to detect any illicit activities. The IADA would have the authority for sanctions against any violator. And lastly, the plan was to be put into effect by stages. The control system was to be established first and then the United States would halt the manufacture of atomic bombs, dispose of its existing bombs, and hand over to the authority its scientific and technological knowledge. The idea of sanctions was Baruch's own.* It appears that the Committee of Consultants considered this plan, minus the sanctions, as a genuine stab at a solution to the nuclear weapons problem and specifically considered international control, in some form, as the only practical system to prevent the eventual use of nuclear weapons. [redacted]

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*John W. Spanier and Joseph L. Nogee, *The Politics of Disarmament*, F. A. Praeger, Inc., New York, 1962, page 56.

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At the second meeting of the U.N. Disarmament Commission, on July 19, 1946 (less than a year after Trinity), a Soviet draft proposal was presented by Andrei Gromyko. The Soviet proposal was for:

> . . . prohibiting the production and use of atomic weapons and providing that within three months from its entry into force, all atomic weapons were to be destroyed. Violations of the conventions were considered to be a serious crime against humanity; severe penalties for violation were to be provided by domestic legislation; the agreement, of indefinite duration, was to come into force after the approval by the Security Council and ratification by the Council's permanent members; and all states, whether or not members of the United Nations, would be required to fulfill all provisions of the agreement.

Further, Gromyko proposed setting up other control measures to ensure observance. (*The United Nations and Disarmament*, page 13.) At this time, the United States had, as a reaction to popular emotion, largely dismantled its armed forces with the exception of retaining the nuclear capability, whereas the Russians still had under arms a great number of soldiers, probably somewhere between two and a half and three and a half million.

While a great deal of discussion was carried on in the United Nations on this subject in the years 1946, 1947, 1948, and 1949, the situation was actually quite static, with the United States standing behind its offer of the Baruch Plan and the Russians making variations of the proposal to ban all bombs with no control. The actual propaganda, of course, on the Russian side implied control but did not specify a way to accomplish it. The United States' position was that there should be control first, and then we would do away with the bombs. It is interesting to note that in this period of time, the United States conducted both the Crossroads and Sandstone operations in the Pacific, with essentially no notice of that fact being taken in the United Nations' debates and with essentially no feedback from those debates upon the operations, or vice versa.

Again, it should be pointed out that at that time the arguments were concerned with disarmament, specifically with nuclear disarmament, but including all disarmament, rather than the question of nuclear weapon testing alone.

(Parenthetically, up until the early 1950s, the United States had a position of keeping atomic and conventional disarmament talks separate, whereas the Soviet Union argued that they should be discussed simultaneously. However, both sides changed position in the early 1950s.)

The situation changed rather drastically in the period of 1949 to 1952. The Soviet Union fired its first nuclear fission device in 1949. The United States tested its first full-scale hydrogen bomb in 1952, and the Soviets fired their first hydrogen bomb in 1953. Thus, the United States and Britain no longer had a monopoly on nuclear weapons and the Baruch Plan was no longer as apparently generous a gesture as it had been at one time. On the other hand, the Soviets could no longer logically simply push the propaganda to do away with the bomb completely because they, too, now had a stockpile. (The British tested their first indigenous atomic bomb in 1952.)

The United Nations Atomic Energy Commission, which had been set up in 1946 with the hopes of being the forum and implementing body in which important steps towards solving the new problem posed by the atomic bomb and atomic energy in general could be handled, did not meet after July 29, 1949, and was subsequently dissolved in

January of 1952.

The period of 1949 to 1953 was one that saw little formal action with respect to nuclear disarmament or test bans. Stalin, having developed the fission weapon, was apparently concentrating both on the production of the thermonuclear weapon and, more significantly, developing his nuclear forces, both weapons and delivery systems, in order to get out of the situation in which the United States had a strong military edge on the U.S.S.R. During this period, the Russian propaganda gradually changed from "do away with the bombs completely" to "nuclear warfare will only hurt the capitalistic system." At the same time, the United States became engaged in the Korean War, which led to a large American military buildup. We were, therefore, more interested in armament than disarmament. The United States joined Western Europe in the formation of NATO in 1949 and, hence, had to be concerned with the arming of that organization. As previously mentioned, we also elected in early 1950 to go ahead with the development of the hydrogen bomb, which was first fired full-scale in 1952. In the early 1950s, we began to equip our divisions in Europe with tactical atomic weapons to compensate for our numerical inferiority to the Red Army.

Possibilities of joint agreements or steps towards any types of disarmament took an abrupt turn in early 1950 when the Russians began their boycott of the U.N. In January, they walked out of the U.N. Atomic Energy Commission and in April, they did the same in the U.N. Commission for Conventional Armaments, when both of these Commissions refused their request to seat the Communist Chinese, just as the larger body of the U.N. had done. They were not to return to the U.N. disarmament activities until August of 1950, a couple of months after the Korean War had started. The period of lack of compromise between the Soviets and the U.S. on these nuclear and disarmament issues continued through Stalin's rule in Russia into early 1953. During this early period of the disarmament negotiation in the Cold War, the American intent was generally to establish a control system prior to agreeing to any disarmament and finally, to move to the mechanics of destroying nuclear arms. The Soviet position was the reverse with the elimination of nuclear weapons coming first followed by conventional disarmament and then a control system. The Russian-proposed control system would be tantamount to self-control.*

The year 1953 saw the conclusion of the Korean War, the death of Stalin, and a new administration in Washington. In August of 1953, a new Russian Premier, Malenkov, in announcing the detonation of their first hydrogen bomb, warned that the U.S.S.R. now had weapons of retaliation and, thus, an atomic war against the U.S.S.R. would be folly. In December, Eisenhower appealed for extraordinary measures to save mankind from the holocaust of a hydrogen war in his famous "Atoms for Peace" address to the United Nations on December 8, which he hoped would inaugurate an international program to develop peaceful uses of atomic energy, while acknowledging the impact of the emerging thermonuclear impasse. He proposed that governments involved in atomic research and development should begin to make joint contributions from their stockpiles of uranium and fissionable materials to an international atomic energy agency to be set up under the aegis of the United Nations. Several months later, in March of 1954, Malenkov admitted that a nuclear war would mean the ruin of the world civilization, as opposed to the previous Russian line that it would only mean the end of capitalism, but was obliged to repudiate the statement two months later.

It was now completely clear that the Baruch Plan had outlived its usefulness and that it had no chance of acceptance in a world in which both sides had nuclear stockpiles and means of delivery. A new position began to take form in the early

*J. Spanier and J. Nogee, *Politics of Disarmament*, page 84.

meetings of a newly formed subcommittee of the United Nations Disarmament Commission, whose task was to agree to a comprehensive and coordinated plan of disarmament. The subcommittee consisted of representatives of Canada, France, Russia, the U.K., and U.S. They began meeting in May of 1954 and continued meeting for several years. Right from the start, the Russian representative, Jacob Malik, challenged the previous Western position (the Baruch Plan) while substantially reiterating the former Soviet position on disarmament. In response, the U.S. representative, Morehead Patterson, soon conveyed through oral and written positions the fact that the United States was now more flexible in arriving at a modified position on these issues and would not adhere strictly to the Baruch Plan as originally set forth. This was to be the beginning of something of a thaw in such discussions between the two sides and the beginning of much greater activitity, if not progress, than had been seen in disarmament discussions since the rejection of the Baruch Plan in 1948. A British-French memorandum to the U.N. disarmament subcommittee,* in June of 1954, offered a prohibition on the use of nuclear weapons except in defense against aggression, and conversion of existing stockpiles to peaceful purposes. The plan would, in successive stages, freeze all military establishments, then reduce them by half and cut off manufacture of nuclear arms, then eliminate all conventional forces, and finally, abolish all nuclear weapons. All the stages would be supervised by an International Control System. The Russians immediately pointed out that the phrase, "except for defense against aggression," was a tremendous loophole, since all nations think of themselves as acting only in self-defense. Furthermore, the proposed controls were tantamount to an espionage system. However, they accepted the plan as a basis for discussion in September, and in May of 1955 the U.S.S.R. reversed its previous position and apparently accepted a control system prior to the complete elimination of nuclear weapons. However, they put in several hookers. One, they called for a ban on nuclear weapon testing, as part of the first phase of disarmament (at this point in time, the U.S. had conducted 66 nuclear detonations, including 6 above a megaton; the Russians had fired 14). Second, they proposed that the use of nuclear weapons, except for self-defense, be subject to the approval of the U.N. Security Council and, therefore, to the Soviet veto.** Third, it was required that the U.S. liquidate its military bases in other nations. They made another point: "There are possibilities beyond the reach of international control for evading this control and for organizing the clandestine manufacture of atomic and hydrogen weapons even if there is a formal agreement on international control." It is, perhaps, worthwhile to remember that point today.

At this time, the argument turned from disarmament to arms control and the latter parts of 1955 and 1956 were largely spent in profitless debate about the number of men that could be in the armed forces of China, United States, Soviet Union, France, and Britain. Again, tied to his proposal of March 27, 1956, Gromyko called for a ban on thermonuclear tests. Thus, in mid-1956, there was again a deadlock, the Soviet Union demanding a drastic reduction in manpower without extensive controls and the United States and Britain insisting on a limited disarmament agreement, including nuclear weapons guarded by strict controls. In July 1956, Gromyko agreed to the Western proposals for force levels (2.5 million each for U.S.S.R., U.S.A., and China, and 750,000 each for Britain and France), but stated that acceptance of these force levels was, amongst other things, contingent upon an immediate nuclear test ban. (By the end of July 1956, the U.S. had fired 87 shots,

*Phillip Noel-Baker, *The Arms Race*, Oceana, New York, 1958.

**J. Spanier and J. Nogee, *Politics of Disarmament*, page 88.

including 12 above 1 Mt. The Russians had fired 22, including one above 1 Mt.) In 1954, the United States had tested its first emergency capability in thermonuclear weapons, and in 1956 tested devices that might fit in a reasonable stockpile, and specifically might fit missile delivery systems. The Russians first successfully dropped the hydrogen bomb from an aircraft in November 1955, whereas the United States did not accomplish that until May 1956. The Russians, on August 26, 1957, announced the completion of a successful test of the intercontinental ballistic missile.

The United States' reaction to these early Russian proposals was one of no particular interest in a ban on nuclear weapon tests, except as part of a broader agreement covering other measures of disarmament as well. After all, our military strategy depended upon nuclear weapons to counter Soviet superiority in conventional forces. However, the development of the Russian ICBM capability in 1957 apparently put more pressure on the United States to move in the disarmament field in some manner. Thus, at the meeting of the Disarmament Commission of the United Nations in London in 1957, after the Russians announced on June 14 that they would agree to the establishment of a control system, even on their own territory, to monitor an agreement for the cessation of nuclear weapons tests, the West indicated that it was willing now to consider test cessation an integral part of the initial stage of a disarmament agreement and would also agree to a temporary suspension of testing while a control system was being established. A 10-month suspension was mentioned. Slightly later, Harold Stassen, the American Representative, offered to extend the period to 12 months and suggested an extension for a second year should there be progress in relation to the cessation of production of fissionable materials for weapons purposes. At this point, the Russians still insisted that test cessation be considered as a separate measure, whereas the West was willing to consider the test cessation only as a portion of broader moves toward disarmament. At this meeting, Mr. Selwyn Lloyd reiterated a suggestion he had apparently made elsewhere, that a committee of technical experts be established within the framework of the disarmament subcommittee to consider possible methods of eliminating nuclear test explosions, and to investigate the requirements of effective supervision over an agreement to limit such explosions. Harold Stassen again made the suggestion in August. In both cases, "The U.S.S.R., however, refused to consent to technical talks unless there was first an agreement on the period and the conditions of a test cessation."*

(In March of 1954, the United States had detonated the Bravo shot of Operation Castle from which the debris was carried up and dispersed over a much larger area than was thought possible. As a result, an appreciable number of Marshallese natives and the crew of the Japanese fishing vessel, Fukuryu Maru ["Lucky Dragon"] received large fallout radiation doses. Not long after that, radioactive rain fell on Japan as a consequence of a Soviet hydrogen bomb test. These incidents, plus an increasing study of the quantity of radioactive material in the atmosphere and its possible effects, began to produce a move on the part of other nations to exert pressure on the United States and Russia to stop testing. Prime Minister Nehru, in an address to the Indian parliament on April 2, 1954, proposed a "standstill" agreement to stop testing, leaving the broader problems for later solution. In the years from 1954 to 1957, the Japanese and the Indians, particularly, pressed for a test ban on the part of the Russians, the United States, and the United Kingdom. Albert Schweitzer issued an appeal to the Norwegian Nobel Committee, broadcast in 50 countries, asking that

*Harold K. Jacobson and Eric Stein, *Diplomats, Scientists, and Politicians*, The University of Michigan Press, Ann Arbor, 1966, page 18.

public opinion demand an end to nuclear tests. That appeal was endorsed by the Pope in 1957. The International Labor Organization and Economic and Social Council of the United Nations recommended a test ban. In August of 1957, the World Council of Churches urged an international court to stop further testing. In the United States, Nobel Prize winner Linus Pauling urged, through many publications and public meetings, a cessation of testing because of the possible genetic effects.

The next step took place at the 12th session of the U.N. General Assembly in the fall of 1957. At that Assembly, the Russians initially proposed a two or three year test ban starting January 1, 1958, with an International Commission to supervise the test suspension and with control posts spread through the appropriate nations. That proposal was withdrawn in favor of an Indian resolution asking that the nuclear powers agree immediately to suspend tests and that a Commission of Experts be created to recommend an adequate control system. This resolution was favored by the Eastern bloc and opposed by the Western bloc and was rejected in each of two slightly different forms in November of 1957. Meanwhile, the General Assembly had adopted a resolution patterned after the earlier London Western proposals after a great deal of discussion and suggested alteration. That resolution included a number of disarmament measures which would occur simultaneously, among which was the immediate suspension of testing of nuclear weapons and prompt installation of effective international control, including inspection posts equipped with appropriate scientific instruments located within the territories of a number of countries, including the United States and Russia. The resolution also requested that the subcommittee of the Disarmament Commission convene as soon as possible to set up the implementation of this resolution, and take as one of their first tasks the establishment of "a group or groups of technical experts to study inspection systems for disarmament measures on which the subcommittee may reach agreement in principle." This entire resolution, adopted on November 14, was supported by the West and opposed by the East. Russia announced that they would no longer participate in the work of the Disarmament Commission or its subcommitee, stating that these bodies were composed in a one-sided fashion. Various moves were made to change the membership of the Disarmament Commission and its subcommittee, but none were satisfactory to the Russians.

In the United States, Adlai Stevenson, in 1956, had suggested that the United States might unilaterally stop testing as a first step toward obtaining an agreement with the Soviet Union. Bulganin, of the U.S.S.R., endorsed the Stevenson proposal. Various religious groups, in 1957, urged test cessation. In February of 1957, the Council of the Federation of American Scientists recommended that the Administration should seek worldwide cessation of nuclear weapons tests without making this contingent on achieving more far-reaching goals in arms limitations. Even in Congress, in 1957, there were proposals for halting tests, at least temporarily, to alleviate the problem of fallout. Surprisingly, one such proposal came from Chet Holifield, Chairman of the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy. In November of 1957, Hubert Humphrey, then Chairman of the Subcommittee on Disarmament of the Senate Committee on Foreign Relations, suggested to President Eisenhower that the United States should declare its willingness to negotiate separately a ban on nuclear weapons tests for a two-year period, with the only condition being agreement on an effective inspection system, with United Nations supervision, to ensure that the ban was being scrupulously observed.* Thus, the pressures were high on Eisenhower in late 1957 to make some move on the cessation of tests.

*U.S. Congress, Senate Committee on Foreign Relations, Subcommittee on Disarmament Control and Reduction of Armaments, *Final Report*, 85th Congress, Second Section, 1958, page 34.

The "Security Resources Panel of the Office of Defense Mobilization Science Advisory Committee," or more briefly, the Gaither Committee, established by the National Security Council in April of 1957 to focus on the question of civil defense, concluded that the Soviet gross national product (GNP) was increasing at a much faster rate than ours and that the Soviets were spending about the same as the U.S. on their armed forces and heavy industry, even though our GNP was about three times that of the U.S.S.R. The U.S. had further concluded that the Soviets had a large nuclear stockpile, advanced missile technology, and a potential for launching a devastating missile attack on the U.S. by late 1959. The committee commented on the relative vulnerability of the U.S. civilian population and the U.S. nuclear offensive force (our so-called deterrent). Accompanying these gloomy conclusions were recommendations for substantial measures to implement a civil defense program and to vastly improve many aspects of our military offensive and defensive forces. The strong pessimism of the Gaither Report may have mainly reflected an impression of the Russian superiority in missiles at this time, coupled with the large devices they had tested. The U.S. also had a large nuclear capability, presumably even larger than that of the U.S.S.R., but mainly aircraft-carried. Perhaps the biggest justification for this report's tone was simply that for the first time in our history, we were clearly susceptible in our homeland to being attacked by a foreign nation.

President Eisenhower was not stampeded by the grim picture and far-reaching recommendations of the Gaither Report. Drawing on views of the overall situation from many other sources and advisors, he concluded that our overall military strength was still distinctly superior to that of the Communists, but he clearly saw the need for vigilance and careful study.

Up to this time, Eisenhower and Dulles had relied almost exclusively on AEC Chairman Lewis Strauss for guidance on the technical side of the nuclear weapons and nuclear test ban considerations. Strauss had long been a strong proponent of maintaining the U.S.'s superiority in these areas and dealing very skeptically with the Russian proposals. With the Gaither Report in hand, it is quite understandable that the President would have sought to have another strong scientific voice as an advisor to address fields other than nuclear weapons, i.e., missiles, civil defense, etc. Thus, he formed a new position on his staff, that of Special Assistant for Science and Technology. The first appointee was Dr. James R. Killian, President of MIT, who was appointed in November 1957, ostensibly as a reaction to the Soviets' Sputnik launch and the need to look at the nation's overall scientific effort. Concurrently, Eisenhower elevated the status of the Science Advisory Committee of the Office of Defense Mobilization, renamed it the President's Science Advisory Committee (PSAC), and brought it under White House auspices as an advisory group chaired by Killian.

Thus, 1958 began with a new, strong scientific voice in high government circles, with a great deal of pressure, both within the U.S. and without (from the U.N., Russians, and others) to work on a specific test ban agreement, and with strong pressures caused by the Gaither Report and Sputnik launch to take very seriously the question of the U.S. defense and technological status vis-a-vis the Russians. Eisenhower, in his autobiography, observed in restrospect that:

> **It was now becoming apparent that both East and West needed a common understanding of the scientific technicalities involved before the possibilities of a comprehensive, regulated test ban could be intelligently discussed.***

*It does not seem to have been apparent to the Russians.

Consistent with the Russian trend of the last several years, and reflecting the Russian worries about proliferation, Premier Bulganin had proposed in a letter of December 10, 1957, to Eisenhower that the nuclear powers agree to stop nuclear weapon testing as of January 1, 1958, for a period of two to three years, and had stated his willingness to meet with Eisenhower and discuss this and other nuclear weapon control subjects. Operation Hardtack was well along in planning by this time. Eisenhower did not answer immediately, but did write to Nehru on December 15, 1957, that he could not agree to stop testing as an isolated step without assurance that other measures to settle the problems of limitations on nuclear weapon production, surprise attack, etc., would follow. However, he did answer directly on January 12, 1958, stating that he could not attend a summit conference on the subject without adequate preparatory work, and reiterating the earlier (Selwyn Lloyd) suggestion of a meeting of East and West technical experts to discuss the feasibility of test ban controls.

With this in mind, and with the further worry, expressed by Dulles at an NSC meeting in early January, that the U.N. would soon adopt a resolution condemning further testing, Eisenhower, at Killian's suggestion, requested that Killian appoint a special panel to consider the effect of a nuclear test ban on American and Soviet weapons development programs, and to what extent evasions of such a ban could be detected. Killian moved quickly in the appointment of what became known as the Bethe Panel, after its chairman, Hans Bethe of Cornell. Other members were Harold Brown, Herbert York, Carson Mark, Roderick Spence, Doyle Northrup, Herbert Scoville, Jr., Major General Richard Coiner, Brigadier General Alfred Starbird, Herbert Loper, and Colonel Lester Woodward. This group constituted a reasonable cross section of the intelligence community, the weapons laboratories, and the Department of Defense. The Panel was to report to the President's Science Advisory Committee. Over the next couple of months, the Panel collected and considered the available information (some to be used by the American contingent at the later conference of experts) and apparently* concluded that continued testing into the indefinite future could only close the gap between the U.S.S.R. and the U.S. in nuclear weapon technology, and that the offsetting gains to be expected by the U.S. from further testing were minimal. The PSAC considered the Bethe Panel findings and concluded that Hardtack should be finished, but that then we could risk a test ban with mutual inspection, and so recommended to Eisenhower.

The pressure to consider a test ban separately from other disarmament measures increased when Harold Stassen, who had just resigned as the President's Special Assistant for Disarmament, testified on February 28, 1958, to Senator Humphrey's Subcommittee on Disarmament that a separate test ban agreement would help break the spiral of the arms race, might lead to other steps of arms control and disarmament, and could be easily policed.

Another apparent gain in world opinion went to the Russians when, having just finished an extensive test series, they announced on March 31, 1958, that they had unilaterally discontinued the testing of nuclear weapons in the Soviet Union, and called on other nations to follow their lead. (The U.S. was just about to begin Operation Hardtack in the Pacific.) They pointed out that they would feel free to resume testing if other nations did so. Eisenhower, in a press conference on April 2, called the move a "gimmick" that should not be taken seriously, but Khrushchev, who had just taken over from Bulganin, reiterated the appeal in a personal letter to Eisenhower of April 4, 1958.

The Senate Committee on Foreign Relations queried, by mail, some 42 senior American seismologists, geophysicists, and geologists in April concerning the

*H. Jacobson and E. Stein, *Diplomats, Scientists, and Politicians*, page 46.

problems of the detection of underground explosions. They received 31 replies. There was no concensus on the feasibility of detection of clandestine underground explosions.

Eisenhower answered Khrushchev on April 8, with essentially no change in his position, and on April 22, Khrushchev stated that it would be impossible for the experts to contribute to the problem of disarmament unless an agreement between governments had been reached. By now, apparently the Bethe Panel finding had sunk in a little deeper, and Eisenhower, without further consultation with the AEC or Department of Defense, wrote to Khrushchev on April 28, 1958, that the United States policy was changing, repeated his suggestion of a meeting of experts, but in the context of an agreement to stop testing, and added "Studies of this kind are the necessary preliminaries to putting political decisions actually into effect." That is, he proposed the technical meetings on the feasibility of monitoring a test ban as a prelude to opening political negotiations if such monitoring appeared reasonable.

Catching the U.S. unprepared, Khrushchev, on May 9, 1958, agreed to the meeting of the experts, but made his view clear that control was really no problem, that the experts' meeting was unnecessary, and that he regarded this as another move on the part of the U.S. to delay the cessation of testing. (By now, the U.S. was well into Operation Hardtack.)

Further correspondence during May 1958 established the date of July 1 for the conference to start. It would be in Geneva at Russian insistence rather than New York as proposed by Eisenhower. The U.S.S.R. insisted that agreement there would automatically commit the governments to a test cessation; the U.S. disagreed. There would be two sets of specialists, one of representatives of the U.S., U.K., France, and Canada, and the other of representatives of the U.S.S.R., Czechoslovakia, Poland, and Rumania. Thus, the U.S.S.R. managed to get the discussion separate from the U.N., and achieved parity of representation, which they felt they could not get in the United Nations.

During June 1958, there was a wild scramble to assemble all data that might be needed by the U.S. experts. An appreciable amount of information was declassified for such use. (But the AEC gave Captain John H. Morse, a Headquarters representative at the conference, the authority to declassify on the spot if necessary.)

After discussion among the four Western nations, the Western delegates were announced on June 20. Dr. James Fisk, a member of PSAC, was the Western chairman of the delegation. Other members were Robert Bacher, also a member of PSAC, E. O. Lawrence, Sir John Cockroft, Sir William Penney, Professor Yves Rocard, and Dr. Ormand Solandt. Advisors to the Western delegation included Hans Bethe (Cornell), Harold Brown (Livermore), Perry Byerly (University of California), Norman Haskel (Air Force, Cambridge), Spurgeon Keeny (Killian's office), J. Carson Mark (Los Alamos), Doyle Northrup (AFOAT-1)*, Herbert Scoville, Jr. (Consultant, PSAC), Anthony Turkevich (University of Chicago), Donald Morris (State), Ronald Spiers (State), and Thomas Larson (State). The AEC and Edward Teller were kept informed by telephone.

The Eastern panel consisted of Yevgeni K. Fedorov, Academy of Sciences of the U.S.S.R.; N. N. Semenov, Academician; I. Ye Tamm, Academician; M. A. Sadovsky, Academy of Sciences of the U.S.S.R.; O. I. Leypunsky, Professor of Physical-Mathematical Sciences; I. P. Pasechnik, Academy of Sciences, U.S.S.R.; Semen K. Tsarapkin, Collegium of the Soviet Ministry of Foreign Affairs; and other scientists from Czechoslovakia, Poland, and Rumania. Thus, the Eastern panel included a senior diplomat, Tsarapkin, a discipline not represented on the Western side.

*Air Force Office for Atomic Energy.

The Western delegation had available to it the experimental information collected in the past on the sound signals expected at great distances (or microbarographic signals) from nuclear detonations, electromagnetic phenomena, and a great deal of knowledge on the optical outputs of nuclear weapons fired at normal altitudes. Further, they were aware of the tropospheric disturbances from such detonations and AFOAT-1 had a great deal of experience in collecting airborne radioactive samples at appreciable distances as well as interpreting the resultant data. Seismic signals at teleseismic distances had been observed from high-yield detonations in the Pacific, but more pertinently from the NTS* Rainier underground shot. However, identification of underground shots was uncertain. Also, there was essentially no information on high-altitude detection, the highest detonation to this time being a small-yield shot at about 37,000 feet. There was no information available on deep space shots. Some underwater detonations had been observed. There was, however, appreciable theoretical information on all of these areas, some of which had been worked out specifically to prepare for the Bethe Panel report earlier in the year and expanded in preparation for the Experts Conference.

It is not clear what information the Russians had available to them when the conference began. Clearly, they had made observations close-in on normal atmospheric detonations but, to our knowledge, had not conducted any underground, underwater, or high-altitude detonations up to this time. They clearly had the same competence as we to carry out calculations to predict what would happen with shots in these other environments, but it is not known how many of these calculations they had already worked out when the conference began.

The British had available to them at the beginning of the conference the same information that we did, essentially as a result of our coordination with them on these subjects, and they also had some information they collected themselves from their tests in Australia and Christmas Island.

The conference convened as scheduled.** The Western side was clearly concerned with the possibilities of evasion and had discussed at home a number of those possibilities. During the initial parts of the conference, the Americans tended to present theories and data, with the Russians listening and making comments. A great deal of the debate and the discussion was between the various Western delegates. The Russians expressed apparent surprise at some of the theoretical concepts which the West wished to introduce. In fact, one could get the impression that the Russians had not seriously considered a number of the aspects of clandestine testing that we brought up and wished to discuss in detail. Even though this was not a political meeting, there was sometimes the impression that it was hard for the Soviets to see why we wanted to discuss these technical subjects at all since it was clear that one could simply stop testing and detect evasions very easily.*** The conference rather rapidly reached agreement on circumstances surrounding detection and identification of atmospheric tests, underwater tests, and high-altitude tests. In retrospect, it appears that perhaps underground testing was treated as the only serious medium for clandestine testing, neglecting altitudes above 50 kilometers, which the conferees knew they were not addressing in sufficient detail. The bulk of the discussion addressed the possibilities and situations with respect to underground test detection and some discussion of possibilities of test evasion. The system of detection

*NTS--Nevada Test Site, the later term used for the Nevada Proving Ground (NPG), established in 1951.

**On July 2, DeGaulle announced that the French would not agree to a test ban without other measures of disarmament. This does not seem to have affected the course of the discussion.

***Spurgeon Keeny--private communication.

stations eventually endorsed, it was felt, would allow detections and identification down to a few kilotons. The network of posts eventually agreed upon was a British-suggested compromise between U.S. and Soviet extremes. The detection stations would number some 160-170 land based plus about 10 on ships, with the land spacing being from 1,000-1,700 kilometers based on seismicity, and the spacing in ocean areas from 2,000-3,500 kilometers. The 110 posts on the continents would include 24 in North America, 6 in Europe, 37 in Asia, and the rest on the other continents: the other 60 land-based posts would be on 6 large and small oceanic islands.

Whereas the conferees discussed and formulated their findings on methods of detection at altitudes greater than 30-50 kilometers, the system described for test detection did not include coverage of that region.

On-site inspection was not treated in depth. Statements were made that teams could be sent to investigate a suspicious event, that perhaps 20-100 earthquakes a year would be indistinguishable from deep underground events at about 5-kilotons yield, but no clear-cut number of inspections was suggested.

The American team clearly felt the need of more data on seismic signals from underground detonations, and believed that further "proof tests" would be required. However, Chairman Fisk felt that this subject would "scare off" the Russian scientists, so it was never raised during the conference.

Nevertheless, the conference issued a communique on August 21, 1958, including the statement, "The conference reached the conclusion that it is technically feasible to set up, with certain capabilities and limitations, a workable and effective control system for the detection of violations of a possible agreement on the cessation of nuclear weapons tests."

The conclusions of the conference were published by the State Department on August 30 and stated that methods of test detection available at that time made it possible to detect and identify nuclear explosions down to somewhere between 1 kt and 5 kt underwater, underground, or in the atmosphere up to perhaps 10 km, and that detonations of the same yield would probably be detected but not always identified up to perhaps 50 km. The conference gave its findings on the methods of detecting nuclear explosions at altitudes greater than 50 km, but did not describe specific means for such detection and identification. The methods to be used for detection and identification included the collecting of samples of radioactive debris; recording of seismic, acoustic, and hydroacoustic waves; recording of electromagnetic waves; and on-site inspections of identified events which could be suspected of being nuclear explosions. They outlined a workable control system including appreciable development of equipment, operational considerations, data analysis, staffing, and control posts. The conference report mentioned several clandestine circumstances that might make detection or identification very difficult. They concluded the following:

> **However, the conference considers that, whatever the precautionary measures adopted by a violator, he could not be guaranteed against exposure, particularly if account is taken of the carrying out of inspection at the site of the suspected explosion.**

In retrospect, it seems that a major cause of uncertainty was that there was no agreement in the U.S. as to what yield constituted a "significant" test. The experts clearly recognized that they were really discussing a threshold situation, that bombs below some yield could probably be detonated without detection (although there is always a chance of getting caught). However, what that significant threshold is has

not yet (1979) been agreed upon in the U.S.* Clearly, the value determines the number of detection stations required and the estimate of possible inspections required. It seems possible that the differences that showed up between East and West during the Conference of Experts, and become so serious in the next few years, could have come about by a genuine difference in judgment on this point, due to the different weapon design and deployment philosophies.

During mid-1958, a group to assist the President in consideration of these matters, eventually to be called the "Committee of Principals," had gradually come into existence. During this period, it consisted of the Secretary of State (John Foster Dulles), the Secretary of Defense (Neil H. McElroy), the Director of the CIA (Allen W. Dulles), the Chairman of the AEC (John A. McCone, who replaced Lewis Strauss in July 1958), the Special Assistant to the President for Science and Technology (James R. Killian, Jr.), an ex officio member, and the Special Affairs (Gen. Robert Cutler). Sessions were occasionally attended by George V. Allen, Director of the U. S. Information Agency.

Having some forewarning, the Committee of Principals discussed moves now necessary as a result of the conclusions of the Committee of Experts. It seemed necessary to enter test ban negotiations (perhaps to call the U.S.S.R.'s "bluff"), although McElroy and McCone felt that a treaty was not in the best interests of the U.S. Furthermore, Dulles wanted to stop testing at the beginning of negotiations, while AEC and Defense argued that this should only come about when the treaty came into force.

The result was that Eisenhower announced on August 22, 1958, that the United States was prepared to enter into test ban negotiations beginning October 31, 1958, and was prepared to suspend nuclear weapons testing for one year after the beginning of negotiations, with that suspension to be extended year by year depending upon the operation of the control and inspection system, and upon the progress in arms control measures. Limiting the moratorium to one year was apparently a sop to the AEC and DOD. The British issued an almost simultaneous statement.

Chet Holifield (Representative) immediately stated that the inclusion of the aim for further arms control was "susceptible of different interpretations" and that if it were maintained, he had "little hope for the completion of a nuclear testing agreement." His was a voice in the wilderness.

Now it was up to the Russians, and on August 29, 1958, Khrushchev came through with a signal of the future. The Russians were still "observing" their self-imposed moratorium, while the U.S. was testing vigorously. Khrushchev objected, in an interview with Pravda, that the U.S. was still avoiding an immediate discontinuance of nuclear tests, that the conditions for progress on disarmament were unrealistic since the lack of progress was the fault of the West, and that a one-year moratorium was just the time needed to prepare for another test series. Nevertheless, the next day the Russians formally agreed to begin negotiations on October 31, 1958, in Geneva.

Using the continued Western tests as an excuse, Russia resumed testing on September 20, 1958.

The purpose of the negotiations continued to be argued in September and October, with no agreement being reached. During this time, at the thirteenth General Assembly of the U.N., the Russians continued to try to separate "test ban" from "other measures of disarmament" with little success.

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*In 1978, the Department of Energy testified that it could not indefinitely certify the present stockpile without continued testing Ex.(b)(3) and that the Soviets could test at that level for any foreseeable verification capability.

In spite of these uncertainties, time went by, as time will, and the nuclear test moratorium went into effect for the United states at midnight, October 30, 1958, Pacific Standard Time.

The Devices

The developments of the gun device (Little Boy or Thin Man) and the Christy* implosion device (Fat Man) during the years 1943 through 1945 have received detailed historical comment and need not be discussed here. Suffice it to say that the problem was early-on recognized as one in which a sufficient mass of active material had to be assembled in short enough time that any neutron background present would have a low probability of starting a chain reaction and developing enough energy to prevent the assembly of the device. Thus, either fairly large masses of active material could be assembled slowly if one could be sure there was no appreciable neutron background, or smaller masses of active material could be assembled more rapidly. It was preferable to compress the material if possible, but this then had to be done in a comparatively short time if there was any appreciable neutron background. Furthermore, the criticality achieved had to be such that the nuclear reaction would then take place in a short time compared to the hydrodynamic times involved in disassembly. The pre-Trinity effort (1943, 1944, and half of 1945) devised two devices satisfying these conditions. One was the gun device, which was eventually used on Hiroshima. It was simply the linear assembly in a gun barrel, using a small amount of gun powder as a propellant, of a large mass of oralloy, that is, uranium enriched in U-235 so that it was approximately 84 percent U-235. [redacted] Ex.(b)(3) [redacted] In July of 1945 such a device had been constructed using a large fraction of the nation's separated U-235. There was no real question about its operation if there was no basic error in the whole philosophy of rapid fission chain reactions. That point could be tested with a spherical assembly. The gun device drop weapon weighed 8,900 pounds.

The other method, that of rapid assembly of the fuel by implosion with high explosive, first became practical in the so-called Christy device, or "Fat Man," [redacted] Ex.(b)(3) [redacted] These were also furnished by an internal polonium-beryllium source (Urchin). [redacted] Ex.(b)(3) [redacted]

*After a concept of Robert F. Christy of Los Alamos Theoretical Division.

Ex.(b)(3)

[redacted]

While the initial concepts among the senior originating people of the Manhattan District at that time (Lawrence, Fermi, Oppenheimer, et al.) were of a fission bomb, it was recognized at the same time that a thermonuclear bomb might also be practical. However, it was clear that to start the burning of a thermonuclear bomb would require temperatures and pressures greater than could be achieved by existing techniques, and, furthermore, the appropriate cross sections and arithmetical methods were not available to make reliable calculations on the problem.* So while one path was clearly feasible in the light of the physical knowledge available at that time, the other was very questionable. The path of the fission reaction was taken. However, during that time, an appreciable amount of theoretical calculation was done on possible thermonuclear assemblies and burn systems, and an appreciable amount of laboratory work was done in the measurement of the appropriate cross sections for thermonuclear reactions.

After the massive exodus from Los Alamos, in late 1945, of the senior laboratory people and the revitalization under N.E. Bradbury, the designers and Laboratory experimenters began to follow up some of these concepts.

Ex.(b)(3)

[redacted]

The development of composite devices was also desirable in order to allow a stockpile that would match the oralloy and plutonium production.

Ex.(b)(3)

[redacted]

Lighter-weight devices were desired by the military in order that other planes than the B-29s could be used for delivery systems and, of course, a variation in yields would also offer more flexibility to the military. The Navy was strongly interested in devices for their specific applications.

No new concepts were tested on Crossroads (1946), since that was purely a Navy effects test series using two stockpile "Christy" devices. Sandstone, in 1948, after a gap of some three years since Trinity, saw the investigation

Ex.(b)(3)

[redacted]

*It appears that the Germans put some effort on the thermonuclear concept, perhaps not realizing that only the fission bomb could produce the starting conditions necessary for sustained thermonuclear burn.

Ex.(b)(3)

Even though the Christy device had worked at Trinity, weapon design theory was quite primitive compared to the understanding we have today. Thus, some further time was spent in the years between Trinity and Sandstone developing a better theoretical basis for weapons calculations. The computer capability was very small compared to today, so the time required, even for a primitive weapon design calculation, was great.

Ex.(b)(3)

*Code name for natural uranium, from Tube Alloys Limited, the British cover for their uranimum project.

Ex.(b)(3)

Ex.(b)(3)

[redacted]

Ex.(b)(3)

[redacted]

Ex.(b)(3)

Ivy Mike, fired in the fall of 1952, was the first large thermonuclear reaction, yielding a little over 10 megatons.

Ex.(b)(3)

Ivy King was already out of date when it was fired shortly after Mike. It was designed in order to produce a very large fission bomb for the stockpile in case the thermonuclear designs did not work.

Ex.(b)(3)

The polonium-beryllium initiators used up to this time had a number of disadvantages, including cost and radioactive hazard in their manufacture. Even more important, the polonium decayed, leading to a stockpile replacement problem.

Ex.(b)(3)

Ex.(b)(3)

Ex.(b)(3)

[redacted]

While these longer-range ideas were being investigated, Los Alamos was also working hard at producing a so-called emergency capability for stockpile, large-yield, thermonuclear devices. Operation Castle, in the spring of 1954, was to check out a number of these stockpile possibilities. They were all large devices by modern-day standards. ..

Ex.(b)(3)

[redacted]

*Lawrence Radiation Laboratory

Ex.(b)(3)

[redacted]

Ex.(b)(3)

The University of California Radiation Laboratory at Livermore (UCRL), now called the Lawrence Livermore Laboratory (LLL),* was formed in 1951 and began to contribute devices to the test program in early 1953.

Ex.(b)(3)

In the period between Operation Castle and the beginning of the moratorium, both weapon design laboratories continued to develop more militarily acceptable devices.

Ex.(b)(3)

Both weapon design laboratories studied lightweight, very small-yield devices during this period for possible tactical use.

Ex.(b)(3)

*Ed. note: LLL was renamed the Lawrence Livermore National Laboratory in 1980-1981.

Ex.(b)(3)

[redacted]

The large number of primary tests between 1956 and late 1958 is partly accounted for by the difficulty in striking the balance between full-scale yield and one-point safety.

Ex.(b)(3)

[redacted]

Both Laboratories experienced a flurry of tests on the subject in Hardtack, Phase II, but both Laboratories entered the moratorium with problems on this subject.

Ex.(b)(3)

[redacted]