DISARMAMENT

A periodic review by the United Nations

The Partial Test Ban — 25 Years Later

Volume XII, Number 1 Winter 1988/1989

Disarmament is published periodically by the Department for Disarmament Affairs, at United Nations Headquarters in New York. It is intended to serve as a source of information and a forum for ideas concerning the activities of the United Nations and the wider international community with regard to arms limitation and disarmament issues. The periodical is also printed in Arabic, Chinese, French, Russian and Spanish, and can be ordered by writing to the Sales Section, Room DC2-853, United Nations, New York, NY 10017.

UNITED NATIONS PUBLICATION

Sales No. E.89.IX.3

00600

ISBN 92-1-142146-2

THE PARTIAL TEST BAN — 25 YEARS LATER*

The Partial Test-Ban Treaty: A British View

William Waldegrave

"During my talks with the President, when he was in London, I did my best to urge upon him the necessity for a comprehensive agreement banning all nuclear tests, whether underground or atmospheric ... I told [the] President that we ought to take risks for so great a prize. We might be blessed by future ages as saviours of mankind, or we might be cursed like the man who made il gran rifutto. "[1]

The British Prime Minister who took this view was Macmillan. The passage comes from his memoirs and refers to a meeting with President Eisenhower in 1959. It serves as a reminder that for the British Government of the day the subsequent achievement of the partial test-ban Treaty in 1963 represented the failure of larger hopes.

The Course of the Negotiations

For some time after the end of the Second World War the idea of banning nuclear tests was discussed only as part of much more comprehensive schemes for controlling atomic energy or for general and complete disarmament.[2] By the beginning of the mid-fifties these schemes had made little progress. Meanwhile, the testing of nuclear weapons had gone steadily forward. The Soviet Union and the United Kingdom joined the atomic club in 1949 and 1952, respectively,[3] and thermonuclear devices were first tested by the United States and the Soviet Union in 1952 and 1953.[4] With the advent of thermonuclear devices, the prospect loomed of larger and larger atmospheric tests, followed by the deployment of weapons with destructive capabilities far greater than those of their atomic predecessors. These potentialities first attracted

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**DISARMAMENT* will publish additional articles on this subject in the forthcoming issue.

public attention on a large scale during March 1954. On the first day of that month an American thermonuclear test at Bikini Atoll turned out to have twice the anticipated yield. Because of the prevailing wind conditions, a Japanese fishing vessel, the Lucky Dragon, was showered with radioactive debris that caused severe radiation sickness among the crew, one of whom subsequently died. Inhabitants of the Marshall Islands were also affected. This event sparked the first calls for a ban on nuclear testing quite apart from any comprehensive scheme for controlling atomic energy or for general and complete disarmament. Many eminent individuals appealed for such a ban,[5] but the first statesman to propose it was Jawaharlal Nehru. Speaking in the Indian Parliament on 2 April 1954, he reiterated India's hopes for complete nuclear disarmament, but called in the meantime for a "standstill agreement" on tests.[6] It took another four years, however, before the Conference on the Discontinuance of Nuclear Weapon Tests opened in Geneva on 31 October 1958. The participants were the United States, the Soviet Union and the United Kingdom, at that time still the world's only nuclear-weapon States.

The course of the negotiations has been chronicled in detail elsewhere, but it is necessary to give a broad outline of their development as a prelude to assessing the extent of the British contribution to their final product, the partial test-ban Treaty.[7] During the summer of 1958, a conference of experts was held in Geneva to study the methods of detecting violations of a possible agreement on the suspension of nuclear tests. The experts devised an elaborate control system (later known as "the Geneva System") which called for a world-wide network of internationally manned seismic control posts and provisions for on-site inspections. On the basis of this scheme, the experts announced in their final communiqué, issued on 21 August 1958, that they had "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 worldwide cessation of nuclear weapons tests".[8] The next day the United States and the United Kingdom announced that by 31 October they would be ready to enter into negotiations for a comprehensive ban and that they would refrain from further testing for one year from that date. The Soviet Union agreed to start negotiations on that date, but announced later that it would feel free to conduct tests until it had carried out an equivalent number to those of the United States and the United Kingdom. In practice, however, it ceased testing shortly after the negotiations began.

The negotiations ran into immediate difficulties. The Soviet Union wanted the three Powers to stop testing and then to agree on the details of the control system. The Western Powers preferred to agree on the details of the control system before committing themselves to stop test-

ing. There were also difficulties over the practical details of the control system. In particular, the Soviet Union wanted the right of veto over on-site inspections, while the United States insisted that they be veto-proof. There were also concerns about the detection and identification of high-altitude tests. Further difficulties arose when the United States concluded from new data that had not been available to the Conference of Experts that it would be much harder to distinguish earthquakes from underground nuclear explosions than they had supposed. In April 1959 these difficulties led the United States to propose a ban on atmospheric testing up to an altitude of 50 km monitored by a simplified control system not involving on-site inspection. The Soviet Union quickly rejected this as inadequate but indicated some interest in exploring the idea of on-site inspections that could be veto-proof yet limited to a fixed number each year. The negotiations therefore continued to be aimed at a comprehensive test ban, but there were continuing doubts about the ability of the Geneva System to monitor such a ban. During the summer, these doubts were reinforced when a study by Albert Latter suggested that the seismic impact of an underground nuclear explosion could be reduced by detonating it in the centre of a large cavity. In order to resolve these difficulties, various improvements were sought to the Geneva System, but the Soviet Union proved unwilling to consider any major changes.

On 11 February 1960 the Western Powers adopted a new approach. Instead of continuing to press the Soviet Union, without success, for a comprehensive test ban monitored by an improved Geneva System, they proposed a treaty that would prohibit only those tests which could be verified by the original Geneva System, as they now judged its capabilities. The treaty would have prohibited all atmospheric and underwater tests, tests in space to the height at which detection was feasible, and underground tests producing signals with a seismic magnitude greater than 4.75. In addition, it was proposed that there should be a joint East-West seismic research programme to make it feasible to lower this threshold. The Soviet Union stated that it wished to see the treaty prohibit all tests in space and that, while the joint seismic research programme was in progress, there should be a moratorium on underground tests registering a seismic magnitude of less than 4.75. This moratorium was to run for four to five years, after which the three nations would confer on whether to extend it. The Western Powers agreed to accept a moratorium on underground tests below a seismic magnitude of 4.75, but only after a treaty banning all verifiable tests had been signed and the joint seismic research programme arranged. They were also unwilling to contemplate a moratorium of the length proposed by the Soviet Union. Nevertheless, the two sides seemed at this point to be drawing closer together and there were expectations that the four-Power summit

in Paris in May 1960 might see major progress. In the wake of the U-2 incident, however, the summit was a failure and for the remainder of 1960 the negotiations marked time as the Eisenhower Presidency came to a close.

The new Kennedy Administration tried to give fresh momentum to the negotiations by tabling the first complete draft of a treaty on 18 April 1961. Although it still proposed a threshold for underground tests, it contained various modifications to the control system that were designed to meet Soviet concerns. The Soviet reaction was nevertheless negative. The reason for this became clear on 30 August, when the Soviet Union announced that it would resume nuclear testing and shocked the Western Powers by carrying out an atmospheric test almost immediately, on 1 September. An immediate Western proposal on 3 September for an atmospheric test ban to be monitored only by national means was swept aside as the Soviet Union proceeded with a large number of atmospheric tests in a short space of time (fifty were held by 4 November, including one of almost 60 megatons). The resulting pressures on President Kennedy to resume testing, at first only underground but then in the atmosphere as well, proved irresistible. As for the Geneva Conference, it adjourned on 9 September, met again briefly during the winter of 1961/62, but finally adjourned for good in 1962 when it became quite clear that there was no point in proceeding with it. Subsequent discussion of the test ban issue took place in the newly-created Eighteen-Nation Disarmament Committee, comprised of five Western, five Eastern and eight non-aligned nations. It was in this forum, during August 1962, that the Western Powers tabled two alternative draft treaties: one providing for a fully comprehensive test ban involving complex control provisions, the other providing for a partial test ban covering all but underground tests and involving only national means of detection. The Soviet Union rejected the draft comprehensive test ban because of its control provisions and the draft partial test ban because it did not cover underground tests. Once again, therefore, the stalemate seemed complete.

However, the Cuban missile crisis in October 1962 led to an acutely sharpened awareness of the need for improved super-Power relations. In the next few months the two sides began to edge towards agreement on a comprehensive test ban. The Soviet Union indicated a new willingness to accept a limited number of on-site inspections each year and the United States reduced the number of such inspections on which it had previously been insisting. Nevertheless, there remained a small but crucial difference between the two numbers. On 24 April 1963, in an effort to overcome this difference, Kennedy and Macmillan sent a joint letter to Khrushchev urging further efforts to conclude a test ban and suggesting that senior representatives of both men should travel

to Moscow to discuss the subject further. After an exchange of correspondence, Khrushchev accepted this proposal on 8 June. On 10 June, Kennedy declared that the United States would not conduct any more tests in the atmosphere unless others did so, and on 29 June he visited Macmillan at his Birch Grove home to agree on a joint approach to the Moscow talks. The United States and United Kingdom teams left for Moscow on 15 July, led by Ambassador Averell Harriman and Lord Hailsham, respectively. At this stage, despite statements by Khrushchev which suggested that he was no longer prepared to accept any on-site inspections, it was still the intention of the Western Powers to try for a comprehensive test ban. Once Harriman and Hailsham arrived in Moscow, however, Khrushchev confirmed his new refusal to accept any on-site inspections. It was therefore quite plain that a comprehensive test ban was not a realistic objective. Consequently, attention focused on the negotiation of a partial test ban. The final text of the partial test-ban Treaty was agreed on 25 July, the Treaty was signed at the Foreign Minister level on 5 August, and on 10 October the three nuclear-weapon States deposited their instruments of ratification with each other.

The rapidity with which the partial test ban was negotiated in Moscow should not obscure the fact that it was the last episode in a long-running saga. As noted above, different varieties of a partial test ban had already been suggested on several previous occasions: in April 1959, in September 1961, and in August 1962. It is also worth remembering that the final episode in Moscow was by no means as easy and straightforward as its short duration might imply. The Western Powers and the Soviet Union began by tabling rival drafts, and a number of awkward issues had to be resolved before the partial test ban emerged in the form of the present Treaty. The initial Soviet draft was simplicity itself. It had only two operative articles. The first said that each party undertook to discontinue test explosions in the prohibited environments: the atmosphere, outer space and under water. The second stated that the agreement would enter into force immediately upon ratification by the United States, the USSR, the United Kingdom and France (France had begun testing in 1960). The rival Anglo-American draft was identical to the one they had proposed at the Eighteen-Nation Disarmament Committee in August 1962. It differed from the Soviet draft in three significant respects. It did not require the adherence of France before it entered into force (nor indeed Chinese adherence, even though there was increasing concern about China's nuclear intentions, a concern which proved to be soundly based when China also began testing in 1964). It provided that peaceful nuclear explosions could take place in the prohibited environments if they were unanimously agreed to and carried out in accordance with the provisions of an annex (which had

yet to be completed). The Anglo-American draft also included a provision for withdrawal, whereas the Soviet draft did not. One further problem, not related to the substance of the Treaty but which nevertheless had to be solved, was the difficulty of finding a mechanism by which States not recognized by one of the depositaries could still adhere to the Treaty.

All these differences had to be reconciled or overcome during the Moscow negotiations. Harriman and Hailsham flatly insisted that entry into force could not be made dependent on French adherence. De Gaulle's firm opposition to any test ban meant that such a provision would make a nonsense of any agreement that might be reached, and, in due course, the Soviet Union agreed to drop this requirement. However, the Soviet Union did insist that the provision for peaceful nuclear explosions in the prohibited environments would arouse suspicion in other countries and reduce the appeal of the Treaty. This attitude came as something of a surprise to the Western Powers, since they believed the Soviet Union had plans for such explosions just as extensive as their own. The Soviet Union also objected to the withdrawal clause on the grounds that it would raise doubts about the seriousness of the parties' intentions in signing the Treaty and was in any case unnecessary since it was the inherent right of a sovereign nation to abrogate any Treaty if and when the national interest required it. The United States responded by offering to give up the peaceful uses provision in exchange for Soviet acceptance of a withdrawal clause. This deal became the basis of the Treaty in its final form, after some hard bargaining about the precise language of the withdrawal clause. The problem of the adherence mechanism was solved by an oral understanding that a ratification or accession would be considered valid if it was received by any one of the three depositary Governments.

The British Contribution

The British contribution to this process has to be assessed with care. Considerable claims have been made for it. The Earl of Home, the Foreign Secretary, claimed at the time that "we would never have got that treaty unless the UK had been in a position to intervene".[9] Lord Hailsham wrote later that "I do not myself believe that if Britain had been absent from that table a viable agreement would at that time have been negotiated, since Russian relations with the United States were far less relaxed then than now".[10] Macmillan himself referred to it as "one of the great purposes which I had set myself".[11] But what exactly was the nature of the British contribution?

It did not really lie in the Moscow negotiations themselves. Lord Hailsham generally followed Ambassador Harriman's lead, and a

member of Hailsham's delegation dubbed Harriman "the great man of the meeting".[12] Although there was one instance during the negotiations when Hailsham was alarmed enough about Harriman's stubborn insistence on a particular formulation of words for the withdrawal clause to get Macmillan on the telephone to Kennedy, it seems that this was not a decisive factor in how the Americans decided to play the issue.[13] The British contribution really lay in the preceding years of hard toil, which had finally created the opportunity for the Moscow negotiations. Throughout that period the United States Government had been divided on the desirability of a test ban. By contrast, Macmillan and his Government were consistent advocates of it.

In early 1959, for example, when there seemed to be no middle way between the Soviet insistence on a veto over on-site inspection and the American insistence on veto-proof inspections, it was Macmillan who took up the proposal that they might be veto-free but suggested they be limited in number to a small annual quota, a proposal which he put to Khrushchev during his visit to Moscow in March 1959. Later in the year Macmillan helped to persuade Eisenhower that there should be no resumption of testing by the Western Powers when the year-long moratorium they had announced from 31 October 1958 expired. In early 1960, the Soviet Union rejected the United States proposal for a threshold treaty unless accompanied by a moratorium on tests below the threshold. At that point Macmillan intervened strongly with Eisenhower to prevent the outright rejection of this response and to secure its acceptance for a limited period, subject to the pursuit of the joint seismic research programme. It was also Macmillan who persistently sought the four-Power summit in Paris, and its failure was a severe personal disappointment to him.[14]

Macmillan had new opportunities, however, with the Kennedy Administration. Indeed, even before Kennedy's inauguration, Macmillan was once again pressing the case for a comprehensive test ban. His enthusiasm for another effort to secure a ban probably helped to ensure the tabling of the joint Anglo-American draft treaty in April 1961. When the Soviet Union resumed atmospheric testing later in the year, Macmillan argued that if the West did not respond in kind and continued to press for a test ban, then the Soviet Union would be forced to stop testing before it gained any significant military advantage. When it became clear that Kennedy could not resist the pressures for a resumption, it may have been pressure from Macmillan that ensured that the resumed tests were held only underground. As Kennedy came under increasing pressure to resume atmospheric testing as well, Macmillan continued to hold out against it. At Bermuda in December 1961, Kennedy and his advisers sought to overcome this opposition to renewed atmospheric testing. They argued that the resumed Soviet tests were

part of a programme to develop an anti-missile missile, and that the United States needed to conduct similar tests. Macmillan and his advisers were sceptical about the feasibility of anti-missile missiles. They argued that there was still scope for one more effort to obtain a comprehensive test ban. In the end they did not prevail, but as preparations for resumed atmospheric testing proceeded, Macmillan continued to argue for coupling this resumption with a renewed effort to obtain a test ban. This persistent pressure may well have been a factor behind the tabling, in August 1962, of two alternative draft treaties, one for a comprehensive test ban and one for a partial test ban.[15]

After the Cuban missile crisis of October 1962 and the Nassau Meeting in December 1962, Macmillan sought yet again to push forward with the test ban. When the Soviet attitude to on-site inspections suddenly became somewhat more forthcoming, he decided to make one more approach to Kennedy in a further effort to overcome the remaining difficulties. On 16 March 1963 he sent a long and wide-ranging letter to the President in which he recalled their past efforts to make progress, including arguments designed to assist Kennedy with his internal battles, and pressed for a new move to break the deadlock. His specific proposal was that Kennedy should offer to send a personal representative to Moscow to clear the way for an agreement, perhaps at a new summit. He suggested that either the President's brother, Robert, or Averell Harriman might be suitable envoys. It was Kennedy's favourable response to this approach which led to the joint letter which both he and Macmillan sent to Khrushchev on 24 April and the acceptance of which—by Khrushchev—paved the way for the Harriman/Hailsham mission. Finally, while little is known for certain about Macmillan's meeting with Kennedy at Birch Grove on 29 June, it seems likely that he helped to convince the President that the Western Powers should go to Moscow with a continued willingness to sign a comprehensive test ban as well as a partial test ban.[16]

Of course, it is important not to overemphasize the British contribution, particularly when those who play it up were the participants. But one historian has recently concluded that "Britain pressed very hard indeed for a comprehensive test-ban treaty and her endeavours probably represented the high point of post-war British influence with the US and USSR".[17] Nor was it just the British who thought they had played an important role. Glenn Seaborg, Professor and Associate Director of the Lawrence Berkeley Laboratory, comments in his memoirs that "considering their relative unimportance as a military force, particularly in nuclear weapons, it is remarkable to consider how much influence the British had over US arms and arms control policies during this period".[18] And on the day he ratified the Treaty, Kennedy wrote to Macmillan that he "could not but reflect on the extent to which your

steadfastness of commitment and determined perseverance made this treaty possible".[19] Having said all this, it remains the case, as Lord Hailsham has pointed out, that "obviously we would never have reached agreement if the two Great Powers had not basically wished for one and, within limits, thought it to their interest to conclude one".[20]

The Value of the PTBT

The partial test-ban Treaty has stood the test of time reasonably well. There have been venting incidents which have caused radioactive debris to be present outside the territorial limits of the super-Powers, but for the most part it has been accepted on all sides that these incidents have been genuine mistakes and wholly unintended.[21] In 1979 a question arose about whether there had been a nuclear explosion above the South Atlantic, but as yet there is no conclusive evidence that the event recorded was a nuclear explosion.[22] As for the single Indian nuclear explosion in 1974, this was conducted underground, and although France and China, unlike India, did not become parties to the Treaty, they have in practice restricted themselves to underground testing since the close of 1974 and 1980, respectively. On balance, therefore, the partial test-ban Treaty has been a success from the viewpoint of both compliance and its exemplary effect.

It is in other respects that the success of the Treaty has been more generally questioned. It clearly falls short of the comprehensive test-ban treaty which Macmillan and his Government sought. Moreover, while the Treaty may have had some impact on the development of anti-ballistic missile systems,[23] and while the Americans did at first find underground testing "to be slow, costly and replete with unanticipated difficulties",[24] it is generally accepted that in practice it has proved over time to have very little effect on the ability of its nuclear-weapon State parties to develop new warheads. Consequently, the Treaty has sometimes been regarded as little more than a clean air act. This criticism, however, overlooks the fundamental importance of clean air, and the fact that the Treaty immediately allayed the widespread and legitimate concern about the effects of fall-out from atmospheric tests. It is worth remembering that fall-out from pre-Treaty atmospheric tests remains the principal source of man-made radioactivity in the general environment. Modern research tends to attach more importance than was the case in the past to the dangers of such increases in low-level background radiation, from whatever source.

The main value of the partial test-ban Treaty, however, has been its political significance rather than its military impact. It was signed eighteen years to the day after the obliteration of Hiroshima. Through-

out those eighteen years, apart from a brief period in the mid-fifties, the cold war had dominated the international landscape. Crisis had succeeded crisis: Berlin in 1958/9, the U-2 incident in May 1960, the Bay of Pigs in April 1961, Berlin again in September 1961, and finally the Cuban missile crisis in October 1962. Over the whole unhappy scene lay the shadow of the nuclear bomb and the dreadful fear that, in Churchill's words, "in a few years this awful agency of destruction will be widespread and the catastrophe following from its use by several warring nations may not only bring to an end all that we call civilization but may possibly disintegrate the globe itself". Into this scene the partial test-ban Treaty broke, in Kennedy's words, like "a shaft of light cut through the darkness".[25] It seemed a mark of determination on both sides to draw back from the brink and to move forward into a new era in which East/West relations might be stabilized and nuclear weapons controlled. Apart from France and China, almost every other State expressed its hopes for the future by adhering to the Treaty.[26]

These hopes were not entirely misplaced. Much experience of the political and technical aspects of arms control talks had been gained, and the conclusion of the partial test-ban Treaty was followed by intensive efforts to prevent the further proliferation of nuclear weapons. As a result, the Treaty on the Non-Proliferation of Nuclear Weapons was opened for signature in July 1968, and on the same day the two major Powers announced that in the near future they would begin bilateral discussions on their strategic nuclear weapons. The opening of these talks was postponed when the Soviet Union intervened in Czechoslovakia in August 1968, but, after a decent interval, they began in November 1969 as the Strategic Arms Limitation Talks (SALT). It then took only until 1972 to produce both the anti-ballistic missile Treaty and the SALT I interim agreement on offensive strategic missiles. These agreements were immediately followed by the opening of the SALT II negotiations, and at Vladivostok in November 1974 the framework was agreed for a comprehensive agreement on offensive nuclear weapons covering bombers as well as missiles. 1974 and 1976 also saw the negotiation of two Treaties limiting the super-Powers to underground explosions not exceeding 150 kilotons (the threshold test-ban Treaty, and the peaceful nuclear explosions Treaty). Nor was progress confined to the sphere of nuclear arms control. The negotiation of the European treaties, the conclusion of the four-Power agreement on Berlin, the establishment of the mutual balanced force reduction talks, and the beginning of the Conference on Security and Co-operation in Europe produced a major relaxation of tensions in Europe and a burgeoning atmosphere of co-operation in super-Power relations, marked symbolically in 1975 by the Apollo-Soyuz link-up.

In retrospect it is clear that the achievement of the partial test-ban Treaty marked the beginning of this fruitful phase in East/West relations. As Hedley Bull so aptly put it:

> "Between 1963 and 1974—from the PTB to the Vladivostok Accords—the superpowers...managed to create a structure of co-operation which, rudimentary although it was, was widely recognised throughout international society as a whole to embody hope, if not for the building of peace in any positive sense then at least for the avoidance of general nuclear war...It was improvised in response to new and unexpected dangers that gave them a sense of a common interest in survival. This sense of a common interest in avoiding a ruinous nuclear war, which had developed at the height of the Cold War in the 1950s, came in the course of the 1960s and 1970s to be translated into at first inchoate rules or guidelines for the avoidance and control of crises and into understandings about arms control which later in some cases were institutionalised in formal agreements...The United States and Soviet Union, by drawing together in these years, did give the impression that they were creating at least the foundations of a more secure international order."[27]

Hedley Bull was writing in 1980, and he proceeded to lament the end of this hopeful era. During the second half of the seventies, Soviet interventions in Angola, in Ethiopia, and finally in Afghanistan soured the international atmosphere and made it impossible to sustain the improvement in super-Power relations. Despite the Carter Administration's strong commitment to arms control and the eventual signing of the SALT II Treaty, in June 1979, these activities undermined the political basis not only for ratification of this agreement but also for the successful pursuit of the renewed negotiations for a comprehensive test ban. Meanwhile, the threshold test-ban and peaceful nuclear explosions Treaties remained unratified. The difficulties continued during the first half of the 1980s. But since the beginning of 1985, there have been new developments in East/West relations and a new dialogue about a whole range of subjects. The authors of the partial test-ban Treaty would be pleased at this development. For Macmillan, certainly, the Treaty was not just an arms control measure; it was also part of a much broader effort to defuse the East/West confrontation.

The Proposed Amendment

The new phase in East/West relations since the beginning of 1985 has seen renewed talks on nuclear testing. After discussion at the expert

level, the two major Powers announced in September 1987 that they would start full-scale step-by-step negotiations on nuclear testing. It was stated that:

> "...in these negotiations the sides as the first step will agree upon effective verification measures which will make it possible to ratify the US-USSR Threshold Test Ban Treaty of 1974 and Peaceful Nuclear Explosions Treaty of 1976, and proceed to negotiating further intermediate limitations on nuclear testing leading to the ultimate objective of the complete cessation of nuclear testing as part of an effective disarmament process."[28]

The negotiations began in November 1987 and so far have concentrated on the additional measures to ensure the verifiability of the threshold test-ban and peaceful nuclear explosions Treaties. As part of this process, each side has now been able to monitor an underground explosion at the other's nuclear test site. The results of this Joint Verification Experiment are now being analysed and, unless there are unforeseen difficulties, it should be possible to conclude new protocols to both Treaties that will enhance their verifiability. The British Government supports these developments and hopes they will lead to the early ratification of both Treaties.

Further steps to limit testing will then have to be considered. In contemplating what these should be, however, it is important to remember that much has happened in the twenty-five years since a comprehensive test ban was first sought. It has become clear, for example, that there are some important advantages to continued testing. It has helped in the development of at least two important safety measures: one-point safety and insensitive high explosives. The criterion for one-point safety is that if the chemical high explosive in a nuclear warhead is accidentally detonated at any one point on its surfaces (for example by being dropped on a sharp spike or being hit by a projectile), it shall not produce a significant nuclear yield. Insensitive high explosive is a conventional explosive material for use in nuclear warheads which is less likely to be detonated by accidental impact than were the previously employed explosives. Testing has also enabled smaller-yield weapons to be developed, with the result that there has been a substantial decrease in the overall explosive force of both major Powers' nuclear arsenals. By helping to maintain confidence in the reliability of existing stockpiles, tests may also have reduced pressures to expand them beyond their present levels.[29]

It has also become increasingly recognized since the late 1950s that limits on testing are no longer the best way to control the arms race. It had been assumed that this was the best approach because, until then, the major leaps forward in nuclear capability had mainly reflected

changes in warhead technology, notably the development of thermonuclear weapons in place of atomic weapons. Since then, however, the main technical factor in driving the arms race has been the competition between delivery systems and the means of defending against them, for example between ballistic missiles and ballistic missile defences, between cruise missiles and look-down radars, between bombers and anti-aircraft defences. It is competition of this type which has bred the technologies that dominate present debates—multiple independently targetable re-entry vehicles, directed energy weapons, stealth technology, and so on.

This competition has implications for further limits on testing. As delivery systems have become more sophisticated, the nuclear device has ceased to be simply a package to be transported in a carrier and has had to become an integral part of a weapon system. The required warhead characteristics for a new delivery system are unlikely to be met by an existing and tested device. So a new design will be necessary and there will be a lack of confidence in that design unless it can be tested. The difficulty of limiting tests without first limiting the competition between delivery systems and the means of defending against them has been reflected since the 1960s in a move away from the earlier emphasis on a comprehensive ban toward controls on delivery vehicles, warhead numbers, and defences against them.[30]

Until there has been greater progress in these areas, and until there has been a sustained development in political relations, the security of the West will continue to depend on deterrence based in part on the possession of nuclear weapons. That means that for the foreseeable future there will be a continuing requirement to conduct underground tests so as to ensure that the nuclear weapons which are so crucial to deterrence remain effective and up-to-date. This in turn means that, while a comprehensive test ban remains a long-term goal, progress towards it will only be made by the step-by-step approach on which the two major Powers are now embarked. This approach must take account not only of verification problems (and serious verification problems do remain), but also of progress elsewhere in arms control and the attitudes of other States.[31]

The recent proposal for turning the partial test-ban Treaty into a comprehensive test-ban treaty by means of an amendment conference runs directly counter to this step-by-step approach.[32] As a depositary Power, the United Kingdom will naturally carry out its international obligations, and, if the necessary number of parties request it, will work closely with its co-depositaries to convene the amendment conference, as required by article II of the Treaty. But as a State party, the United Kingdom does not see any value in the exercise. It seeks to go

too far too fast. It cannot succeed. At best it would be an irrelevance. At worst it would be a source of new tensions and differences at a moment when the general mood is to diminish tensions and conciliate differences. It would, in short, be out of character with the times. By contrast, the step-by-step approach is a realistic way of making progress that is far more likely to prove effective.

The partial test-ban Treaty marked the start of a fruitful period for East/West relations and for the whole international community. It would be a sad irony if a proposed amendment to the Treaty were to hinder the renewed progress of recent years. It is worth pondering on the conclusion drawn by one of the nuclear era's sharpest intellects and keenest arms controllers, Herbert York. An important passage in his autobiography reads:

> "In short, however desirable a CTB may be, it seems not to be a promising option under current world conditions. Moreover, if another President were again to push hard for a CTB, doing so would, as it did in Carter's time, make it much more difficult for him to achieve other, and, I think, much more valuable forms of arms control, such as that involved in the SALT and the START negotiations."[33]

References

1. Harold Macmillan, *Pointing the Way 1959-1961* (London, Macmillan, 1972), p. 86.

2. For a detailed survey of these schemes see Bernhard G. Bechhoeffer, *Postwar Negotiations for Arms Control* (Washington, D.C., Brookings Institution, 1961). For a shorter survey see Anthony Nutting, *Disarmament: An Outline of the Negotiations* (London, Oxford University Press, 1959).

3. For the British programme see Margaret Gowing, *Britain and Atomic Energy 1939-1945* (London, Macmillan, 1964), and Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy* (London, Macmillan, 1974), vols. 1 and 2. For the Soviet programme see David Holloway, *The Soviet Union and the Arms Race* (New Haven, Yale University Press, 1983), chap. 2.

4. For further details about these devices see Herbert F. York, *The Advisors: Oppenheimer, Teller and the Bomb* (San Francisco, W. H. Freeman and Co., 1976). See also David Holloway, "Soviet thermonuclear development", *International Security*, vol. 4, No. 3, Winter 1979/80. As they explain, the United States device tested in 1952 was far from practical as a deliverable weapon, and the Soviet device tested in 1953, though deliverable, was not much more powerful than a large fission device. The first United States test of a device that was practical as a deliverable weapon took place in the spring of 1954 and the first Soviet test of a really powerful fusion device took place in late 1955. Nevertheless the devices tested by each country in 1952 and 1953 were clear harbingers of future developments.

5. For example, Albert Einstein, Albert Schweitzer and Pope Pius XII.

6. The text of the speech to the Indian Parliament in which Nehru made the proposal is reprinted in the United States Government's *Documents on Disarmament 1945-1959* (Washington, D.C., Department of State, 1960), vol. 1, p. 408.

7. For a full treatment of the negotiations see Harold K. Jacobson and Eric Stein, *Diplomats, Scientists and Politicians: the US and the Nuclear Test Ban Negotiations* (Ann Arbor, University of Michigan, 1966). For an insider's account of the Kennedy years, see also Glenn T. Seaborg, *Kennedy, Khrushchev and the Test Ban* (Los Angeles, University of California Press, 1981).

8. *Report of the Conference of Experts to Study the Methods of Detecting Violations of a Possible Agreement on the Suspension of Nuclear Tests*, Cmnd.551 (London, HM Stationery Office, October 1958), p. 41.

9. Quoted in D. C. Eliot, *The United Kingdom and Arms Control 1963-1973* (California Arms Control and Foreign Policy Seminar, 1974), p. 4.

10. Lord Hailsham, *The Door Wherein I Went* (London, Collins, 1975), p. 217.

11. Harold Macmillan, *At the End of the Day* (London, Macmillan, 1973), p. 484.

12. Seaborg, p. 253.

13. Seaborg, pp. 246-247.

14. For further details of the British contribution during this period see J. P. G. Freeman, *Britain's Nuclear Arms Control Policy in the Context of Anglo-American Relations 1957-68* (London, Macmillan, 1986), chap. 4; Macmillan, *Riding the Storm* (London, Macmillan, 1971), chap. 18, and *Pointing the Way*, chaps. 4, 5, 7 and 9; and Sir Michael Wright, *Disarm and Verify* (London, Chatto & Windus, 1964), chap. 11.

15. For further details of the British contribution during this period see Freeman, chap. 5; Seaborg, chaps. 8 and 9; Macmillan, *Pointing the Way*, chaps. 11 and 14, and *At the End of the Day*, chap. 6; and Wright, chap. 11.

16. For further details of the British contribution during this period see: Freeman, chap. 5; Seaborg, chaps. 16 and 17; Macmillan, *At the End of the Day*, chap. 14; and Lord Zuckerman, *Monkeys, Men and Missiles* (London, Collins, 1988), chap. 26.

17. Freeman, p. 254.

18. Seaborg, p. 112.

19. Quoted in Wright, p. 156.

20. Hailsham, p. 219.

21. There have been some public exchanges of accusations between the super-Powers over venting incidents, but in the main they have been discussed and explained privately. The first occasions on which the United States and USSR vented radioactive debris beyond their borders are interestingly discussed in Glenn T. Seaborg, *Stemming the Tide: Arms Control in the Johnson Years*, pp. 207-211 and pp. 221-225. Previous and subsequent references in these footnotes to Seaborg are to his other book *Kennedy, Khrushchev and the Test Ban* (see ref. 7).

22. For a fuller discussion see United Nations document A/35/358, the appendix to which contains the report of an *ad hoc* panel of non-governmental scientists convened by Dr. Frank Press, Science Adviser to President Carter.

23. For comments on this point and for a fuller discussion of all the issues covered in this section see Ivo Daalder, "The limited test ban treaty", in Albert Carnesale and Richard Haass, eds., *Superpower Arms Control* (Cambridge, Ballinger, 1987).

24. Seaborg, p. 90.

25. Seaborg, p. 257.

26. France had already exploded its first atomic bomb in 1960 and China was about to do so in 1964.

27. Hedley Bull, "The great irresponsibles? The United States, the Soviet Union, and world order", *International Journal*, vol. XXXV, No. 3, Summer 1980, p. 442 and p. 445.

28. Joint Statement by the American and Soviet Foreign Ministers on 17 September 1987.

29. There is an extensive literature on these subjects, most of it American. A recent survey of the issues which also references much of the previous literature is Steve Fetter, *The Comprehensive Test Ban* (Cambridge, Ballinger, 1988). For a recent statement of the Reagan Administration's views see the text of a letter from the President to the Speaker of the House of Representatives and the President of the Senate dated 8 September 1988 and transmitting a report dated 26 August 1988 on the *Relationship between Progress in Other Areas of Arms Control and More Stringent Limitations on Nuclear Testing*.

30. On this subject see J. Carson Mark, "The purpose of nuclear explosions: paper 1" in Jozef Goldblat and David Cox, eds., *Nuclear Weapon Tests: Prohibition or Limitations* (SIPRI-CIIPS publication, Oxford University Press, 1988).

31. The British Government's position has been set out most recently in an answer to a parliamentary question on 27 June 1988 (Hansard, House of Commons, Col 66). Some of the remaining difficulties about seismic verification of a test ban are set out in a British paper to the Conference on Disarmament, CD/610, 9 July 1985.

32. The exact proposal is set out in CD/852, 5 August 1988.

33. Herbert F. York, *Making Weapons, Talking Peace: A Physicist's Odyssey from Hiroshima to Geneva* (New York, Basic Books, 1987), p. 321.