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NATIONAL AND INTERNATIONAL CONTROL OF ATOMIC ENERGY

Text of an address made by
General A.G.L. McLaughton,
Canadian Representative on the
Atomic Energy Commission of the
United Nations, before the University
of Toronto Engineering Society,
Ajax, October 30, 1947.

I am very pleased indeed to have this opportunity to speak to the members of the Engineering Society of Toronto University about the problem of the control of atomic energy. This is a problem which has become of the first importance in international relations. In fact I would venture to say that its satisfactory solution is an indispensable condition for the survival of civilization itself. This is a strong statement but in the light of the evidence the conclusion, unfortunately, is not escapable that this very serious menace does in reality exist.

Used as weapons of war, atomic bombs have the great advantage that explosions can be produced from relatively small amounts of fissionable materials which are readily transportable over great distances in perfect safety and under complete control as to the instant that they are to be set off. The individual bomb releases energy in such a vast amount that, up to several thousand feet, man cannot withstand the tremendous concussion, the enormous temperature or the intense radiations which are produced when a bomb is burst in the air over an objective; similarly the works of man, unless very specially and massively constructed, are vulnerable.

These facts are now within the knowledge of everyone who has read the descriptions of what happened at Hiroshima and Nagasaki some two years ago.

The two bombs which obliterated these cities each released energy equivalent to about twenty thousand tons of TNT. These bombs were early patterns in which high efficiency had not then been developed. In contrast, as a result of intensive research and development, the latest types may be much more powerful. There is no reason why this increase of power should not take place. There is, of course, a definite scientific reason for a minimum size below which no explosion can occur but, above this critical mass, it seems that the larger the bomb the higher the efficiency with which the fissionable material will be used in an explosion and thus the effect will increase much more than in proportion to size.

An alternative to the airburst bomb, and perhaps an even more terrible method of using it, is to explode the bomb under water as was done in one of the experiments at Bikini. In this case about ten million tons of water contaminated with the radioactive products of the explosion were blown up into the air. This spray may travel downwind for several miles and, wherever it falls, the resulting radiation may persist for years at such a strength that human beings could not remain within the area and survive. Thus it

might happen that one bomb, or perhaps two or three for good measure, set off in the harbour of this city would force its immediate evacuation. By immediate I mean a time interval measured in minutes and hours -- not days.

The intensity of the radioactive products of the explosion, the persistence with which they cling to some of the substances used in buildings etc., the vast quantities of the materials which would be required for their removal, the difficulties, verging on the impossible, of protecting persons engaged in this task from the radiations are among the considerations which render it quite impracticable to decontaminate a city which has been immersed in a radioactive mist. The only thing which could be done by the survivors would be to wait, with whatever patience they can muster, for the long years required for the radioactivity to decay to a tolerable level.

In World War II up to the time atomic bombs were employed against Japan, the most destructive instrument used against life and property was long range heavy aircraft armed with high explosive or incendiary bombs. Scales of attack of the order of ten thousand tons in a single raid were realized. There is no doubt that with air raids on this scale the target was "saturated", which means that anti-aircraft gun fire and other forms of defence were completely subdued.

There is no doubt also that immense damage was done in these raids by fire and blast, but it is likewise not open to doubt that, despite the enormous quantities of explosive used in the larger attacks, the paralysis of enemy activities in the target area was only of very temporary duration. Once the raid was over many people were recovered from the ruins -- road and railway communications were quickly restored -- factories managed somehow to get back into production in a few days.

With the scale of effort represented by air raids of greatest intensity results show evidence of diminishing returns. That is, it probably will not be worth while -- even if it could be done in future wars -- to increase the intensity of bombing. Also the cost to the national effort represented by expenditures in bombs, aircraft, trained personnel etc. tends to become of the same order of magnitude as the cost of replacement of damage done.

From what we know now of the new counter measures which were under development in the closing phases of World War II including, among others, rocket armed jet fighters and high velocity ground to air rockets, both with proximity or target-seeking fuses, it can be concluded that the counter to the large bomber raid was in sight and that very probably these raids would shortly have become too expensive in aircraft to be continued. That is, like so many other weapons and methods of warfare, defence was at last on the threshold of catching up with bombing aircraft as a weapon of attack.

Now, the question we must ponder is this. Is the atomic bomb like bombing aircraft and other weapons, which were decisive in their day, in that in due course we may expect that its possibilities for offensive use will be limited by some form of defence which may be evolved?

As is now generally known, an atomic bomb consists of two or three or so pieces of Uranium 235 or Plutonium or Uranium 233, each of which is below the critical size, that is, below the size at which the generation of neutrons by fission could become cumulative.

To cause the bomb to explode it is merely necessary to bring the separate pieces together rapidly. As soon as this happens a chain reaction sets in. Successive generations of neutrons follow each other in periods measured in millionths of a second. Each neutron that cannot escape from the mass of the fissionable material causes the release of a number more and so on; and each fission of uranium or plutonium atoms contributes energy in the form of heat or gamma and other rays. The whole process, involving billions upon billions of atoms, is complete in an exceedingly brief instant and the release of energy is incredibly large and violent.

There is no known way by which fissionable material in less than critical size can be made to explode -- there is likewise no known way by which amounts in greater than critical size can be prevented from exploding. The facts of the situation are clear and well understood, and there is little possibility that they will be changed by new knowledge coming from further scientific research and development. There is thus no way, and no likelihood of one being found, by which an atomic bomb might be neutralized. It is not against the bomb, therefore, but against its carrier that we must look for forms of defence which might prove effective.

The carriers which might be used for atomic bombs are:-

- (a) the long range guided missile, whether it be rocket or crewless aircraft;
- (b) manned aircraft of the large bomber class;
- (c) submarines and other carriers or saboteurs who would place the bombs with delay fuses in position by stealth.

Of these, guided missiles have today a reliable range of perhaps two or three hundred miles. Unmanned aircraft will travel well above supersonic speed and rockets may have velocities of five thousand or six thousand feet per second which is more than four times that of sound at sea level.

It is likely therefore that these missiles, because of their great speed, will be almost immune to enemy interference. Their accuracy is of the order of a couple of percent of range -- that is, even now they can be placed with certainty within the limits of a large target, such as a city, which is the only kind of target they would be used against in any event. Nothing less than a few million people and their goods and chattels would be counted as a worthwhile target until all such remunerative objectives had ceased to exist.

There is thus very little hope of effective defence against the guided missile once it has been launched. The only prospect is to deal with the ship, or other platform from which it is to be launched, to hold it out of range or at least to prevent it from launching its missile at short range where the accuracy would be higher. Thus, as matters stand at the moment, there is a sort of defence to be found in distance but this is not very comforting as ranges for guided missiles certainly show every indication of great increase, perhaps even to the extent of substituting thousands of miles of range for the present hundreds within a few decades. However, these futuristic conditions are not here yet, and most fortunately we are a long way from the push button type of warfare described in the sensational magazines.

Manned aircraft in the large bomber class which have been specially designed have today a radius of action of about five

thousand miles out and the same distance back after due allowance has been made for the weight of an atomic bomb payload. These machines will fly in the stratosphere at thirty or forty thousand feet with speeds of five hundred miles per hour or better. Thus the means of intercontinental attack even today are well within the limits of established practice. The over-all cost, including casualties, of operating bombers these great distances with a payload of ordinary h.e. would certainly not be worth while but with atomic bombs, each of which is at least several thousand times more powerful weight for weight, this limitation would not exist.

An aircraft flying in on a target at stratosphere heights at five hundred miles per hour or more poses an exceedingly difficult problem for the defence. It takes a long time for a defence rocket to rise to forty thousand feet or so, and jet propelled fighters have as yet a very limited endurance. As a result, it seems possible that at least a proportion of the attackers will get through. Applied to the small numbers of atomic bomb carriers required, a high casualty rate does not represent the prohibitive scale of loss which it would be if the same, or even a fraction of the same, percentage of loss were applied to the vastly larger numbers of aircraft required with ordinary h.e. bombs to give a comparable result. Thus it does not seem that the expectation of casualties can be counted on as a deterrent to intercontinental attack with atomic bombs borne in manned aircraft. In this connection, I would observe that modern methods of radio navigation permit these aircraft to know their position at all times with the precision required for bombing a city.

The third method of using atomic bombs to which I have referred was their placement by submarines or saboteurs who would set the delay to give plenty of time for escape. I do not think it necessary to enlarge on these methods except to say that against skilled operators I can foresee great difficulties in establishing any really effective defence against atomic bombs because their secret placement is so much less difficult than ordinary h.e., where the volume and weight of the explosive required to secure a worth while result is so vast that the chances are it could not be placed in position secretly let alone kept hidden if it were. Thus whether by guided missiles, by manned aircraft, by submarine or by saboteur it seems that it will not be possible by any conceivable physical means to prevent an attack with atomic bombs which might conceivably result in a crippling blow through the destruction of centres of population and industry which, as I have said, are the kinds of target against which the atomic bomb will be used.

However, with the prospect of atomic war no nation will leave all its defence resources in these vulnerable locations, and it is not probable therefore that an atomic attack would determine the outcome. In consequence in the military establishments the atomic bomb does not replace the army, navy or air force -- it is a weapon of special application which is added to all other weapons.

If we accept, as I think we must on the evidence available, the thesis that there is no physical defence against atomic war, then what avenues of hope remain to us for the preservation of the world?

There are indeed two possibilities which merit consideration. The first and most attractive is to develop an international agreement under which we may hope that all nations may come to have confidence that atomic energy will be used for peaceful purposes only. As part of this agreement, it is proposed to set up a system of safeguards and controls which will in fact ensure that atomic

war cannot be prepared, or at the least that if any nation should attempt to do so then the situation will be promptly known and reported to all other nations so that they may take whatever action is appropriate.

It has been thought by those who have studied all aspects of this problem that without undue restriction on the peaceful uses of atomic energy and without the setting up of an unduly cumbersome organization, it would be possible to provide at the least several months' warning before atomic war could be launched by any nation on any significant scale. It is thought that the certainty of having such a period of warning, during which appropriate counter measures could be taken, should give the nations confidence to undertake the establishment of such a system which, once established, could be expected to develop in reliability. This is what the United Nations Atomic Energy Commission has been set up to study and later I will have more to say about the progress of this work.

The second possibility of preserving peace, which is, I think, fully justified in the short term view by considerations of expediency and practicability, is that the United States, which is the only nation which at the moment possesses the atomic bomb in quantity, should be encouraged to continue to retain for as long as may be possible its paramount ascendancy in this field.

There can, of course, be no continuing monopoly in the facts of science; what one nation has found out, others can learn also by the application of appropriate efforts and granted sufficient time. In truth there never have been any really scientific secrets about the atomic bomb. The whole epic history of nuclear physics has been international in character, from the first detection in France of the peculiar rays given off by uranium minerals to the first recognition of atomic fission in Germany, with very substantial contributions in between from almost every other country engaged in scientific research.

While I make the point that there are no real scientific secrets yet there are most important technological advantages and engineering know-how which are the exclusive perquisite of those who have laboured and carried the burden of development. I would say that in the atomic energy project, like any other major undertaking, there is a phase where prodigious effort is required for little in the way of return; then there comes a point at which the returns increase very rapidly for a little additional effort and everything goes forward on a rising curve.

The United States is today on this rising curve with atomic energy and, if our American colleagues maintain their research and development on the scale authorized by Congress, it seems that their ascendancy will remain for a decade at least. Meanwhile no other country on earth has as yet passed out of the difficult first phase to which I have referred.

Quite frankly the only major country or association of countries about which we of the Western world might feel anxiety is the U.S.S.R.. I pose the question that having regard to the devastation of war, the primary requirements of rehabilitation, the limited resources in materials and industrial equipment and particularly in technological skills, is it likely that the U.S.S.R. could at this time be capable of diverting effort on the scale necessary to make atomic war? The United States capital equipment for atomic plants is estimated to have cost over two and a half billion dollars mostly in payment in one way or another for skills which had to be taken out of the national economy. No other

country is as yet endowed with these skills on such a lavish basis nor is it likely that any other country could make this diversion without destroying, or at the least seriously crippling, their national economy.

In the light of what I have said as to the great magnitude and long continued efforts required for the preparation of atomic war, it seems reasonably probable that we need not fear its outbreak on any significant scale for a while yet. There is thus no occasion for hysteria but, on the other hand, it would be folly to waste the time which remains to us through a failure to give proper consideration to the defensive measures which are open, and in particular to advance by every means within our power the setting up of an international agreement which will effectively protect the peoples of the world.

The first international step towards the creation of such an agreement was made very shortly after the termination of the war by the United States, Great Britain and Canada, the three countries which were associated in the wartime project. The Washington declaration on atomic energy issued on November 15, 1945, by President Truman, Prime Minister Attlee and Prime Minister King recognized the need for an international agreement and proposed as a matter of great urgency the setting up of a Commission under the United Nations to study the problem and to make recommendations for its control. These discussions were followed by a meeting of the Foreign Ministers in Moscow in December, 1945, at which the Washington proposals were endorsed. At the meeting of the General Assembly on January 24, 1946, in London, the United Nations Atomic Energy Commission was established by unanimous resolution.

The Commission, composed of delegates from each country represented on the Security Council, as well as Canada when Canada is not a member of the Council, was charged with making specific proposals:

- (a) For extending between all nations an exchange of basic scientific information on peaceful ends,
- (b) For the control of atomic energy to the extent necessary to ensure its use only for peaceful purposes,
- (c) For the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction,
- (d) For effective safeguards by way of inspection and other means to protect complying states against the hazards of violations and evasions.

When the Commission first met in New York in June, 1946, it was presented with two different plans for the control of atomic energy, one proposed by the United States and the other by the Soviet Union. The United States proposal generally resembled that outlined in the Lilienthal Report, which had been released in the United States a few months previously. It called for the formation of an International Atomic Development Authority, which would foster beneficial uses of atomic energy and would control atomic activities in all nations either by direct ownership, management or supervision, in the case of activities potentially dangerous to world security, or by a licensing and inspection system in the case of other activities. This system of control would be set up by stages and, after it was in operation, the manufacture of atomic bombs would stop, existing bombs would be disposed of, and the

world authority would be given information regarding the production of atomic energy. In addition, the United States proposal emphasized that the veto of the Great Powers in the Security Council should not apply in the event that any nation was charged with having violated the international agreement not to develop or use atomic energy for destructive purposes.

I may say that the proposals made by the United States accord very closely with the views of the Government of Canada, and of many other nations in the Western World, as to how this problem might be brought under control. On the other hand, the Soviet Government put forward a plan which differed fundamentally. It proposed the immediate outlawing of the atomic bombs and the destruction of all existing stocks of atomic weapons within a three month period. To this end the Soviet delegate tabled a draft convention which, he said, should be negotiated forthwith as the first step towards the establishment of a system of international control. The Soviet delegate was prepared to discuss methods of control and inspection, but he maintained that this should not hold up the immediate prohibition of atom bombs.

The idea that the menace to world peace presented by the atomic bomb could be solved merely by the signing of an international agreement to prohibit its use or manufacture seems very unreal. The experiences of the last twenty-five years have shown that international agreements alone are not enough to safeguard the peace. The prohibition of the use and manufacture of the atomic bomb at the present time would merely seriously reduce the military strength of the United States, the only nation now in possession of atomic bombs. It would be an act of unilateral disarmament which would give no assurance that any country engaged in atomic energy activities would not or could not make and use the bomb in the future. Fissionable material, the essential material for such peaceful applications of atomic energy as the development of industrial power, is also the explosive element of the bomb, and in the absence of effective inspection and control could readily be diverted from peaceful to military uses by a nation secretly preparing for atomic war.

For this reason, most members of the Commission were in general agreement with the principles of the American proposals. They considered that the prohibition of the use or manufacture of the atomic bomb should form part of an over-all control plan, so that when such prohibitions were put into effect they would be accompanied by the applications of safeguards such as international inspection of all countries to ensure that no secret activities in atomic energy were in progress.

After weeks of discussion along these lines, the Commission decided to seek a new approach to the problem by a study, in committee of the available scientific information, to determine whether an effective control of atomic energy was feasible. This study resulted in a unanimous report by the scientists of all nations represented on the Commission that "they did not find any basis in the available scientific facts for supposing that effective control is not technologically feasible". With this conclusion before it, the Commission then proceeded to discuss the safeguards that would be required at each stage in the production and application of atomic energy to ensure its use only for peaceful purposes.

The Commission's findings were set out in detail in its First Report which was approved on December 31, 1946, by a vote of 10 to 0, with the Soviet and Polish delegations abstaining. In this report the Commission pointed out that as all applications of

atomic energy depended on uranium and thorium, control of these materials was an essential safeguard. The Commission, therefore, recommended international inspection of all mines, mills and refineries to prevent possible diversion of materials to the making of atomic bombs. As the materials assumed a more concentrated form and were therefore more directly applicable to bomb making, the Commission believed that the controls would have to be even stricter. They considered that at least certain plants producing substantial quantities of fissionable material should be placed under the exclusive operation and management of the international authority.

Concurrently with the discussions in the United Nations, the question of the control of atomic energy in Canada came before Parliament and, as a result, an Act was passed which established the Atomic Energy Control Board with the duty of controlling and supervising the development and application of atomic energy in the interest of the people of Canada, and generally of preparing to carry out the obligations which it would be necessary to assume under an international agreement of the character and scope which had been indicated in the discussions taking place in the United Nations.

You are, of course, familiar with the significant contributions made in Canada during World War II and before to the development of knowledge of nuclear physics and, in consequence, I shall not attempt tonight to describe the work which has been done or that which is in progress in the Universities, in the National Research Council or at the pilot plant at Chalk River which is operated by the National Research Council for the Board. I would like, however, to say that research in Canada is being directed to the acquisition of fundamental knowledge in nuclear physics and towards the peaceful applications of atomic energy but, in view of the dangerous possibilities of fissionable materials, the Board has issued regulations controlling dealings in these substances to ensure that they do not fall into improper hands; similarly some of the information obtained in research has a bearing on national security and naturally the Board is concerned that these matters should be properly safeguarded.

To return to the discussions of atomic energy in the United Nations, the Second Report of the Atomic Energy Commission was approved by the Commission on September 11 last and sent forward to the Security Council. Ten nations voted in favour, the U.S.S.R. voted against and Poland abstained. The Report contains specific proposals as to the powers and functions which an international agency would need to have. Particular consideration has been given to a system of checks and balances to be applied to the operations of the proposed agency through the Security Council, the General Assembly or the International Court of Justice as appropriate. These limitations have been worked out so as not to impede prompt action by the agency wherever this may be required, but at the same time to make the Agency "responsible" in the sense that we use this term in reference to our Cabinet system of government in Canada, that is, to check any arbitrary and unnecessary use of authority and to provide for methods whereby any complaints against the Agency or its staff could be fully investigated and corrected. I think I can claim that the proposals in the present Report are fully in accord with this democratic conception and yet that they do not compromise the powers needed to be exercised by the Agency in any way.

On behalf of Canada, I had the authority to state that in our view these proposals, together with the General Findings and Recommendations of the First Report, provide the essential basis for the

establishment of an effective system of control to ensure the use of atomic energy for peaceful purposes only and to protect complying states against the hazards of violations and evasions.

As I have said this view is shared by ten out of the twelve nation members of the Commission. On the other hand, Mr. Gromyko, speaking for the U.S.S.R., expressed his continued opposition. He reiterated his view that no progress had been made because the report did not provide a solution for what he described as the urgent problem of prohibiting atomic weapons and particularly for the early destruction of the U.S. stocks of atomic bombs. He objected also to the ownership of fissionable material, and of plants for its processing and use, being vested in an international authority which he held to be both unnecessary and contrary to the principles of national sovereignty. He took similar objection to the proposals for the licensing of non-dangerous atomic energy activities which the majority of the Commission felt should be supervised by the Agency although their operation had been entrusted to a national authority.

Mr. Gromyko thought that some system of "quotas" would suffice, and he said that this proposal had not been sufficiently explored. The only point on which he seemed to have moved forward from the position which he took at the time of the First Report was in relation to inspection and control, which he now conceded must be international in scope and organization, with personnel who are international. However, it is thought that by international control and inspection the U.S.S.R. merely contemplates occasional or periodic inspection rather than the meticulous continuous process which the other members believe to be essential for security. There thus remains a very wide gap between the views of the U.S.S.R. supported by Poland and those of the rest of the Commission, but I do not think that we should be unduly cast down on that account, and we should certainly not underestimate the value and the significance of the progress which has been made.

When the Commission began its sessions in June of 1946, now some eighteen months ago, there was little to go on beyond a conviction that the dread potentialities of atomic war needed to be brought under effective international control. Since then the problem has been examined in its many intricacies and multitude of aspects. Gradually a consensus of opinion has formed and found expression until today ten nations out of twelve believe that they have found the right path forward. The circumstance that the other two nations on the Commission do not yet agree should not be regarded too seriously at this stage. As a matter of fact both these nations have made substantial contributions to the discussion. Certainly the representative of Poland has done so in a positive sense, and at the least the U.S.S.R. has formed an anvil on which the rest of us have had an opportunity to forge and hammer out the conclusions we have now reached.

Up to date we have been more anxious that the U.S.S.R. should continue to be represented in the discussions and less concerned that they would at once agree to the majority proposals. I think I can claim that we have felt so convinced of the necessity for proper control, and we are now so genuine in our belief as to how it must be brought about, that we feel that something of this sincerity must find its way through to the people of Russia. It is a fact that no people would benefit more than they would from what we have proposed and so both on the grounds of benefit from the peaceful application as well as of security, it is not too much to hope that eventually a way will be found to traverse the position of those who presently control the policy of the Soviet.

Meanwhile, as I see the matter, we and the whole world have everything to gain and nothing to lose by steadfastly pursuing the course which the Commission has mapped out for itself.

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