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Metallurgical Laboratory

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BUFFENFIELD 4509

June 12, 1945

To: Secretary of War - Attention: Mr. George Harrison

From: Arthur H. Compton

In re: Memorandum on "Political and Social Problems" from Members of the
"Metallurgical Laboratory" of the University of Chicago.

Dear Mr. Secretary:

I have submitted to you a memorandum which has been prepared on short notice by certain key members of the scientific staff of the Metallurgical Laboratory of the University of Chicago. It deals with the long-term consequences of use of the new weapons with which we are concerned. I am submitting this at the request of the Laboratory, for the attention of your Interim Advisory Committee. The memorandum has not yet been considered by other members of the "Scientific Panel." This will be done within a few days, and a report by the panel dealing with the matter in question will be submitted. In the meantime, however, because time is short for making the necessary decisions, I have personally taken the liberty of transmitting this memorandum to you for the consideration of your committee.

The main point of this memorandum is the predominating importance of considering the use of nuclear bombs as a problem of long-range policy rather than for its military advantage in this war. Their use should thus be directed primarily toward bringing about some international control of the means of nuclear warfare.

The proposal is to make a technical but not military demonstration, preparing the way for a recommendation by the United States that the military use of atomic explosives be outlawed by firm international agreement. It is contended that its military use by us now will prejudice the world against accepting any future recommendation by us that its use be not permitted.

I note that two important considerations have not been mentioned:

- (1) that failure to make a military demonstration of the new bombs may make the war longer and more expensive of human lives, and
- (2) that without a military demonstration it may be impossible to impress the world with the need for national sacrifices in order to gain lasting security.

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To: Secretary of War - Page 2

Nevertheless, the importance of the problem considered, and the weight of the arguments presented for never permitting the bombs to be used in war, are such that I have considered it wise to bring the memorandum immediately to your attention.

Yours very truly,

Arthur H. Compton

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Arthur H. Compton

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Political and Social Problems

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I. Preamble

The only reason to treat nuclear power differently from all the other developments in the field of physics is its staggering possibilities as a means of political pressure in peace and sudden destruction in war. All present plans for the organization of research, scientific and industrial development, and publication in the field of nucleonics are conditioned by the political and military climate in which one expects these plans to be carried out. Therefore, in making suggestions for the postwar organization of nucleonics, a discussion of political problems cannot be avoided. The scientists on this Project do not presume to speak authoritatively on problems of national and international policy. However, we found ourselves, by the force of events, the last five years in the position of a small group of citizens cognizant of a grave danger for the safety of this country as well as for the future of all the other nations, of which the rest of mankind is unaware. We therefore felt it our duty to urge that the political problems, arising from the mastering of nuclear power, be recognized in all their gravity, and that appropriate steps be taken for their study and the preparation of necessary decisions. We hope that the creation of the Committee by the Secretary of War to deal with all aspects of nucleonics, indicates that these implications have been recognized by the government. We feel that our acquaintance with the scientific elements of the situation and prolonged preoccupation with its world-wide political implications, imposes on us the obligation to offer to the Committee some suggestions as to the possible solution of these grave problems.

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Scientists have often before been accused of providing new weapons for the mutual destruction of nations, instead of improving their well-being. It is undoubtedly true that the discovery of flying, for example, has so far brought much more misery than enjoyment and profit to humanity. However, in

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the past, scientists could disclaim direct responsibility for the use to which mankind had put their disinterested discoveries. We cannot take the same attitude now because the success which we have achieved in the development of nuclear power is fraught with infinitely greater dangers than were all the inventions of the past. All of us, familiar with the present state of nucleonics, live with the vision before our eyes of sudden destruction visited on our own country, of Pearl Harbor disaster, repeated in thousandfold magnification, in every one of our major cities.

In the past, science has often been able to provide adequate protection against new weapons it has given into the hands of an aggressor, but it cannot promise such efficient protection against the destructive use of nuclear power. This protection can come only from the political organization of the world. Among all arguments calling for an efficient international organization for peace, the existence of nuclear weapons is the most compelling one. In the absence of an international authority which would make all resort to force in international conflicts impossible, nations could still be diverted from a path which must lead to total mutual destruction, by a specific international agreement barring a nuclear armaments race.

II. Prospectives of Armaments Race

It could be suggested that the danger of destruction by nuclear weapons can be prevented - at least as far as this country is concerned - by keeping our discoveries secret for an indefinite time, or by developing our nucleonic armaments at such a pace that no other nations would think of attacking us from fear of overwhelming retaliation.

The answer to the first suggestion is that [although we undoubtedly are at present ahead of the rest of the world in this field, the fundamental facts of nuclear power are a subject of common knowledge. British scientists know as much as we do about the basic wartime progress of nucleonics - with the

exception of specific processes used in our engineering developments - and the background of French nuclear physicists plus their occasional contact with our Projects, will enable them to catch up rapidly, at least as far as basic scientific facts are concerned. German scientists, in whose discoveries the whole development of this field has originated, apparently did not develop it during the war to the same extent to which this has been done in America; but to the last day of the European war, we have been living in constant apprehension as to their possible achievements. (The knowledge that German scientists were working on this weapon and that their government certainly had no scruples against using it when available, was the main motivation of the initiative which American scientists have taken in developing nuclear power on such a large scale for military use in this country.) In Russia, too, the basic facts and implications of nuclear power were well understood in 1940, and the experience of Russian scientists in nuclear research is entirely sufficient to enable them to retrace our steps within a few years, even if we would make all attempts to conceal them. Furthermore, we should not expect too much success from attempts to keep basic information secret in peacetime, when scientists acquainted with the work on this and associated Projects will be scattered to many colleges and research institutions and many of them will continue to work on problems closely related to those on which our developments are based. In other words, even if we can retain our leadership in basic knowledge of nucleonics for a certain time by maintaining the secrecy of all results achieved on this and associated Projects, it would be foolish to hope that this can protect us for more than a few years.

It may be asked whether we cannot achieve a monopoly on the raw materials of nuclear power. The answer is that even though the largest now known deposits of uranium ores are under the control of powers which belong to the "western" group (Canada, Belgium and British India); the old deposits in Czechoslovakia

are outside this sphere. Russia is known to be mining radium on its own territory; and even if we do not know the size of the deposits discovered so far in the USSR, the probability that no large reserves of uranium will be found in a country which covers 1/5 of the land area of the earth (and whose sphere of influence takes in additional territory), is too small to serve as a basis for security. Thus, we cannot hope to avoid a nuclear armament race, either by keeping secret from the competing nations the basic scientific facts of nuclear power, or by cornering the raw materials required for such a race.

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One could further ask whether we cannot feel ourselves safe in a race of nuclear armaments by virtue of our greater industrial potential, including greater diffusion of scientific and technical knowledge, greater volume and efficiency of our skilled labor corps, and greater experience of our management - all the factors whose importance has been so strikingly demonstrated in the conversion of this country into an arsenal of the Allied Nations in the present war. The answer is that all that these advantages can give us, is the accumulation of a larger number of bigger and better atomic bombs - and this only if we produce these bombs at the maximum of our capacity in peace time, and do not rely on conversion of a peace time nuclear industry to military production after the beginning of hostilities.

However, such a quantitative advantage in reserves of bottled destructive power will not make us safe from sudden attack. Just because a potential enemy will be afraid of being "outnumbered and outgunned", the temptation for him may be overwhelming to attempt a sudden unprovoked blow - particularly if he would suspect us of harboring aggressive intentions against his security or "sphere of influence." In no other type of warfare does the advantage lie so heavily with the aggressor. He can place his "infernal machines" in advance in all our major cities and explode them simultaneously, thus destroying a

a major part of our industry and killing a large proportion of our population, aggregated in densely populated metropolitan districts. Our possibilities of retaliation - even if retaliation would be considered compensation for the loss of tens of millions of lives and destruction of our largest cities - will be greatly handicapped because we must rely on aerial transportation of the bombs, particularly if we would have to deal with an enemy whose industry and population are dispersed over a large territory.

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In fact, if the race of nuclear armaments is allowed to develop, the only apparent way in which our country could be protected from the paralyzing effects of a sudden attack is by dispersal of industries which are essential for our war effort and dispersal of the population of our major metropolitan cities. As long as nuclear bombs remain scarce (this will be the case until uranium and thorium cease to be the only basic materials for their fabrication) efficient dispersal of our industry and the scattering of our metropolitan population will considerably decrease the temptation of attacking us by nuclear weapons.

Ten years hence, an atomic bomb containing perhaps 20 kg of active material, may be detonated at 6% efficiency, and thus have an effect equal to that of 20,000 tons of TNT. One of these may be used to destroy something like 3 square miles of an urban area. Atomic bombs containing a larger quantity of active material but still weighing less than one ton may be expected to be obtainable within ten years which could destroy over ten square miles of a city. A nation which is able to assign 10 tons of atomic explosives for the preparation of a sneak attack on this country, can then hope to achieve the destruction of all industry and most of the population in an area from 500 square miles upwards. If no choice of targets, in any area of five hundred square miles of American territory, will contain a large enough fraction

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of the nation's industry and population to make their destruction a crippling blow to the nation's war potential and its ability to defend itself, then the attack will not pay, and will probably not be undertaken. At present, one could easily select in this country a hundred blocks of five square miles each whose simultaneous destruction would be a staggering blow to the nation. (A possible total destruction of all the nation's naval forces would be only a small detail of such a catastrophe.) Since the area of the United States is about six million square miles, it should be possible to scatter its industrial and human resources in such a way as to leave no 500 square miles important enough to serve as a target for nuclear attack.

We are fully aware of the staggering difficulties of such a radical change in the social and economic structure of our nation. We felt, however, that the dilemma had to be stated, to show what kind of alternative methods of protection will have to be considered if no successful international agreement is reached. It must be pointed out that in this field we are in a less favorable position than nations which are either now more diffusely populated and whose industries are more scattered, or whose governments have unlimited power over the movement of population and the location of industrial plants.

[If no efficient international agreement is achieved, the race of nuclear armaments will be on in earnest not later than the morning after our first demonstration of the existence of nuclear weapons. After this, it might take other nations three or four years to overcome our present headstart, and 8 or 10 years to draw even with us if we continue to do intensive work in this field.] This might be all the time we have to bring about the re-groupment of our population and industry. Obviously, no time should be lost in inaugurating a study of this problem by experts.

III. Prospectives of Agreement

The prospect~~ive~~ of nuclear warfare and the type of measures which have to

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be taken to protect a country from total destruction by nuclear bombing, must be as abhorrent to other nations as to the United States. England, France, and the smaller nations of the European continent, with their congeries of people and industries, are in an entirely hopeless situation in the face of such a threat. Russia, and China are the only great nations which could survive a nuclear attack. However, even though these countries value human life less than the peoples of Western Europe and America, and even though Russia, in particular, has an immense space over which its vital industries could be dispersed and a government which can order this dispersion, the day it is convinced that such a measure is necessary - there is no doubt that Russia, too, will shudder at the possibility of a sudden disintegration of Moscow and Leningrad, almost miraculously preserved in the present war, and of its new industrial cities in the Urals and Siberia. Therefore, only lack of mutual trust, and not lack of desire for agreement, can stand in the path of an efficient agreement for the prevention of nuclear warfare. The achievement of such an agreement will thus essentially depend on the integrity of intentions and readiness to sacrifice the necessary fraction of one's own sovereignty, by all the parties to the agreement.

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From this point of view, the way in which the nuclear weapons, now secretly developed in this country, will first be revealed to the world appears of great, perhaps fateful importance.

One possible way - which may particularly appeal to those who consider the nuclear bombs primarily as a secret weapon developed to help win the present war - is to use it without warning on an appropriately selected object in Japan. It is doubtful whether the first available bombs, of comparatively low efficiency and small size, will be sufficient to break the will or ability of Japan to resist, especially given the fact that the major

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cities like Tokyo, Nagoya, Osaka and Kobe already will largely be reduced to ashes by the slower process of ordinary aerial bombing. Certain and perhaps important tactical results undoubtedly can be achieved, but we nevertheless think that the question of the use of the very first available atomic bombs in the Japanese war should be weighed very carefully, not only by military authority, but by the highest political leadership of this country. If we consider international agreement on total prevention of nuclear warfare as the paramount objective, and believe that it can be achieved, this kind of introduction of atomic weapons to the world may easily destroy all our chances of success. Russia, and even allied countries which bear less mistrust of our ways and intentions, as well as neutral countries, will be deeply shocked.

It will be very difficult to persuade the world that a nation which was capable of secretly preparing and suddenly releasing a weapon, as indiscriminate as the rocket bomb and a ~~thousand~~ ^{thousand} times more destructive, is to be trusted in its proclaimed desire of having such weapons abolished by international agreement. We have large accumulations of poison gas, but do not use them, and recent polls have shown that public opinion in this country would disapprove of such a use even if it would accelerate the winning of the Far Eastern war. It is true, that some irrational element in mass psychology makes gas poisoning more revolting than blasting by explosives, even though gas warfare is in no way more "inhuman" than the war of bombs and bullets. Nevertheless, it is not at all certain that the American public opinion, if it could be enlightened as to the effect of atomic explosives, would support the first introduction by our own country of such an indiscriminate method of wholesale destruction of civilian life.

Thus, from the "optimistic" point of view - looking forward to an international agreement on prevention of nuclear warfare - the military advantages and the saving of American lives, achieved by the sudden use of atomic bombs against Japan, may be outweighed by the ensuing loss of confidence and wave

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of horror and repulsion, sweeping over the rest of the world, and perhaps shaking even the public opinion at home.

From this point of view a demonstration of the new weapon may best be made before the eyes of representatives of all United Nations, on the desert or a barren island. The best possible atmosphere for the achievement of an international agreement could be achieved if America would be able to say to the world, "You see what weapon we had but did not use. We are ready to renounce its use in the future and to join other nations in working out adequate supervision of the use of this nuclear weapon."

This may sound fantastic, but then in nuclear weapons we have something entirely new in the order of magnitude of destructive power, and if we want to capitalize fully on the advantage which its possession gives us, we must use new and imaginative methods. After such a demonstration the weapon could be used against Japan if a sanction of the United Nations (and of the public opinion at home) could be obtained, perhaps after a preliminary ultimatum to Japan to surrender or at least to evacuate a certain region as an alternative to the total destruction of this target.

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It must be stressed that if one takes a pessimistic point of view and discounts the possibilities of an effective international control of nuclear weapons, then the advisability of an early use of nuclear bombs against Japan becomes even more doubtful - quite independently of any humanitarian considerations. If no international agreement is concluded immediately after the first demonstration, this will mean a flying start of an unlimited armaments race. If this race is inevitable, we have all reason to delay its beginning as long as possible in order to increase our headstart still further. It took us three years, roughly, under forced draft of wartime urgency, to complete the first stage of production of nuclear explosives - that based on

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the separation of the rare fissionable isotope U²³⁵, or its utilization for the production of an equivalent quantity of another fissionable element. This stage required large-scale, expensive constructions and laborious procedures. We are now on the threshold of the second stage - that of converting into fissionable material the comparatively abundant common isotopes of thorium and uranium. This stage requires no elaborate plans and can provide us in about 5 - 6 years with a really substantial stockpile of atomic bombs. Thus it is to our interest to delay the beginning of the armaments race at least until the successful termination of this second stage. The benefit to the nation, and the saving of American lives in the future, achieved by renouncing an early demonstration of nuclear bombs and letting the other nations come into the race only reluctantly, on the basis of guesswork and without definite knowledge that the "thing does work," may far outweigh the advantages to be gained by the immediate use of the first and comparatively inefficient bombs in the war against Japan. At the least, pros and cons of this use must be carefully weighed by the supreme political and military leadership of the country, and the decision should not be left to *considerations, merely of military tactics*.

One may point out that scientists themselves have initiated the development of this "secret weapon" and it is therefore strange that they should be reluctant to try it out on the enemy as soon as it is available. The answer to this question was given above - the compelling reason for creating this weapon with such speed was our fear that Germany had the technical skill necessary to develop such a weapon without any moral restraints regarding its use.

Another argument which could be quoted in favor of using atomic bombs as soon as they are available is that so much taxpayers' money has been invested in these projects that the Congress and the American public will require a return for their money. The above-mentioned attitude of the American public

opinion in the question of the use of poison gas against Japan shows that one can expect it to understand that a weapon can sometimes be made ready only for use in extreme emergency; and as soon as the potentialities of nuclear weapons will be revealed to the American people, one can be certain that it will support all attempts to make the use of such weapons impossible.

Once this is achieved, the large installations and the accumulation of explosive materials at present earmarked for potential military use, will become available for important peace-time developments, including power production, large engineering undertakings, and mass production of radioactive materials. In this way, the money spent on war time development of nuclear energy may become a boon for the peace time development of national economy.

IV. Methods of International Control

We now consider the question of how an effective international control of nuclear armaments can be achieved. This is a difficult problem, but we think it to be soluble. It requires study by statesmen and international lawyers, and we can offer only some preliminary suggestions for such a study.

Given mutual trust and willingness on all sides to give up a certain part of their sovereign rights, by admitting international control of certain phases of national economy, the control could be exercised (alternatively or simultaneously) on two different levels.

The first and perhaps simplest way is to ration the raw materials - primarily, the uranium ores. Production of nuclear explosives begins with processing of large quantities of uranium in large isotope separation plants or huge production piles. The amounts of ore taken out of the ground at different locations could be controlled by resident agents of the international Control Board, and each nation could be allotted only an amount which would

make large scale separation of fissionable isotopes impossible.

Such a limitation would have the drawback of making impossible also the development of nuclear power production for peace-time purposes. However, it does not need to prevent the production of radioactive elements on a scale which will revolutionize the industrial, scientific and technical use of these materials, and will thus not eliminate the main benefits which nuclear science promises to bring to mankind.

An agreement on a higher level, involving more mutual trust and understanding, would be to allow unlimited production, but keep exact bookkeeping on the fate of each pound of uranium mined. Certain difficulty with this method of control will arise in the second stage of production, when one pound of pure fissionable isotope will be used again and again to produce additional fissionable material from thorium. These could perhaps be overcome by extending control to the mining and use of thorium, even though the commercial use of this metal may cause complications.

If check is kept on the conversion of uranium and thorium ore into pure fissionable materials, the question arises how to prevent accumulation of large quantities of such materials in the hands of one or several nations. Accumulations of this kind could be rapidly converted into atomic bombs if a nation would break away from international control. It has been suggested that a compulsory denaturation of pure fissionable isotopes may be agreed upon - they should be diluted after production by suitable isotopes to make them useless for military purposes (except if purified by a process whose development must take two or three years), while retaining their usefulness for power engines.

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One thing is clear: any international agreement on prevention of nuclear armaments must be backed by actual and efficient controls. No paper agreement

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can be sufficient since neither this or any other nation can stake its whole existence on trust into other nations' signatures. Every attempt to impede the international control agencies must be considered equivalent to denunciation of the agreement.

It hardly needs stressing that we as scientists believe that any systems of controls envisaged should leave as much freedom for the peace development of nucleonics as is consistent with the safety of the world.

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Summary

The development of nuclear power not only constitutes an important addition to the technological and military power of the United States, but also creates grave political and economic problems for the future of this country.

[Nuclear bombs cannot possibly remain a "secret weapon" at the exclusive disposal of this country, for more than a few years. The scientific facts on which their construction is based are well known to scientists of other countries. Unless an effective international control of nuclear explosives is instituted, a race of nuclear armaments is certain to ensue following the first revelation of our possession of nuclear weapons to the world. Within ten years other countries may have nuclear bombs, each of which, weighing less than a ton, could destroy an urban area of more than five square miles.] In the war to which such an armaments race is likely to lead, the United States, with its agglomeration of population and industry in comparatively few metropolitan districts, will be at a disadvantage compared to the nations whose population and industry are scattered over large areas.

We believe that these considerations make the use of nuclear bombs for an early, unannounced attack against Japan inadvisable. If the United States would be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race of armaments, and prejudice the possibility of reaching an international agreement on the future control of such weapons.

Much more favorable conditions for the eventual achievement of such an agreement could be created if nuclear bombs were first revealed to the world by a demonstration in an appropriately selected uninhabited area.

If chances for the establishment of an effective international control of nuclear weapons will have to be considered slight at the present time, then not only the use of these weapons against Japan, but even their early demonstration

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may be contrary to the interests of this country. A postponement of such a demonstration will have in this case the advantage of delaying the beginning of the nuclear armaments race as long as possible. If, during the time gained, ample support could be made available for further development of the field in this country, the postponement would substantially increase the lead which we have established during the present war, and our position in an armament race or in any later attempt at international agreement will thus be strengthened.

On the other hand, if no adequate public support for the development of nuclear science will be available without a demonstration, the postponement of the latter may be deemed inadvisable, because enough information might leak out to cause other nations to start the armament race, in which we will then be at a disadvantage. At the same time, the distrust of other nations may be aroused by a confirmed development under cover of secrecy, making it more difficult eventually to reach an agreement with them.

If the government should decide in favor of an early demonstration of nuclear weapons it will then have the possibility to take into account the public opinion of this country and of the other nations before deciding whether these weapons should be used in the war against Japan. In this way, other nations may assume a share of responsibility for such a fateful decision.

To sum up, we urge that the use of nuclear bombs in this war be considered as a problem of long-range national policy rather than military expediency, and that this policy be directed primarily to the achievement of an agreement permitting an effective international control of the means of nuclear warfare.

The vital importance of such a control for our country is obvious from the fact that the only effective alternative method of protecting this country, of which we are aware, would be a dispersal of our major cities and essential industries.

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