It is probably easier to agree on the long term goals than on the more immediate objectives and we may as well start off with the long term goals.

Those who take the position that we must have peace with justice and imply that if we can't have that we may just as well not ~~need not~~ have peace are ~~probably~~ pursuing an unattainable objective and if the world were to follow their lead it would have neither peace nor justice. Peace -- in a liveable world might be, with luck, an attainable goal.

What would it take to have a liveable world? Even in a generally disarmed world, armies equipped with machine guns could spring up so to speak overnight and such a disarmed world will remain at peace only if there is an agreement between the nations on how to secure the peace in it. * Footnote (This does not mean that we must have a ~~world~~ centrally controlled world police force, with the Secretary General of the United Nations as the Commander in Chief. Indeed! ~~Such~~ a solution would not be acceptable to Russia in the circumstances which prevail today and it might not be acceptable to America in the circumstances which might prevail in a few years hence. I have discussed this problem as well as the problem ~~and other aspects of the problem of disarmament~~ — such as the problem of "inspection" — in a paper on Disarmament submitted to the 8th Pugwash Conference at Stowe, Vermont in 1960 and also ~~in fictional forms~~ in a little book, "The Voice of the Dolphins." The book contains five stories of social and political satire, and the lead story attempts to show what it would take

Transcribe

to accomplish disarmament in the predictable future. (Published by Simon and Schuster. Paperback, $1.00.)

The world will not remain disarmed for long unless disarmament goes far enough to lead to substantial savings because only if it does this will the nations have ~~substantial~~ a sufficiently strong incentive to keep the disarmament agreement in force. For a Disarmament ~~could not be maintained~~ agreement to remain in force ~~for long unless~~ the nations ~~could~~ would have convince each other that they are not secretly evading the disarmament agreement. This brings us to the problem of inspection. ~~and~~ The difficulties of inspection are probably over-rated at present. The most important issue is not whether the Russian government could hide a limited number of bombs and rockets if it wanted to do so, but rather how much inspection it would take before it ~~becomes~~ would impossible ~~say~~ for the Russsian government to maintain in existence an effective system of delivery, be it rockets or bomber planes, in existence and to keep its existence secret. ~~When it comes to~~ The question ~~if~~ whether the Russian ~~g~~government could hide a limited number of bombs and rockets ~~we go~~ goes beyond the problem of inspection -- in the conventional ~~meaning~~ sense of the term. I, personally, am convinced that if the Russian government wanted to hide a limited number of bombs and rockets, foreign inspectors could not discover such bombs and rockets even were Russia to admit such inspectors in limited numbers. If it becomes ~~impossible~~ important for Russia and America to convince each other that there are essentially no bombs or rockets hidden --- and indeed, in certain circumstances it might become important for them to do so, then Russia ~~and~~ America would have to create conditions in which American could rely on Russian citizens in general, and Russian scientists and engineers in particular, to report any

such violation to an international control commission. Similarly, Russia would have to be able to rely on American citizens' reporting secret violations.*

*Footnote

I raised this particular issue in the conversations which I had with Khrushchev in Oct. '59 in New York and when I got to Moscow in Dec. of that year, I found that a detailed report of this conversation had been made available by the Soviet government to some of my colleagues at the Academy of Sciences of the USSR. In this report K was quoted as having said to me that the Soviet government would seriously consider the possibility of creating conditions in which America could rely on Russian citizens'reporting violations --- if an agreement is reached on general disarmament.

Even if the Soviet government would want to do this, it is not a foregone conclusion that she would be able to do it. I tried to explore this question in my conversations in Moscow in December '59 and at this point I would not say that what needs to be done in this regard could be easily done, but even less, would I want to say that what needs to be done, would not be done.

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at present America is committed t protect nations which are geographically within the proximity of Russia and China. Since, in a generally disarmed world, America would not be able to live up to such commitments, it follows that general disarmament will be politically acceptable to America only if it can liquidate these commitments without loss of prestige , without sacrificing the ligitimate requirements of other nations involved. If the Soviet Union and the Peoples Republic of China reach the point where they are able to recognize this fact then it may become possible to have a political settlement both in Europe and in the Far East - that may make generl disarmament acceptable to America. * Footnote America's commitments in the Far East will not be easy to liquidate because they go back to a period after the second World War when America was the only country in possission of the bomb and as a result of this America was suffering from delusions of political grandeur. Over a period of years America set herself up as a World policeman in the Far East. She entered into Military committments and engaged her prestige at the slightest provocation. During the Korean War Pres. Truman sent the fleet into the Formosa Straights as a strictly temporary measure and the fleet was supposed to protect impartially Formosa from attack fro the Chima mainland and visa versa. But when the Korean War ended contrary to President Truman's pledge was disregarded by the next administration and the fleet was left in the Straits of Formosa and it was left there no longer as an impartial

Footnote

guardian of peace but for the purpose of protecting Formosa from possible attack by the Peoples Republic of China.

When ever the islands of Matsu and Quemoy are under attack from the mainland of China the government declares that it is not willing to yeild to force and when there is a prolonged period when these island are free from attack the government sees no reason why it should suggest to the Government of Formosa to withdraw its troops from these off shore islands.

When the War of Indo China ended with the partitioning of Indo China, America engaged her prestige in South Vietnam which up to then was of concern only to France. It it were possible for A America to develop South Korea and South Vietnam economically and politically so that economic progress in South Korea dn South Vienam would keep ahead of economic progress Of North Korea and North Vietnam and at the same time achieve a ~~pli~~ political development of South Korea and South Vietnam that would secure to the people of these nations a measure of freedom which is necessary to regard as then it could be argued with some justification that the American presence in South Korea and South Vietnam leads to a containment of Communism in Southeast Asia. Perhaps it is too early to say whether this is in fact so, but if ~~it-is-too~~ in the next few years it should become manifest that this is not so, then continued American presence either in South Korea or South Vietnam will become impossible to justify. Through disarmement we may, with luck, abolish was but disaramament is not likely to end the rivalry between America and Russia. There is no reason to expect that thenations one after the other, shall adopt

Footnote

one after the other, shall adopt an economic system resembling the free economies of America or West Germany or France or Italy. Nor is there any reason to expect that the nations one after another shall adopt the parlimentary form of democracy and establish governments under free elections. We shall have to be satisfied ~~for~~ if the nations in whose welfare America takes an interet are capable of making economic progress which is comparable with economic progress of the nations within the Soviet sphere of influence. We shall have to be satisfied if these nations adopt that minimum standard of freedom below which one could no longer regard them ad liveable places. What is that minimum standard of freedom? What that minimum standard of freedom is, I am not able to define with any precision but it might be somewhere about and perhaps slightly above the freedom whcih prevails at this time in Poland. If anyone wants to aim at a higher degree of freedom it is his privilege to do so but if he claims that higher degree of freedom will be generally attainable in most countries isn the predictable future then the burden of proof is on him. The prospects of freedom would be much brighter if the issue was simply the issue of freedom versus communism for in that case on would only have to beat communism. Even though this might not be an easy goal, it would have been an attainable goal. But the issue of freedom versus Communism is a fake issue and trouble goes much deeper than that.

It ~~will~~ may not be possible to unify Germany under free elections in the predictable future, ~~and it is not even certain that it would be desirable to do so~~ and it is not even certain that it would be desirable if it were possible. ~~but~~ We ought to aim at a political ~~sentiment~~ settlement in Europe that would make it possible to set up a confederation between the West German State and the East German State under conditions that would make it possible for the Soviet Union to agree to a step by step transformation of this confederation into a more and more closely knit confederation. Such a political settlement would have to involve the transformation ~~of~~ into a neutral city (having a status similar to that of Austria) not only of West Berlin but also of East Berlin and for the setting up of a confederation between these two neutral cities. This is possible only if East Germany can be induced to shift its capitol from East Berlin to some other place like Dresden or Leipzig, for instance.

Since the current Berlin crisis, representing even more a conflict of prestige than a conflict of real interests, the Soviet Union may ~~might~~ be reluctant to accept the loss of prestige ~~that she might suffer~~ would if East Berlin were to cease to be the capitol ~~Ea~~ of East Germany. ~~For reasons~~ On the basis of this sort, it ~~will be better~~ would seem to negotiate ~~over~~ at the same time a political settlement in Europe ~~at the same time one negotiates over a political settlement~~ and at the same time in the Far East. If the Soviet Union ~~were to~~ would induce East Germany to relinquish East Berlin at the same time when the United States would induce the government of Formosa to relinquish Quemoy and

Matsu it might be possible to balance in an equitable fashion the losses of prestige on both sides. In view of the present extreme rigidity of United States foreign policy any political settlement that makes sense must, of course, appear Utopian today. Today in deference to Western Germany whom we regard rightly or wrongly as an indespensible ally, we are unable to negotiate for a political settlement in Europe that would offer hope of creating a politically stable Europe. Also today, in deference to the so-called China Lobby we are unable to prepare the ground for a political settlement in the Far East. When Quemoy and Matsu are under attack from the Chinese Mainland we declare that we are not going to yield to force. And during periods of quiet, when these off shore islands are not under attack the government finds it easier to yeild to the China Lobby than to common sense and common decency. Thus where the arms race goes on the status quo is frozen and the situation is getting more and more explosive.

It is doubtful that the present rigidity of the United States foreign policy ~~will~~ may be maintained for more than one or two years, after that something ~~will~~ may have to give and we ~~shall~~ assume that something will give. Even if we have general disarmament and a any global political settlement this does not mean that the rivalry with the Soviet Union and the Peoples Republic of China on the one hand and the United States on the other hand will cease. Moreover, for better or for worse, a rivalry may also develop between the Soviet Union and the Peoples Republic of China. It is a foregone conclusion that we shall not have in the predictable future a world operating under a rule of law. As long as there are no generally accepted principles of international justice to which a reasoned appeal may be directed in court as well as out of court, it would be impossible to maintain a rule of law even if such a rule were set up on paper. But, even if we can't have justice prevail we may still attain a liveable world provided the nations can rach a meeting of the minds on the means they will employ in pursuing their political objectives. If such a rule of conduct were formulated and made explicit by listing a sufficient number of hypothetical case histories there would be a fair chance that the great powers would abide by these rules ~~provided~~ unless that they ~~are not going~~ continue to pursue unattainable political objectives, — as we are at present very much inclined to do. —

Suppose under some such rules of conduct the United States would be free to try to forestall a Communist revolution in Brazil by some such program as the current - Alliance for Progress or preferably by some more effective version of such a current program. But what if in spite of all economic aid and political advice and such undercover operations as may remain possible under the rules of conduct and without any outside military help from either the Soviet Union or the Peoples Republic of China, there is a successful Communist revolution in Brazil? Will under some generally acceptable rules of conduct, the United States be free to send in the Marines? Raising this question in form leaves little doubt as to what the answer would be. It is true, of course, that in a generally disarmed world, none of the countries located within the geographical proximity of the Soviet Union or America or the Peoples Republic of China would be likely to look for military protection to any distant country and would readjust their policies to the changed circumstances. Accordingly, the countries located in geographical proximity of America would be tacitly recognized as part of America's sphere of influence. But Brazil, of course, is not located within the geographical proximity of American and the Monroe Doctrine, at least the modern version of it in a generally disarmed world.

We cannot have our cake and eat it too and if we try we will come to grief.

~~It was~~ the arms race ~~itself which led to~~ the Cuban incident.

Ever since the end of the war our policies have followed the line of least resistance. It was easier to drop the bomb on Hiroshima than to agree with our Allies on the peace terms to be offered to Japan, and it is easier to keep on ~~builing~~ building long-range solid fuel rockets, the Minutemen, as fast as ~~existing~~ production facilities ~~admit~~ than to devise an agreement providing for arms control that Russia would be impelled to accept. If we continue to follow ~~this~~ line of least resistance we shall before long reach a point of no return in an all out arms race. If we continue to follow this ~~road~~, peace is ~~not likely to~~ last another ten years. The present Administration has enlisted the services of ~~an exceptionally large number~~ of able ~~and intelligent~~ men. ~~All of them~~ know that America cannot be made secure by keeping ahead in the arms race. There are those among them who are on the side of the angels and who would be willing to give up ~~some~~ temporary advantages which we may hold over the Russians for the sake of obtaining an agreement that would stop the arms race. ~~Others would like to eat their cake and have it too.~~ They would like to hold on to whatever advantage we may have at the present--to the last possible moment--and they would also like to put an end to the arms race here and now.

~~insert, p. 2~~

2

II

~~Even though~~ many able people within the Administration have a clear enough insight into what ~~it would take to solve the problem with which we are faced, we might--with our eyes open--still~~ needs to be done yet we are likely to keep on following the ~~road that leads to war~~ line of least resistance. Only if Congress ~~adopts an attitude that will~~ shall encourage rather the Administration to ~~adopt~~ undertake a truly constructive approach to the problem with which we are faced ~~shall~~ any we be able to get off the road to war.

Another Man
to take such a
[illegible]
[illegible]
[illegible]
that the Adm. insight
[illegible]

Many able people inside the Administration have insight into what it would take to solve the problems with which we are faced. But still we may keep on following the line of least resistance unless we can bring about a marked change in the attitudes of Congress. Only if Congress adopts an attitude that encourages the Administration to adopt a bold constructive approach to the problem we face shall we be able to get off the present road that leads to war.

Is it possible to bring about such a change in Congressional attitudes? The people who are able to understand what it would take to get off the road to war do not control a majority of the votes. But if a minority of 20,000 having an income of about $20,000 were able to unite on a set of political objectives and were willing to spend one or two percent of their income on campaign contributions to Congressional candidates there might very possibly bring about a very marked change in Congressional attitudes. Their contributions would amount to about $4 million a year and this amount, if wisely spent, could have a profound influence both on the composition and the attitude of Congress.

IV

If you are willing to spend one or two persent of your income on campaign contributions to Congressional candidates, we stand ready to advise you where your contributions should go in order to bring about a necessary change in Congressional attitudes. In the last elections ~~our Board of Directors, established in June of last year,~~ the Council was established in June and recommended to a sample of our supporters to make out their check to a Senatorial candidate who was running in one of the small midwestern states. ~~We received~~ In response to this recommendation, we received for transmittal checks totalling over $20,000 and he was elected with a margin of a few hundred votes. He is the first Democratic Senator elected in his state in the last 26 years.

In 1964 we hope to be instrumental in much the same manner in the election of ~~six~~ about Senators.

In addition to supporting for reelection in 1964 good men who are now serving in the Senate, we shall seek to find good men who could get elected to the Senate if they were to receive the nomination of their party, ~~we~~ shall ~~are trying~~ try to persuade ~~such men~~ them to seek the nomination ~~and of~~ and ~~their party and we propose to~~ help them get ~~the nomination~~ it.

The selection of the candidates ~~recommended for~~ to be supported rests with our Board of Directors which includes scientists, political scientists, and also men well versed in practical politics. William Doering, Director of the Science Division of Yale University, and Leo Szilard, Professor of Biophysics at the University of Chicago, are co-chairmen of the Board, which includes Morton Grodzins, Professor of Political Science at the University of Chicago, and James G. Patton, President of the Farmers Union.

The support of Congressional candidates is only one among several of our activities. Our operations in Washington, D. C. are aimed at bringing about a consensus on what needs to be done among like-minded people within the Administration and the Congress who are deeply concerned about the drift towards war. If you think you might be impelled to join those who are helping the Council attain its objectives, please let us have your name and address, so that we may send you the information that you may need in order to arrive at a decision.

According to a study carried out for the Institute of Defense Analysis (described in Hearings on the Biological and Environmental Effects of Nuclear War before the Special Subcommittee on Atomic Energy, 86th Congress, 1st session, June 1959 pp. 859-881) the casualties from a 2,000 megaton attack are expected to be 60% in an untrained population and 38% in a trained population with six months to build shelters. A larger attack (20,000 megatons) would result in 89% casualties for a sheltered population, 98% for an unsheltered population. This study assumed a weapons delivery error of 100 miles, and considered deaths due to fallout occurring up to 60 days after an attack proportional to population density.

Another study (for the Office of Civil Defense and Mobilization mentioned in the Bulletin of Atomic Scientists, October 1961, pg. 347) estimates 65% of our population dying in a 23,000 megaton attack *if* existing shelter facilities are mapped and marked.

In response to my letter of November 15 the head of the Russian Mission to the United Nations in Geneva, N. J. Moliakov, conveyed to me, a few days later, the Chairman's invitation to come and see him in Moscow and it was thereupon arranged that I would fly, with my wife, to Moscow on November 26.

Two days before that date I received a telephone call from a friend in Washington; from what he told me I gathered that during my absence from Washington some misunderstandings have arisen there concerning the nature and objectives of the project, which would have to be cleared up before we could proceed to implement the project.

Thereupon I cancelled my flight to Moscow and explained to Chairman Khrushchev what had happened. I left it up to him whether he preferred that I come to Moscow before I returned to Washington or whether he preferred that I straighten out matters in Washington first.

Khrushchev's reply reached me in the form of a telephone message, brought to m e by Moliakov. He said that Chairman Khrushchev thought that I would know best whether in the circumstances I would want to go to Moscow or whether I would rather go back to Washington and straighten out matters there first. The Chairman felt that perhaps it would be better for me to go first to Washington but that it was up to me to make this decision.

I told Moliakov that in the circumstances I would propose to return to Washington and communicate with the Chairman at some later date through Ambassador Dobrynin. Moliakov stressed that I was free to change my mind, my visa was valid for another two weeks and if I proceeded to go to Moscow the Chairman would see me.

I did not go to Moscow, but returned to Washington. Since this is a private, non-governmental, project we would want to involve the U.S. Government as little as possible. The success of the project demands, however, that the Government smile on it, rather than frown on it, and we need to make sure that the project is fully understood and appreciated by the Government.

Upon my return to Washington I was able to clear up the misunderstandings which had arisen during my absence. In order to eliminate any ambiguities that might remain I am now trying to formulate the text of the "instructions" under which the American and the Russian participants of the project would operate. Because of the need to consult with others there might be a short delay before the final text may be drafted. Thereafter it should not take too long to learn whether we can count on the Government to smile on the project.

When we have the green light in Washington I might then have to go to Moscow, but not until we have the names of the Americans who would participate in the project.

The End.

In view of the urgency of a decision, and assuming that the governmental committee will advise you upon enquiry in favor of taking action in this matter, I should greatly appreciate conferring with you in the course of next week at your convenience, and will hold myself in readiness to come forthwith.

2. The necessity for creating a board of trustees that would serve as an intermediary between the governmental group and the scientists engaged in this work, and in particular the question of making available governmental funds to some such non-profit organization as may have to be set up, might make it desirable to bring one of your legal aides into the circle of discussion, along with General Watson, serving as a liaison for the representatives of the Service Departments and the Bureau of Standards.

Novick and I have two rooms of 1,050 square feet in toto, and adjoining a 37 degree room of 200 square feet, and a room for dish washing and preparation of media of 125 square feet. In addition I have an office whereas Novick's office is a desk in one of the labs. Not all the space of the 37 degrees room will be needed by us, but only about two-thirds of the space, according to present computations. We shall at first work with two technicians and one full-time "dish washer." Later on we might perhaps have only one technician; on the other hand, later on we might have two or three graduate or post-graduate students work in our lab.

There still must be many members sitting in Congress who believe that a man who works, even though he spends all that he earns, takes away another man's job and, therefore, promotes unemployment. This may then explain why under the existing provisions of social security a man is cut off from social security in any month in which he earns more than $80 (income other than earned income does not interfere with his social security benefits). Clearly this provision is against the public interest and in times of labor shortage its absurdity is particularly evident.

A very large fraction of our voting population is above 65 years, and most of them enjoy the benefits of social security. If Congress is going to try their patience much longer, sooner or later someone will come along and organize them as a pressure group. Once that happens, there is no telling where they will stop for their voting power will be such that they will be able to force Congress to legislate in their favor and pass both laws which are unreasonable and laws which are unreasonable.

Let this be a fair warning to my friends in Congress that unless they do something quickly and that if this unreasonable provision of the social security law is still in force by the time that I retire and begin to draw social security, I may move to Washington as a lobbyist for the aged, and then woe to those who fail to listen to the voice of reason.

so that when I retire and cannot have any gainful occupation without losing my social security benefits, I may move to Washington, register as a lobbyist for the aged, and then, woe to those who would not listen to the voice of reason.

I have never been able to see how the issue of ~~the~~ stopping or continuing the testing of ~~the~~ bombs could have an important bearing on the issue raised by the existence of the bomb. For that reason I have never ~~given much attention to~~ occupied myself with the subject except at the various Pugwash meetings where the issue ~~inadvertedly~~ inevitably came up for discussion among the Russian and American participants, both during the official session and, more importantly, in private conversations. At the first Pugwash meeting I ~~abstained from~~ would not bring myself to ~~signing~~ the ~~concluding~~ statement issued by the conference because ~~it~~ it said that the conclusion of an international agreement providing for the stopping of ~~testing of the~~ bomb test would be a good first step towards the solving of the problem posed by the bomb. ~~It~~ To me it ~~seems to me~~ seems that one must ~~first agree~~ determine or know what the solution ~~to the~~ ~~this~~ ~~discuss~~ what does or does not to a problem may be before one can ~~know what may~~ represent a good first step towards ~~the~~ that solution.

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Insert:

In the following we shall assume that Mr. Smith is in the 80% income tax bracket, that the yearly dividend paid by a ~~million dollars~~ M/. ars ago worth of stock A is about $50,000, i.e. 5% of ~~the~~ to-day's market price, ~~at Harbrow~~ and that the ~~estimation of the~~ University ~~is fairly certain~~ believes that the dividend over the next 5 years will be in toto certainly in excess of $200,000, i.e. that it will average not less than 2% of today's market price. —

If stocks yield 5% and dividend and interest is reinvested the income during four years would total about 275,000 for five year period.

If dividend average 2% 10,000 University gets

$\frac{275000}{2} + \frac{10400}{2}$

If dividends average only 2% 137,500 into income from dividends and interest on loan

52000

189,500

Assuming that Mr. Smith exercises the option for a loan, the deed shapes up for him as follows: ~~he~~ He will have none of his own funds invested. He will pay in interest a total of $250,000 over the 5 year period, and since he is in the 80% income tax bracket this will actually cost him a total of $50,000. If the stock ~~does not go~~ is neither up nor down up in price ~~during the next 5 years~~ at the end of the five year period, he will make a capital gain of $175,000. If the stock goes down in value, Mr. Smith will not lose unless the price of the stock falls from a million dollars below $825,000. and from then on will lose 1/2 of the original loss due to sinking

From the point of view of the University, the deal shapes up as follows: If the stock continues to pay a dividend of $50,000 per year over a 5 year period and if the University re-invests the dividends in the same stock, the University will make on the deal--if the price of the stock at the end of the 5 year period has neither risen nor fallen--$200,000. If the dividends average less than 5% and if the value of the stock falls, the gain of the University will be less. However, the University cannot lose on this deal unless the average dividend over the 5 year period falls below 2%. All this is meant in comparison with the case where the University does not make the deal with Mr. Smith but keeps holding one-half million dollars worth of stock A in its portfolio. It seems to me that a deal of this type is advantageous both for the University and for Mr. Smith. The question remains whether the treasury might object, but this is a point about which Mr. Smith's legal advisers ought to worry more than the University.

Early in 1939 Dr. Szilard took the initiative in an attempt to induce ~~his colleagues~~ physicists in America, England, France, and Denmark to withhold from publication all papers relating to atomic energy. His own paper on the possibility of maintaining a chain reaction in a system composed of graphite and uranium was the first one withheld. This paper was withheld at the request of the government, but it took months of hard work to elicity such a request. After the war Dr. Szilard was one of the few who counciled against the publication of the Smyth Report, because he thought it detrimental to the national security.

Today he is no less concerned about the real requirements of security, but the formal way in which these requirements are frequently handled in utter disregard of commonsense offends his sense of proportions. Two years ago, he wrote a satire on this subject for his own amusement with no thought of publication; following the revokation of Dr. Oppenheimer's clearance, however, he made the manuscript available to the Bulletin.

We are now rapidly approaching a state of affairs when scientists will say to each other "Some of my best friends are security risks."

What valid argument is there for revoking Oppenheimer's clearance in this year of grace, 1954 unless ~~there is some man who in his right mind senses regards~~ it as conceivable within reason that secret information correctly given to Oppenheimer ~~will~~ may leak to ~~a potential enemy.~~ ~~In the last few weeks many physicists talked to me about Oppenheimer - some of them had supported his view on the hydrogen bomb; others were violently opposed to it.~~

~~None~~ All of the ~~numerous~~ ~~scientists~~ those who talked to me the last few weeks about Oppenheimer none would admit that possibility. But ~~xxxxx~~ if there were really some ground for suspicion ~~would~~ with Oppenheimer knowing what he ~~knows~~ does - wouldn't ~~the~~ he a more logical arresting him and shooting him without trial ~~in the absence of sufficient evidence~~ be the only ~~safe~~ evident course of action from the point of view of "National Security."

Classing Oppenheimer as a Security Risk and subjecting him to a formal hearing ~~will be~~ is ~~is~~ regarded by scientists in this country as an indignity and an affront to all. It ~~will be~~ ~~is~~ is regarded by our friends abroad as a sign of insanity -- which it probably is.

I have no reason to believe ~~that~~ the Gen. Manager of the Commission Gen Nichols the Chairman Adm Strauss and ~~these~~ other members of the commission who know opp as well as the rest of us think otherwise

O_{16} O_{18}

O_{16}

$1V_1$

$O\ O\ O^*$

$O_3 \rightarrow O_2 + O + M$

$O\ \ O\ O^* \rightarrow O\ O\ \ O^*$

$H\ \ H\text{-}H \rightarrow H \cdot H\ \ H$

$d = 7000$

They might serve the purpose of

~~Conceivably we might have succeeded in~~ fooling others but would ~~we~~ have succeeded in fooling ourselves? ~~Perhaps~~ the majority of the voters ~~who determine the outcome of elections and to whom therefore the Administration is responsive~~ might ~~have~~ perhaps been fooled. But what about the spiritual minority that ~~who~~ might not determine the outcome of the ~~elections~~ elections but might well determine the ultimate fate of the nation? There is in America, as there is in every country, ~~a spiritual~~ such a minority, amounting to perhaps of no more than 5% of the population, ~~who in some sense~~ which make up the life blood of the nation. This ~~spiritual~~ minority important though it is, has never been clearly defined. Out of their ranks come those who ~~reorganize the organized~~ recognize the unrecognized problems. Out of their ranks come those who perform the unassigned tasks. They alone speak for ~~the~~ posterity which is not represented in Congress. They alone ~~distinguish between peripheral issues and our the~~ can perceive true national goals. They alone give moral considerations the weight they deserve, ~~and by and large their actions are determined~~ guided by a religious attitude ~~—~~ which may be called in the broad sense of the term.

They alone manifest in

They alone are really sensitive to the National true interests

This minority responds, with great sensitivity to ~~what may be says~~

In order to test ~~any assumption~~, ~~a number of~~ different types of control experiments were made. ~~We found that the phenomenon observed did not occur if in place of the filtrate we used a corresponding mixture of~~

We ~~found~~ ascertained for instance that if we repeated the experiment but used in place of the filtrate obtained ~~derived~~ from the lysate of a mixedly infected bacterial culture) a mixture corresponding of the the viruses T2 and T4 ~~permitting absorption on B/2 no corresponding increase was~~ obtained ~~in the~~ the number of plaques on agar plates which were inocultaed on B/4 ~~indicating that such mixtures of T2 and T4 do not~~

Insert : After one passage on B/2 ~~this incipient T2 does not seem~~ to be able to grow in B/2 ~~after one passage~~ for we were not able to obtain any more further increass in the number of plaques obtained on agar plates which were inoculated with B/4, ~~if after~~ first ~~incubation~~ with B/2 ~~for 11/4 hours~~ after one step of growth on B/2 ~~to permit lysis~~, we added ~~to~~ the suspension B/2 allowed time for absorption, ~~diluted in broth, and again~~ incubated for 1 1/2 hours at 37°C ~~to permit lysis~~.

We found that if we repeated our experiment, under conditions with a filtrate which was so diluted that when we added B/2 and allow time for

further made certain

We ~~found~~ that if we repeated our experiment but ~~used the filtrate~~ so diluted the filtrate that when we added B/2 only very few of the bacteria ~~could~~ had absorb more than one virus particle (i.e. multiple infection ~~could be neglected~~ was negligible), ~~the~~ ~~phenomenon~~ observed ~~remained unchanged~~. ~~From this we are forced to~~ conclude that either a single phage particle or else two or more phage particles which stick together are responsible for our phenomenon. We were able, however, to exclude that possibility that the phenomenon is ~~not~~ produced by ~~aggregates of~~ T2 and T4 particles which might stick together and might jointly enter bacteria of the B/2 variety. This possibility we excluded by means of the following experiments

All men classed as scientists or engineers would be invited to spend each year four weeks' vacation, or six weeks if you wish, abroad with their families as guests of the United Nations Organization.

The Russian government would be expected to take similar action with respect to its own scientists and engineers.

These vacations abroad would give an opportunity to all those who wish to report secret violations to secure immunity by staying abroad rather than returning home after having delivered their report.

TP Clearly, the vast majority of American scientists and engineers would respond to such a request by the President of the United States, and would not hesitate to report any illicit activity.

My knowledge of the Russians is far less complete--but even if only a small percentage, say 10 per cent, of them responded, as the Americans would respond, they would represent a far more reliable source of information than the body of foreign inspectors whose activities they would supplement.

Secret violations of the agreement would in these circumstances be risky undertakings indeed.

TP If time permitted we could examine to what extent we could remove any incentive which Russia or the United States might have towards invoking their legal right and abrogate such an agreement after it had been in operation for a number of years.

We cannot go into these questions tonight.

TP An arrangement of this sort can, of course not rule out the possibility of war, and in case of war, sooner or later, atomic bombs would drop from the skies.

Yet under such an arrangement war would break out only if one of the parties actually decided to start an arms' race and risk a war.

It would give us a respite which would be worthwhile to have provided we know how to make use of it for building a permanent peace.

Jones

The extent of that information which, in fact, was public knowledge to the scientists of the world, is the limit of the Smyth report which you have heard so much about. In other words, nothing in that report discloses any secrets to the world.

Bush

We had the courage, and I think the wisdom, to publish the Smyth Report with a great deal of the fundamental information in it, which was certainly a gesture, it was certainly an indication that we wished to proceed down the path of free interchange of basic scientific information.

Weidenhammer
Dept. of Com
Ext. 2214

[ ]

Hanna
Linder

E. J. Craig

Paul Hays
Ext 351
18th Pennsylvania
exec
0100

Mr. Szilard raised a question about the operation of the 4 E contract on inventions and patents. Both the President and the Chancellor said that the revision of 4 E would not affect the policy of the University with respect to patents.

Mr. Szilard raised the question whether restricting the appointment of assistant professors to two years under Paragraph 2a of the Committee's recommendation was advisable since two years may be too short a period to permit an assistant professor to prove his worth and whether it wouldn't be better to permit the appointment of assistant professors under Paragraph 2a up to four years. Mr. Zachariasen pointed out that this would imply a total of nine years probation and the Committee report had stressed the need for decreasing the probationary period. Mr. Szilard then moved to amend the recommendation of the Committee under 2a to permit the appointment of an assistant professor in the first instance for a term not less than two and not more than four years and an appointment for a further term with the proviso that the two terms together shall not exceed seven years. The motion to amend was lost for want of a second. Mr. Szilard asked why associate professors who have tenure shall not be automatically promoted to professors when the new provision goes into effect which eliminates the rank of associate professor for new appointments with tenure. Mr. Ward explained that the Sub-committee had debated this point and decided against it on the ground that there had already been too much blurring in the graded steps preceding the associate professorship.

Sept Oct Szilard

In September of last year I was advised by Professor E. P. Wigner and Professor Albert Einstein of Princeton that Dr. Szilard had devised a method for maintaining a chain reaction in a system composed of uranium and carbon, and that the energy liberated in such a system could be effectively used for producing power. A conservative estimate shows that one can expect one ton of uranium to supply as much power as 3,000 tons of oil and, in the circumstances, uranium might be used as a fuel reserve in warships of the larger types. I understand that there is at present a 50-50 chance that this chain reaction could also be maintained under conditions in which one ton of uranium might supply as much power as would correspond to the burning of one million tons of oil. If this favorable alternative can be realized, then the larger naval units built according to the present naval program would have to be considered obsolete in the near future.

In order to test the method proposed by Dr. Szilard, an experiment using 100-200 tons of graphite and 10-30 tons of uranium metal would have to be carried out. Such an experiment may involve expenses which ultimately may aggregate half a million dollars, and in October of last year I made an appeal to the Government for its moral or material aid in carrying out this project. In response to a letter received from Professor Einstein the President appointed a committee, with Dr. Briggs as chairman, and I submitted the matter to this committee jointly with Dr. Szilard, ~~Professor E.~~ Dr. P. Wigner of Princeton University and Dr. E. Teller of George Washington University, Washington, D. C. We emphasized the urgency of deciding the question whether a chain reaction could be made to work with ordinary unseparated uranium, so that in case of a

favorable result, steps might be taken to secure an adequate supply of rich uranium ore from the Belgian Congo. It was also pointed out that Dr. Szilard had discussed the matter extensively with Professor E. Fermi and Dean G. B. Pegram of Columbia University, that their collaboration could be counted upon, and that certain preliminary experiments were being prepared at Columbia.

The Government representatives expressed their interest and their desire to help at this meeting, and various Government departments represented on the committee promised material aid towards the preliminary experiments (which have since been carried out to their completion at Columbia with a definitely encouraging result. A favorable report was sent to the President in October.

A number of meetings, with constantly varying membership, have taken place between October of last year and July this year, at which the Government representatives showed a steadily increasing desire that the proposed project be carried out with Government funds rather than private funds. The representatives of Columbia University - Dr. Fermi, Dean Pegram and Professor H. C. Urey - played an increasingly prominent part in these conferences, as well as Admiral Bowen of the Naval Research Laboratory. The opinions of scientists from other universities, such as Dr. Breit of the University of Wisconsin and Dr. Wigner, were heard and were favorable. A consensus of opinion developed to the effect that a fund of $140,000, if it could be spent freely with no strings or red tape attached, might be sufficient to bring the project to a stage at which the ultimate success of the whole enterprise could be considered as established as beyond doubt.

In spite of the favorable opinion and manifest desire to help

of all those concerned, the project has failed to make any headway since its introduction last October. It has become known during this period that work on uranium is proceeding in Germany in great secrecy and on a very large scale in two of the Kaiser Wilhelm Institutes under the auspices of the German Government. The increasing degree of interest shown by the Government representatives in this country has so far only resulted in dissuading Dr. Fermi and Dr. Szilard from seeking assistance from private sources and in establishing a constantly changing system of committees, none of which seems to possess any clearly defined authority.

The present state of affairs in this respect is as follows: Drs. Fermi, Szilard, Wigner and Teller are now supposed to act as unofficial advisors to six other scientists who form an official scientific advisory committee to the special advisory committee headed by Dr. Briggs. This latter committee is supposed to be a sub-committee of Dr. Bush's advisory committee. I understand that Dr. Bush's committee has now decided to appropriate $40,000 for the proposed project, if and when it will have funds at its disposal, and is also recommending that $100,000 worth of material be purchased through some purchasing agency of the Government for the requirements of the project. I understand that Dr. Bush's committee has no funds at present at its disposal. It decision to provide the material required through a Government purchasing agency was made without having heard either Dr. Fermi or Dr. Szilard, and does not solve the problem, since the bulk of the material required cannot be bought but has to be procured by methods other than straight purchase.

The task of establishing a chain reaction in unseparated uranium under conditions in which the energy liberated can be efficiently used for power production is of considerable complexity. It cannot successfully be carried out unless those who are familiar with all its aspects and who are supposed to carry out the work are given the authority necessary to effectuate the task. It is therefore proposed that (1) a fund of $140,000 should be entrusted without restriction to a board of trustees comprising Dr. Briggs, Dean Pegram, Professor Urey and Mr. Sachs; (2) that the seat of the board be in New York City; (3) that Drs. Pegram, Sachs, Fermi and Szilard should act as executives; (4) that a board of scientists, - namely Drs. Pegram, Urey, Wigner, Tuve, Teller, Breit, Fermi and Szilard - supervise the work and coordinate the work conducted at universities outside of New York. An estimate of the cost for the measurement of nuclear values which will have to be carried out is enclosed. This will leave $90,000 of the total of $140,000 to be used for buying materials required for an experiment with large quantities of material for the purpose of deciding the issue. The largest item, as far as materials are concerned, is an amount of 5-10 tons of uranium metal. It is not possible at present to buy uranium metal in the required quality and quantity. It is therefore proposed to approach two or three firms with a fixed offer to buy one ton of uranium metal of a specified quality at a price of about $5 per pound, and thereby to induce these firms to carry out such experiments as they find necessary in order to be able to accept such an order or to be able to make a bid of their own. If the firms find that they have to charge a higher price, we would then be free to place an order for a quantity of 5-10 tons with the firm which makes the lowest bid.

liberated in a nuclear reaction between light elements. The nuclear reactions between the light elements were brought about either by the bombardment of a target containing light elements with a beam of fast light atoms or by heating up a small space containing a light element. Now two further methods will be described for the liberation of the neutrons leading to the generation of radioactive bodies. One of these is based on the fact that neutrons can be liberated from certain elements, for instance beryllium, by X-rays.

Figure 5 shows an arrangement suitable for the production of hard X-rays. 1 is the primary of a transformer, the secondary 2 of which is connected to the points 3 and 4. 3 is connected to the cathode 8 of the rectifier tube 5 and to the anode 7 of the rectifier tube 6. Point 4 is connected to the cathode 9 of the rectifier tube 10 and to the anode 11 of the rectifier tube 12. The cathodes 13 and 14 are connected to each other and to the earth. The anodes 15 and 16 are connected to point 17, and this point is connected to the pole 18 of the impulse generator 20, the pole 19 of which is connected to earth. The impulse generator 20 is built of condensers 21, resistances 22 and spark gaps 23.

This impulse generator is adapted to produce intermittant voltage up to 10 million volts, transmitted to the discharge tube 24 through the spark gap 25. 26 is the cathode of the discharge tube, the anode 27 of which is connected to the earth. The fast electrons emerge through the metal window 27 (which is the anode as well) and are hitting a body 28. This body is used as an anticathode and yields hard X-rays with very good efficiency if it is built of Bi, Pb or some other heavy element.

This sheet appears to be from the American application of March 11, 1935, and is probably extraneous to British #7810.

K.W. 3/18/69

It would seem that in addition to the work which is already being done by a number of physicists within the field work of the NDRC, something could be accomplished by those who are not engaged in defense work. This would be done by using an entirelydifferent approach in order to meet the special needs which the situation requires. It is proposed to proceed in the following way. Physicists who are not engaged in defense work are unable to help, however resourceful they might be, if they don't have the basic information which would enable them to critize themselves any suggestion which they might be inclined to make. The first step would therefore be the compilation of a book which would contain such information. To indicate the type of information which is required, we quote the following steps; The speed of submarines on the surface and submerged, the the distance at which submarines can be detected by sound detectors, the cruising range of submarines, the longest time up to which asubmarine can stay away from its base from the point of view of necessary repairs, etc., etc.

Such a book should be made available to any who express their willingness to have it, and should be studied carefully by them with utmost speed. Groups of those who read the book should them meet regularly and discuss any ideas which might be put forward by any member of the group. Such discussion might take place in camps at which the members of this organixation might spend a few weeks and experts from the army and the navy should attend to critize the tentative suggestions which are being put forward.

Only after being acquired the basic information and after having put forward a large number of tentative suggestion and having listened to the criticism of their suggestions will the average physicist be in the position to make suggestions which have a chance of being really useful. If a physicists feels that he has learned enough to be able to rely on his own knowlege he will then be admitted to the advanced group and as a

member of such a group he should be in a position of passing over all suggestions which have been put forward in the past to the army and which the army or navy or the NDRC has rejected. He should be also made acquainted with those suggestions which have not actually been rejected but which are not pursued with vigour at present. If any of the physicists in this advanced group comes to the conclusion that he would be able to make a suggestion of any idea, his own or somebody else's, which is at present not pursued, he should be given the facilities which he requires to work out himself the methods of his choice.

If there is any hope left that war with Russia can be avoided, it lies in the election in 1948 of a President and Congress who are in a position to make an adequate attempt at a settlement with Russia. The isolationist sentiment which is still strong in the Republican party and the Republican party's tendency toward high tariffs and economic nationalism make it appear unlikely that a President elected on the Republican ticket could successfully perform this task. The only remaining hope therefore, seems to be to nominate a strong personality on the Democratic ticket who would make the issue of peace the cornerstone of his campaign, who would take a strong stand against appeasement and give qualified approval for the request of the present administration for additional military appropriations, but would convince the people of his sincere desire for peace and thus would also obtain the support of Henry Wallace for his candidacy.

A very large number of people in this country are by now convinced that the policy of the present Administration will lead to war, and with the increasing awareness of just what that war would mean, there will be an increasing desire to see an adequate attempt at a settlement with Russia before this country is irrevocably committed to war. A strong and sincere candidate nominated on the Democratic ticket, who runs on a peace platform, might therefore get the support of a majority on the basis of the following considerations:

The successful attempt for reaching a settlement with Russia will have to repudiate Truman's policy and will have to start from scratch where we left off at the death of President Roosevelt. It will have to take the position that cooperation with Russia has not failed, rather it has never been really tried. A new approach to Russia will have to be based on strength and generosity. On the other hand the U.S. should not be willing to exercise generosity at other nations' expenses. Generosity at other people's expense is the very essence of appeasement and appeasement will not lead to peace. Nor will it be possible to maintain peace if Czechoslovakia and other democratic countries are transformed into police states.

In a new approach to Russia, we should bear in mind that peace can be established only if we create conditions under which Russia has a strong incentive for continued cooperation with us and the countries in western Europe. It should be possible to create such conditions within the framework of a large scale economic reconstruction of the whole of Europe, American assistance to this reconstruction on a 20 years basis, re-establishment of trade relations between eastern and western Europe at an early date, the settlement of the problem of the international control of atomic energy, not as an isolated issue but within the framework of general disarmament.

The measures of inspection which must necessarily accompany any disarmament agreement will impose on Russia conditions which are difficult for her to accept, for as long as war between the U.S. and Russia is considered probable the iron curtain remains Russia's most important strategic defense. Inspection, being essential we cannot give in on this point; but we could make many concessions to Russia along the lines of general disarmament which would alleviate Russia's fears of being attacked and make inspection acceptable to her.

The strength of the U.S. does not lie in a large standing army or in weapons which may be stockpiled in peace time. The strength of the U.S. lies in her production capacity which, given a unity of purpose, ~~is a guarantee~~ offers the best hope that, in the long run, the U. S. would win ~~the~~ the war; if ~~war should come~~ the peace should not endure.

If the new approach is based not on the assumption that Russia is a potential enemy, but that she is a potential friend, the approach will have a chance of success.

Success is by no means certain of course. However sincerely and wholeheartedly the approach is made, we cannot be sure that it will succeed. If such a wholehearted approach fails, war will remain inevitable. It will be no less terrible than it would otherwise be; but it ~~will~~ would be fought on our side by a country which is united, rather than by a country where a big section of our population opposes the war, and another big section supports it, but does so with a guilty conscience.

The elections this fall will give the country an opportunity to make a new

approach to Russia with a chance of establishing peace. In the meantime requests of the Truman administration for increased military appropriations ought not to be opposed provided they lead in fact to an increase in our military strength. They ought not to be supported however, on the ground that military preparedness will help to avoid war (which it will not), but rather on the ground that the present foreign policy must inevitably lead to war, and that if we cannot avoid war, we would want to win it rather than to lose it.

Norman Thomas

approach of Russia with a chance to establish permanent peace. At the moment Congress ought not to be asked to appropriate military appropriations for increased military administration. The Army and Navy are strength. They opposed provided that less at fact of an increase ~~in~~ two million of men ought not to be supported however, on the ground that military preparedness will plan of navy (which it will not), but rather on the ground that the present foreign policy must inevitably lead to war, and that it we cannot avoid war, we would make of him it rather than to lose it."

not failed , rather it has never been really tried. A new approach to Russia will have to be based on strands and generosity and not on patience and firmness. By generosity we do not mean a generosity at other nation's expense which is the very essence of appeasement and cannot lead to the establishment of peace. A new approach to Russia must be based on the conviction that peace can be established only if we create the conditions and on which Russia has a strong incentive for continued cooperation with us, and the countries in Western Europe. It should be possible to create such conditions within the framework of a large scale economic reconstruction of the whole of Europe, American assistance to this reconstruction on a 20 year basis, re-establishment of trade relations between eastern and western Europe at an early date, the settlement of the problem of the international control of atomic energy, not as an isolated issue but within the framework of general disarmament.

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The strands and security of the U.S. does not rest on a large standing army or on weapons which may be stockpiled in time of peace. The strands and security of the U.S. lies in her war potential which given a unity of purpose, offers reasonable assurance that in case of war the U.S. would not be the loser.

draft

If there is any hope left that war with Russia can be avoided it lies in the election in 1948 of a president and congress who are in a position to make an adequate attempt at a settlement with Russia. Nothing less than the establishment of peace will serve our purpose. The establishment of a mere truce would be of doubtful value.

The isolationist sentiment which is still strong in the Republican Party, and the Republican Party's inclination toward high tariffs and economic nationalism, make it appear unlikely that ny President elected on the Republican Ticket could succeed in the task of establishing peace. The only remaining hope, therefore, seems to lie in the election on the Democratic ticket, of someone who would be equal to this task.

~~With awareness growing in the next few months what~~ as people becoming more aware the real nature and scope of war ~~would be, if war were to be fought in the near future~~ then hangfire between the U.S. and Russia, becoming clearer in the next few months there might be an increasing desire on the part of the general public to see an adequate attempt at a settlement with Russian before this country is irrevocably committed to war, and it might be that the majority of the voters would be responsive to the following considerations:

The polich which has been followed by the Truman administration at Potsdam, and since Potsdam, cannot lead to peace, and because it cannot lead to peace it will lead to war. If the Russians resist our demands, or become aggressive, war may start at an early date. If they yield to our tough attitude on a number of ~~ink~~ territorial issues, war will still come, but it will come later and it will be no less disastrous if it is delayed. If we wish to establish peace rather than a truce, we will have to start from scratch ~~xxxxxx~~ where we left off at the death of Roosevelt. ~~and perhaps even somewhat earlier.~~ We ~~would~~ shall have to take the position that cooperation with Russia has

n

The question of controlling atomic energy on the domestic and on the international scale represents a problem to which there is no single central answer, but we can begin by ruling out proposals which have been made and whcih certainly represent no solution and by doing so we can narrow down the area of useful discussion. The Associated Press reports under Tokyo headline on November 24th the following:

> "American troops wielding sledges, crowbars and cutting torches began today the destruction of five cyclotrons through which Japan worked on the secrets of atomic power.
>
> "By order of General MacArthur, occupation forces started at 10 a. m. (8 p. m. Friday, EST) to wreck a 200-ton American-made cyclotron and a smaller model in the Nishina Laboratory in Tokyo; etc.
>
> "The small machines from Osaka and Kyoto were being dismantled for removal to a clearing where they will be wrecked by explosives and the remnants dumped into the sea. The huge machine at the Nishina laboratory here was being cut into sections which will be loaded on barges and dumped in the pacific."

I know of no clearer way to illustrate a method of control of atomic energy which is sure to fail than by giving you this quotation from the Associated Press report. The control of atomic energy on an international scale along the lines of the press report, a control which is based on a fight against scientific instruments by means of sledges and crowbars, does not appear to be a rational approach to our problem. This does not mean that you may not come to a conclusion to withhold temporarily technical information relating to the scientific and engineering details which concern the manufacture of platonium and other similar f. material, all of which concern the construction of bombs which can be made from these f. materials. You might even decide to withhold certain basic scientific

Security has incontrovertible evidence that his was a case of mistaken identity and that another man named Fred Kelly was ~~in fact~~ a Communist. Incidentally, the missing documents turned up today; they had been misfiled it seems.

Unfortunately, security is unwilling to recommend that the new regulations be revoked. They say it is irrelevant that Kelly has not been framed and blackmailed. The point is that undoubtedly he would have acted just the way he had described it had he been in fact blackmailed. His story reflects ~~only~~ the fears that actually haunted his mind and clearly men who have such large famil~~ites~~ies can more easily be blackmailed than those who have only one or two children.

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Introduction

I am writing to you and a number of other scientists, whose names you will find listed below, in order to propose that we meet in a suitable neutral country and ~~see if it is possible for us to~~ make a serious effort to reach a meeting of the minds on the problem that the existence of the bomb poses to ~~us~~ the world. ~~[illegible]~~

The technical problems of ~~x~~ international control of atomic energy should not ~~be~~ the main topic of our meeting. ~~though we need not necessarily exclude it from our discussion, but there would be little point in discussing such technical questions unless we can first find out~~ And before discussing it, it is to be clarified in our minds just what kind of an overall settlement between Russia, America and the ~~xx~~ other nations it would take to make the elimination of bombs as instruments of war acceptable to these nations.

We would have to make sure

It required originality, imagination, resourcefulness and hard work to create the atomic bomb and it will require these very same things to solve the political problem which the bomb poses to the world. Yet the amount of ~~thinking~~ thought devoted to this problem ~~has so far amounted to~~ is a very small fraction of the amount ~~of thought~~ which went into the creation of the bomb.

Hans Morgenthau wrote in the Bulletin of Atomic Scientists in May 1950 the following lines:"I do not know whether a negotiated settlement with the Soviet Union is possible. I do know, however, that no such attempt at a negotiated settlement has been made; instead we have wasted our time with polemics over isolated secondary issues which must remain insoluble as long as the basic issues remain unsettle. I also know that, in view of the present and foreseeable distribution of power between the United States and the Soviet Union, the choice before the world is between negotiated settlement and war, that is, universal destruction." I finally know that no nation can survive the ordeal of a third world war, if it can survive it at all, without being convinced in its collective conscience that it has done everything humanly possible to preserve peace. It is for these reasons that I deem it worth while and even imperative to consider seriously the possibility of a negotiated settlement with the Soviet Union."

Thus far we may all agree so

~~Many people will agree with him but~~ nobody seems to know just what it is that we should negotiate for, just what kind of a settlement, in just what kind of a setting the problem ~~can~~ with which we are faced be solved. A meeting ~~of~~ scientists is somewhat handicapped to cope with this question even though they ~~are~~ can count on the aid of those who are more versed(expert) in the political field. Yet there ~~is~~ ~~are some strong arguments for~~ that a group of scientists with diverse national backgrounds ~~that~~ ~~might hope to~~ may succeed where other similar groups might fail.

The group of men to whom this letter is addressed are by and large addicted to the truth, to thinking the truth and stating the truth. If in discussing this issue with which we are faced, one of them says something the others need not ask ~~fromxwhatxpremisxx~~ for what purpose this is said, they only have to ask "Is he not mistaken?" If there is disagreement, they don't question eachother's motives and it doesn't take long for them to find out what the differences in the premises are that lead them to different conclusions. It is this inherent respect of these men for eachother and the common language which they speak which gives me hope that a meeting of minds can be reached in such a group.

Sincerely yours
Elmer Knapp
responsible

The following is the text of a personal letter which I intend to send in a short time to a number of American scientists who, because of their achievements, have the respect of the community of scientists far beyond the confines of the United States, and who, moreover, have shown in the past that they are willing to take action outside the narrow field of their profession, if this is demanded by public interest, I believe that these people form a balanced group which is broadly representative of the thinking of scientists in America.

I am taking the unusual course of publishing the text of this letter before it is actually sent ~~to these people~~ out because I feel that if ~~something should come~~ these proposals should lead to action, the public ought to be informed from the very outset. Moreover, before ~~answering the questions I am asking~~ those to whom the letter will be sent may wish to know, before answering it, whether the proposals can command any public support, and the only way to find this out is to let the people know and let them have their say.

This is a far cry from the situation which the United States and Russia will find themselves if they reach a settlement. Such a settlement would have to embrace many nations and once it is agreed upon it could be enforced by collective action against most of the participating nations. It clearly could not be thus enforced either against America or Russia. Clearly there are not enough nations of sufficient independence left in the world whose combined force would be enough to coerce either Russia or America. Neither of these two countries can be coerced short of a world war of indefinite duration and uncertain outcome.

This being the case we must ask ourselves what precisely would be the value of America having an agreement with Russia if the observance of that agreement cannot be enforced. Cleary such an agreement against either of them will remain in force only if it gives both Russia and America security and if it permits them to achieve and to maintain economic prosperity. It will remain in force only if both American and Russia believe it will achieve its objective not only when they put their signatures to it but if they continue to believe this, and, therefore, would wish to maintain the agreement in operation even if they were legally free to abrogate it at any time. If we think about a settlement in these terms then we may as well assume that in the agreement to be concluded both Russia and America may retain the legal right to abrogate the agreement (even though most other nations who are signatories to it might not retain the right to abrogate it). If you make this assumption you would be forced to keep in mind that the only force that can keep the agreement in operation is the desire of American and Russia that it shall continue to operate. We shall also be forced to keep in mind that even if the agreemtn does all that it was supposed to do there is a chance that the agreement may be abrogated if either America or Russia for some reason or other deviates from what might be considered a reasonable course of action, and we will be forced to think through in advance in what position the abrogation will leave the United States from a point of view of defense. Beyond this, however, retention of the right to abrogate might

for it would make it unnecessary to spell out the details of implementation.

of the agreement to achieve this end.—

provide a safety valve ~~and~~ it ~~will~~ be ~~impossible~~ to spell out in the agreement all the details that will enter into its implementation. It ~~will~~ be quite difficult to devise a ~~full~~ system of inspection that ~~for instance~~ will ~~enable~~ the United States ~~to be certain~~ that there are no secret violations of the disarmament clauses of the agreement. On the other hand we may be sure that if Russia wants to convince the United States that there ~~will be~~ in fact no secret violations, she will be able to make arrangements in each case of doubt that may come up that will give America satisfaction. If America retains the right to abrogate, ~~Russia~~ will ~~feel inclined to satisfy~~ the American Government on the score of possible secret violations of ~~armistice arrangements,~~ as long as Russia has strong incentives for keeping the arrangement in force ~~and it will~~ be our job then to propose from time to time modifications of the agreement so as to be sure Russia retains a strong incentive for continued collaboration.

P.T.O

If we think about an agreement in these terms ~~that~~ then it ~~becomes clear that~~ is obvious that negotiating from strength will not help us very much. For our problem is not to ~~devise an agreement that Russia will~~ to draw up a list of demands in our favour and then get Russia to accept an agreement that will incorporate as many of these demands as possible. Our problem is ~~to~~ to devise an agreement

as we see it.

Our problem is not to get Russia to sign an agreement which is very favourable to us but rather to devise ~~an~~ an acceptable agreement which once signed Russia will be eager to keep in force.

~~This is the only point of agreement really worth having and the question is~~

Can such an agreement be devised; ~~which are many~~ my thesis is that ~~it will require~~ it will require the solution of many problems

This letter is addressed to seventeen American scientists to whom it will be communicated two weeks after its appearance in print. Because of their scientific achievement, these men have the respect of the community of scientists which extends beyond the confines of the United States; moreover each one of them has shown in the past that he is willing to take action outside of the narrow field of his profession if this is demanded by the public interest. The names have been selected with a view to obtaining a balanced group which is broadly representative of the thinking of scientists in America.

Insert 2:

This being the case we must ask ourselves what precisely would be the value of having an agreement with Russia if the observance of the agreement cannot be enforced. Clearly an agreement with Russia will remain in operation only if it gives both Russia and America security and if it permits them to achieve and to maintain economic prosperity. Whether or not Russia and America are legally ~~to~~ free to abrogate an agreement ~~will~~, the agreement will remain in operation only as long as Russia and America want to maintain it in operation.

If we think about a settlement in these terms, then we may as well assume that both Russia and America may retain a legal right to abrogate the agreement. At least if we make this assumption we shall be compelled to keep in mind that only the desire of America and Russia to keep the agreement in operation can keep the agreement alive. We shall also be impelled to keep in mind that even if the agreement does all that it was supposed to do there is still a chance that the agreement may be legally terminated by either America or Russia and that, therefore, before entering into the agreement it will be necessary to think through in what position an abrogation by Russia will leave the United States from the point of view of defense.

The retention of the right to abrogate might make it much easier to devise an agreement that will be acceptable to Russia and America for it will make it unnecessary to spell out in advance all the terms of implementation. Indeed, to devise in advance a full-grown system of inspection that, if implemented would convince the United States that there are no secret violations of the disarmament clauses of the agreement or that there are no secret violations in Russia of the disarmament clauses of the agreement, There is little doubt that if Russia wants to convince the United States that there are in fact no secret violations she will in each specific case of doubt be able to make arrangements that would permit America to satisfy herself on the issue. If America retains the right to abrogate, then as long as Russia

has strong incentives for keeping the arrangement in force she will be anxious to convince the American government that the agreement is not secretly violated. America, on the other hand, if she wants the agreement in force, will want to make sure that Russia retains a strong incentive for continued cooperation and may even wish to propose from time to time modifications of the agreement to provide for increased incentives.

As we see it, our problem is not to get Russia to sign an agreement which is very valuable to us, but rather to devise an acceptable agreement which Russia will be eager to keep in force after she has signed it.

Can such an agreement be devised? My thesis is that it will require the solution of many problems.

The subject of the proposed discussion is the issue of peace and the bearing of atomic energy on it. Or more narrowly, what we propose to discuss is whether we can see any avenue along which Russia and the United States could conceivably move towards an arrangement that could permit us to hope that peace would be maintained over a long and indefinite period of time. We propose to discuss what are the difficulties in the way of coming to such an arrangement assuming that both Russia and the American government are responsible and disregarding for the moment the difficulties which arise from theemotional attitudes of the people which might make reasonable action difficult for the governments involved.

In the following the group of scientists who have lived with the problem created by the atom bomb since 1939 are not unanimous in their interpretation of the present war situation. They fall roughly in two groups. Those who believe that Russia is bent on war domination no different from Hitlar-Germany, and that, therefore, the only question which is worth considering is how to win the war when it comes, and those who are not willing to accept this view as a premise of their considerations. Speaking as a respresentative of this second group, I wish to preface this memorandum by a quotation of an article written by Morgenthau in the Bulletin of the Atomic Scientists, "In spite of fully agreeing with the above statement as far as it goes I have to add that I do not believe that an attempt to sit down with the Russians today to "negotiate" a sentiment could lead to a satisfactory article. The reason for this doubt is not that I believe that we are not yet strong enough to negotiate, but rather because our whole political thinking concerning the issue of what is involved in the peace settlement is based on a fallacy. To solve the problem with which we are faced we require imagination andresourcefulness, and it is very unlikely that imaginations could possibly come into play in the course of negotiations between governments."

The decision of the Soviet Union to concur in the reduction of the arms level from stage (1) to stage (4) followed, within a month, the establishment of the regional armed force in Africa. The subsequent reduction of the arms level from stage (4) to stage (7) followed the establishment of regional armed forces in the Middle East, in South-East Asia and in Central America.

When the possibility of setting up regional police forces under the control of various "groups" of nations was first discussed, many people opposed it on the ground that each such region would be likely to become the sphere of influence of one or the other of the great powers. They conceded that an agreement among the great powers on the "groups" in control of the various regional police forces would represent a political settlement, and they acknowledged that in one form or another a political settlement must be reached, but their conscience recoiled from a political settlement based on an agreement on spheres of influence. It turned out, however, that the regions under the control of the various groups of nations were spheres of <u>non-influence</u>, rather than spheres of influence. For instance, Central America was under the control of Uruguay, Canada, Austria and Australia, and this did not place Central America into the sphere of influence of the United States, but it did exclude Central America from the sphere of influence of the Soviet Union. Quite similarly, the Middle East was excluded from the sphere of influence of the United States without falling into the sphere of influence of the Soviet Union.

The drastic reduction of the arms level to stage (7) resulted for many countries in a considerable saving in arms cost. This did not amount to very much in the case of Russia since Russia had based her

defence almost exclusively on long-range rockets, but it was very substantial in the case of America. It has always been taken for granted that when disarmament makes a substantial reduction in arms cost possible there would be a great increase in aid to under-developed countries. What happened was the opposite. Americans felt that, after a long period of stagnation, the time had come to increase the standard of living. There was a substantial reduction in taxes and wages went up. The annual income of the average American family jumped up by about $1500. In the first five years following ratification of the disarmament agreement, Congress failed to appropriate any funds for foreign aid. There was retained a modest point 4 program but it did not amount to very much, because, high school education having steadily deteriorated in America, America was in no position to send a substantial number of engineers and physicians abroad.

Russia had retained the six-day working week but had increased the annual paid vacation to three months and was in the process of trying to extend the vacation period to four months. Russia continued to lend funds to under-developed nations even after the conclusion of the disarmament agreement, but she charged 5% on such loans. Russia also continued to make available to under-developed nations the services of her engineers and physicians, and this was being done on a large scale, but after the conclusion of the disarmament agreement, Russia began to charge for these services, whatever the market would bear.

While the events of decades that followed general disarmament are of great historical interest, they do not come within the scope of this dissertation.

THE END

The solution of these problems will require the kind of imagination and resourcefulness which we can hardly expect to see forthcoming in a negotiation between two governments. In actual negotiations once a point is conceded it is impossible to go back on it and this makes it impossible to make tentative proposals for the purpose of developing a complete picture of the final settlement which has to be corrected or withdrawn later in order to make the adjustments the total picture requires. Realizing this the Emergency Committee of Atomic Scientists made an attempt in the spring of 1950 to establish a Commission of carefully selected American citizens who would organize themselves into a Commission and carry out among theselves the kind of discussion that would lead to devising a settlement which in their opinion ought to be acceptable to both American and Russia and which would provide the incentives that would make continued operation of an agreement likely. The response to this attempt was sympathetic but not overly enthusiastic, and the attempt was abanondened at the outbreak of the Korean war. The memorandum outlining this attempt is enclosed because mamy of the probelems discussed in the memorandum willarise in some future attempt which might be made along similar lines. It was, of course, realized if it were possible to have an informal discussion of problems involved in an over-all settlement which would include both Americans and Russians who have no governmental responsiblities that would, of course, be preferable, Atomic scientists made two attempts in the past to bring about such a discussion. The first of these attempts failed because of the objection of Burns and the second attempt failed because of the refusal by the Russian government. The stories of these two attempts are as follows: In the spring of 1945 when the war was essentially won and before even the bomb had been tested in New Mexico many of us became quite concerned about what appeared to be the likely post-war development in American-Russian relations. We believed that in the long run the existence of the bomb would weaken rather than strengthen their miliatry position and that unless there was a post-

(1)

To many of us who worked on the uranium project in Chicago it became evident in the spring of 1945 that after the war there will arise ~~we should be faced with an exceedingly dangerous international situation. It was clear that we should be faced with~~ a power conflict between American and Russia and that if the statesmen will attempt to deal with this conflict in the same manner in which power conflicts have been handled in the past they will be disastrous before the advent of the atomic bomb, ~~the world~~ ~~it will be impossible to find a solution to the situation which we shall face.~~ to solve the problem with which the world is faced. When we developed the atomic bomb we have opened a new area in which we could foresee that each year that the powerful destruction in the hands of the government will rise to greater and greater heights.

Starting in the spring of 1945 we tried ~~Many of us felt that we had a task to try to make the statesmen both in the United States and Russia try to understand what this change in the character of warfare meant for the world.~~ to make it clear to the statesmen on the real meaning of the advent of the A.B. more than ever before. There had been numerous power conflicts in the past, many of them leading to war in short order, ~~and~~ some of them through skillful handling were resolved without war, only ~~g~~ to give way to another power conflict and ultimately leading to war. The aim of foreign policy in the past was to prolong the peace that is to lengthen the interval between wars, but to us physicists this aim ~~did~~ could not appeal. ~~We could see~~ From our vantage point we could see that ~~Physics has entered a state where it can be foreseen that the next war~~, if it comes, ~~this~~ to war between American and Russia with every year of peace that passes ~~now that~~ war that follows will mean a more and more certain destruction not only of our cities, ~~and our operating institutions~~ but also our way of life, and above all our political institutions to the point where one may ask just precisely what is it that we ~~will~~ shall preserve ~~by going~~ if we go to war ten or fifteen years from now.

2.) with a measure of relief

Because foreign policy of the United States pursued at Potsdam, and condemned under Yalta and Potsdam is so eminently unsatifactory one reads such criticism as is being put forth by Walter Lipman, and George Kennan. If all we have to do is to follow a policy of expedience of Lippman or Kennan stated from time to time it makes better sense than what the State Department does whether under its own volition or under political pressures. But basically what Lippman or Kennan say makes not very much sense either, because we are following a policy of expedience. It is quite true that by following a policy of expedience we could avoid war indefinitely provided it will be possible to do the right things each time when we are faced with a decision, but in the situation with which we are faced even an enlightened power policy will force us from time to time to take calculated risks and sooner or later someone somewhere will make a mistake and we will have war. An enlightened power policy will thus lead to a longer period of peace and the outcome of the war which we will be all the more disastrous whenever it comes. This does not mean that for the next year or two we could do away with the policy of expedience for if peace is to be preserved at all we will need a breathing spell and nothing but an enlightened policy of expedience can bring us such a breathing spell. But if we wish to go further and wish really to have peace not only for a few years but as far as we can tell forever. Our only hope lies in making the American and Russian government to understand where this development of modern physics leads and what the real taks is with which we are faced. Before Russia and American can adopt a policy that makes sense it will be necessary to recognize that our declared present policy is based on a gigantic fallacy. For to think in terms of an oral agreement with Russia to be negotiated if and when we shall be militarily so strong that we can get an agreement on our terms is a dangerous fallacy. It is, of course, true that if two private persons negotiate an agreement it is af great advantage just to be in a very strong position at the

3.)

time when you negotiate for once the other fellow has signed the agreement he will have to preform or you can take him to court. It is a mistake to think of an agreement with Russia and the United States in these terms. If such an agreement is concluded we might just as well have the United States and Russia retain the right to abrogate the agreement at any time, For unless an agreement is such that Russia and the United States wish to keep it even though they have the legal right to abrogate it, the agreement will not be kept. An agreement will be kept only if a situation has been created in which it is clear to the interest of Russia and the United States to maintain an agreement in operation. The first problem which we have to solve then is not to sit down and start negotiating with Russia but rather somehow to find out whether it is possible to think of ~~any~~ an agreement which will fulfill these conditions. This in itself is a difficult problem which will require for its solution imagination and resourcefulness, even if we completely disregard all practical difficulties such as the pre-conceived notions of the government, the actual distrust which exists at present and the political pressures to which the governments are exposed. The task is made particularly difficult because if if ~~the~~ an agreement is dreamed up and accepted by the governments, which offers both nations great incentives for continued cooperation it is not permissable to rule out the possibility of an unreasonable abrogation and, therefore, it will be necessary to be concerned with the situation that we face in the United States in case such an abrogation should occur in a year or two or possibly after ten years after the agreement has been concluded. Because of the advent of atomic energy the agreement will have to be much more far-reaching than it would otherwise have to be. Atomic energy will make it necessary to include in the agreements restrictions which will make it exceedingly difficult for Russia to fulfill and will not be agreed to unless the situation is cleared where they will no longer have the present strong reason for maintaining exclusive secrecy

sense, been generally understood. We need to be clear that there will not be very many great atomic wars for us, nor for our institutions. It is important that there not be one. We need to liberate our own great resources, to meet our destiny.

Even ~~in December, 1942, it appeared likely~~ that atomic bombs would be available within a couple of years, ~~and~~ within a year or two we were ~~not only~~ sure of this fact ~~but we could also see that~~ the destructive power of these bombs ~~would rapidly~~ increase in the coming years, ~~and that it might not take long until a~~ super-bomb would supercede the atomic bomb. Long before Hiroshima, it ~~became~~ clear to those of us who are inclined to look ahead ~~into the future~~ that the existence of these bombs poses a problem which cannot be resolved on the level at which political thinking - even the best political thinking - has moved before the war. ~~My task here would be easier if political thinking after the war had moved at least on the level at which it did before the war.~~

There have been in the past long periods of peace, and by following an enlightened policy it was frequently possible in the past to avoid war. But even the best of foreign policies have never achieved more in the past than to postpone war, i.e. to lengthen the interval of peace between two subsequent wars. ~~And those of us who were concerned about the survival of man found it difficult to get enthusiastic about the best of foreign policies that could do no more than to postpone war when we knew that war would be all the more catastrophic the later it came.~~

But when the survival of man is at stake and when you know that the later war comes the greater will be the catastrophe, you cannot get enthusiastic about foreign policies that may postpone the war. You ask yourself instead, "on what level of political thinking must we seek a solution to the problem which faces the world if, in fact, there is a solution?"

That this problem cannot be solved on the level of political thinking that has moved in the years that followed the war is only too clear. The level of public discussion has reached in these post-war years an all-time low, far below the level even of thinking that went on prior to the war. Because of the confusion generated by this public discussion, the task today is even more difficult than if we had to start from scratch, i.e. start from where we left off before the war. For this public discussion not only disregards the new problem posed by the existence of atomic bombs for which the teachings of history afford us little guidance but it also disregards what we could and should learn from past history.

Yns. I

In the conversation with Dr. Bush I mentioned the following ~~a number of~~ points which in my opinion illustrate shortcomings ~~in~~ of the uranium project and which arise out of certain general principles which characterize the overall conduct of these projects. ~~I mentioned specifically~~ (1) what we thought in January 1942 about the division of authority between Compton and Murphree and how the division of authority worked out in the six months that followed.

(2) What "we" thought about the scanty support given in 1942 to Dr. Wigner's group who attempted to make a design for a water cooled power unit.

(3) What "we" though in July 1942 of the decision ~~handed down~~ to place ~~us of placing~~ a contract with Stone and Webster for building an experimental plant and a pilot plant and to what extent the subsequent events justified our views.

(4) What "we" thought in 1942 about the wisdom of the decisions of the executive committee in general; also what we thought about ~~the~~ one decision communicated to us in September 1942--in particular (this decision ~~which~~ canceled the original plans of building a chemical separation unit near Chicago which was supposed to go into operation in May 1943.)

(5) What we thought about the recommendations of the ad hoc appointed committee which visited our laboratory about Thanksgiving 1942 made with respect to schemes which originated at Chicago. Also what we thought about the recommendation made ~~of such a committee about the same time~~ with respect to schemes which originated in Dr. Urey's laboratory.

Wrauer

(6) What we thought about not building a water cooled pilot plant of about 10,000 to 20,000 kw at the time when the decision was reached to build water cooled production plants of 250,000 kw each.

(7) What we think about the question-answer game and how this game resulted in placing production units ten miles apart at Hanford.

(8) What we think about the shortcomings of our collaboration with du Pont, about the blueprint situation and how it came about that our laboratory is attempting to invent at this late date a method of canning which may give a reasonable assurance of success.

(9) What we thought about the difficulties of obtaining permission to contact other firms than du Pont in connection with certain alternate lines of development which we desired to see pushed at least into the process design stage.

(10) What we thought about the handling of the question of designing a heavy water power unit which kept the Chicago laboratory in commotion from April to August 1943 and mentioned particularly the loss of faith that followed when it was believed that the recommendation of the so-called reviewing committee had been shelved.

(11) What we thought about the shift of authority concerning the design of the heavy water power unit from Wigner to others and the large demands for chemists and engineers which were made in this connection.

(12) What we think about the tendency of running the whole project by means of directives and the danger of suppressing completely certain lines of development which may later suddenly rise to prominence.

(13) I gave Dr. Bush ~~a list~~ of opportunities which ~~were lost~~ were lost ~~and the loss of which can be traced to the way in which~~ due to compartmentalization of information ~~is organized~~ and emphasized the possibility of ~~loss due to~~ overlooking potential possibilities which up to this day remain unrecognized.

Bush

Sir,

Scientists are aware of the danger arising from the use of their discoveries in modern warfare.

The temptation to resort to war would be lessened if each individ al nation knew that territorial changes brought about be force would not be tolerated by therest of the world. Sooner or later means will have to be found to bring about peacefully justifiable changes. In the meantime no nation should be allowed to take the law into its own hands, and every act of aggression should be met by adequate international action.

Japan, by invading Manchuria has taken the law into her own hands. The unanimous verdict of the League of Nations, bore out the generalconviation that Japan, a signatory of the Kellogg Pact, resorted to war in order to settle a conflict, the rights of wrongs of which are irrelevant to the principle concerned.

Other nations have been guilty of similar invasions in the past, but this is no reason for tolerating such acts in the present. At the time when the conflict started, some of us may have hoped for an early change in the attitude of the government of Japan, but there is no evidence till now of such a change, and if the case of Manchuria is allowed to go by without further international action, other nations may be tempted to follow Japan's example.

In order to do what little there lies in our power towards such an action, which calls for sacrifices from all those who participate, we shall for the present refuse all co-operation with Japan. We shall accept no invitations to lecture in Japan. We shallwithhold, if we are free to do so, the copyright of our publications for Japan. We shall refuse to co-operate with students from Japan, as far as university regulations permit, with the possible exception of students whom we know to be free from the spirit that actuates their government.

If other scientists all over the world take similar action it will be possible to consider whether publishers should be approached in order to prevent all periodicales and other publications relating to science and engineering being sent to Japan.

~~We hope that the Japanese scientists will understand our motives, and that we need not emphasize the sympathy we have for the Japanese. We hope that in order to bring about a change in the attitude of their government, Japanese scientists will co-operate by exerting their influence, disregarding, if necessary, difficulties, hardship and even personal safety.~~

We know that scientists in Japan are hindered from freely exerting their influence in favour of a change in the attitude of their government. We hope that they will understand our motives and that we need not emphasize the sympathy we have for the Japanese.

The discoveries of scientists have given weapons to mankind which may destroy our present civilization if we do not succeed in avoiding further wars.

The temptation to resort to war would be less if the individual nations knew for certain that they would be ~~compared~~ compelled by international action to restore the status quo if they attained any of their objects by force. It is obvious that no status can be maintained forever and that soon or later means will have to be found which will permit us to bring about peacefully those changes which will by then have become justified. However, as long as such means are not available only the rigid maintenance of the status quo against attempts at forcible changes can ensure security.

In Japan's conflict with China the scientist is in no position to know the rights or wrongs of either side. However, it is obvious that Japan has taken the law into its own hands, which no nation should be allowed to do. Other nations have been guilty of similar actions in the past, but this is no reason for tolerating such actions in the present or in the future. If in the case of the Japanese-Chinese conflict the status quo is not restored either by the good-will of Japan or by international action, Japan's example may soon be followed by others.

Therefore scientists should give careful consideration to the question as to whether they should join an international action of this kind by resorting to strict non-cooperation. This would involve the refusal to send scientific and technical information, including the periodicals, to the country against which the international action is directed and also the refusal to cooperate with

students of that country.

One must hope, thatscientists in Japan will understand that there is no feeling against them and that they will undertake the difficult and ungrateful task of exerting their influence in favour of Japan's giving up any attempt at taking the law into its own hands.

The second attempt to bring about a meeting of American and Russian scientists was made by the Emergency Committee of Atomic Scientists in 1947, a short time before the communists took over Czechoslovakia. The Emergency Committee proposed to invite American, English, and French scientists on the one hand, Russian, Czech, and Polish scientists on the other, to a meeting to be held in Jamaica, British West Indies. The meeting was to be devoted to discussing what political conditions would have to be met before international control of Atomic Energy, with adequate safeguards, could be expected to be acceptable to the governments involved.

This time it was decided not to ask for the State Department's consent ~~in advance~~ at the outset, but rather to keep the State Department merely informed of all the steps taken and to seek its consent only after the consent of the Russian government had been obtained. Accordingly, Dr. Harrison Brown, acting as executive vice-chairman of the Emergency Committee, had two personal interviews with Andrei Gromyko (who was at that time Russia's representative in the Security Council). Dr. Skobelsyn was with Gromyko on both of these occasions. Since it was felt that Dr. Brown should not go alone, he was accompanied ~~at~~ on the first ~~meeting~~ occasion by Mr. Beardsley Ruml (at that time chairman of the board of R. H. Macy and Co, New York) and on the second occasion by Fowler Hamilton, ~~(of the law firm~~ a corporation (Cleary, Gottlieb, Friendly & Cox New York.)

In the first interview, Gromyko informed Dr. Brown that he would have to transmit the proposal to Moscow and in the second interview, which took place at Gromyko's suggestion, he informed Dr. Brown that the proposal had been turned down. It might very well be that at the second interview, even while he transmitted the rejection of the proposal, Gromyko knew in his heart that a mistake had been made.

You may be inclined to think that Russia and America are moving toward a third world

Fowler Hamilton
(Cleary, Gottlieb, Friendly and Cox

war in a predestined course and that nothing that anyone of us can do is likely to deflect them from this course, ~~We ta[illegible]~~ but ~~that is no reason why any one of us should not do whatever lies in his power to try to avert the impending clash.~~ It would be wrong to give up hope until such time as bombs begin to fall, and perhaps we should not give up hope even then. And if it comes to the worst, let each one of use have at least such satisfaction as we may get from the knowledge that we have done our utmost to prevent it.

Clearly, private initiative in inter-national relations is long overdue. Unfortunately private initiative will often come late, because to take action is not the responsibility of anyone in particular.

In this instance, the responsibility would seem to rest in the first place with the public; for unless some friendly voices are raised in response to the publication of this letter, it will be very difficult for us to proceed with the plan here presented.

Ever since October of last year scientists had been going discussed, behind closed doors, whether America should or should not attempt to develop hydrogen bombs. Soon after the Atomic Energy Commission put the issue up to the White House, the "news" began to leak to the press. The scientists, not wishing to embarrass the Administration at a time when it had to arrive at a difficult decision, exercised great restraint, and with one single exception no scientist of standing made any comment in public until the President had made his announcement. In retrospect, this self-imposed silence might appear to have been a mistake, but at least it goes to show that if some scientists speak up now, it is not for lack of restraint that they do so. ~~The scientists who speak up now do so because they~~ Rather because they believe that it is important for the public to know the nature of the adventure upon which we are embarking in ~~when we~~ attempt to develop hydrogen bombs.

The obvious raw material for a hydrogen bomb is heavy hydrogen, which is the only naturally-occurring light element that ~~may~~ might be expected ~~to~~ cause burn in the fire of a nuclear explosion.

~~INSERT~~ 1 A

That heavy hydrogen might conceivably be not detonated if a sufficiently large quantity of it is suddenly heated up to a sufficiently high temperature is ~~ob-vious.~~ evident. But whether this can in fact be achieved, and achieved with the means that are at our disposal, is not known.

This was the state of affairs at the time the news broke upon the world that the United States was seriously considering developing hydrogen bombs. To physicists all over the world this news could have but one meaning, i.e., that responsible American physicisits now consider it likely that heavy hydrogen can in fact be detonated.

Is it possible to start a thermo-nuclear reaction in heavy hydrogen which once initiated would spread and so that on the principle — the unlimited amount of heavy hydrogen could be detonated or any one single explosion? —

INSERT

16

That heavy hydrogen might be detonated if a sufficiently large quantity is suddenly heated up to a sufficiently high temperature is abvious. But whether this can in fact be achieved with the means that at present are at our disposal is not known. ~~Physicists all over the world will take the President's decision to order the development of hydrogen bombs to mean that responsible American physicists consider it likely that heavy hydrgoen can in fact be detonated.~~

It ~~is of course possible the~~ the attempt to develop a hydrogen bomb will prove abortive and that with the means at our disposal ~~we shll~~ not ~~be~~ ~~able~~ to detonate heavy hydrogen. It might still be possible, of coure, to burn limited quantities of hydrgown in a nuclear explosion, thus obtaining bombs which are more powerful than ordinary atomic bombs. But since every nuclear explosion involves certain quantities of materials which are very expensive, to procure, the burning of ~~strictly~~ limited quantities of heavy hydrogen in such a nuclear explosion ~~will not revolutionize warfare~~. Such abortive hydrogen bombs might perhaps be of some military value beyond and above ordinary A bombs, but they would probably be used just like ordinary bombs, ~~which are~~ used primarily for destruction based on blast effect, or their ability to set fires and inflict injuries through the direct effect of the radiating heat which is generated in the moment of explosion. ~~They will not deserve to be called super bom~~

They might be very big bombs but ~~the~~ they should not be called super bombs. ~~I~~ This we must leave for bombs in which we might be able to burn ~~[illegible]~~ heavy hydrogen ~~not~~ in quantities

can be burned in a nuclear explosion. If this were the case it would still be possible to ~~tak~~ talk of hydrogen bombs, but the term would be used in ~~the~~ a meaning in which it would represent little more than a curiosity. It would at best represent a weapon which is, dollar-for-dollar, perhaps more destructive than an ordinary atomic bomb, but it would not be a weapon which is of an entirely different order of magnitude than ordinary atomic bombs, and its mode of application would therefore necessarily be the same as for atomic bombs. The mode of application of the ordinary atomic bomb is based on the destruction which it causes by its blast, or the injuries it inflicts by causing flash burns, and the damage which it causes by setting fires through the direct effect of the heat radiation which is generated in the moment of explosion.

Super bombs might be used in a very different manner, namely, for the purposes of radio active warfare. That super bombs might be used for such warfare rather than for the blasting of cities was disclosed for the first time three years ago. and It was disclosed by no less an authority than Professor Edward Teller in an article which has been cleared for publication by the AEC, and which appeared in the BAS, pages 35-36, Vol ~~III~~ 3, (February) 1947. Dr. Teller wrote: "

"In a subject ~~as~~ as new as atomic power we must be prepared for startling developments. It has been repeatedly stated that future bombs may easily surpas those used in the last war be a factor of a thousand. I share this belief. . . .

. . . "The radioactivity produced by the Bikini bombs was detected within about one week in the United States. In the meantime the westerly winds had swept the air mass from Bikini to this country. . .

. . . "If the activity liberated at Bikini were multiplied by a factor of a hundred thousand or a million, and if it were to be released off our Pacific Coast, the whole of the United States would be endangered. That the enormous amounts of activity just mentioned can in actuality be released at some future date is by no means an established fact; but it is much more than a fantastic

possibility. If such great quantities of activity should become available, an enemy could make life hard of even impossible for us without delivering a single bomb into our territory."

The possibility of making bombs 1000 times as powerful as those used in the last war was first mentioned in January, 1946, by John J. McCloy, previously Assistant Secretary of War, and at present U.S. Commissioner in Germany. In a speech which has been frequently quoted, John J. McCloy mentioned the possibility of such giant bombs, and identified them as hydrogen bombs. Thus, even though Dr. Teller himself did not use the term hydrogen bomb, it must have been obvious to every physicist who read Dr. Teller's article that he was talking about hydrogen bombs. No strongly radio active elements are projected from heavy hydrogen when it is detonated, but large quantitites of neutrons would be liberated at the moment of explosion, and many of the 92 natural elements become radio active when they absorb neutrons. Thus it is obvious that a hydrogen bomb can be rigged for the production of intense radio activity by incorporating into it some suitable natural element that will catch a substantial fraction of the neutrons that are emitted when the hydrogen bomb is detonated. Dr. Teller wrote:

"It is to be noted that different radioactive products have different rates of decay. The attacker is therefore in a position to choose the radio active products best suited to his work attack; with the proper choice he could ensure that his victim would be seriously damaged by the, and that they would have decayed by the time they reached his own country. Naturally this is not easy, but under the circumstances, within the realm of possibility."

The President's decision to go forward with the development of H-bombs was generally interpreted to mean that our experts believe there is a better than even chance that such bombs can in fact be built. If it becomes possible to detonate heavy hudrogen by suddenly heating sufficiently ~~high~~ large amounts to a sufficiently high temperature so as to set up a self-propagating thermal nuclear reaction, then the amount of heavy hydrogen which can be detonated in any one single bomb will be unlimited in principle and will be limited only be considerations of expediency. If the bombs have to be delivered by air to targets in enemy territory, ~~and~~ there exists, of course, a limit to their size. But to the application which I propose to discuss here, it is not necessary to transport the bombs and in that case the bombs can be made very large. The number of bombs which we can make will still remain limited as has been discussed by H. Thiering in 1946 as the bombs must have a detonator and the number of detonators which we can build is limited by the amount of U235 or plutonium that is available. Because a large number of neutrons is liberated when heavy hydrogen is detonated, it is possible to produce large quantities of radio-active substances when the bomb is detonated. Many of the natural elements are transformed into a radio-active element if they absorb neutrons and by incorporating such a natural element into the h-bomb, the h-bomb may be rigged so as to produce a radio-active element when it is detonated. Among the natural elements there is a wide choice which may be used, depending on whether we want to produce a radio-active element that lives for a few days or one which lives for a few years. If a number of bombs rigged to produce a radio active element which has a lifetime of a few years were detonated in the United States, the radio-active substances produced in the explosive would gradually be dispursed first over the whole northern hemisphere and later over the whole globe, and would settle down as a dust covering fairly uniformly the surface of the globe. The question which we wish to raise is the following: could the United States ~~actually~~ accumulate say in the course of the next ten or fifteen years enough of these bombs and have them large enough to produce a sufficient amount of radio-activity ~~among~~

when the bombs were detonated to kill everyone on the Northern Hemisphere and possibly all over the whole globe. And if this could be done, could the United States become invincible by letting the world know that rather than to suffer invasion or bombardment of her cieies by Russia, the United States would, if necessary, detonate her bombs and kill the whole population of Russia as well as her own population. If this were done, the United States would, in fact, be invincible, provided only that she succeeds in persuading others that her threat in fact would be carried out.

The initial investment required for such a defense would be substantial, but once made, no appreciable defense expenditures need to be incurred. From the financial point of view, if our defense expenditure should sky-rocket in the next ten years from 15 to 25 or 35 or even 45 billion dollars, the adoption of a policy of defense based on suicide bombs would bring relief rather than an additional burden.

In an article which has been cleared for publication by the Atomic Energy Commission and which appeared in the Bulletin of the Atomic Scientists, pages 35-36, Vol. 3 (February) 1947, Dr. Teller wrote: . . .

"In a subject as new as atomic power we must be prepared for startling developments. It has been repeatedly stated that future bombs may easily surpass those used in the last war by a factor of a thousand. I share this belief. . .

". . .The radioactivity produced by the Bikini bombs was detected within about one week in the United States. In the meantime the westerly winds had swept the air mass from Bikini to this country. . .

". . .If the activity liberated at Bikini were multiplied by a factor of a hundred thousand or a million, and if it were to be released off our Pacific Coast, the whole of the United States would be endangered. That the enormous amounts of activity just mentioned can in actuality be released at some future date is by no means an established fact; but it is much more than a fantastic possibility. If such great quantities of activity should become available, an enemy could make life hard or even impossible for us without delivering a single bomb into our territory."

FINAL REPORT - ROUGH DRAFT

In the presence of 150 mg/l of theophylline the mutation rate of the strain B/lt is about 11 per 10^8 bacteria per hour. This rate is reduced to about half if we have present the following concentrations of the three above mentioned antimutigents:

Adenosine 0.4 mg/l
Guanosine 2.0 mg/l
Inosine 2.0 mg/l

In order to suppress the spontaneous mutations it seems to take a higher concentration of the antimutigents. For the strain B/lt it takes about 10 to 20 mg/l of Guanosine to reduce the spontaneous mutation rate to T5 resistance to about half, and even higher concentrations of Guanosine the mutation rate does not go to zero but drops only to about one-third of its value.

Another mutent of the B strain which is resistent to the value of T_1 and which requires tryptophane was obtained from a radiation resistent mutent of the B strain kindly furnished to us by E. Witkin. When grown in the chemistrat in a minimal lactate medium for tryptophane as the controlling growth factor this strain showed a spontaneous mutation rate to T_5 which was about three times as high as the mutation of our B/lt strain. It is a rate of 4.22 per 10^8 bacterial per hour. The mutation rate to T_6 resistence was also about three fold and had a value close to 1 per 10^8 bacteria per hour. 150 mg of theophylline per litter increased the mutation rate to T_5 resistance to a value of about 21 per 10^8 bacterial per hour which is about twice as much as one would obtain for our strain of B/lt. The rate of T_6 resistence was about 2 per 10^8 bacteria per hour.

50 mg of Adenosine reduces the spontaneous mutation rate to T_5 resistance to 1.2 per 10^8 bacteria per hour, or about one-third. Concentrations of 5 mg/l of Adenosine or less did not seem to have an appreciative affect on the spontaneous mutation rate to T_5 resistance.

In the presence of 150 mg/l of theophylline 10 mg/l of Adenosine completely ~~controacts~~ counteracts the mutagenic affect of theophylline ~~and the observed mutation rate is below~~ the spontaneous mutation rate. ~~The~~ The value actually ~~obtained~~ observed was 1.4 per 10^8 bacteria per hour, which is below. When grown in ~~simple~~ synthetic medium containing both lectate and glucose aerobically the mutation rate to T_5 resistence was 4.2 per 10^8 bacteria per hour. ~~It~~ This is the same as in the lectate medium which ~~did~~ does not contain glucose. But when grown anaerobically the spontaneous rate to T_5 resistance was ~~so low that its value could not be determined with any degree of certainty.~~ not appreciably different from zero.

When B/lt ~~was~~ is grown in the presence of 150 mg/l of theophylline (resistance) in ~~the~~ synthetic medium containing both glucose and lectate, the mutation rate to T_5 resistance ~~was~~ is about 14 when grown aerobically but ~~the mutation rate to T_5 resistance fell to~~ seems to have a very low value (i.e. less than ~~one~~ 1 per 10^8 bacteria per hour) when grown anaerobically. The same result was obtained for an aerobic growth of the strain B/r/lt in the presence of 150 mg/l of theophylline which gave mutation rate to T_5 resistance of about 1.

2

50 mg of Adenosine reduces the spontaneous mutation rate to T_5 resistance to 1.2 per 10^8 bacteria per hour, or to about one-third.

In the presence of 150 mg/l of theophylline 10 mg/l of Adenosine completely counteracts the mutagenic effect of theophylline. The value actually observed was 1.4 per 10^8 bacteria per hour which is below the spontaneous mutation rate.

When grown in synthetic medium containing both lactate and glucose aerobically the mutation rate to T_5 resistance ~~was~~ is 4.2 per 10^8 bacteria per hour. This is the same as in the lactate medium which does not contain glucose. But when grown anaerobically the spontaneous rate to T_5 resistance was not appreciably different from zero.

When grown anareobically in the presence of 150 mg/l of theophylline in synthetic medium containing both glucose and lactate the mutation rate to T_5 resistance is again very low and has a value of about 1.

Phase A

We might now summarize our results obtained on the mutation rate to T_5 resistance with the strains B/lt and B/r/lt when grown in the chemostat in simple nutrient medium with stryptophane as a controlling growth factor at generation times of 2 hours or longer. These two strains differ in mutation rate to T_5 resistance from each other by a factor of about 3 but they are similar ~~in this respect. In~~ in as much as as in both 2/3 of the mutation rate to T_5 resistance can be suppressed by the presence of 50 mg/l of Adenosine and in both strains the mutation rate to T_5 resistance is about 5 times as high as the mutation rate to T_6 resistance. In both strains the mutation rate to T_5 resistance responds strongly to theophylline which is a Purine type mutagen and this effect of theophylline is in both strains fully counteracted by 10 mg/l of Adenosine. In these circumstances it is possible to assume that 2/3 of the spontaneous mutation rate of T_5 resistance might be caused by a Purine type mutagen. Anaerobic growth suppresses both the spontaneous mutation rate to T_5 resistance and the theophylline induced mutation rate to T_5 resistance. Independence of the spontaneous mutation rate to T_5 resistance and to T_6 resistance has been well established for the strain B/lt for generation times ranging from two hours to 8 hours.

EXPERIMENTS CARRIED ON BY DR. MAUREY FOX

B/lt was grown in continuous culture in the absence of any controlling growth factor under conditions in which the turbidity of the culture controls the feeding of fresh nutrient. We shall refer to the apparatus in which bacteria are grown under such conditions as a "breeder". B/lt when grown in a "breeder" in broth has a mutation rate to T_5 resistance of about 3.7 per 10^8 bacteria per hour and a mutation rate to T_6 resistance of about 1.8 per 10^8 bacteria per hour. Compared to the values obtained in the chemostat with tryptophane as a controlling growth factor in the simple lactate medium the mutation rate to T_5 resistance is increased more than twofold and the mutation rate of T_6 resistance is increased about sixfold.

Since the Purine type mutagens increase the mutation rate of T_5 resistance much more than they do the mutation rate to T_6 resistance, the result cannot be explained by assuming that the bacteria grown in broth are affected by Purine type mutagen. Some other mutagenic agent or some unknown physiological condition must be responsible for these high mutation rates to T_6 resistance.

The presence of 150 mg/l of theophylline has no affect on the mutation rate to T_5 resistance ~~and on the mutation rate to T_6 resistance~~ when B/lt grows in the "breeder" in broth and it might be that there is enough of Purine type antimutagen present either in the broth or in the bacteria growing in broth to counteract the mutagenic action of theophylline. The high mutation rate to T_6 resistance observed is apparently not due to peroxides or other products of aerobic metabolism since it is found that B/lt when grown anaerobically in broth supplemented with glucose in a "breeder" has a mutation rate of about 2.3 to T_6 resistance. The high mutation rates to both T_5 resistance and T_6 resistance observed with bacteria grown in broth in the "breeder" might either be due directly to some of the amino acids Purines Pirimidines, vitamins, or other constituents of the broth or else ~~it~~ they might be due

to the fast growth rate or else it might appear as a direct result of the fast growth rate in broth. In order to distinguish between these two possibilities B/lt was grown at different generation times ranging from 32 minutes to 46 hours. Both in breeders and in tryptophane controlled chemostats in casein hydrolysate to which was added tryptophane.

Fox

The experiments are consistant with the following picture:

When we grow B/lt in the chemostat in minimum medium with tryphophane control the T5 rate is 1.5 and the T6 rate is 0.3. About 2/3 of the T5 rate can be suppressed by 50 m_g of adenosine. 150 m_g/l of recrystallized theophylline will raise the T5 rate to about 14. This effect can be completely eliminated by adding about 2 m_g/l of adenosine to the medium. We shall tentatively assume that that part of the T5 rate which can be suppressed by 50 m_g/l adenosine might be due to a purine type mutagen. It amounts to about $1/10^8$ bacteria/hour. The T6 rate is only raised to 1 for 150 m_g/l theophylline. If we now grow B/lt in the breeder in nutrient broth, we find a mutatien rate to T5 resistance of about 3.7, and to T6 resistance of about 1.8. The ratio of the T5 to T6 rate is very much higher when grown in these conditions and therefore we have to assume that some other mutagenic agent or condition is responsible. The T5 rate is higher by a factor of 2.5 while the T6 rate is higher by a factor of 6.0. If the increase in the T5 rate were due to the presence of some purine type mutagen, we would have to expect the T5 to T6 ratio to fall rather than rise since the T6 rate has heretofore been less responsive to the purine type mutagens than the T5 rate.

150 m_g/l of theophylline has no effect on either the T5 rate or the T6 rate for B/lt grown in the breeder in broth and it might be that there is enough antimutagen present in the broth or in the bacteria grown in broth to counteract the effect of the theophylline added to the broth. There might not be enough antimutagen present though to suppress that part of the minimal chemostat occurring spontaneous mutations to T5 resistance that occur in broth.

When grown anaerobically in broth supplemented with glucose the T6 rate was about 2.3 so that we may conclude that the high T6 rate in broth is not due to peroxides or other oxidative metabolic products.

In order to see whether the high mutation rates in broth are due to the fast growth rate or rather directly to the chemical composition of the medium, experiments were done in breeders and tryptophane controlled chemostats in casein hydrolysate to which added tryphophane, vitamins, purines, pyrimidines, glucose, lactate and phosphate between generation times of 32 minutes and 4.6 hours. The T5 rate for the shortest generation time was about 3.8 falling with increasing generation to about 3.0 for τ = 280 minutes. The T6 rate for short generation times starts at about 2.0 and fall to about 1.0 at τ = 100 minutes and remains at 1 up to generation times to 280 minutes.

150 mg/l recrystallized theophylline (no glucose or lactate) for generation times between 40 and 50 minutes raise the T5 rate to about 8.4 (by about 5 units). The contrasts with the broth experiments in which the theophylline had no effect and with experiments in minimal medium in the chemostat where this theophylline raises the T5 mutation rate from 1.5 to 14.

Grown anaerobically in the presence of 50 mg/l adenosine the T6 rate is unchanged averaging 2.4 (data) where the T5 rate is reduced to an average of about 2. This reduction of the T5 rate can be interpreted as the elimination of that part of the T5 rate which responds to antimutagens and the remainder is then clearly not due to peroxides just as the T6 rate cannot attribute to peroxides.

S. Szilard

September 21, 1945

Because of the absence of a considerable number of members of the group, the next meeting will be held on Tuesday, September 25, at 7:45 p.m. in Room 209 (instead of Friday, September 21). Enclosed is a plan of organization submitted by the organizational committee and approved at the last meeting, a draft of the declaration which was adopted by the same meeting as a basis for discussion of a common release with the groups on the other sites, and a statement of intent issued by the group at X.

In accordance with the decisions taken at the last meeting, the agenda of the meeting on Tuesday, September 25, will include two points:

(1) Constitution of the organization to be known temporarily as "Atomic Scientists of Chicago" and election of temporary officers.

(2) Further discussion of the declaration to be released.

It is suggested in the proposals of the organizational committee that all scientific workers who participated in the preliminary meetings in the last two months will be considered for the purpose of the first organization as members of the temporary council. This is a temporary arrangement and the final decisions concerning the statutes of the organization and election of permanent officers will be left to all members who have joined the organization after it has been constituted.

Szilard draft
for met. lab

The development and use of the atomic bomb has created a situation filled with much uncertainty for our nation and for the world. Only a full understanding of the new situation will enable the citizens of this country to solve intelligently the problems created by the unleashing of atomic power. If a wrong course is taken, it could mean the destruction of our cities, death for millions of our people, and the possible end of our nation. To try and map out what course should be taken many people have been seeking information, and asking questions. The following are some of the basic questions which have been asked, and the answers that a large group of scientists who were active in the development of the atomic bomb have prepared.

"Does the atomic bomb really change the situation?" The tremendous destructive power of the first atomic bombs was dramatically revealed in the demolition of Hiroshima and Nagasaki. It is reasonable to expect that bombs of even greater destructiveness will be available in the near future. Aviation and rocket developments may make possible destruction of the principal cities, essential industry and military strength of any nation within a few hours or even minutes. A city may be demolished by a single inconspicuous mine, planted in advance. Such destructive power fundamentally changes the situation existing before the advent of the atomic bomb.

"Can't we expect that a defense will be found?" Scientists can see no hope of adequate defense against the atomic bomb. The only conceivable defense is not against the bomb itself, but against the carrier. Complete protection against all planes or rockets, which come without warning from any direction including the stratosphere, is more than can be expected from radar or any other foreseeable weapon. Furthermore, it is impossible to anticipate all the kinds of carriers or projectiles which might be used. Because the first attack with atomic bombs might be decisive, no opportunity to perfect a defense may be expected.

"Can't we just keep the secret?" Since the bomb resulted from a relatively simple physical idea Perhaps the greatest secret in connection with the atomic bomb was the fact that it was possible successfully to develop it. The War Department, by releasing the Smyth Report, has made public much information ~~and particularly made public~~ including the most essential secrets, i.e., it has described along what roads the development has to move in order to reach the goal. Once this is known any group which is determined to produce atomic bombs can follow any one of the roads indicated by the War Department's release and will then, step by step, rediscover what we have discovered and obtain the results which we have obtained. If all the information available were made public it would make it somewhat easier for other countries to follow in our footsteps. They would gain, however, months rather than years. ~~Even if we sent them the blueprints of our industrial processes we would not help them much since it is more likely than not that they would wish to improve upon processes and construction which we used rather than follow these outdated patterns.~~ To suppose that without access to our

blueprints scientists and engineers in other countries will require more than a few years to develop one of the several processes which we have successfully used would be ~~foolhardy.~~ a serious mistake.

If we have any real secrets these consist in basic scientific information which has no bearing on the atomic bombs which are at present available but which would indicate along what roads to travel if we wish to carry the development beyond the stage which we have so far reached. The information released by the War Department gives other countries information which carries them beyond the position in which we found ourselves in the late fall of 1942. It took us from then on three years to achieve the transfer from the laboratory to the battlefield. As far as knowledge is concerned, other countries which have access to uranium and which have a fraction of the technically trained personnel employed by the United States in this work should be able to produce atomic bombs, if they are determined to do so, within two to five years.

"Can the United States control the raw materials?" The world wide distribution of uranium ores makes it unlikely that the United States alone or jointly with the British Empire could monopolize this commodity. Apart from the deposits in the Belgian Congo, Canada, and the United States, there are deposits in Czechoslovakia ~~which yielded 20 tons of uranium per year before the war and which probably could yield 40 tons per year if they were more energetically exploited.~~ The Czechoslovakian deposits may not be very significant, but it would be foolhardy to assume that, for instance, upon the vast territory which is controlled by Russia

in Europe and in Asia there could not be found uranium deposits once prospecting is carried out with such an extraordinary high premium on finding uranium.

"Would we be vulnerable to atomic bombs?" Vulnerability to atomic bombs is greatest in industrial nations with large metropolitan centers. We are such a nation. In the not too distant future other nations might possess a few hundred atomic bombs which would be sufficient to annihilate in a few minutes 60% of our industrial resources, paralyze 90% of our productive capacity and destroy one third of our entire population. (These figures are based on the part of our population and national economy which are concentrated in 30 metropolitan centers.)

"Will more and better bombs protect our security?" We cannot rely on more and better bombs for more than a few years. After this time other nations could have enough bombs to cause tremendous destruction in the United States. Once each nation is armed with sufficient bombs to destroy the cities of other nations, the accumulation of more bombs is not of much avail. An attack by ~~stratosphere~~ rockets, or by mines planted in advance in our cities, could be anonymous and we would not know against whom to retaliate.

An armaments race in atomic weapons may well become the greatest single cause of a future war. The fear created in such a situation would imperil peace, and could lead to a war that no country wants in times of international stress.

Kohrmann

Rabinowitch

Goldsmith

Jaffey

Simpson

Nichols

Hull

Wie

Friedman

Feinberg

Hartley

Perlman (Manning)

Bruce

Fitch

Moon

Mayer

Robinson

Hall

There are those who believe that the solution lies in setting up, almost as a first step, a world government, limited to a narrow area, i.e., the area of security ~~mf~~ or police functions. Others are inclined to believe that a world government, in order to be able to command the loyalty of people and have appreciable stability, must, from the start, concern itself with the welfare of the people, to whom its power extends. Those who believe this may take the view that a considerable shift in the loyalty of people is a prerequisite for a stable world government, and that such a shift of loyalty cannot be brought about in a shorter time than perhaps one generation, i.e., about 25 years. If we allowed that much time for such a transformation, we could bring about a considerable shift of loyalty, giving our children the adequate education. Education is, however, only one of the factors that affect the loyalties of people and also it would seem safer not to wait two or three decades before bringing about a considerable shift of loyalties. If, starting soon, we could establish from year to year new international institutions which would more and more affect our lives and, affecting our lives, modify our loyalties, we could, perhaps, reach more safely the state of a genuine and stable world government in one genration. Even though the new institutions may go into operation, one after the other, so that we approach, step by step, a world community, over an extended period of time, that need not necessarily mean that their creation has to be decided upon more or less haphazardly, step by step, Clearly it would be much better to have the whole pattern carefully thought out in advance and have the several nations agree to begin with to a fixed schedule for the establishment of these institutions. Only in the light of new experience and by practically unanimous consent of the several nations need deviations from this schedule be adopted.

If a carefully worked out plan could be adopted by several nations, within the next few years, and if the plan provided for a fixed schedule for the transition period, people would know at all times what to expect and as long as that is the case, it would probably not matter very much whether the total time of transformation were fixed at a longer or a shorter period. What matters is that world government should appear as inevitable to most men as war appears to many as inevitable as present.

Clearly, the crucial point in this transition will be reached when a world government in fact exists in the area of security or police functions. When that point is reached, the right to abrogate might cease and cessation would become both illegal and, impossible, in fact. Opinions may differ just how early or late this point should be scheduled to come during the period of transformation.

The discussion of such a long range program would go beyond the scope of this chapter. The need for it was mentioned because the author doubts that the danger of an arms race can be successfully averted unless the problem of creating a breathing spell and the problem of establishing a world community that is the short range and the long range programs will be attacked simultaneously, for, if we wish to avert an arms race, we will have to give up our own of atomic bombs and scrap our own manufacturing facilities before we have a full proof peace system. We shall have to take risks and we shall have to derive the courage to take risks from the conviction that we have embarked on the solution of the problem of permanent peace.

Arland drop
for Met Lab

It is the consensus of this group that it would be highly desirable, in order to provide the best basis for working out a durable peace, to have no atomic bombs available in the United States or any other country. We believe that the production of atomic bombs in the United States ought to be stoped if and when we can reach an agreement with the other countries concerned which ~~offer~~ would offer us a reasonable guarantee that no move towards the manufacture of atomic bombs will be made so long as the agreement remains in force, and that any attempted violation would be detected and become known to the world.

It is further the consensus of the group that such an agreement should authorize the agents of an international authority to supervise or inspect all relevant mining operations, to inspect all industrial installations which use uranium, and to exercise surveillance at other relevant key points.

The agreement should provide a fixed schedule for the establishment of supervision by the International Agency, the disposal of existing stockpiles, and the dismantling of existing installations for the production of atomic explosives.

Large scale atomic power installations shall be permitted but with certain restrictions. The purpose of these restrictions is to make it impossible to achieve production of bombs from these installations within less than a six months period of conversion. Small scale installations, sufficient for the production of radioactive materials for scientific,

medical, and industrial uses will not be affected by these restrictions.

An integral part of the proposed agreement would be the removal of all secrecy regulations so far as they concern activities relating to atomic energy. It would be highly desirable that this agreement should create conditions under which the scientists and engineers shall be free to disclose violations of the agreement to an international authority and that those who do so should be guaranteed immunity by being automatically removed from the jurisdiction of their respective national governments.

Staley

It is the consensus of this group that it would be highly desirable, in order to provide the best basis for working out a durable peace, to have no atomic bombs available in the United States or any other country. We believe that the production of atomic bombs in the United States ought to be stopped if and when we can reach an agreement with the other countries concerned which would offer us a reasonable guarantee that no move towards the manufacture of atomic bombs will be made so long as the agreement remains in force, and that any attempted violation would be detected and become known to the world.

It is further the consensus of the group that we ought to accept, as a first step, an agreement that would authorize the agents of an International Authority, to be set up under the United Nations organization, to supervise or inspect all relevant mining operations, to inspect all industrial installations which use uranium, and to excercise surveillance at other relevant key points.

The agreement should provide a fixed schedule for the establishment of supervision by the International Agency, the disposal of existing stockpiles, and the dismantling of existing installations for the production of atomic explosives.

An integral part of the proposed agreement would be the removal of all secrecy regulations so far as they concern activities relating to atomic energy. This agreement should also provide for cooperative efforts in the field of atomic research and development, under the auspices of the International Agency, such as an international survey of and prospecting for uranium ores, the establishment of an

International Institute for Nuclear Studies, international congresses, and other means adapted to promoting the growth of mutual confidence and to strengthening international cooperation.

It was suggested that the Government of the United States should make it clear at an early date that it already has an obligation to refrain from using armed force except in accordance with the United Nations charter and that this obligation applies to atomic bombs.

Stokes
Necht
Lherms
Stils
~~Wallace~~
Warschak
Friedman
Wirth
Wolfsen
Gundrich
Lindbergh
Condon
Rabinowitsch
Sailord

Lindbergh
~~Hutchins~~

Langmuir
Merriam
Hutchins
Rosenman
Klein

the overwhelming majority of this
group

In order to obtain an accurate value for it is necessary to use an arrangement in which a large fraction of the neutrons emitted by the source but absorbed as thermal neutron by uranium. In order to achieve this a sphere of graphite of about 60 cm. diameter will be imbedded in paraffin or water and the spherical layer of uranium having a diameter of about 40 cm. is embedded in this graphite. The neutron source is placed in the center of the graphite sphere and thermal neutrons are produced both in paraffin or water and in the graphite. A large fraction of the thermal neutrons produced may be absorbed in the uranium layer apart from the thermal neutrons which are produced in the water or paraffin in the proximity of the graphite sphere and which difuse into the graphite and are ultimately absorbed by the uranium.

The number of thermal neutrons absorbed in the water is determined by measuring in four different set-ups. These set-ups are the following:

1. In the absence of both cadmium and uranium layers.
2. In the presence of the cadmium layers but without the uranium layers.
3. In the presence both of the cadmium layers and the uranium.
4. In the presence of the uranium layer without the cadmium layers.

In this way we obtain four values for I.:
Since the absorption of neutrons in the carbon can be regulated, the value I. obtained in the first experiment gives us a measure of the number of neutrons emitted by the source.

The second experiment gives us information about the thermal neutrons absorbed in the cadmium since obviously the difference can be considered as a measure of this quantity. In the second experiment we can also measure the gradient of the thermal neutron density in the graphite inside and outside of the cadmium spheres R1 and R2, and if we designate the value of these gradients at G1 and G2 we may write for the number of thermal neutrons absorbed by the cadmium shares.

The factor can t can thus be determined by measuring A1 and A2 in the second experiment.

In the third experiment neutrons are absorbed as thermal neutrons by cadmium and water by a said number of neutrons R does not reach thermal velocities but will be absorbed at resonance by the uranium layer. We can determine this number by measuring the gradient of the thermal neutron density outside and inside of the spherical layer at R1 and R2 and the value of the integral I in the water we then have.

In the third experiment we may further measure with a cadmium shielded indium, or even better iodine, indicator. The average intensity of the corresponding resonance neutrons in a 10 cm. layer on both sides of the uranium layer and we thus find for this average resonance neutron intensity some value designated by P3.

In the fourth experiment we shall again measure the gradients of the thermal neutron density A B, the integral of the thermal neutron density in the water I and the average neutron density in the neighborhood of the uranium layer P4.

The number of neutrons, N. emitted from the uranium in the fourth experiment is then given by

In this expression the first term gives the number of neutrons absorbed as thermal neutrons in water.

The second term gives the number of neutrons absorbed as thermal neutrons in uranium.

The third term gives the number of neutrons absorbed by uranium with resonance.

The fourth term is the number of neutrons emitted by the source.

Accordingly we have four

Let us now first determine the number of thermla neutrons which are absorbed by a single uranium sphere of radius R embedded in an infinite space filled with carbon if Q thermal neutrons are produced per cc and sec. in the carbon. If R is large compared to $\lambda(C)$, themean free path for elasic scattering of thermal neutrons in carbon, the density ρ of the thermal neutrons in the carbon can be calculated by treating the problem as a diffusion phenomenon. We thus find for ρ as a function of the distance r from the center of the sphere

3 $$D(C)\frac{d^2(r\rho)}{dr^2} - S(C)\,r\rho + Q(r)\,r = 0$$

$$D(C) = \frac{v\lambda(C)}{3} \quad ; \quad S(C) = \frac{v}{\lambda(C)}\frac{\sigma_c(C)}{\sigma_{sc}(C)}$$

If the same number of thermal neutrons are produced everywhere in the carbon per cc and sec. we have

4 $$\frac{dQ}{dr} = 0$$

For a sphere which absorbes each thermal neutron which reaches its surface i.e. for a " black" sphere we have $\rho(R) = 0$ and find from (3) and (4) for $r > R$

5 $$\rho(r) = \frac{Q}{S(C)}\left(1 - \frac{R}{r}\,e^{-(r-R)/A}\right)$$

6 $$A = \sqrt{\frac{D}{S}} = \frac{\lambda(C)}{\sqrt{3}}\sqrt{\frac{\sigma_{sc}(C)}{\sigma_c(C)}} = \frac{\lambda(C)}{\sqrt{3}}\sqrt{k^{th}}$$

y^{th} the number of thermal neutrons which is absorbed by a single uranium sphere per sec. is given by

7 $$y^{th} = D(C)\,4\pi R^2\,\rho'(R)$$

and for a black uranium sphere we find from No. 5 $y^{th} = y_0^{th}$

8 $$y_0^{th} = 4\pi\,Q\,R\,A^2\left(1 + R/A\right) \quad ; \quad A = \frac{\lambda(C)}{\sqrt{3}}\sqrt{k^{th}}$$

where A has the dimension of a length and will be called the range of thermal neutrons in carbon.

Edward Teller

The purpose of this report is to describe a "peristaltic" method for carrying out successive recrystallizations. Among other applications this method could be used for purifying various metals and the purification of plutonium by this method appears to deserve particular consideration.

1. Purification of Metals.--If we have to deal with a metal which would attack in the liquid state the wall of the container the "peristaltic" method of purification proposed in this memorandum might be applied in the following form:

The metal is contained in a tube which is long compared to its diameter and is internally heated, for instance by sending an alternating current through it. By cooling the tube to a certain extent along its whole surface and at the two ends we can always make sure that the metal remains frozen in the immediate vicinity of the wall of the tube throughout the whole length of the tube. Now in order to obtain a "peristaltic" apparatus alternate sections of the tube along the axis will be cooled strongly and weakly so that in the weakly cooled sections the metal in the interior of the tube will be liquid and in the strongly cooled sections the metal will be solid throughout the whole cross section of the tube. Two liquid sections are thus separated by one solid section. A lively circulation can be

maintained within the liquid sections through the combined action of the temperature distribution within the liquid section and the action of gravity. For instance, if the axis of the tube is vertical the liquid metal at the top of a liquid section will be in contact with a frozen section and will sink down to the bottom of the section and thereby a circulation will be maintained. If in the cooling system which is responsible for the establishment of the alternate cold and hot zones is moved slowly downward until the displacement corresponds to full identity period and is then quickly shifted back upward to the original position we obtain a continuous motion of the system of solid and liquid sections from the top of the apparatus towards its bottom. Impurities dissolved in the metal which are less soluble in the solid phase than in the liquid phase will, after a while, concentrate at the bottom of the apparatus and in the stationary state the concentration of such impurities may increase from top to bottom by a factor of a^n if n is the number of liquid sections and a is the ratio of solubility of the impurity in the liquid and solid phases.

If the tube is horizontal rather than vertical we may also have adequate stirring of the liquid sections through the action of gravity. In this case both axial ends of the liquid sections the cold liquid will sink down and it will raise up in the control plane of the liquid section. An even more lively circulation can be obtained by rotating the tube around its axis. Under the action

of the centrifugal gravitational field the liquid will then move radially outward at both axial ends of the liquid section and will move radially inward in the center plane of the liquid section. If we wish the peristaltic motion to be directed toward the right end of the tube the cooling system will have to be moved slowly from left to right until the displacement corresponds to a whole identity period and then the cooling system will have to be pushed back suddenly into its initial position.

The following questions have to be considered:

1. If the graphite is cooled by gas and without contact between the uranium and the gas, heat has to go through a gap between uranium and graphite. How small has this gap to be made in order to lose less than half of the total temperature drop between surface of metal and cooling gas in the gap? What is the relationship between h and size of the gap which correspond to the same ΔT for various gases and various pressures? Can a given thermal contact be made between uranium and graphite?

2. Can we make an air-cooled machine in which the air flows in Karbade tubes and the uranium and the graphite are in helium or hydrogen?

3. Can hydrogen be used at 10 atm. without interfering with the reaction?

4. What is the power requirement for helium cooling in the Dralis arrangement at 1 atm. pressure, at 20,000, and at 100,000 KW/10 tons? In Dralis' arrangement, how is radius of metal rods in bundles determined, by thermal conductivity or by ~~age~~ h? How does this depend on the pressure and ΔT in metal? What is the gas velocity in the bundle?

Cooling with water or heavy water

If a water is used for cooling it is best to use a cylindrical arrangement or more precisely, cylindrical clusters. A number of uranium rods of perhaps 3 to 5 mm. in diameter can be bundled together in a Karbade (Be or Li) tube and water can be made to flow through the tube. If ordinary water is used in this arrangement there will be some loss due to an increase in the surface absorption of uranium. However, not the total surface of the uranium which is produced by the clusterization has to be counted as new surface since there is a very high chance for a neutron which leaves a uranium rod in the bundle to enter another uranium rod before colliding with the hydrogen or oxygen atoms.

Deposit Sirland Memo notrent

Re: Hamilton

1. Experiments for Seaborg: bombard plutonium and uranium with alpha particles.

2. After reconditioning of cycle raise magnetic field and bombard uranium with H_3. Purpose to obtain a mixture of plutonium and supra-plutonium.

a. If supra plutonium has only a weak alpha emission, determination of fission to alpha ratio on 1 microgram sample will show whether supra plutonium is fissionable with thermal neutrons. If supra plutonium ~~isxfixxxizxxxkle~~ has a strong alpha emission then the amount of plutonium will have to be determined by differentiating between the two different alpha particle ranges after which determination of alpha to fission ratio will show whether supra plutonium is fissionable. Alternatively, by determining of fission per weight we might learn whether supra plutonium is thermally fissionable. U^{240} would also be formed in this experiment but is chemically different from plutonium so that it would not interfere.

3. Bombardment of plutonium with very fast cyclotron neutrons in an attempt to form plutonium 236. This would be done in the hope that plutonium 236 is spontaneously fissioning and would provide a fission neutron source for experiments. An alternative suggested by Hamilton would be to bombard neptunium 237 (if this material can be obtained in quantity from Clinton) with deuterons in the hope of obtaining plutonium 236.

4. Yield of H_3 bombardment. It is estimated that 10 cc of H_3 would have to heat in form of ions a uranium target in order to produce one microgram of plutonium and supra-plutonium. Whether this is practicable will depend both on the recovery arrangements of the cyclotron and the production arrangements at Clinton and possibly at W. 1 cc per day could be produced at Clinton if we poison 1% and 250 cc could be produced per day at Hanford if we poisoned Hanford by 1%.

209 Depot

Prove lokely than not, that it is true

1. The main purpose of our work is to make a chain reaction with neutral uranium used primarily for the production of element 94.

2. It might be necessary to have stages in the production of 94, namely, a stage of slow production in which 94 is produced from natural uranium, and the second stage in which there is a rapid transformation of the total amount of uranium 238 into 94.

3. We may expect from our present knowledge that a chain reaction will go with pure uranium and pure graphite. But since this is not true Be ↓ D

4. Conditions would be most favorable if pure uranium metal would be used at a high temperature, but with sufficient cooling so that uranium metal and the surrounding graphite would be cold and the rest of the graphite would be hot. This is possible in a machine which transfers 10^6 KW / 10 ton

5. While it is certain that uraniu metal is better than uranium oxide or uranium carbide, it is not possible to say how much better the uranium metal would be.

6. Practical considerations may make it imperative to use in the industrial stage uranium in the form of carbide rather than in the form of metal.

7. The problem of heat transfer is capable of a satisfactory solution and it does not cause considerable difficulty to transfer one million killowatts per ten tons of uranium. One system of cooling which has been considered in detail makes use of liquid bismuth (see paper of February 1940) and a detailed memorandum on this subject could be submitted if required).

8. The chief difficulties and perhaps the only serious difficulties which at present have to be anticipated concern the poisoning of the chain reaction by the accumulation of fission product[redacted]s which have been considered by Wheeler and Wigner, and the difficulty of handling the uranium which has taken part in the chain reaction and which is strongly radioactive. As far as the poisoning of the chain reaction by fission productions is concerned, I should like to defend the thesis that it is not quite as dangerous as would appear from the considerations of Wheeler and Wigner.

9. ~~That~~ the Princeton experiments in the first place and in the second place experiments on the capture of [redacted] hundred thousand volt neutrons by uranium (see memorandum of Marshall and Szilard dated) ~~; and in the second place have~~ show that there is much more capture of high energy neutrons by uranium as ~~at first~~ originally anticipated. This is an additional reason for believing that the most favorable uranium carbon ratio might be in the neighborhood of ten percent uranium rather than in the neighborhood of the ratio used in the Schermerhorn experiments. While it is quite possible that the use of very small spheres of oxide, recently proposed by Wigner, is most favorable, it is not possible to know this for certain in view of the fact that there are many other factors, none of which are known with sufficient accuracy to to drawn a conclusion. At present it is equally possible to defend the thesis that uranium metal spheres of three to four cm radius or even larger spheres used at higher temperature would be more advantageous,

since both the effect by fission neutrons at the temperature favor larger size spheres and high density. 10.) The temperature effect is of importance only if the uranium spheres are sufficiently large to be somewhat black for thermal neutrons. Two different cases have been calculated by Feld and myself; (a memorandum could be submitted on this subject if requested) a) The case of equal temperatures in the uranium and carbon; b) the uranium at about six hundred centigrades and carbon at about eighteen hundred centigrades; together with the uranium, a certain amount of graphite in the neighborhood of the uranium sphere is kept at a lower temperature and heat is submitted by radiation from the graphite at high temperature to the graphite at low temperature. About one hundred thirty thousand kilowatts per ten tons of uranium would thus be submitted and would take care of the heat liberated in the graphite by the chain reaction. A factor of about 1.1 to 1.12 could be won in this way.

Fission by fission neutrons was studied by Marshall and Szilard (memorandum of November 14, 1941) and the slowing down of neutrons in uranium was studied by Szilard and Zinn (see memorandum of). From these results it is possible to estimate the contribution to fission by fission neutrons to the chain reaction. A memorandum of the effect of size and density of the uranium spheres on this contribution is being prepared by Feld and myself, and will be available if requested in January of this year. This contribution is about a factor of 1.023 for the Schermerhorn experiment

of Anderson and Fermi, and would be about a factor of 1.1 for a uranium sphere of 8 cm radius (increase over Schermerhorn by factor 1.077) and it would be a factor from 1.045 for a uranium sphere of 4 cm radius (increase by factor of 1.0225 over Schermerhorn).

SUMMARY

Recent experimental work and calculations based on its results make it appear possible that in the immediate future a nuclear chain reaction might be set up under certain well specified conditions in a system composed of uranium oxide and graphite. In view of this and other possibilities it seems desirable

1. that it should be made the responsibility of some person or persons to watch on behalf of the government the further develpment of this branch of research, so that the government should be at any time in the position of taking such action as it deems appropriate;

2. that some person or persons who have the confidence of the government should take upon themselves the task of furthering this branch of research, of insuring that it should not suffer from lack of facilities, and of preparing the grounds for experiments on a large scale, which might become necessary.

Observation to the above.

The fairly large quantities of material, which might be required for performing large - scale experiments, might perhaps be secured, without drawing on existing funds, by enlisting the assistance of certain industrial firms in the U.S.A. and of the Union Minière du Haut Katanga. Most of the amterials required are produced by large corporations who own uranium mines and would therefore directly benefit if the present development created a market for uranium. Some of these firms could be approached now with a view of obtaining the promise of their assistance.

THE POSSIBILITY OF A LARGE-SCALE EXPERIMENT IN THE IMMEDIATE FUTURE.

At present it appears quite possible that a nuclear chain reaction could be set up in a system composed of uranium oxide (or uranium metal) and graphite. The graphite would have to be piled up in a space of perhaps 4 x 4 x 4 metres and might weigh about 100 metric tons. Perhaps 10 x 20 tons of uranium oxide would have to be used, embedded in some such pile of graphite.

The probable success or failure of such large-scale experiment can not be forecast at present with any degree of assurance, The properties of a system composed of uranium and graphite have been calculated independently, for a homogeneous mixture by Fermi, for a lattice of spheres of uranium oxide, or uranium metal, embedded in graphite, by myself. The results of these two independent calculations are in reasonable agreement and show that the two independent calculations are in reasonable agreement and show that the two arrangements have different properties. For instance, in the case of using a lattice of spheres a great advantage could be obtained by using uranium metal instead of uranium oxide, whereas in the case of the homogeneous mixture the use of uranium metal would be of no great advantage. In spite of these calculations, we ca cannot foretell with certainty whether or not a nuclear chain

reaction can be maintained in such a system because the absorption cross-section of carbon for slow neutrons is not sufficiently known.

In order to remove this incertainty Fermi and I have devised two different experimetns by means of which the absorption cross-section of carbon, which is very small, could be measured. It is assumed that one of these experiments, or both of them, will be started at Columbia University as soon as the facilities required can be obtained.

If the absorption of carbon should turn out to be comparatively large we could conclude that the large-scale experiment is bound to fail, and in this case it need not be started. If the absorption of carbon should prove to be exceedingly small the large-scale experiment would appear to be very promising, and it can be assumed that everybody will then be in favor of starting it without delay.

Unfortunately, we must be also prepared to find an intermediate value for the carbon absorption. Inthis case a large-scale experiment will have to be performed in order to find out whehter or not a nuclear chain reaction can be achieved with a combination of uranium and graphite. So we may have ro make the experiment and risk its possible failure.

It should be borne in mind that a negative result of the large-scale experiment could also be of value by showing with certainty that a chain reaction cannot be achieved with simple means in the near future. Otherwise there remains an ever present potential threat arising out of experiments on uranium, which are carried out in certain other countries. Therefore, in my personal opinion a large-scale experiment ought to be performed unless the possibility of its success can be excluded with reasonable assurance on the basis of experiments which are designed to determine the absorption of carbon, or other similar experiments which can be carried out on a moderately small scale.

RECOMMENDATIONS CONCERNING LARGE-SCALE EXPERIMENTS.

No expenses need be incurred in connection with large-scale experiments until the absorption of carbon has been measured. On the other hand, steps ought to be taken now in order to prepare the ground for a large-scale experiment, so that this can be started without delay at the proper time. For instance, the possibility of converting uranium oxide into uranium metal ought to be explored. An attempt ought to be made to obtain a promise on the part of certain industrial corporations to supply at the proper time the quantities of the materials, which are required. If possible, these materials ought to be loaned wihtout any financial consideration. Barring an accident in the case of a successful large-scale experiment most of the materials used would remain unaffected and could be returned after the experiment is completed.

100 metric tons of graphite represent a value of about $ 33.000 at the rate of $ .15 perlb. If a purer brand of graphite has to be used, which rates at $ .24 per lb, the value involved would be $ 53.000.-

20 metric tons of uranium oxide represent a value of $ 100.000 at the rate of $ 2.50 per lb. If it need not be converted into uranium metal but can be used in the form of oxide in the large-scale experiment, this material could be kept pure and could be returned undamaged. It would be desirable to have up to 50 tons of uranium oxide readily available for experiments in the United States.

STATEMENT CONCERNING THE POTENTIAL ASSISTANCE OF THE UNION MINIERE DU HAUT KATANGA.

It would be of particular value to enlist the assistance of this Belgian corporation which is to some extent controlled by the Belgian Government. It appears to be the only corporation which could supply at short notice 20 metric tons of uranium oxide, and probab even 50 tons. I understand that the Managing Director, Mr.E. Sengier is on a short visit in America.

From conversations which Professor G.B. Pegram of Columbia University had with a representative of the Eldorado Gold Mines, Ltd. it appears that this Cancadian corporation might be able to supply uranium oxide for our purposes at the rate of 1 ton per week. If the uranium oxide were to be bought rather than obtained as a gift or a loan, it might be secured from Canada probably just as easily as from Brlgium. On the other side, the Canadian corporation is rather small and can hardly be asked to give away large quantities of material without financial compensation.

So far, radium up to about 2.5 grams was used in our experiments, and we had to pay high rent to a subsidiary of the Union Minière, the only corporation from which large quantities of radium can be readily rented in this country. An attempt oight to be made to obtain radium for the purposes of such experiments rent-free from the Union Minière in the future.

Carnotites containing uranium are mined in the U.S.A. by the U.S. Vanadium Corporation which is owned by the Union Carbon and Carbide Corporation. A conversation which I recently had with William F. Barrett, Vice-President of this corporation, did hot encourage the hope of obtaining large quantities of uranium oxide from this firm, but the issue could perhaps be reopened.

STATEMENT ABOUT URANIUM ORE.

As far as I was able do find out, pitchblend ,which is an ore rich in uranium, is mined in Czechoslovakia, Canada and

Belgian Congo. The total content of uranium in the deposit in Czechoslovakia is estimated to be between 1000 and 1500 tons. T he Canadian deposit visibly contains a total of 3000 tons. The amount of pitchblend in the Belgian Congo is not known, but it is believed to be very much larger. In the United States uranium occurs chiefly in the form of carnotites, which is an ore poor in uranium , and is mined for the sake of its vanadium content. The total deposit is estimated to contain 3000 tons of uranium oxide. (Perhaps there are in the United States larger quantities of ore containing a very small amount of uranium which are not included in the above estimate.)

RECOMMENDATION CONCERNING URANIUM ORE.

Steps to secure a stock of uranium ores for the government can hardly be recommended at the present time if such steps would involve financial commitments in the part of the government. It might, however, be advisable to begin to study the question in what manner the government could secure such a stock at a later date if required.

For instance, the question has been raised whether it might not be possible to obtain for the government a large quantity of pitchblend from Belgium as a token reparation payment. Such a transaction would not cause alarm abroad if it were arranged before the world learns of th e results of some successful large-scale experiment. The transaction could be justified wihtout reference to the uranium content of the ore. Pitchblend is also the ore of radium, and action could be taken on the ground of securing the ore of radium, and action could be taken on the ground of securing the ore for the sake of its radium content, with a view of extracting the radium at some future date for medical purposes. Action taken on this ground alone might in fact be entirely jüstified.

In order to achieve this it is proposed to have an enriched core which is not too rich in plutonium and accordingly does not have too high or ~~great~~ multiplication constant. In that case the leakage of the neutrons from the enriched core into the peripheral layer may be kept sufficiently low to have in the inner core full replacement and perhaps even an increase of the amount of plutonium during the course of the chain reaction ~~and to have a~~ tendency of the effective multiplication factor of the arrangement to increase in the course of the chain reaction. Another reason for not using a too rich mixture in the inner core is the fact that the value of ε is highest for low concentrations of plutonium and therefore we cannot use a too rich mixture without lowering the number of neutrons produced per fission of plutonium.

~~This leads to~~ This is desirable in order to have a

Insert 11

Fission neutrons appear to be more effective in producing high energy reactions such as (n,p) and (n,α) reactions than boron neutrons and we may therefore assume that they are more effective in producing the (n, 2n) reaction in uranium. Turkevich finds that in the X pile U^{237} is produced by an (n, 2n) reaction in the amount of about 1% of the plutonium produced. This would mean that about $\frac{1}{2}$% of the neutrons lead to the emission of one additional neutron in an (n, 2n) reaction. Now in the X pile according to Weinberg's estimate based on ~~a fission of~~ σ_f = .3 and ν = 2.6 there is an increase of the multiplication factor of about 3% arising from fast neutron fission in 28, which means that about $\frac{3}{2.6 - 1}$ = 1.9% of the fission neutrons cause fission in 28. Since about .5% of the neutrons cause an (n, 2n) reaction at X, the cross section for this reaction would be $\frac{.3}{4}$ = .075. Since the inelastic cross section may be taken at 2.7 the (n, 2n) would contribute about $\frac{.075}{3}$ = 2.5% to the chain reaction and the value ε given above would have to be increased from 1.2 to 1.225 if we assume that no (n, 2n) reaction takes place with boron neutrons.

I

Insert:

This value ε can be calculated also if the relevant cross sections are known and we may write

$$\varepsilon_\infty = \frac{\sigma_f^* + \sigma_{in} - \sigma_p^* q}{\sigma_f^* + \sigma_{in} - V \sigma_f^* q}$$

with the values of

~~This formula gives $\varepsilon_\infty = 118$~~

$\sigma^* q = 0.35$ $\quad q = 3/4$

$\sigma_{in} = 2.7$

Stoke ! <u>Cukrone</u>

we get for $V = 2.2$ $\quad \varepsilon = 1.18$

" $V = 2.6$ $\quad \varepsilon \approx 1.245$

Mr II.

$$\begin{array}{r} 0.466 \\ 2.7 \\ \hline 3.166 \\ -\ 35 \\ \hline 2.816 \end{array} \qquad \begin{array}{r} 3.166 \\ 91 \\ \hline 2.256 \end{array}$$

In a preliminary report (CK-1077) prepared over a year ago the production of plutonium from U^{238} was discussed. Of particular interest appeared to be systems in which U^{238} is initially enriched with plutonium and it was pointed out that particularly favorable conditions for the production of plutonium in such enriched mixtures can be obtained by maintaining a fast neutron chain reaction in the absence of slowing agents such as graphite, etc. In such a purely fast neutron chain reaction it is possible to utilize in the chain reaction the fast neutron fission of U^{238} to a higher degree than in the chain reaction in which the neutrons are slowed down to thermal energies. For this reason it appeared to be reasonable first to consider such pure fast neutron chain reactions maintained in a mixture of plutonium and U^{238} which is sufficiently rich in plutonium to be capable of maintaining a chain reaction in the absence of slowing agents. It was estimated that 1 kilogram of plutonium could be produced per day in such a chain reaction in excess of the plutonium which is destroyed at the reaction rate of $1\frac{1}{2}$ million kilowatts. Nuclear data which have become available since that time make it desirable to revise this estimate as follows:

<u>Contribution of U^{238} fission to the chain reaction.</u>--Measurements which we have carried out after March 1943 with radium-boron neutrons on the fast neutron emission of U^{238} make it possible to give at present a more reliable estimate for the contribution of the fast fission of U^{238} to the chain reaction. This estimate is arrived at in the following manner: A radium-boron neutron source was placed

in the center of a uranium sphere and we found that the total number of neutrons leaving the sphere was 5.3% greater than the total number of neutrons emitted by the source. We further found that the number of those "fast" neutrons leaving the sphere which were capable of producing fission in U^{238} was about 62.8% of the number of such "fast" neutrons emitted by the source.

If we now assume that the energy distribution of the neutrons of this source closely resembles the energy distribution of the fission neutrons we can obtain directly from these values the number of neutrons which a fission neutron would liberate in an infinitely large mass of U^{238}. This number represents the contribution of the fast fission of U^{238} in a mixture of U^{238} and plutonium for the limiting case of very low plutonium concentration. Obviously we have

$$\varepsilon = \frac{5.3/100}{1 - 0.628} = 19.5\%$$

- <u>Number of neutrons emitted in fast neutron fission of 94.--</u>

In the preliminary report of March 26, 1943 it was assumed that 2.2 neutrons are emitted by the number of neutrons absorbed in U^{235} or element 94^{239}. At present we know however that we have to distinguish between the fission cross section and the absorption cross section of these elements and according to Fermi's latest measurements about 17.5% of the neutrons are captured without fission by U^{235} in the thermal region. We would thus have for the number of neutrons emitted per fission from U^{235}

$$\nu^{235} = 2.2 \times 1.175 = 2.6$$

Incidentally $\nu^{235} = 2.6$ is also the value which Zinn and I found in 1939

by a direct measurement of the number of neutrons emitted per fission in which the number of neutrons was determined by the number of hydrogen recoils produced in an ionization chamber and was ~~observed~~ determined by ~~means~~ of counting fissions in ~~in~~ a fission chamber. This agreement is better than can be expected since our measurement was not an accurate one.

A direct comparison carried out at site Y of the number of neutrons emitted per fission of U^{238} and plutonium indicates that this number is 20% higher for plutonium than for U^{235}. According to this finding we would have to write

$$\nu^{Pu} = 1.2\,\nu^{235} \approx 3.1$$

Radiative capture of neutrons in plutonium.--Plutonium seems to have a considerable cross section for radiative capture of neutrons in the thermal region and this process presumably leads to the formation of an isotope of plutonium to which I shall refer, for the sake of convenience, as supra plutonium. If supra plutonium is not fissionable at low neutron energies then we have to use for calculating the balance of plutonium production and destruction in a chain reaction the value of μ, i.e. the number of neutrons emitted by plutonium per neutron absorbed rather than the value of ν i.e., the number of neutrons emitted per fission.

In that case there may be a further advantage of the fast neutron chain reaction over the slow neutron chain reaction arising from the possibility that with increasing neutron energy the probability of supra plutonium formation relative to fission decreases and perhaps ~~even~~ becomes negligible above one million volts.

If supra plutonium ~~is~~ were not formed with high energy neutrons or if supra plutonium ~~is~~ were fissionable at low neutron energies, then the balance of plutonium formation and destruction ~~is~~ (in the fast neutron reaction) determined by ν^{Pu} for which ~~the~~ (would be) the Site Y results indicate a value of 3.1. In view of all the uncertainties involved we shall ~~use, in order to be reasonably conservative, in place of such a this high value, as a reasonable value upon which to base an estimate of the balance of plutonium production and destruction~~ for the present the value of

~~$\nu_{eff}^{Pu} = 2.6$~~

~~$\nu_{eff}(Pu) = 2.6$~~

In view of all the uncertainties involved we shall, for the present, base our estimate in the case of a fast neutron chain reaction on the balance of plutonium production and destruction on a value of

$$\nu_{eff}(Pu) = 2.5$$

whereas for estimating the critical dimensions of the chain reaction unit we shall use the value of

$$\mu_{eff}(Pu) = 2.2$$

Overall balance of plutonium production.--In a mixture of U^{238} and plutonium we may expect at low concerntrations of plutonium the production of $\varepsilon \times \nu$ neutrons for every plutonium atom which undergoes fission. According to the statements made above, we shall base our estimate of the overall balance of plutonium production and destruction on the value of

$$\varepsilon \nu_{eff} = 1.2 \times 2.5 = 3.0$$
$$(\varepsilon \mu_{eff} = 1.2 \times 2.2 = 2.65)$$

This means that in such a fast neutron chain reaction in which all neutrons which do not react with plutonium are captured by U^{238} about 3 neutrons are formed for every atom of plutonium which is destroyed. Consequently two atoms of Pu are produced while 1 is destroyed and we have a net gain of one atom of plutonium produced in excess whenever one atom of plutonium undergoes fission and is replaced by another atom of plutonium that is formed. At the same time .2 atoms of U^{238} are destroyed by undergoing fast neutron fission. Accordingly the production of 1 kilogram of excess plutonium per day will be accompanied by heat dissipation of about 1.2 million kw.

Requirement of detailed balance.--So far we have merely considered the overall balance of plutonium consumption production. This overall balance would hold both for small and large chain reacting units provided that the leakage of neutrons from the chain reacting unit is kept at zero, that is, if the chain reacting unit is surrounded with so much U^{238} that all neutrons are absorbed and do not leak out, the preceding considerations will hold and we produce two atoms of plutonium for on which is destroyed.

However, let us now consider an enriched core of uniform composition so that we may talk about the multiplication factor of the mixture. This core is surrounded with unenriched uranium of sufficient quantity to assure the overall balance previously discussed. If we used a very rich mixture which has a very high multiplication factor there would be a great leakage of neutrons from the enriched core into the peripheral layers. The amount of plutonium within the enriched core could then actually decrease in the course of the chain reaction and the effective multiplication factor of the arrangement could fall below one if the chain reaction is maintained for a finite amount of time. We are more interested here in systems in which the core is not too rich so that the effective multiplication factor increases when the chain reaction is maintained and we will discuss how the chain reaction can be regulated to offset this increase and to bring the effective multiplication factor down and to keep the effective multiplication factor one over a long period of time during which the excess amount of plutonium produced may be of the same order of magnitude as the amount of plutonium originally contained in the enriched core.

Requirement of Detailed Balance.--In the following we shall consider a system which is composed of a core containing U^{238} enriched by plutonium and surrounded by a peripheral layer of U^{238} which is sufficiently thick to absorb all neutrons arising in the chain reaction. For the sake of simplicity we shall assume that the composition of the enriched core is uniform so that we can talk about the multiplication factor of the mixture. It appears reasonable to aim at running the chain reaction for a sufficiently long time to perhaps double the amount of plutonium in the system in the course of the chain reaction. If such violent changes in the constitutional system occur methods must be found which allow us to keep the effective multiplication of the system at one without poisoning the system in an unproductive manner. This can be done in a very convenient way which will be described later provided that the ~~mixture used in the core of the system is not too rich in plutonium and accordingly does not have a too high multiplication factor.~~ effective multiplication constant of the system has a tendency to grow rather than to decrease in the course of the chain reaction.

~~While in such a system we may produce two atoms of plutonium for one which is destroyed, there is a leakage of plutonium from the enriched core into the peripheral layer and if this leakage is too great we may have a decrease of plutonium in the core and a tendency of the effective multiplication factor of the arrangement to decrease in the course of the chain reaction. In this memorandum it is preferred to consider a system in which the multiplication factor of the enriched core is not too large and which has a tendency of increasing its effective multiplication factor in the course of the chain reaction.~~

SUMMARY

In order to produce plutonium from U^{238} it appears of interest to consider a fast neutron reaction maintained in a mixture of plutonium and U^{238}. One might envisage a unit of 2 meter diameter and 2 meter height with an enriched core of about 2 tons of uranium containing 200 kg of plutonium. It might be possible to remove 250,000 kw from such an enriched core. This means that the amount of plutonium in the arrangement could be about doubled in a little over two years. If the specific heat removal is halved the amount of plutonium vested would be doubled in about $4\frac{1}{2}$ years. It should be noted that these times given are practically independent of the size of the enriched core and are essentially determined by the specific heat removal. This is so because the amount of plutonium in the arrangement would increase almost as fast as the weight of the enriched core increases, i.e. the concentration of plutonium in the enriched core does not rapidly decrease with increasing size of the core if we go from a two-ton core to a 16 ton core. During that time the multiplication factor would increase unless we constantly readjusted the arrangement. This can be done simply by rotating three disks which support part of the uranium lattice of the power unit.