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(Memorandum of Leo Szilard submitted to Dr. Briggs, October 26, 1939)

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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 to 20 tons of uranium oxide would have to be used, embedded in some such pile of graphite.

The probable success or failure of such a large-scale experiment cannot 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, and, 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 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 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 uncertainty, Fermi and I have devised two different experiments 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. In this case a large-scale experiment will have to be performed in order to find out whether or not a nuclear

chain reaction can be achieved with a combination of uranium and graphite. So we may have to 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 without 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 $33.00 -- at the rate of 15¢ per pound. If a purer brand of graphite has to be used, which rates at 24¢ per lb. the value involved would be $53.00.

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 probably even 50 tons. I understand that the Managing Director, Mr. E. Songier, 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 Canadian 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 Belgium. On the other hand, 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 gms. was used in our experiments, and we had to pay a high rent to a subsidiary of the Union Miniere, the only corporation from which large quantities of radium can be readily rented in this country. An attempt ought to be made to obtain radium for the purposes of such experiments rent-free from the Union Miniere 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 not encourage the hope of obtaining large quantities of uranium oxide from this firm, but the issue could perhaps be reopened.

STATEMENT ABOUT URANIUM ORE

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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 the results of some successful large-scale experiment. The transaction could be justified without 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 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 justified.

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submitted to Dr. Briggs

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c/o Department of Physics
Columbia University
New York, N.Y.

October 26th, 1939

Dr. Lyman J. Briggs
U.S. Bureau of Standards
Connecticut Avenue
Washington, D.C.

Dear Dr. Briggs:

Enclosed you will find a memorandum in which the statements and recommendations made by me at the meeting of October 21st are repeated and somewhat amplified.

Both at the meeting and in the memorandum I have refrained from putting forward a detailed plan for promoting further research on uranium. Having recently started conversations on this subject with Dr. Pegram, Dr. Fermi, Dr. Wigner and others, I feel that it is best to limit myself to general recommendations until a consensus of opinion on details has been reached.

I personally believe that if sufficient interest in the subject could be aroused, intensive research on uranium might be carried on at four or five different laboratories. Columbia, the Carnegie Institute for Terrestrial Magnetism, the University of Virginia, M.I.T and Princeton were so far tentatively mentioned in this connection. If a committee, foundation, or some other non-profit organization considered it his task to encourage research on uranium, and had the approval of the government, it could approach the presidents of certain universities in order to obtain the release of some younger physicists from their teaching duties. These men could then devote their

entire time to experiments on uranium, which they might want to undertake. They could work either at their own universities, or could work as guests of one of the four or five universities at which larger groups are active on the same subject. In a year or two these men could return to their regular work, and we would thus avoid creating the problem of how to place them later. Such a problem might arise if some of the alternative schemes that have tentatively been put forward were adopted. Also, by proceeding in this way we could avoid interfering with existing research projects in various physics departments, which would inevitably suffer if a large number of men in any single department were persuaded to work on uranium.

One point which might have to be considered in this connection is the following: some of the work which has to be done may be of such nature that the publication of the results had better be avoided. For a young physicist, who has not yet made a name for himself, refraining from publication means a sacrifice which he should not be asked to make without being offered some compensation. Some addition to the salary which he is normally drawing from his university might therefore be desirable and might require the creation of some special fund. This observation is based on experiences gained early in March, when Fermi and I agreed to delay the publication of our experiments on the neutron emission of uranium and attempted to obtain the cooperation of French and English physicists with regard to withholding all publications on this particular subject. I am enclosing for your information copies of the letters and cables exchanged on this issue between February 2nd and April 19th of this year.

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Copies of the enclosed memorandum will be sent by me to Dr. Wigner and Dr. Teller, who are old personal friends of mine and with whom I have been in almost constant consultation on this subject since January of this year. I shall also send copies to Dr. Alexander Sachs, Professor G.B. Pegram and Professor E. Fermi. Three additional copies will be sent to you, to be used at your convenience.

Yours sincerely,

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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 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 development of this branch of research, so that the government should be at any time in the position of taking such actio n 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 ground for experi - ments on a large scale, which might become necessary.

Observation to the above.

The fairly large quantities of material, whkch 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 materials 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.

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U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

LJB:DEK

November 1, 1939

IN YOUR REPLY
REFER TO FILE

D

Dr. Leo Szilard,
King's Crown Hotel,
420 West 116th St.,
New York, N. Y.

Dear Dr. Szilard:

I wish to thank you for your letter of October 31, transmitting four additional copies of your memorandum, and to say that your memorandum will be very helpful.

Sincerely yours,

Lyman J. Briggs, Director.

XXXXXXXXXX

October 31st, 1939

Dr. Lyman J. Briggs
U.S. Bureau of Standards
Connecticut Avenue
Washington, D.C.

Dear Dr. Briggs :

Enclosed I am sending you four copies of the memorandum which I have previously sent you. A few words have been changed here and there on the suggestion of Professor G.B.Pegram, for the purpose of clearer expression.

I hope to write Part II , in which would be repeated and amplified the statements made by me at the meeting concerning the rdative merits of the three different lines of research which might lead to a chain reaction in uranium.

I am also writing an Appendix, in which I shall attempt to give details which go beyond the scope of the discussion at the meeting of October 21st.

Yours sincerely,

(Leo Szilard)

October 31, 1939

M E M O R A N D U M

Part I.

Meeting of October 21st, 1939.

by Leo Szilard

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

IN YOUR REPLY
REFER TO FILE

LJB:DEK November 1, 1939 D

Dr. Leo Szilard,
King's Crown Hotel,
420 West 116th St.,
New York, N. Y.

Dear Dr. Szilard:

I wish to thank you for your letter of October 31, transmitting four additional copies of your memorandum, and to say that your memorandum will be very helpful.

Sincerely yours,

Lyman J. Briggs, Director.

Brigg

COPY

U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington

COPY

Address reply to
National Bureau of Standards
GEFL:GFH

January 5, 1940.

In your reply
refer to file
V-0

Dr. George B. Pegram,
Columbia University,
New York, N. Y.

Subject: Graphite.

Dear Dean Pegram:

Upon receipt of your letter of December 9, we requested the National Carbon Company and the United States Graphite Company to submit samples of graphite blocks for determination of the hydrogen content. Neither was able to furnish blocks of the contemplated size, but both companies forwarded samples representing the composition and the state of aggregation of the graphite which they propose to furnish. The samples arrived on January 2nd and tests were started immediately. Our results are as follows:

I. Loss on drying at 105° C

National Carbon Co. (rods) -- 0.01 per cent

U. S. Graphite Co. (small slab) -- .007

II. Hygroscopicity
(Increase in weight after exposing dried samples to an atmosphere of 50 per cent relative humidity)

National Carbon Co. -- 0.006 per cent

U. S. Graphite Co. -- .006 per cent

III. Percentage of hydrogen in graphite "as received".
(The method of test should yield all of the hydrogen in the graphite, regardless of the form in which it occurs.)

National Carbon Co. -- 0.004 per cent

U. S. Graphite Co. -- .002 per cent

IV. Percentage of ash

National Carbon Co. -- 0.075 per cent

U. S. Graphite Co. -- .053

It will be noted that the values obtained in the drying and in the hygroscopicity tests are approximately equal, and indicate that the graphite "as received" has reached the equilibrium which will obtain in graphite handled and installed under ordinary conditions. It seems reasonable, therefore, to believe that the percentages of hydrogen indicated in the "as received" graphites represent the hydrogen contents that may be expected. If the blocks could be dried and protected from moisture during installation and use, the percentages of hydrogen would approximate 0.003 for the National Carbon Co. and 0.001 for the U. S. Graphite Co. blocks.

Sincerely yours,

(Signed) L. J. Briggs, Director

Will you now please advise whether graphite from either source would be acceptable; if so, competitive bids may be secured.

We are planning to ask for bids on

8,800 pounds of graphite

4,400 pounds of paraffin

100 pounds of cadmium

L. J. B.

Copy

U. S. Department of Commerce

National Bureau of Standards

Washington

April 13, 1940

Professor Albert Einstein
Princeton University
Princeton, N.J.

My dear Prof. Einstein:

There will be a meeting of the Special Advisory Committee appointed by President Roosevelt at my office at the National Bureau of Standards on Monday, April 22, at 2 p.m. The other members present will be Dean Pegram of Columbia University and Dr. Alexander Sachs of New York as well as the Washington members of the Committee. I hope very much that you will find it possible to be with us.

Sincerely yours,

sign. Lyman J. Briggs,
Director

C
O
P
Y

U. S. DEPARTMENT OF COMMERCE

National Bureau of Standards

WASHINGTON

April 13, 1940

Dr. Alexander Sachs,
Care of Lehman Bros.,
One William Street,
New York, N. Y.

Dear Dr. Sachs:

Confirming our telephone conversation of this morning the meeting of the Advisory Committee will be held at my office at 2 p. m. Monday, April 22nd. I have written to Prof. Einstein and Dean Pegram.

Sincerely yours,

LYMAN J. BRIGGS
Lyman J. Briggs, Director

May 13, 1940

Dear Dr. Briggs:

Since speaking with you I have learned from Dean Pegram that the experiment conducted on graphite at Columbia University by Drs. Fermi and Szilard has now been concluded, and that we shall shortly be advised of the results.

With the clearing up of this preliminary question and with the new urgency brought about by the invasion of Belgium, your committee is enabled and impelled to advise the President as to the importance of the work of Drs. Fermi and Szilard for problems of national defense. In this connection, it occurs to me that it might serve the convenience of yourself and your colleagues to examine the synoptic statement originally prepared by Dr. Szilard at my suggestion and delivered by him orally at the conference of April 27th in response to your request.

In the event that the governmental committee reports favorably, the problems that are thrown into sharp relief, as already suggested in Dr. Einstein's letter to you, go beyond the appropriate augmentation of the financial support to be accorded by the Government. We are confronted with the pressing need to establish an organizational framework under which the work - conducted as it must be at universities, with their traditional discursive attitude and leisurely tempo - can proceed with the requisite (a) secrecy, (b) acceleration and (c) flexibility required for a going enterprise. The imminence of vacation periods at universities and the attendant dispersal of scientific workers adds another element of immediacy to a situation that, in the present setting so fateful for the survival of the European democracies, is already surcharged with urgency.

Yours sincerely,

Dr. Lyman J. Briggs, Director,
National Bureau of Standards,
Department of Commerce,
Washington, D. C.

Copy to General Watson

May 23, 1940

Dr. Lyman J. Briggs, Director
National Bureau of Standards
Washington, D. C.

Dear Dr. Briggs

Enclosed you will find a copy of a letter to Dr. Tate which I wrote in pursuance of the course upon which we decided during our last discussion on April 27.

Yours sincerely,

(Leo Szilard)

LS/jbc
ENC.

U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington

Address Reply to
National Bureau of Standards
LJB:DEK

In your reply
Refer to file
D

June 5, 1940

Dear Dr. Sachs:

In your capacity as a member of the coordinating committee established here in Washington, I would be greatly obliged if you could find it practicable to secure from the Union Miniere of the Belgian Congo answers to the questions outlined below. In presenting this matter you may desire to be accompanied by one or more of our scientific advisors at Columbia University, including Drs. Pegram, Urey, Fermi and Szilard, but I shll leave this to your own good judgment.

The questions in which our Committee is interested are as you know as follows:

(1) What is the stock of mined uranium left in the Belgian Congo, and in what form is it? What stocks, if any, were left in Brussels?

(2) What are the possibilities of mining uranium ore in the Belgian Congo and transporting it to this country under present conditions? What would be the out-of-pocket costs of mining "X" amounts, according to scale of profitability of operations from the standpoint of overhead?

(3) Under what conditions would the company on a business bases and at the request of the Belgian Government in response to American mediation, be willing to export its own uranium ore to the United States, the company to retain title to the ore, but committing itself not to re-export it without special permission.

(4) Finally, what would be the practical amounts that could be extracted and transported over, say, three and six months periods, in order to have a basis of comparison with similar maximal amounts that could be secured from, say, Canada in the same periods?

I shall await your findings with much interest.

Sincerely yours

Lyman J. Briggs, Director
(Signed)

U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington

Addfess Reply to
National Bureau of Standards

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LFB:DEK

D

June 5, 1940

Dr. Alexander Sachs,
One South William Street,
New York, N. Y.

Dear Dr. Sachs:

I have prepared a letter along the lines indicated in your letter of June 3rd which was very helpful. Please use your own good judgment as regards the best way to proceed for in such matters you are far more experienced than I am.

The scientific advisory committee is shaping up very nicely. Dr. Bush, the President of the Carnegie Institution of Washington, has assured us that his only desire in calling the conference was to determine in what way the Institution might be most helpful, and the way is now entirely clear to appoint the scientific advisory committee which we discussed last Saturday. I saw Dr. Urey today and we arrived tentatively at the following list:

Dr. Urey, Chairman
Dr. Tuve
Dr. Beams
Dr. Breit
Dean Pegram
Dr. Rabi
Dr. Gunn
Dr. Fermi
Dr. Szilard

It seemed to me advisable to make this strictly a scientific committee which will report its findings and recommendations to us for action. It rust this will meet with your approval. A meeting has been planned in Washington for June 15th.

Sinserely yours,

Lyman J. Briggs, Director
(Signed)

June 5, 1940

Dear Dr. Briggs:

In furtherance of our conversation last Saturday at Admiral Bowen's office, may I submit to you the facts and considerations bearing on the urgency of initiating discussions with the officials of the Union Miniere of the Belgian Congo resident in New York.

The questions to take up with the managing director, Dr. Sengier, - and perhaps, eventually, with the diplomatic representatives in Washington of the Belgian Government-in-exile.are these:

1. What is the stock of mined uranium left in the Belgian Congo, and in what form is it? (b) What stocks, if any, were left in Brussels?

2. What are the possibilities of mining uranium ore in the Belgian Congo and transporting it to this country under present conditions? (b) What would be the out-of-pocket costs of mining "X" amounts, according to scale of profitability of operations from the standpoint of overhead?

3. Under what conditions would the company (a) on an business basis and (b) at the request of the Belgian Government in response to American mediation, be willing to export its own uranium ore to the United States, the company to retain title to the ore, but committing itself not to re-export it without special permission.

4. Finally, what would be the practical amounts that could be extracted and transported over, say, three and six months periods, in order to have a basis of comparison with similar maximal amounts that could be secured from, say, Canada in the same periods?

Assuming that the institution of such an inquiry meets with your approval, I would suggest that you authroize

a small committee consisting, in addition to myself, of the present group at Columbia concerned with uranium, namely, Doctors Pegram, Urey, Fermi and Szillard. My thought is not to have the whole committee call with me on Dr. Sengier, but only two of its members - one a scientist who is a citizen and the other drawn from the unique experimental team which happens to be non-citizen as yet. But in order to lend authority to the group, it seems to me advisable that you state that these individuals are part of a coordinating committee which has been appointed for keeping the scientific division of the Government advised of the theoretical and the other work. While it might not be necessary to show any credentials to Dr. Sengier, it seems to me important that we have express documentary authorization before calling on him.

Finally, the delegation would, in my opinion, have to agree in advance on the representations to be made. On the negative side, this implies non-disclosure as to focus and methodology of the work and the progress made, and the substitution for that of some general designation with emphasis, perhaps, on the Isotop separation. On the positive side, it requires formulation of alternative probabilities of amounts of the metal - desirable under varying conditions - by experimentors: Tasks of this sort in practice get delegated to Dr. Szillard, for all his modesty, since Dr. Fermi and the others regard him as resourceful in the practical aspects of the work as he is deemed to be original and inventive in ideas and methods In keeping with the practice I have followed, the formulation by anyone is submitted to the others of the group and generally undergoes some revision. Needless to add as soon as agreed upon I would forward you a copy for your record and, if you desire, also, for your approval; though the above details given in the indent as to scope and method may well suffice.

Sincerely yours,

Dr. Lyman J. Briggs, Director
National Bureau of Standards
Department of Commerce
Washington, D. C.

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

IN YOUR REPLY
REFER TO FILE

LJB:DEK June 7, 1940 D

Dr. Leo Szilard,
Columbia University,
New York, N. Y.

Dear Dr. Szilard:

I should like very much to have you accept membership on an advisory committee on nuclear physics to guide the Government in supporting necessary work in this field. This Committee is being organized under the leadership of Prof. Urey and the first meeting is being called at the National Bureau of Standards on Thursday morning, June 13th, in the South Building Conference Room at nine o'clock. The members of the Committee are Messrs. Urey, Breit, Pegram, Tuve, Fermi, Szilard, Wigner and Teller.

Please use the enclosed transportation request in securing your railroad and Pullman tickets. A subsistence allowance of $5.00 per diem will be made for the time you are absent from your official station.

I shall greatly appreciate your cooperation in this matter.

Sincerely yours,

L. J. Briggs

Lyman J. Briggs, Director.

43022

May 10, 1941

Dr. Lyman J. Briggs, Director
National Bureau of Standards
Washington, D. C.

Dear Dr. Briggs:

This week we have discussed again the question of how much uranium metal we would recommend you to buy. Our conclusion is this: Of the unmortgaged remainder of the $100,000 you had with which to buy materials all but a reserve of about $10,000 can best be used in buying uranium in powder form, if as much as approximately three tons of the degassed, non-pyroforic metal can be obtained for the money available.

It seems probable that the way to get the best bid from Alexander will be to tell him the whole amount of money that can now be spent for uranium, tell him also that we need three tons, and ask him how nearly three tons he can supply for the money.

If the amount of money available is $30,000, it would provide three tons at $5.00 a pound, about $2.25 a pound for the oxide and $2.75 a pound for reducing. Dr. Szilard, who has had the latest conversations with Alexander, thinks that on an order for approximately three tons Alexander could afford to produce the metal from oxide supplied by you, for not much more than $2.75 a pound. Since to make as much as 1000 pounds Alexander would have to arrange about a suitable staff and the steady use of his equipment for some weeks, we are of the opinion that a much better offer might be obtained on a bid for three tons than Alexander could probably undertake to give on a bid for only 1000 pounds.

In placing any order with Alexander it should be understood that the material would be subject to test from batch to batch to make sure of its quality.

It may be that the $30,000 will not be enough to provide three tons of metal unless the uranium oxide were furnished to Alexander, but whether that would be the case or not would come out in the reply from Alexander to the request for an estimate on three tons.

CONFIDENTIAL

NRB

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

IN YOUR REPLY
REFER TO FILE

GB:KSV July 3, 1941. D

Dr. L. Szilard,
Department of Physics,
Columbia University,
New York, N. Y.

Dear Dr. Szilard:

The Uranium Committee established by the National Defense Research Committee has appointed you as a member of the Subcommittee on Theory of Nuclear Chain Reactions.

The Committee hopes that you will find it possible to help the defense program by undertaking this very important national service.

In accordance with my instructions from the National Defense Research Committee it is necessary for me to impress upon you the need for utmost secrecy in regard to all activities which come to your attention in connection with your appointment. The only justification for the inclusion of the Uranium work in the program of the National Defense Research Committee lies in the military applications which are the purpose of the work. It is necessary, therefore, to adhere to the requirements of military secrecy such as are imposed on us by the military authorities.

All members of the National Defense Research Committee and organizations working under its auspices have taken the usual oath of allegiance to the United States. I should appreciate it greatly, therefore, if you would return to me the enclosed oath, duly notarized, together with a written acknowledgement of this letter.

Dr. Breit has been appointed Chairman of the Subcommittee. After I hear from you he will get in touch with you regarding the work and meetings.

I should like to assure you of my deep appreciation of your interest in the work on Uranium.

Yours very truly,

L J Briggs

Lyman J. Briggs, Director.

Enclosure: Oath of Allegiance.

~~CONFIDENTIAL~~

July 7, 1941

Dr. Lyman J. Briggs, Director
National Bureau of Standards
Washington, D. C.

Dear Dr. Briggs:

Many thanks for your kind letter of July 3, of which I herewith acknowledge the receipt.

I shall be very glad to serve as a member of the Subcommittee on Theory of Nuclear Chain Reactions, and I am herewith enclosing, signed and notarized, the oath which you sent to me.

Yours very truly,

L. S.

LS:H

(Leo Szilard)

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

IN YOUR REPLY
REFER TO FILE

LJB:DEK

August 20, 1941

D

Dr. Leo Szilard,
Columbia University,
New York, N. Y.

Dear Dr. Szilard:

I wish to acknowledge and thank you for your helpful and constructive report of August 18th.

Sincerely yours,

L. J. Briggs

Lyman J. Briggs, Director.

Dear Dr. Briggs:

More than two years ago in July, 1939, I found a method for setting up a chain reaction under condition which were permitted to utilize the heat developed in this action for purposes of bar production. A lattice of uranium metal spheres embedded in graphite was calculated in detail and the result of it was so favorable that,after consultation with Professor E. P. Wigner, Professor E. Teller, and Dr. Sachs, Professor Einstein wrote a letter to the President of the United States pointing out that work on chain reaction had reached the stage at which large scale liberation of neucular energy is an immediate possibility. Our work was sufficiently far advanced in July, 1939 to demonstrate this and all that was necessary to do was to pile up a sufficiently large amount of graphite and uranium oxide according to the formuli which were derived and see whether we could make a chain reaction go. Two years have since passed and we have not yet reached the stage of this last clear experiment for which we were all ready in July of 1939. In these circumstances it appears necessary to ask what the reasons are for such an enormous lapse of time between the conception of the experiment and its execution. It seems to me that there are two different factors which contribute to this unsatisfactory state of affairs. One is the complicated organization which has been set up and which prevents a direct contact between those who originated this work and who are carrying it on and those executives who have the authority actually to appropriate money for the project. The other is the composition of the committees who are supposed to be responsible for this work.

Two different spirits are represented among those who are interested in the of chain reaction. One group wishes to procede step by step and the chief concern is to avoid mistakes through which they might expose themselves to criticism. Those who belong to this group would have quite willingly performed the last clear

experiment in 1939x if they could have obtained the facilities for it without actually asking for them. But to ask for those facilities, if there were a one to ten chance of failure would appear to them as recklessness. Any peace time enterprise might do well to have its Board selected from this type of people. To disregard their advice would lead to bankruptcy! But to listen to their advice in war time, however, might might lead to defeat. The group of people on the other hand who took upon themselves the responsibility of approaching the Government in connection with this subject in 1939 were of a different kind. They pressed for action two years ago and they would have exerted their influence to more vigorous action ever since if they had not been, one by one, eliminated from those committees in which they could have exercised their influence.

This work has now been carried on for two years under the auspices of Government. Complicated organization with a number of committees is supposedly directing it, but in spite of the good will of everyone, with one possible exception, in spite of the fact that all of the reports so far have been very favorable, there is a lag of two years between the conception of the required experiments and their execution. The task which is before us was consists of two parts. First of all, one has to demonstrate by a last clear experiment that the chain reaction can be made to work in a system composed of uranium and graphite, and secondly, one has to set up a power plant in which the energy liberated in the chain reaction is utilized. The first task is easy. It could have been performed as soon as this method was brought to the notice of the Governmentxxxxxx two years ago and ever since at any time, provided the facilities required had been put at the disposal of those who proposed this experiment. In spite of the complicated organization which is at present set up it can perhaps be assumed that this task will be performed in the near future. The second task is very difficult and can not be soled in a short time unless the work is carried out in a set up which is

very different from the one acting at present. The direct application for defense may be very important and urgent, yet it is quite clear that unless the industrial application of operating a power plant is first worked out the applications for defense will not develop for lack of experience. Let us imagine that at the time the first automobile motor was devised the Government had been approached with the plan to develop an explosion motor for fighter airplanes and some branch of the Government would be entrusted with this task. There is little doubt that they would have failed to produce the required result and that it took years of development based on industrial mass production of the ordinary automobile motor before the time would arrive for the production of the high speed airplane engine. The situation is not very different in this case.

Dear Dr Szilard

I hope you can join us in a further discussion of uranium experiments at my office in the Nat. Bureau of Standards on Saturday at 2 pm

Sincerely yours

Lyman J. Briggs