

Columbia University
in the City of New York

DEPARTMENT OF PHYSICS

December 18, 1940

Memorandum for Professor Mitchell:

1. Uranium Metal

~~It is suggested to have 10 kg. of uranium metal bought from Alexander returned to him, with the request of keeping this uranium for an hour at 850°C, i.e. the same temperature which he used in preparing the samples tested by the Bureau of Standards.~~

*As well
as the
1/19/40*

2. It is suggested to make an inquiry with the Bureau of Standards on the following points:

- (a) Would they be willing to make a quantitative spectroscopic test for boron and the rare earths in a number of samples of coke and graphite? One part in a million of boron and less would have to be detected and estimated. One part in ~~ten~~ million of gadolinium, dysprosium, europium or samarium would be of importance.

It is, however, more important to get quickly an estimate of the boron content than to find out something about the rare earths.

How quickly could such analyses be made after receiving the samples, and what would be the charges, if any?

Would it be more convenient for the Bureau of Standards to receive graphite samples, or would they prefer to have the ash? We may or may not be in a position to supply the ash.

- (b) Would the Bureau of Standards be able to reduce ~~4~~ samples of five pounds of graphite to ash under conditions at which all the boron, iron and vanadium, as well as the rare earths, would be obtained in the ash? How quickly could such samples be ~~tested~~ and what would be the charge, if any?

prepared

L. R.

(Leo Szilard)

December 18, 1940

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L. Szilard
(Leo Szilard)

December 18, 1940

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(Leo Szilard)

420 West 116th Street
New York, N. Y.
December 19, 1940

Dear Mitchell:

I am sending you the enclosed copy of a letter which I am writing to Dr. Alexander, in order to keep you informed as far as that is possible of the present trend of our ideas.

Dr. Alexander said that he will make no charge for preparing small sintered blocks. He will send us two small sintered blocks of uranium without a binder within the next few days, and he will try some of the binders which I selected from the nuclear point of view, because he is confident that such binders will make it much easier to obtain a decent sintered block.

Yours,

LS:H

February 26, 1941

Dear Mitchell:

I propose to send you, care of Dr. Briggs, National Bureau of Standards, ten pounds of uranium oxide in the near future. Do you think you could arrange to have it tested in the following way: One pound of this material should be dried at 200°C in air and the residual hydrogen content determined; another pound should be similarly treated at 400°C; another at 600°C; another at 800°C; another at 1000°C; and another at 1100°C.

Apart from the hydrogen content of these samples, we are interested in making certain experiments here on the above six one-pound lots, so that these samples would have to be shipped to us in sealed containers.

This matter has an urgency No. 2, as compared to the urgency of No. 1, the graphite problem.

Yours sincerely,

L. S.

LS:H

(Leo Szilard)

P. S. The uranium oxide will be shipped in the tinned iron tube in which it was used in the manganese sulphate experiment and its weight will be closer to 9 pounds than to 10 pounds. Since the possibility of a leak cannot be entirely excluded, and since such a leak would mean that the uranium oxide contains some manganese sulphate, it might be desirable to have a qualitative test for manganese made on this sample. Otherwise, perhaps the presence of manganese sulphate might lead to misleading results.

L. S.

cc: 1 - Pegram
1 - Szilard
1 - I. S. Bemis

February 26, 1941

Dear Mitchell:

I am not satisfied with the progress we have been able to make on the subject of the production of uranium dioxide, and I wonder if the Bureau of Standards could help us also in this matter? I should consider its urgency as designated by the number 3.

I suppose that a reduction could be carried out on U_3O_8 by hydrogen between 900 and 1000°C. We are primarily interested in the density of the product. The density could be determined by having a measuring cylinder filled with chlorbenzene and the sample dropped into this liquid. By weighing the sample before dropping it into the measuring cylinder and by observing the volume of chlorbenzene displaced, one would obtain the density. The minimum amounts which we would require are one to two pounds, and an estimate of cost for the production in one-ton lots would interest us very much if the quality of the product obtained in a quantity of one or two pounds is satisfactory.

Yours sincerely,



(Leo Szilard)

LS:H

cc: 1 - Pegram
1 - Szilard
1 - I. S. Bemis

May 16, 1941

Dear Mitchell:

We have been expecting you for today, but since Mrs. Bemis didn't hear from you, I assume that you were not able to come.

It seems to be essential that we should have another talk with Professor Pegram and Fermi before any further steps are taken about ordering metal from Alexander. In the meantime, let me give you my picture of our need for uranium metal, since you can arrive at the right decisions only if you have a complete picture of how this uranium metal fits into our other plans.

In order to perform an intermediate experiment with 40 tons of carbon and uranium metal, we would probably need about 6 tons of metal. Four tons of metal are probably considerably below the optimum, and it is doubtful whether it is worth while performing the experiment with any less amount of uranium metal.

Assuming that we are authorized to spend \$35,000 out of the remaining \$42,000, for the purpose of obtaining the required quantity of uranium metal, and further assuming that we can obtain up to 8 tons of uranium oxide on loan from the Canadians, in accordance with what you said to me on Monday, we could then proceed as follows: We could ask Alexander whether he would be willing to convert for \$35,000 the uranium oxide, which we will supply him, into 10,000 pounds of uranium metal, or at the worst to convert 10,000 pounds of uranium oxide, which we will supply him, into metal. No separate degassing would be necessary, according to our present experience, so that the reduction would take place in one single operation.

I am convinced that this price is not too low and that it will leave Alexander a modest profit. However, if you should think that this price is too low, in view of the risk that something goes wrong and that in a number of cases, for one reason or another, the charge of the furnace is lost through oxidation or through becoming pyroforic, we could safeguard Alexander against such an unforeseen loss by contracting in the following way: Alexander would commit himself to supply uranium metal, obtained by reducing uranium oxide, which he would produce by operating a certain number of furnaces for a certain number of days, and instead of specifying that he would supply 10,000 pounds of metal, we would only specify that he would supply not less than 7,000 pounds of metal. I am just as anxious as you are to see that Alexander should not be losing money on such contracts. On the other hand, I believe that it is in his best interest that we should have enough uranium to carry out the proposed experiment, and that he will have an opportunity on later contracts to recover the general development costs which he has incurred in connection with titanium and uranium during the past years.

Corresponding to 10000 lbs metal, but

first of month
 As to the order, Professor Pegram tells me that you arranged with Alexander that, if an order is placed for a larger amount within six weeks, he would consider all orders placed during that period as a single order, and the higher price which he would charge for the first 1,000 pounds would thus have no significance except from the point of view of bookkeeping.

I believe that we have to be particularly careful about how to spend the \$42,000 remaining, because of the fact that our project is in a rather different class from the other projects which are handled through the Bush committee. In the case of these other projects there are immediate applications, of which the Army and Navy are fully aware, whereas in our case the possibility of such applications is not officially recognized. We had to wait for a year before we actually got this appropriation for uranium metal, for which we asked in June of last year, and I am afraid that we have to act on the assumption that for some time to come we will have no further funds available for buying materials for the intermediate scale experiment.

In the circumstances my inclination would be to talk to Alexander and to ask him to write us a letter agreeing to charge less than \$3.50 per pound on a \$35,000 order if he should receive such an order within six weeks. If we can get from him such a letter, the Bureau of Standards could then use this letter as a basis and ask Alexander for a formal bid at a later date. I phoned Alexander last Saturday and might have obtained such a letter by now if I had not in the meantime received a copy of the letter which you wrote to him. Since you saw him in the meantime, and since I am not fully informed of your conversation, I do not want to have any contacts with Alexander until I see you. It is, of course, quite essential at this stage of the negotiations that one of us should not hold out to Alexander hope for a higher price than the other one does. Of course if you should already have obtained an assurance from Alexander of a price between \$3.00 and \$4.00 per pound, then we could very well leave it at that.

If you have not yet obtained such an assurance, but if you are convinced in your heart, as I am, that it would not be unfair to ask Alexander to give us a price of about \$3.50 per pound on a larger order, then you would be in just as good, and maybe a better, position to get an assurance from Alexander now. On the other hand, if you are not convinced that it is fair to ask Alexander for such a low price, then I had better ask him, since a sincere conviction on this point is a prerequisite for successfully bringing down the price to the level at which we can obtain, with our present appropriation, a sufficiently large quantity of metal to make the intermediate scale experiment appear promising.

Hoping to see you soon to discuss the point raised in this letter,

Yours sincerely,

S:H

(Leo Szilard)

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS

DFM:DEK

May 15, 1941

IN YOUR REPLY
REFER TO FILE

D

Memorandum to the Director:

Subject: Production of uranium metal by
the Metal Hydrides, Inc.

The amount of material contemplated is 6000 lbs. to be prepared in accord with the following approximate schedule.

(1) An initial order of 1000 lbs. upon which a bid has been submitted at \$10, ~~000~~ per lb. providing the oxide is supplied by the Government. This material will be produced under the following approximate conditions: 3 retorts, 1 leaching tank, 1 filter press, and a large vacuum drying oven will be set aside for this work so that production at the rate of 75 lbs. of metal per day, 5 days a week, will provide the necessary experience and cost records upon which a bid for the additional 5,000 lbs. can be based.

(2) The total price for the 5,000-lb. lot is to be established as follows: cost data obtained as outlined in part 1 will indicate the lowest cost of 6,000 lbs. The price to be charged for 5,000 lbs. will be obtained by subtracting the \$10,000 for the first thousand pounds from the estimate for 6,000 lbs. Obviously this gives the Government the benefit of the lowest price that Metal Hydrides can submit after the educational order of the thousand pounds under such conditions that the actual amount paid for the 1,000 pounds is automatically reduced through the adjustment of the price for 5,000 lbs.

(3) Fortunately Mr. P. P. Alexander, President of Metal Hydrides fully understands that due to the potentialities of the James method of producing this metal (which is now being developed by Dr. Rodden), it is not sensible to conclude at the present time that the entire 6,000 pounds must be in the form of metallic powder. Dr. Alexander agrees that at some time prior to the completion of the above program for the production of metallic powder it may become advisable to stop producing powder and produce instead solid castings by the James-Rodden method:

that the facilities of his plant and personnel ^{is} such that it is reasonable to expect to use the James-Rodden method in his plant and thus continue the production of metal under the contract which initially calls for powder material. The details of such a change are of course not available at present and hence the effect of such a change upon the cost of the material being produced cannot now be estimated. It is, however, believed that if the change were made in the way of increased cost it would be easy to stipulate a part of this change in a supplementary order so that the work could proceed without the cancellation of the original order. Dr. Alexander also agrees that in case the change in method of production should involve an actual reduction in the cost of such production the Government will get the benefit of such savings.

Dr. P. P. Alexander's position in regard to all of the above may be summarized as follows:

(a) The educational order for 1,000 pounds of metal at \$10,~~000~~ per pound is very important if his Company is to submit a bid that will represent the lowest possible cost for the 6,000 lbs.

(b) The price of \$10,~~000~~ a pound is necessary until further experim~~ent~~ is gained.

(c) The price of \$10,~~000~~ a pound will be automatically reduced in fixing the price for the additional 5,000 lbs.

(d) The method of production can and will be changed on the basis of the experiments now being carried on by Dr. Rodden when and if these experiments indicate the advisability of such a change.

(e) Only a guess concerning the probable cost of the 6,000 pounds can be made at this time. The present indication is about \$7,~~000~~ per pound or \$42,000 for the lot of 6,000 pounds (It should be strongly emphasized that the whole point of the above arrangement is that we cannot now place any evaluation of the probable accuracy of this figure of \$7,~~000~~ per pound.)

D. P. Mitchell.

May 17, 1941

Professor D. P. Mitchell
Carnegie Institute for Terrestrial Magnetism
Washington, D. C.

Dear Mitchell;

(1.) Enclosed you will find a draft of a letter which I might write to Alexander. I feel, however, that it would perhaps be better if you wrote this or a similar letter and if you think you will be able to do so I would ask you to send me a telegram in which case I will not send my letter to him.

(2.) I need very urgently sixty pounds of uranium metal and I shall try to get Professor Pegram's O.K. tomorrow morning ^{for} ~~that~~ ^{to} you ask Alexander to manufacture this amount for me at once assuring him that in case he should not receive the one thousand pound order ^{from Briggs} Columbia will foot the bill ^{for 60 lbs} at the twenty dollar per pound rate upon which we agreed. If Pegram agrees I shall send you a telegram tomorrow morning saying, "Please go ahead. Szilard." If you receive my telegram kindly confirm it by wire since I ~~am~~ ^{would} not know whether or not the telegram reached you in Washington and I would contact Alexander directly about this sixty pounds if you can not be reached. I am very anxious to have this sixty pounds as soon as possible as we are badly held up without it.

(3.) I have given much thought to your proposal of using the whole appropriation which is at the disposal of the

National Bureau of Standards for the purchase of uranium metal and I am in full agreement with the basic ideas which prompted your suggestion. I am, however, very anxious to avoid a situation in which any money from a present Columbia project appropriation which is at the disposal of Pegram has to be used for purchasing materials such as the paraffin. All the money which we have at our disposal at present is urgently needed to secure the employment of a number of additional men who are available now, but who will not be available later. Pegram has already agreed to take on a mechanic and another physicist but this is not enough and I fear that if our appropriation runs low there will be hesitation about taking on additional men. We are, at present, terribly shorthanded and securing the additional personnel appears to be even more important than securing additional amounts of uranium metal corresponding to the value of the paraffin.

With kind regards,

Yours sincerely,

(Leo Szilard)

JC/LS

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
NATIONAL BUREAU OF STANDARDS
DPM:DEK

IN YOUR REPLY
REFER TO FILE
D

May 17, 1941

Dr. George B. Pegram,
Physics Dept., Columbia Univ.,
538 W. 120th Street,
New York, N. Y.

Dear Prof. Pegram:

I have just talked to Dr. Briggs as here indicated.

(1) It is of prime importance to reserve all funds now available (and which will lapse June 30) for the purchase of the largest possible amount of uranium metal (3 tons of metal absolute minimum, 6 tons optimum). For this reason no paraffin will be purchased (order signed and stopped this morning) until we are assured of a sufficient quantity of metal.

(2) The request for the immediate loan of 8 tons of oxide will be made by Dr. Briggs.

(3) The educational order for 1,000 pounds uranium powder to be produced by Alexander will be placed as soon as (a) a suitable formula (is agreed to in writing) for the determination of the cost of 5 or more thousand pounds of metal as outlined in the memorandum of May 15 addressed to Dr. Briggs; (b) a written statement of the criterion for determining if the material is non-pyrophoric and determining the purity if the acceptance tests are agreed upon.

(4) The above makes it imperative to (a) obtain delivery of the 4 tons of oxide now in New York, take samples therefrom and ship them to the Bureau of Standards immediately (if possible make arrangement for the determination of moisture content of similar samples at Columbia); (b) for Dr. Alexander to complete shipment of his calcium to the Bureau where a suitable analysis may be made; (c) for the half-pound sample of metal now at the Bureau to be analyzed and tested to see if pyrophoric.

Dr. Briggs is very pleased to learn that exclusive use of the east room has been obtained and that the preparations of the room will soon be under way.

Respectfully,

D. P. Mitchell.

CLASS OF SERVICE DESIRED	
DOMESTIC	CABLE
TELEGRAM	<input checked="" type="checkbox"/> FULL RATE
DAY LETTER	<input type="checkbox"/> DEFERRED
NIGHT MESSAGE	<input type="checkbox"/> NIGHT LETTER
NIGHT LETTER	<input type="checkbox"/> SHIP RADIOGRAM

Patrons should check class of service desired; otherwise message will be transmitted as a full-rate communication.

COPY OF WESTERN UNION TELEGRAM

C O P Y

Physics Department
Columbia University
New York City
June 26, 1941

TO: DR. D. P. MITCHELL
CARNEGIE INSTITUTION LABORATORIES
5241 BROAD BRANCH ROAD, N. W.
WASHINGTON, D. C.

ONE THOUSAND POUND ORDER FOR BISMUTH IF PLACED SHOULD GO TO CERRO DE PASCO COPPER CORPORATION FORTY WALL STREET NEW YORK CITY ATTENTION W C SMITH STOP SHOULD SPECIFY SELECTED LOW SILVER BISMUTH FROM REGULAR PRODUCTION QUOTED TO ME BY LETTER DATED JUNE TWENTY THIRD AT ONE DOLLAR TWENTY-FIVE CENTS PER POUND IN ONE HUNDRED POUND LOTS AND PURITY BETTER THAN FOUR NINES

L. SZILARD

Copies to: 1--Fermi
2--Mitchell
3--Pegram
4--Szilard

SENT OUT

Columbia University
in the City of New York

DEPARTMENT OF PHYSICS



BY
1941
JUL
10

July 10, 1941

Memorandum to Szilard from Mitchell:

The contents of the brass box indicate 98.77% U metal;
1.12% metal oxide; Calcium .08%; total H .012%; Cl--Hoff-
man expects to have this figure tomorrow.

DPM

DPM/jt

0.012%

(H)

corresponds to

$$1.2 \times 10^{-4} \times 238 \times 50 \text{ per U Atom} \\ = 1.43$$

100 ppm Boron reported
in this sample

and 0.02% Chlorine

M E M O R A N D U M

TO: Mr. Szilard July 11, 1941
FROM: D. P. Mitchell
SUBJECT: Report from Mr. Scherrer

Mr. Scherrer reported the following at one o'clock today:

#81	#16	.08% H O
82	17	.08
83	18	.09
84	19	.09
85	20	.11
86	32	.11
87	35	.14
88	49	.10
78	7	.08
79	8	.11
80	13	.11

74 Contents of Brass box 90 p.p.m. B.

75 Ca Metal U. C. & C. distilled from silicide .5ppm B.

D.P.M.

DPM/sk

Copies

1 Pegram
1 Fermi
1 Szilard
✓ 2 Mitchell

August 9, 1941

Dr. Joseph Rosin
Vice-President
Merck & Co., Inc.
Rahway, New Jersey

Dear Dr. Rosin:

For some research work which is carried out by Columbia University for the Government, we would require 5 or 10 tons of calcium chloride. We have tested some of the grades of calcium chloride which you list as stock items and found certain brands which are satisfactory whereas all other brands both from you and from other manufacturers cannot be used for our purpose.

We have counted on obtaining this material from your firm and learned only recently from your sales department that the quantity required is not in stock. Unfortunately the work which we are doing is part of a very extensive project and the whole project would be held up and endangered if we are unable to secure this material in the near future.

I wonder if it would be possible for me to see you and explain to you the emergency which has arisen so that you might use your own judgment in giving directions to your plants concerning the manufacture of calcium chloride for our needs.

Tuesday, August 12, or any day after that date would be convenient for me, but if those days are inconvenient to you, I could come to Rahway on Thursday, August 14, preferably in the afternoon if that would be agreeable to you.

Yours very truly,



(Leo Szilard)

LS:lh

Copies to:

- 1 Pegram
- 2 Fermi
- 3 Szilard
- 4 Bemis
- 5 Mitchell



October 4, 1941

Dr. Joseph Rosin, Vice President
Merck & Company, Inc.
Rahway, New Jersey

Dear Dr. Rosin:

Dr. Leo Szilard has asked me to write to you in regard to an immediate potential need for one ton of the purest available sodium fluoride.

I have just written to The Harshaw Chemical Company (Mr. Champion), requesting detailed chemical analysis of the most pure batches of this material that they have prepared recently. I understand that Harshaw supplies you with this material so it is probable that you also have representative analysis of their purest product and that most likely you purify it further.

Will you please, therefore, be kind enough to have sent to us as soon as possible representative analysis representing what you believe is the purest sodium fluoride that will be available at this time in a quantity of about one ton.

As we are in immediate need of this information and it may well be that one of your men will wish to discuss the matter, please feel free to call Dr. Szilard, New York City telephone number - University 4-3200, Extension 35 (we will accept reverse charges.)

Very truly yours,

D. P. Mitchell
Pupin Physics Laboratories

DPM:H

Copies

1 Pegram
2 Fermi
3 Szilard
4 Bemis
5 Mitchell



October 4, 1941

The Harshaw Chemical Company
1945 East 97th Street
Cleveland, Ohio

Attention: Mr. R. W. Champion

Dear Sir:

It looks as though we will have urgent need in the near future of about one ton of the purest available sodium fluoride for use in a National Defense research project.

I have just talked to your New York office and have been given your name as the most probable one who can give me quickly the following information:

Complete chemical analysis of recent batches that you have manufactured with the highest purity. On this list to indicate lower values of the various impurities, which you believe it would be reasonable for you to attain with great care in your present manufacture but without waiting to develop better methods of purification.

Probable price and time required for delivery of the above product.

I am also writing to Merck concerning the same problem, since I understand that they may purify your product.

An immediate reply will be very much appreciated. If you feel that you cannot reply without discussing the matter further, please call Dr. Leo Szilard, New York City telephone number - UNiversity 4-3200, Extension 35 - who will receive reverse charges and give you more details.

Very truly yours,

D. P. Mitchell
Pupin Physics Laboratories

DPM:H

- 1 Pegram
- 2 Fermi
- 3 Szilard ✓
- 4 Bemis
- 5 Mitchell

October 7, 1941

American Fluoride Corporation
151 West 19th Street
New York, New York

Gentlemen:

We will have need in the near future for between 500 pounds and one ton of the purest available sodium fluoride for use in a National Defense research project.

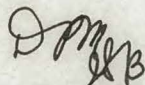
We would like to obtain as quickly as possible the following information:

Complete chemical analysis of recent batches that you have manufactured with highest purity. On this list to indicate lower values of the various impurities which you believe it would be reasonable to attain with great care in your present manufacture, but without waiting to develop better methods of purification.

Probable price and time required for delivery of the above product.

An immediate reply will be very much appreciated.

Very truly yours,



D. P. Mitchell
Pupin Physics Laboratories

ISB:H

~~CONFIDENTIAL~~

Copy for [unclear] & [unclear]

4801 Connecticut Ave., N. W.,
Washington, D. C.

Mr. P. P. Alexander, President,
Metal Hydrides Incorporated,
Box 816,
Clifton, Massachusetts.

Dear Mr. Alexander:

Yesterday afternoon after we discussed the present situation with regard to the production of uranium metal, Dr. Briggs, the Director of the National Bureau of Standards, had requests for bids on 1000 lbs. of uranium metal, to be produced from Canadian oxide supplied by the Government, sent to three different companies. Your Company is, of course, one of these. In view of the recognized fact that yours is the only one on this continent that has the equipment and experience to produce this metal at reasonable cost, the solicitation of these bids is practically speaking a formality. On the other hand, the selection of 1000 lbs. as the quantity to be bid upon is another matter.

We will need, certainly by the first of October, 6000 lbs. of this material. As you know, it would be a great advantage to have it in the form of solid hemispheres, and at the present time we are not sure that we can produce it in this form. If we cannot do so we, of course, know that we can use the powdered metal, provided that it is not dangerously pyroforic. For fiscal reasons the contract or order for the total amount of material must be closed prior to July 1, and in view of the time required for production, it is, of course, advisable to close the contract as soon as possible.

This preliminary order for 1000 lbs. is to be produced in such a way as to provide a maximum amount of information concerning the cost of production on a sufficient scale to yield at least 1600 lbs. per month. Production on the basis of not less than 200 lbs. per week should be begun immediately after the order is placed, and complete figures kept on cost. Within not more than three weeks it is expected that the data

thus obtained will be sufficient to safely estimate cost figures for the production of an additional 5000 lbs.

Needless to say, I hope that you will submit your bid for the first 1000 lbs. within one week, and start your plans immediately with all reasonable anticipation of this work. If you wish to get me on the telephone you may do so Saturday. Make a person to person call and suggest that I may be reached at Woodley 0863 between 9 and 6, and Emerson 8036, Washington, D. C., at other times.

With thanks for your continued interest in endeavoring to assist us in this work, and the kindest personal regards, I remain

Very truly yours,

D. P. Mitchell.