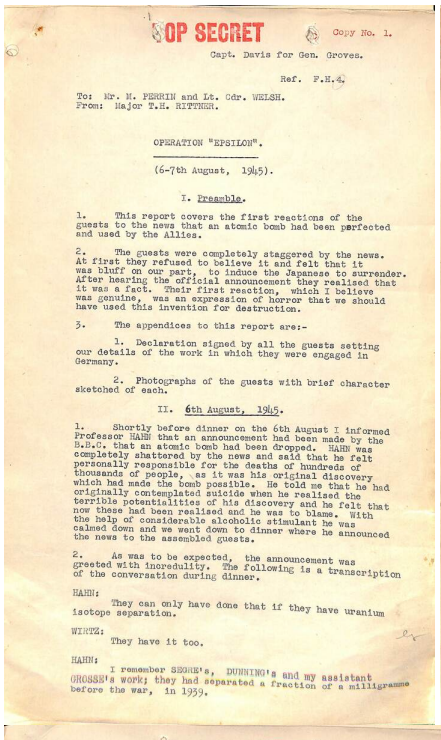
Transcript of Surreptitiously Taped Conversations among German Nuclear Physicists at Farm Hall (August 6-7, 1945)

Source



TOP SECRET Copy No. 1.

Capt. Davis for Gen. Groves.

Ref. F.H.4.

To: Mr. M. PERRIN and Lt. Cdr. WELSH.
From: Major T.H. RITTNER.

OPERATION "EPSILON".

(6-7th August, 1945).

I. Preamble.

1. This report covers the first reactions of the guests to the news that an atomic bomb had been perfected and used by the Allies.

2. The guests were completely staggered by the news. At first they refused to believe it and felt that it was bluff on our part, to induce the Japanese to surrender. After hearing the official announcement they realised that it was a fact. Their first reaction, which I believe was genuine, was an expression of horror that we should have used this invention for destruction.

3. The appendices to this report are:-

1. Declaration signed by all the guests setting our details of the work in which they were engaged in Germany.

2. Photographs of the guests with brief character sketched of each.

II. 6th August, 1945.

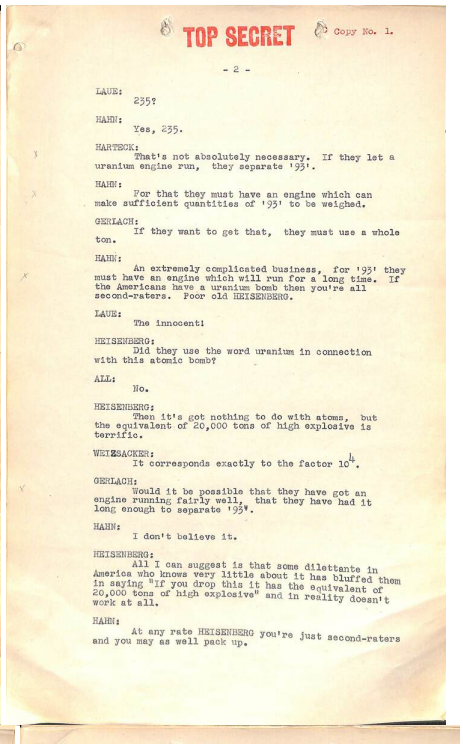
1. Shortly before dinner on the 6th August I informed Professor HAHN that an announcement had been made by the B.B.C. that an atomic bomb had been dropped. HAHN was completely shattered by the news and said that he felt personally responsible for the deaths of hundreds of thousands of people, as it was his original discovery which had made the bomb possible. He told me that he had originally contemplated suicide when he realised the terrible potentialities of his discovery and he felt that now these had been realised and he was to blame. With the help of considerable alcoholic stimulant he was calmed down and we went down to dinner where he announced the news to the assembled guests.

2. As was to be expected, the announcement was greeted with incredulity. The following is a transcription of the conversation during dinner.

HAHN:
They can only have done that if they have uranium isotope separation.

WIRTZ:
They have it too.

HAHN:
I remember SEGRE's, DUNNING's and my assistant (HOSSE's work; they had separated a fraction of a milligramme before the war, in 1939.



TOP SECRET Copy No. 1.

- 2 -

LAUE:
235?

HAHN:
Yes, 235.

HARTECK:
That's not absolutely necessary. If they let a uranium engine run, they separate '95'.

HAHN:
For that they must have an engine which can make sufficient quantities of '95' to be weighed.

GERLACH:
If they want to get that, they must use a whole ton.

HAHN:
An extremely complicated business, for '95' they must have an engine which will run for a long time. If the Americans have a uranium bomb then you're all second-raters. Poor old HEISENBERG.

LAUE:
The innocent!

HEISENBERG:
Did they use the word uranium in connection with this atomic bomb?

ALL:
No.

HEISENBERG:
Then it's got nothing to do with atoms, but the equivalent of 20,000 tons of high explosive is terrific.

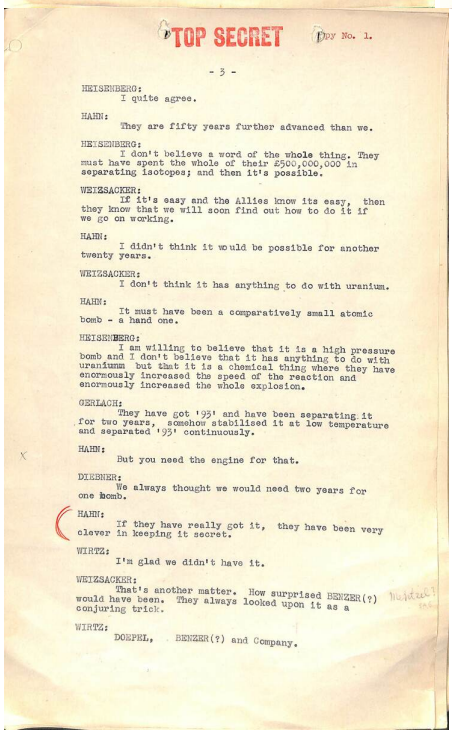
WEIZSACKER:
It corresponds exactly to the factor 10^4.

GERLACH:
Would it be possible that they have got an engine running fairly well, that they have had it long enough to separate '95'.

HAHN:
I don't believe it.

HEISENBERG:
All I can suggest is that some dilettante in America who knows very little about it has bluffed them in saying "If you drop this it has the equivalent of 20,000 tons of high explosive" and in reality doesn't work at all.

HAHN:
At any rate HEISENBERG you're just second-raters and you may as well pack up.



TOP SECRET Copy No. 1.

- 3 -

HEISENBERG:
I quite agree.

HAHN:
They are fifty years further advanced than we.

HEISENBERG:
I don't believe a word of the whole thing. They must have spent the whole of their £500,000,000 in separating isotopes; and then it's possible.

WEIZSACKER:
If it's easy and the Allies know its easy, then they know that we will soon find out how to do it if we go on working.

HAHN:
I didn't think it would be possible for another twenty years.

WEIZSACKER:
I don't think it has anything to do with uranium.

HAHN:
It must have been a comparatively small atomic bomb - a hand one.

HEISENBERG:
I am willing to believe that it is a high pressure bomb and I don't believe that it has anything to do with uranium but that it is a chemical thing where they have enormously increased the speed of the reaction and enormously increased the whole explosion.

GERLACH:
They have got '95' and have been separating it for two years, somehow stabilised it at low temperature and separated '95' continuously.

HAHN:
But you need the engine for that.

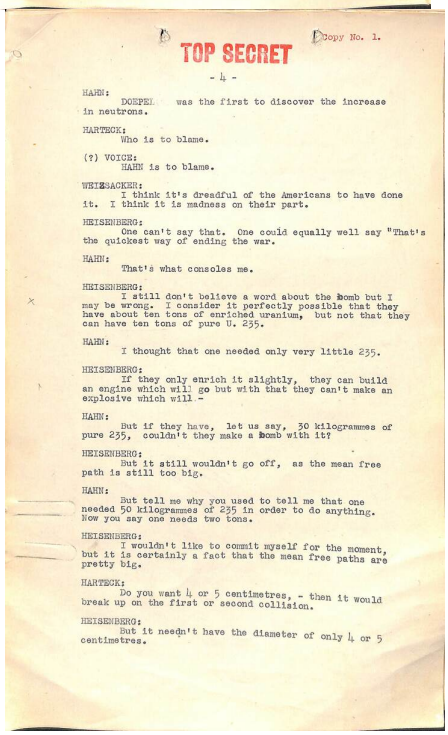
DIEBNER:
We always thought we would need two years for one bomb.

HAHN:
If they have really got it, they have been very clever in keeping it secret.

WIRTZ:
I'm glad we didn't have it.

WEIZSACKER:
That's another matter. How surprised BENZER(?) would have been. They always looked upon it as a conjuring trick.

WIRTZ:
DORPEL, BENZER(?) and Company.



TOP SECRET Copy No. 1.

- 4 -

HAHN:
DORPEL was the first to discover the increase in neutrons.

HARTECK:
Who is to blame.

(?) VOICE:
HAHN is to blame.

WEIZSACKER:
I think it's dreadful of the Americans to have done it. I think it is madness on their part.

HEISENBERG:
One can't say that. One could equally well say "That's the quickest way of ending the war.

HAHN:
That's what consoles me.

HEISENBERG:
I still don't believe a word about the Bomb but I may be wrong. I consider it perfectly possible that they have about ten tons of enriched uranium, but not that they can have ten tons of pure U. 235.

HAHN:
I thought that one needed only very little 235.

HEISENBERG:
If they only enrich it slightly, they can build an engine which will go but with that they can't make an explosive which will -

HAHN:
But if they have, let us say, 30 kilogrammes of pure 235, couldn't they make a Bomb with it?

HEISENBERG:
But it still wouldn't go off, as the mean free path is still too big.

HAHN:
But tell me why you used to tell me that one needed 50 kilogrammes of 235 in order to do anything. Now you say one needs two tons.

HEISENBERG:
I wouldn't like to commit myself for the moment, but it is certainly a fact that the mean free paths are pretty big.

HARTECK:
Do you want 4 or 5 centimetres, - then it would break up on the first or second collision.

HEISENBERG:
But it needn't have the diameter of only 4 or 5 centimetres.

TOP SECRET Copy No. 1.

HAHN:
I think it's absolutely impossible to produce one ton of uranium 235 by separating isotopes.

WEIZSACKER:
What do you do with these centrifuges.

HARTECK:
You can never get pure 235 with the centrifuge. But I don't believe that it can be done with the ..... centrifuge.

WIRTZ:
No, certainly not.

HAHN:
Yes, but they could do it too with the mass-spectrographs. EWALD has some patent.

DIEBNER:
There is also a photo-chemical process.

HEISENBERG:
There are so many possibilities, but there are none that we know, that's certain.

WIRTZ:
None which we tried out.

HAHN:
I was consoled when, I believe it was WEIZSACKER said that there was now this uranium - 25 - minutes - I found that in my institute too, this absorbing body which made the thing impossible consoled me because when they said at one time one could make bombs, I was shattered.

WEIZSACKER:
I would say that, at the rate we were going, we would not have succeeded during this war.

HAHN:
Yes.

WEIZSACKER:
It is very cold comfort to think that one is personally in a position to do what other people would be able to do one day.

HAHN:
Once I wanted to suggest that all uranium should be sunk to the bottom of the ocean. I always thought that one could only make a bomb of such a size that a whole province would be blown up.

HEISENBERG:
If it has been done with uranium 235 then we should be able to work it out properly. It just depends upon whether it is done with 5, 500 or 5,000 kilogrammes and we don't know the order of magnitude. We can assume that they have some method of separating isotopes of which we have no idea.

TOP SECRET Copy No. 1.

WIRTZ:
I would bet that it is a separation by diffusion with recycling.

HEISENBERG:
Yes, but it is certain that no apparatus of that sort has ever separated isotopes before. KORSHING might have been able to separate a few more isotopes with his apparatus.

WIRTZ:
We only had one man working on it and they may have had ten thousand.

WEIZSACKER:
Do you think it is impossible that they were able to get element '95' or '94' out of one or more running engines?

WIRTZ:
I don't think that is very likely.

WEIZSACKER:
I think the separation of isotopes is more likely because of the interest which they showed in it to us and the little interest they showed for the other things.

HAHN:
Well, I think we'll bet on HEISENBERG's suggestion that it is bluff.

HEISENBERG:
There is a great difference between discoveries and inventions. With discoveries one can always be sceptical and many surprises can take place. In the case of inventions, surprises can really only occur for people who have not had anything to do with it. It's a bit odd after we have been working on it for five years.

WEIZSACKER:
Take the CLUSIUS' method of separation. Many people have worked on the separation of isotopes and one fine day CLUSIUS found out how to do it. It was just the question of the separation of isotopes which we neglected completely partly knowingly and partly unknowingly, apart from the centrifuges.

HEISENBERG:
Yes, but only because there was no sensible method. The problem of separating '234' from '238' or '235' from '238' is such an extremely difficult business.

HARTECK:
One would have had to have a complete staff and we had insufficient means. One would have had to produce hundreds of organic components of uranium, had them systematically examined by laboratory assistants and then had them chemically investigated. There was no one there to do it. But we were quite clear in our minds as to how it should be done. That would have meant employing a hundred people and that was impossible.

TOP SECRET Copy No. 1.

HAHN:
From the many scientific things which my two American collaborators sent me up to 1940, I could see that the Americans were interested in the business.

WEIZSACKER:
In 1940 VAN DER GRINTEN (?) wrote to me saying that he was separating isotopes with General Electric.

HARTECK:
Was VAN DER GRINTEN (?) a good man?

WEIZSACKER:
He wasn't really very good but the fact that he was being used showed that they were working on it.

HAHN:
That wicked BOMKE was in my Institute.

HARTECK:
I have never come across such a fantastic liar.

HAHN:
That man came to me in 1938 when the non-aryan Fraulein HERTNER was still there - it wasn't easy to keep her in my Institute. I will never forget how BOMKE came to us and told me that he was being persecuted by the State because he was not a Nazi. We took him on and afterwards we found out that he was an old fighting member of the Party.

WEIZSACKER:
Then we might speak of our "BOMKE-damaged" Institutes. (Laughter).

3. All the guests assembled to hear the official announcement at 9 o'clock. They were completely stunned when they realised that the news was genuine. They were left alone on the assumption that they would discuss the position and the following remarks were made.:-

HARTECK:
They have managed it either with mass-spectrographs on a large scale or else they have been successful with a photo-chemical process.

WIRTZ:
Well I would say photo-chemistry or diffusion. Ordinary diffusion. They irradiate it with a particular wave-length. - (all talking together).

HARTECK:
Or using mass-spectrographs in enormous quantities. It is perhaps possible for a mass-spectrograph to make one milligramme in one day - say of '235'. They could make quite a cheap mass-spectrograph which, in very large quantities, might cost a hundred dollars. You could do it with a hundred thousand mass-spectrographs.

HEISENBERG:
Yes, of course, if you do it like that and they seem to have worked on that scale. 180,000 people were working on it.

TOP SECRET Copy No. 1.

HARTECK:
Which is a hundred times more than we had.

BAGGE:
GOUDSMIT led us up the garden path.

HEISENBERG:
Yes, he did that very cleverly.

HAHN:
CHADWICK and COCKROFT.

HARTECK:
And SIMON too. He is the low temperature man.

KORSHING:
That shows at any rate that the Americans are capable of real cooperation on a tremendous scale. That would have been impossible in Germany. Each one said that the other was unimportant.

GERLACH:
You really can't say that as far as the uranium group is concerned. You can't imagine any greater cooperation and trust than there was in that group. You can't say that any one of them said that the other was unimportant.

KORSHING:
Not officially of course.

GERLACH: (Shouting).
Not unofficially either. Don't contradict me. There are far too many other people here who know.

HAHN:
Of course we were unable to work on that scale.

HEISENBERG:
One can say that the first time large funds were made available in Germany was in the spring of 1942 after that meeting with RUST when we convinced him that we had absolutely definite proof that it could be done.

BAGGE:
It wasn't much earlier here either.

HARTECK:
We really knew earlier that it could be done if we could get enough material. Take the heavy water. There were three methods, the most expensive of which cost 2 marks per gramme and the cheapest perhaps 50 pfennigs. And then they kept on arguing as to what to do because no one was prepared to spend 10 millions if it could be done for three millions.

HEISENBERG:
On the other hand, the whole heavy water business which I did everything I could to further cannot produce an explosive.

TOP SECRET Copy No. 1.

HARTECK:
Not until the engine is running.

HAHN:
They seem to have made an explosive before making the engine and now they say: "in future we will build engines".

HARTECK:
If it is a fact that an explosive can be produced either by means of the mass spectrograph-we would never have done it as we could never have employed 56,000 workmen. For instance, when we considered the CLUSIUS - LINDE business combined with our exchange cycle we would have needed to employ 50 workmen continuously in order to produce two tons a year. If we wanted to make ten tons we would have had to employ 250 men. We couldn't do that.

WEIZSACKER:
How many people were working on V 1 and V 2?

DIEBNER:
Thousands worked on that.

HEISENBERG:
We wouldn't have had the moral courage to recommend to the Government in the spring of 1942 that they should employ 120,000 men just for building the thing up.

WEIZSACKER:
I believe the reason we didn't do it was because all the physicists didn't want to do it, on principle. If we had all wanted Germany to win the war we would have succeeded.

HAHN:
I don't believe that but I am thankful we didn't succeed.

HARTECK:
Considering the figures involved I think it must have been mass-spectrographs. If they had had some other good method they wouldn't have needed to spend so much. One wouldn't have needed so many men.

WIRTZ:
Assuming it was the CLUSIUS method they would never have been able to do anything with gas at high temperatures.

HARTECK:
When one thinks how long it took for us to get the nickel separating tube I believe it took nine months.

KORSHING:
It was never done with spectrographs.

HEISENBERG:
I must say I think your theory is right and that it is spectrographs.

TOP SECRET Copy No. 1.

WIRTZ:
I am prepared to bet that it isn't.

HEISENBERG:
What would one want 60,000 men for?

KORSHING:
You try and vaporise one ton of uranium.

HARTECK:
You only need ten men for that. I was amazed at what I saw at I.G.

HEISENBERG:
It is possible that the war will be over tomorrow.

HARTECK:
The following day we will go home.

KORSHING:
We will never go home again.

HARTECK:
If we had worked on an even larger scale we would have been killed by the 'Secret Service'. Let's be glad that we are still alive. Let us celebrate this evening in that spirit.

DIEBNER:
Professor GERLACH would be an Obergruppenfuhrer and would be sitting in LUXEMBOURG as a war criminal.

KORSHING:
If one hasn't got the courage, it is better to give up straightaway.

GERLACH:
Don't always make such aggressive remarks.

KORSHING:
The Americans could do it better than we could, that's clear.

(GERLACH leaves the room.)

HEISENBERG:
The point is that the whole structure of the relationship between the scientist and the state in Germany was such that although we were not 100% anxious to do it, on the other hand we were so little trusted by the state that even if we had wanted to do it it would not have been easy to get it through.

DIEBNER:
Because the official people were only interested in immediate results. They didn't want to work on a long-term policy as America did.

WEIZSACKER:
Even if we had got everything that we wanted, it is by no means certain whether we would have got as far as the Americans and the English have now. It is not a question that we were very nearly as far as they were but it is a fact that we were all convinced that the

TOP SECRET Copy No. 1.

thing could not be completed during this war.

HEISENBERG:
Well that's not quite right. I would say that I was absolutely convinced of the possibility of our making an uranium engine but I never thought that we would make a bomb and at the bottom of my heart I was really glad that it was to be an engine and not a bomb. I must admit that.

WEIZSACKER:
If you had wanted to make a bomb we would probably have concentrated more on the separation of isotopes and less on heavy water.

(HAHN leaves the room)

WEIZSACKER:
If we had started this business soon enough we could have got somewhere. If they were able to complete it in the summer of 1945, we might have had the luck to complete it in the winter 1944/45.

WIRTZ:
The result would have been that we would have obliterated LONDON but would still not have conquered the world, and then they would have dropped them on us.

WEIZSACKER:
I don't think we ought to make excuses now because we did not succeed, but we must admit that we didn't want to succeed. If we had put the same energy into it as the Americans and had wanted it as they did, it is quite certain that we would not have succeeded as they would have smashed up the factories.

DIEBNER:
Of course they were watching us all the time.

WEIZSACKER:
One can say it might have been a much greater tragedy for the world if Germany had had the uranium bomb. Just imagine, if we had destroyed LONDON with uranium bombs it would not have ended the war, and when the war did end, it is still doubtful whether it would have been a good thing.

WIRTZ:
We hadn't got enough uranium.

WEIZSACKER:
We would have had to equip long distance aircraft with uranium engines to carry out airborne landings in the CONGO or NORTH WEST CANADA. We would have had to have held these areas by military force and produce the stuff from mines. That would have been impossible.

HARTECK:
The uranium content in the stone in the radium mines near GASTEIN was said to be so great that the question of price does not come into it.

TOP SECRET Copy No. 1.

BAGGE:
There must be enormous quantities of uranium in UPPER SILESIA. Mining experts have told me that.

DIEBNER:
Those are quite small quantities.

HARTECK:
If they have done it with mass-spectrographs, we cannot be blamed. We couldn't do that. But if they have done it through a trick, that would annoy me.

HEISENBERG:
I think we ought to avoid squabbling amongst ourselves concerning a lost cause. In addition, we must not make things too difficult for HAHN.

HARTECK:
We have probably considered a lot of things which the others cannot do and could use.

WEIZSACKER:
It is a frightful position for HAHN. He really did do it.

HEISENBERG:
Yes. (Pause) About a year ago, I heard from SEGNER (?) from the Foreign Office that the Americans had threatened to drop a uranium bomb on Dresden if we didn't surrender soon. At that time I was asked whether I thought it possible, and, with complete conviction, I replied: 'No'.

WIRTZ:
I think it characteristic that the Germans made the discovery and didn't use it, whereas the Americans have used it. I must say I didn't think the Americans would dare to use it.

4. HAHN and LAUE discussed the situation together. HAHN described the news as a tremendous achievement without parallel in history and LAUE expressed the hope of speedy release from detention in the light of these new events.

5. When GERLACH left the room he went straight to his bedroom where he was heard to be sobbing. VON LAUE and HARTECK went up to see him and tried to comfort him. He appeared to consider himself in the position of a defeated General, the only alternative open to whom is to shoot himself. Fortunately he had no weapon and he was eventually sufficiently calmed by his colleagues. In the course of conversation with VON LAUE and HARTECK, he made the following remarks:-

GERLACH:
When I took this thing over, I talked it over with HEISENBERG and HAHN, and I said to my wife: "The war is lost and the result will be that as soon as the enemy enter the country I shall be arrested and taken away". I only did it because, I said to myself, this is a German affair and we must see that German physics are preserved. I never for a moment thought

TOP SECRET Copy No. 1.

of a bomb but I said to myself: "If HAHN has made this discovery, let us at least be the first to make use of it". When we get back to Germany we will have a dreadful time. We will be looked upon as the ones who have sabotaged everything. We won't remain alive long there. You can be certain that there are many people in Germany who say that it is our fault. Please leave me alone.

6. A little later, HAHN went up to comfort GERLACH when the following conversation ensued:-

HAHN:
Are you upset because we did not make the uranium bomb? I thank God on my bended knees that we did not make an uranium bomb. Or are you depressed because the Americans could do it better than we could?

GERLACH:
Yes.

HAHN:
Surely you are not in favour of such an inhuman weapon as the uranium bomb?

GERLACH:
No. We never worked on the bomb. I didn't believe that it would go so quickly. But I did think that we should do everything to make the sources of energy and exploit the possibilities for the future. When the first result, that the concentration was very increased with the cube method appeared, I spoke to SPEER's right hand man, as SPEER was not available at the time, an Oberst GEIST (?) first, and later SAUCKEL at WEIMAR asked me: "What do you want to do with these things", I replied: "In my opinion the politician who is in possession of such an engine can achieve anything he wants". About ten days or a fortnight before the final capitulation, GEIST (?) replied: "Unfortunately we have not got such a politician".

HAHN:
I am thankful that we were not the first to drop the uranium bomb.

GERLACH:
You cannot prevent its development. I was afraid to think of the bomb, but I did think of it as a thing of the future, and that the man who could threaten the use of the bomb would be able to achieve anything. That is exactly what I told GEIST (?), SAUCKEL and MURR. HEISENBERG was there at STUTTGART at the time.

(Enter HARTECK)

Tell me, HARTECK, isn't it a pity that the others have done it?

HAHN:
I am delighted.

TOP SECRET Copy No. 1.

GERLACH:
Yes, but what were we working for?

HAHN:
To build an engine, to produce elements, to calculate the weight of atoms, to have a mass-spectrograph and radio-active elements to take the place of radium.

HARTECK:
We could not have produced the bomb but we would have produced an engine and I am sorry about that. If you had come a year sooner, GERLACH, we might have done it, if not with heavy water, then with low temperatures. But when you came it was already too late. The enemy's air superiority was too great and we could do nothing.

HAHN, GERLACH and HARTECK go on to discuss their position if they return to Germany and GERLACH considers that they will have to remain here another two years because they will be in danger. HAHN however feels that he could return to Germany without any danger to himself. GERLACH goes on to explain that the Nazi party seemed to think that they were working on a bomb and relates how the Party people in MUNICH were going round from house to house on the 27th or 28th April last telling everyone that the atomic bomb would be used the following day.
GERLACH continues:
GERLACH:
I fought for six months against ESAU and BEUTHE (?) taking over all the heavy water and the uranium and having the engine made by the Reichs Anstalt. ESAU told me more than once: 'The cube experiment is my experiment and I am going to see it through and I am going to take everything'. And as I was stubborn and refused to give in, BEUTHE (?) sent that letter to HIMMLER through the S.D. regarding my political attitude. I know all about it and you have no idea the trouble I had with ESAU and what my position was in February and March of last year because of BEUTHE's (?) accusations. I wouldn't have given much for my chances of life at that time. That went on till September or October until ESAU eventually officially gave up his claim to the uranium and the heavy water.

HARTECK:
Of course we didn't really do it properly. Theory was considered the most important thing and experiments were secondary, and then almost unintelligible formulae were written down. We did not carry out experiments with sufficient vigour. Suppose a man like HERTZ had made the experiments, he would have done it quite differently.

GERLACH:
They did make experiments. They measured the emission of heat of uranium.

HARTECK:
For instance if you measure the emission of heat and at the same time make the 23 - minute body.

GERLACH:
What SCHUTZE (?) was to have done later?

TOP SECRET Copy No. 1.

HARTECK:
Why was that not done?

GERLACH:
Perhaps it was.

HARTECK:
You might perhaps have boiled the metal, so obtaining a large surface area which would behave towards neutrons as in STEEB's experiments. Then you would see that in one case it was better by a few per cent and in another case worse. But such experiments were not made, or rather they wanted to persuade you against it.

HAHN:
HERTZ did that.

GERLACH:
Yes. He had all the material he could find.

HAHN:
When was that - in 1944?

GERLACH:
Yes, the end of 1944. But he had measured the emission of heat already two years before. I just went to HERTZ and said: 'Look here, HERTZ, let's discuss the uranium business!. He said: 'I know nothing about it', so I told him all about it. Then he told me that SCHUTZE had made such heat experiments and then we discussed it and decided that that really was the best thing.

HAHN:
So he (used) a small radium preparation and beryllium preparation ....

GERLACH:
25 milligrammes and about a hundred grammes of uranium powder (?). He only used powder. When I heard about it, I said straightaway that that was the right method of examining small bodies.

HARTECK:
We had 27 grammes of radium. If we had used - say - 5 grammes of radium as neutron sources we could easily have measured with the best shaped bodies.

GERLACH:
We must not say in front of these two Englishmen that we ought to have done more about the thing. WIRTZ said that we ought to have worked more on the separation of isotopes. It's another matter to say that we did not have sufficient means but one cannot say in front of an Englishman that we didn't try hard enough. They were our enemies, although we sabotaged the war. There are some things that one knows and one can discuss together but that one cannot discuss in the presence of Englishmen.

HAHN:
I must honestly say that I would have sabotaged the war if I had been in a position to do so.

TOP SECRET Copy No. 1.

7. HAHN and HEISENBERG discussed the matter alone together. HAHN explained to HEISENBERG that he was himself very upset about the whole thing. He said he could not really understand why GERLACH had taken it so badly. HEISENBERG said he could understand it because GERLACH was the only one of them who had really wanted a German victory, because although he realised the crimes of the Nazis and disapproved of them, he could not get away from the fact that he was working for GERMANY. HAHN replied that he too loved his country and that, strange as it might appear, it was for this reason that he had hoped for her defeat. HEISENBERG went on to say that he thought the possession of the uranium bomb would strengthen the position of the Americans vis-a-vis the Russians. They continued to discuss the same theme as before that they had never wanted to work on a bomb and had been pleased when it was decided to concentrate everything on the engine. HEISENBERG stated that the people in Germany might say that they should have forced the authorities to put the necessary means at their disposal and to release 100,000 men in order to make the bomb and he feels himself that had they been in the same moral position as the Americans and had said to themselves that nothing mattered except that HITLER should win the war, they might have succeeded, whereas in fact they did not want him to win. HAHN admitted however that he had never thought that a German defeat would produce such terrible tragedy for his country. They then went on to discuss the feelings of the British and American scientists who had perfected the bomb and HEISENBERG said he felt it was a different matter in their case as they considered HITLER a criminal. They both hoped that the new discovery would in the long run be a benefit to mankind. HEISENBERG went on to speculate on the uses to which AMERICA would put the new discovery and wondered whether they would use it to obtain control of RUSSIA or wait until STALIN had copied it. They went on to wonder how many bombs existed. The following is the text of this part of the conversation:-

HAHN:
They can't make a bomb like that once a week.

HEISENBERG:
No. I rather think HARTECK was right and that they have just put up a hundred thousand mass-spectrographs or something like that. If each mass-spectrograph can make one milligramme a day, they they have got a hundred grammes a day.

HAHN:
In 1939 they had only made a fraction of a milligramme. They had then identified the '235' through its radio-activity.

HEISENBERG:
That would give them 30 kilos. a year.

HAHN:
Do you think they would need as much as that?

HEISENBERG:
I think so certainly, but quite honestly I have never worked it out as I never believed one could get pure '235'. I always knew it could be done with '235' with fast neutrons. That's why '235' only can be used

as an explosive. One can never make an explosive with slow neutrons, not even with the heavy water machine, as then the neutrons only go with thermal speed, with the result that the reaction is so slow that the thing explodes sooner, before the reaction is complete. It vaporises at 5,000° and then the reaction is already -

HAHN:
How does the bomb explode?

HEISENBERG:
In the case of the bomb it can only be done with the very fast neutrons. The fast neutrons in 235 immediately produce other neutrons so that the very fast neutrons which have a speed of - say - 1/30th that of light make the whole reaction. Then of course the reaction takes place much quicker so that in practice one can release these great energies. In ordinary uranium a fast neutron nearly always hits 238 and then gives no fission.

HAHN:
I see, whereas the fast ones in the 235 do the same as the 238, but 130 times more.

HEISENBERG:
Yes. If I get below 600,000 volts I can't do any more fission on the 238, but I can always split the 235 no matter what happens. If I have pure 235 each neutron will immediately beget two children and then there must be a chain reaction which goes very quickly. Then you can reckon as follows. One neutron always makes two spheres in pure 235. That is to say that in order to make 10^{24} neutrons I need 80 reactions one after the other. Therefore I need 80 collisions and the mean free path is about 6 centimetres. In order to make 80 collisions, I must have a lump of a radius of about 54 centimetres and that would be about a ton.

HAHN:
Wouldn't that ton be stronger than 20,000 tons of explosive?

HEISENBERG:
It would be about the same. It is conceivable that they could do it with less in the following manner. They would take only a quarter of the quantity but cover it with a reflector which would turn back the fast neutrons. For instance lead or carbon and in that way they could get the neutrons which go out, to come back again. It could be done in that way. It is possible for them to do it like that.

HAHN:
How can they take it in an aircraft and make sure that it explodes at the right moment?

HEISENBERG:
One way would be to make the bomb in two halves, each one of which would be too small to produce the explosion because of the mean free path. The two halves would be joined together at the moment of dropping when the reaction would start. They have probably done something like that.

HEISENBERG went on to complain bitterly that GOUDSMIT had lied to them very cleverly and thinks that he might at least have told him that their experiments in AMERICA were further advanced. They agreed that the secret was kept very well. HAHN remarked on the fact that there had been no publication of work on uranium fission in British or American scientific

journals since January, 1940, but he thought that there had been one published in RUSSIA on the spontaneous fission of uranium with quaterons. HEISENBERG repeated all his arguments saying that they had concentrated on the uranium engine, had never tried to make a bomb and had done nothing on the separation of isotopes because they had not been able to get the necessary means for this. He repeated his story of the alleged threat by America to drop a uranium bomb on DEBEEN and said that he had been questioned by Geheimrat SEGNER(?) of the Foreign Office about this possibility. The conversation concluded as follows:

HEISENBERG:
Perhaps they have done nothing more than produce 235 and make a bomb with it. Then there must be any number of scientific matters which it would be interesting to work on.

HAHN:
Yes, but they must prevent the Russians from doing it.

HEISENBERG:
I would like to know what STALIN is thinking this evening. Of course they have got good men like LANDAU, and these people can do it too. There is not much to it if you know the fission. The whole thing is the method of separating isotopes.

HAHN:
No, in that respect the Americans and in fact all the Anglo-Saxons are vastly superior to them. I have a feeling that the Japanese war will end in the next few days and then we will probably be sent home fairly soon and everything will be much easier then it was before. Who knows that it may not be a blessing after all?

8. The guests decided among themselves that they must not outwardly show their concern. In consequence they insisted on playing cards as usual till after midnight. VON WEIZSACKER, WIRTZ, HARTECK, and BAGGE remained behind after the others had gone to bed. The following conversation took place:

BAGGE:
We must take off our hats to these people for having the courage to risk so many millions.

HARTECK:
We might have succeeded if the highest authorities had said 'We are prepared to sacrifice everything'.

WEIZSACKER:
In our case even the scientists said it couldn't be done.

BAGGE:
That's not true. You were there yourself at that conference in Berlin. I think it was on 8 September that everyone was asked - GEIGER, BOTHE and you HARTECK were there too- and everyone said that it must be done at once. Someone said 'Of course it is an open question whether one ought to do a thing like that.' Thereupon BOTHE got up and said

'Gentlemen, it must be done.' Then GEIGER got up and said 'If there is the slightest chance that it is possible - it must be done.' That was on 8 September '39.

WEIZSACKER:
I don't know how you can say that. 50% of the people were against it.

HARTECK:
All the scientists who understood nothing about it, all spoke against it, and of those who did understand it, one third spoke against it. As 90% of them didn't understand it, 90% spoke against it. We knew that it could be done in principal, but on the other hand we realised that it was a frightfully dangerous thing.

BAGGE:
If the Germans had spent 10 milliard marks on it and it had not succeeded, all physicists would have had their heads cut off.

WIRTZ:
The point is that in Germany very few people believed in it. And even those who were convinced it could be done did not all work on it.

HARTECK:
For instance when we started that heavy water business the CLUSIUS method was apparently too expensive, but I told ESAU that we should use various methods all at once; there was the one in NORWAY; and that we should have a CLUSIUS plant to produce 2-300 litres a year, that is a small one and then a hot-cold one. As far as I can see we could never have made a bomb, but we could certainly have got the engine to go.

WIRTZ:
KORSHING is really right when he said there wasn't very good co-operation in the uranium group as GERLACH said. GERLACH actually worked against us. He and DIEBNER worked against us the whole time. In the end they even tried to take the engine away from us. If a German Court were to investigate the whole question of why it did not succeed in Germany it would be a very very dangerous business. If we had started properly in 1939 and gone all out everything would have been alright.

HARTECK:
Then we would have been killed by the British 'Secret Service'.

WIRTZ:
I am glad that it wasn't like that otherwise we would all be dead.

(Pause)

BAGGE:
It must be possible to work out at what temperature the thing explodes.

HARTECK:
The multiplication factor with 235 is 2.8, and when one collides with the other how long is the path until it happens? 4 centimetres. Rx is the radius. Then you have to multiply that by the mean free path and divide it by the square root of the multiplication factor. That should be 2.8. R is about 14 centimetres, the weight is 800 kilogrammes, then it explodes.

9. GERLACH and HEISENBERG had a long discussion in GERLACH's room which went on half the night. In the course of this conversation they repeated most of the statements that had been made in the course of the general conversation downstairs and have been already reported. The following are extracts from the conversation:

GERLACH:
I never thought of the bomb, all I wanted was that we should do everything possible to develope HAHN's discovery for our country.

HEISENBERG went ont to stress the fact that they had concentrated on the development of the engine and stated that although the Allies appeared to have concentrated on the bomb they could presumably also make the engine now. He attributed that they failed to perfect the engine to the attacks on the factories in NORWAY. He blamed HITLER for the fact that, as he puts it, 'HAHN's invention has now been taken away from Germany.' He went on:

HEISENBERG:
I am still convinced that our objective was really the right one and that the fact that we concentrated on uranium may give us the chance of collaboration. I believe this uranium business will give the Anglo-Saxons such tremendous power that EUROPE will become a bloc under Anglo-Saxon domination. If that is the case it will be a very good thing. I wonder whether STALIN will be able to stand up to the others as he has done in the past.

GERLACH:
It is not true that we neglected the separation of isotopes - on the contrary, we discussed the whole thing at TUBINGEN in February, and there was a meeting at MUNICH. CLUSIUS, HARTECK and I said that this photo-chemical thing must be done. It took till the end of the year before the people who could do it were got together and the spectrograph obtained and special accommodation acquired, as the LITZ(?) Institute had been smashed up.

HEISENBERG:
You shouldn't take remarks like the one KORSHING made too seriously. He now thinks because the Americans have done it that he could have succeeded in separating isotopes if he had had more means at his disposal. That is of course sheer and utter nonsense. His experiment was interesting, that's why we carried it out, but I am convinced that the Americans have done it by completely other methods.

GERLACH:
If Germany had had a weapon which would have won the war, then Germany would have been in the right and the others in

TOP SECRET Copy No. 1.

the wrong, and whether conditions in Germany are better now than they would have been after a HITLER victory -

HEISENBERG:
I don't think so. On the other hand, the days of small countries are over. Suppose HITLER had succeeded in producing his EUROPE and there had been no uranium in EUROPE.

GERLACH:
If we had really planned a uranium engine - in the summer of 1944 we would not have had a bomb - and that had been properly handled from a propaganda point of view -

HARTECK:
That might have been a basis for negotiation. It would have been a basis for negotiation for any other German Government, but not for HITLER.

GERLACH:
I went to my downfall with open eyes, but I thought I would try and save German physics and German physicists, and in that I succeeded.

HEISENBERG:
Perhaps German physics will be able to collaborate as part of a great Western group.

GERLACH then went on to repeat how ESAU had tried to get all the heavy water and uranium in order to have the experiments made at the REICHSAMT. HEISENBERG then continued.

HEISENBERG:
Now that the whole thing has been made public, I assume that in a comparatively short time they will tell us what is to happen to us as I can't see the sense in keeping us detained as it is obvious that they are much further advanced than we were. There may be some details in which we could help them as they appear to have done very little in the heavy water line.

GERLACH:
The only thing to do now would be to say: 'We will get all the uranium people together CHADWICK, FERMI etc., and let them discuss it'.

HEISENBERG:
I wouldn't be surprised if in a comparatively short time we meet some of these people and perhaps something will come of it. It seems to me that the sensible thing for us to do is to try and work in collaboration with the Anglo-Saxons. We can do that now with a better conscience because one sees that they will probably dominate EUROPE. It is clear that people like CHADWICK and CHERWELL have considerable influence.

(Pause)

GERLACH:
I would really like to know how they have done it.

HEISENBERG:
It seems quite clear to me that it is the separation of isotopes. Although it is possible as HAHTECK says that it is done with a hundred thousand mass-spectrographs.

TOP SECRET Copy No. 1.

- 21 -

the wrong, and whether conditions in Germany are better now than they would have been after a HITLER victory -

HEISENBERG:
I don't think so. On the other hand, the days of small countries are over. Suppose HITLER had succeeded in producing his EUROPE and there had been no uranium in EUROPE.

GERLACH:
If we had really planned a uranium engine - in the summer of 1944 we would not have had a bomb - and that had been properly handled from a propaganda point of view -

HARTECK:
That might have been a basis for negotiation. It would have been a basis for negotiation for any other German Government, but not for HITLER.

GERLACH:
I went to my downfall with open eyes, but I thought I would try and save German physics and German physicists, and in that I succeeded.

HEISENBERG:
Perhaps German physics will be able to collaborate as part of a great Western group.

GERLACH then went on to repeat how ESAU had tried to get all the heavy water and uranium in order to have the experiments made at the REICHSAMT. HEISENBERG then continued.

HEISENBERG:
Now that the whole thing has been made public, I assume that in a comparatively short time they will tell us what is to happen to us as I can't see the sense in keeping us detained as it is obvious that they are much further advanced than we were. There may be some details in which we could help them as they appear to have done very little in the heavy water line.

GERLACH:
The only thing to do now would be to say: 'We will get all the uranium people together CHADWICK, FERMI etc., and let them discuss it'.

HEISENBERG:
I wouldn't be surprised if in a comparatively short time we meet some of these people and perhaps something will come of it. It seems to me that the sensible thing for us to do is to try and work in collaboration with the Anglo-Saxons. We can do that now with a better conscience because one sees that they will probably dominate EUROPE. It is clear that people like CHADWICK and CHERWELL have considerable influence.

(Pause)

GERLACH:
I would really like to know how they have done it.

HEISENBERG:
It seems quite clear to me that it is the separation of isotopes. Although it is possible as HAHTECK says that it is done with a hundred thousand mass-spectrographs.

TOP SECRET Copy No. 1.

GERLACH:
I am not sure whether perhaps the BAGGE method -

HEISENBERG:
That would never produce pure 235. The BAGGE method is not bad for enriching but the centrifuge is good for that too.

GERLACH:
The BAGGE method enriches more.

HEISENBERG:
Yes. It is a terrific lot to expect pure 235.

GERLACH:
How pure must it be?

HEISENBERG:
I should say 80% 235, and 20% 238 is alright, 50/50 would be alright, but there must not be much more 238 than 235.

10. WIRTZ and WEIZSACKER discussed the situation together in their room. VON WEIZSACKER expressed the opinion that none of them had really worked seriously on uranium with the exception of WIRTZ and HARTECK. He also accused GERLACH and DIEBNER of sabotage. WIRTZ expressed horror that the Allies had used the new weapon. They went on to discuss the possibility of the Russians discovering the secret and came to the conclusion that they would not succeed under ten years. They went on as follows:

WIRTZ:
It seems to me that the political situation for STALIN has changed completely now.

WEIZSACKER:
I hope so. STALIN certainly has not got it yet. If the Americans and the British were good Imperialists they would attack STALIN with the thing tomorrow, but they won't do that, they will use it as a political weapon. Of course that is good, but the result will be a peace which will last until the Russians have it, and then there is bound to be war.

At this point HEISENBERG joined WIRTZ and WEIZSACKER. The following remarks were passed:

WIRTZ:
These fellows have succeeded in separating isotopes. What is there left for us to do?

HEISENBERG:
I feel convinced that something will happen to us in the next few days or weeks. I should imagine that we no longer appear to them as dangerous enemies.

WEIZSACKER:
No, but the moment we are no longer dangerous we are also no longer interesting. It appears that they can get along perfectly well by themselves.

HEISENBERG:
Perhaps they can learn something about heavy water from us. But it can't be much - they know everything.

TOP SECRET Copy No. 1.

WEIZSACKER:
Our strength is now the fact that we are 'un-Nazi'.

HEISENBERG:
Yes, and in addition, uranium was discovered by HAHN and not by the Americans.

WEIZSACKER:
I admit that after this business I am more ready to go back to GERMANY, in spite of the Russian advance.

WIRTZ:
My worst fears have been realised with regard to the complications which will now arise about us.

HEISENBERG:
I believe that we are now far more bound up with the Anglo-Saxons than we were before as we have no possibility of switching over to the Russians even if we wanted to.

WIRTZ:
They won't let us.

HEISENBERG:
On the other hand we can do it with a good conscience because we can see that in the immediate future GERMANY will be under Anglo-Saxon influence.

WIRTZ:
That is an opportunist attitude.

HEISENBERG:
But at the moment it is very difficult to think otherwise because one does not know what is better.

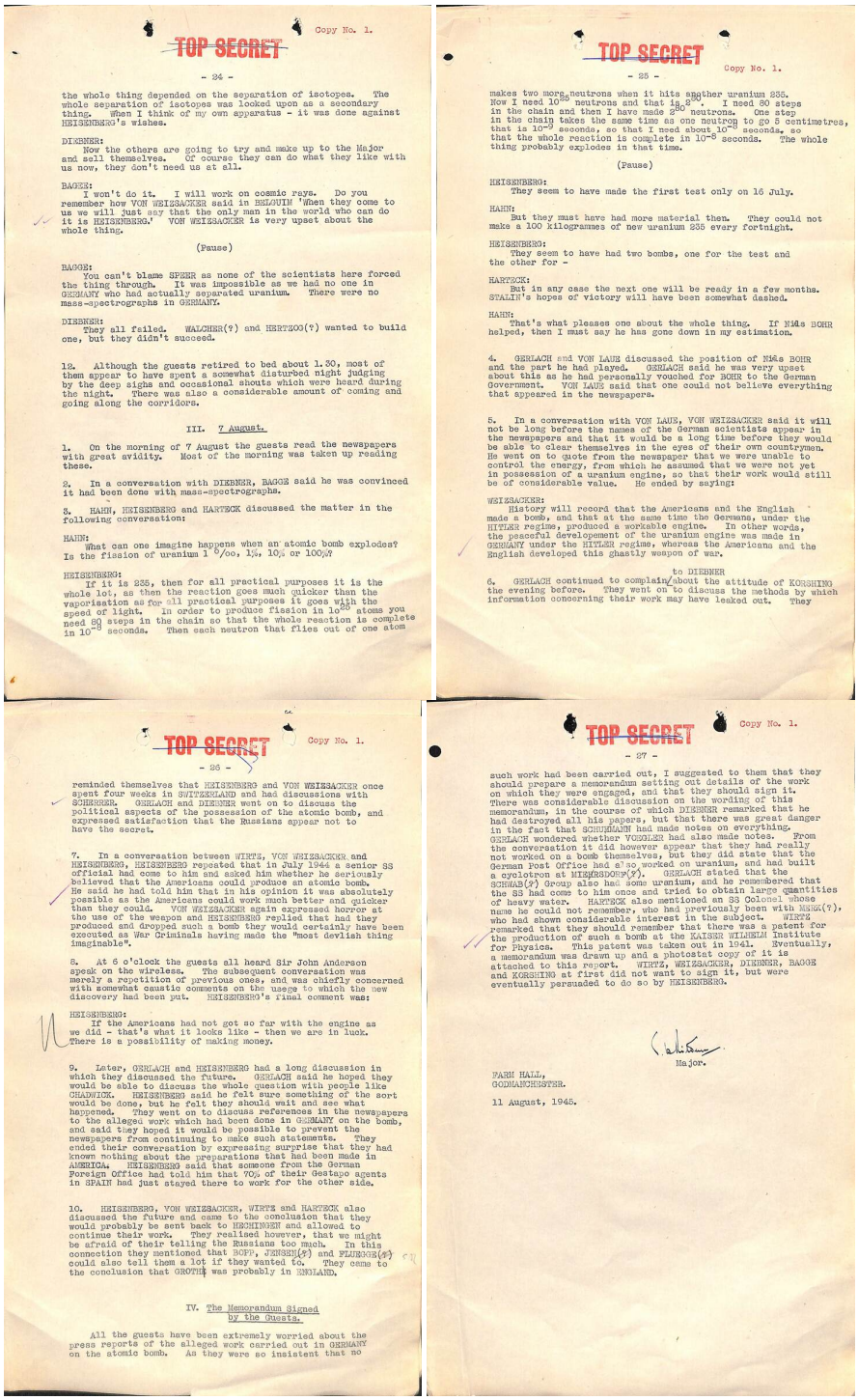
WEIZSACKER:
If I ask myself for which side I would prefer to work of course I would say for neither of them.

11. DIEBNER and BAGGE also discussed the situation alone together as follows:

BAGGE:
What do you think will happen to us now?

DIEBNER:
They won't let us go back to GERMANY. Otherwise the Russians will take us. It is quite obvious what they have done, they have just got some system other than ours. If a man like GERLACH had been there earlier, things would have been different.

BAGGE:
GERLACH is not responsible, he took the thing over too late. On the other hand it is quite obvious that HEISENBERG was not the right man for it. The tragedy is that KORSHING is right in the remarks he made to GERLACH. I think it is absurd for WEIZSACKER to say he did not want the thing to succeed. That may be so in his case, but not for all of us. WEIZSACKER was not the right man to have done it. HEISENBERG could not convince anyone that



TOP SECRET Copy No. 1.

- 24 -

the whole thing depended on the separation of isotopes. The whole separation of isotopes was looked upon as a secondary thing. When I think of my own apparatus - it was done against HEISENBERG's wishes.

DIEBNER:
Now the others are going to try and make up to the Major and sell themselves. Of course they can do what they like with us now, they don't need us at all.

BAGGE:
I won't do it. I will work on cosmic rays. Do you remember how VON WEIZSACKER said in BELGIUM 'When they come to us we will just say that the only man in the world who can do it is HEISENBERG.' VON WEIZSACKER is very upset about the whole thing.

(Pause)

BAGGE:
You can't blame SPEER as none of the scientists here forced the thing through. It was impossible as we had no one in GERMANY who had actually separated uranium. There were no mass-spectrographs in GERMANY.

DIEBNER:
They all failed. WALCHER(?) and HERTZOG(?) wanted to build one, but they didn't succeed.

12. Although the guests retired to bed about 1.30, most of them appear to have spent a somewhat disturbed night judging by the deep sighs and occasional shouts which were heard during the night. There was also a considerable amount of coming and going along the corridors.

III. 7 August.

1. On the morning of 7 August the guests read the newspapers with great avidity. Most of the morning was taken up reading these.

2. In a conversation with DIEBNER, BAGGE said he was convinced it had been done with mass-spectrographs.

3. HAHN, HEISENBERG and HARTECK discussed the matter in the following conversation:

HAHN:
What can one imagine happens when an atomic bomb explodes? Is the fission of uranium 1 °/oo, 1%, 10% or 100%?

HEISENBERG:
If it is 235, then for all practical purposes it is the whole lot, as then the reaction goes much quicker than the vaporisation as for all practical purposes it goes with the speed of light. In order to produce fission in 10^{26} atoms you need 80 steps in the chain so that the whole reaction is complete in 10^{-6} seconds. Then each neutron that flies out of one atom

TOP SECRET Copy No. 1.

- 25 -

makes two more neutrons when it hits another uranium 235. Now I need 10^{26} neutrons and that is 2^{80}. I need 80 steps in the chain and then I have made 2^{80} neutrons. One step in the chain takes the same time as one neutron to go 5 centimetres, that is 10^{-2} seconds, so that I need about 10^{-6} seconds, so that the whole reaction is complete in 10^{-8} seconds. The whole thing probably explodes in that time.

(Pause)

HEISENBERG:
They seem to have made the first test only on 16 July.

HAHN:
But they must have had more material then. They could not make a 100 kilogrammes of new uranium 235 every fortnight.

HEISENBERG:
They seem to have had two bombs, one for the test and the other for -

HARTECK:
But in any case the next one will be ready in a few months. STALIN's hopes of victory will have been somewhat dashed.

HAHN:
That's what pleases one about the whole thing. If Niels BOHR helped, then I must say he has gone down in my estimation.

4. GERLACH and VON LAUE discussed the position of Niels BOHR and the part he had played. GERLACH said he was very upset about this as he had personally vouched for BOHR to the German Government. VON LAUE said that one could not believe everything that appeared in the newspapers.

5. In a conversation with VON LAUE, VON WEIZSACKER said it will not be long before the names of the German scientists appear in the newspapers and that it would be a long time before they would be able to clear themselves in the eyes of their own countrymen. He went on to quote from the newspaper that we were unable to control the energy, from which he assumed that we were not yet in possession of a uranium engine, so that their work would still be of considerable value. He ended by saying:

WEIZSACKER:
History will record that the Americans and the English made a bomb, and that at the same time the Germans, under the HITLER regime, produced a workable engine. In other words, the peaceful development of the uranium engine was made in GERMANY under the HITLER regime, whereas the Americans and the English developed this ghastly weapon of war.

to DIEBNER

6. GERLACH continued to complain about the attitude of KORSHING the evening before. They went on to discuss the methods by which information concerning their work may have leaked out. They

TOP SECRET Copy No. 1.

- 26 -

reminded themselves that HEISENBERG and VON WEIZSACKER once spent four weeks in SWITZERLAND and had discussions with SCHERRER. GERLACH and DIEBNER went on to discuss the political aspects of the possession of the atomic bomb, and expressed satisfaction that the Russians appear not to have the secret.

7. In a conversation between WIRTZ, VON WEIZSACKER and HEISENBERG, HEISENBERG repeated that in July 1944 a senior SS official had come to him and asked him whether he seriously believed that the Americans could produce an atomic bomb. He said he had told him that in his opinion it was absolutely possible as the Americans could work much better and quicker than they could. VON WEIZSACKER again expressed horror at the use of the weapon and HEISENBERG replied that had they produced and dropped such a bomb they would certainly have been executed as War Criminals having made the "most devlish thing imaginable".

8. At 6 o'clock the guests all heard Sir John Anderson speak on the wireless. The subsequent conversation was merely a repetition of previous ones, and was chiefly concerned with somewhat caustic comments on the usage to which the new discovery had been put. HEISENBERG's final comment was:

HEISENBERG:
If the Americans had not got so far with the engine as we did - that's what it looks like - then we are in luck. There is a possibility of making money.

9. Later, GERLACH and HEISENBERG had a long discussion in which they discussed the future. GERLACH said he hoped they would be able to discuss the whole question with people like CHADWICK. HEISENBERG said he felt sure something of the sort would be done, but he felt they should wait and see what happened. They went on to discuss references in the newspapers to the alleged work which had been done in GERMANY on the bomb, and said they hoped it would be possible to prevent the newspapers from continuing to make such statements. They ended their conversation by expressing surprise that they had known nothing about the preparations that had been made in AMERICA. HEISENBERG said that someone from the German Foreign Office had told him that 70% of their Gestapo agents in SPAIN had just stayed there to work for the other side.

10. HEISENBERG, VON WEIZSACKER, WIRTZ and HARTECK also discussed the future and came to the conclusion that they would probably be sent back to HECHINGEN and allowed to continue their work. They realised however, that we might be afraid of their telling the Russians too much. In this connection they mentioned that BOPP, JENSEN(?) and FLUGGE(?) could also tell them a lot if they wanted to. They came to the conclusion that GROTH was probably in ENGLAND.

IV. The Memorandum Signed by the Guests.

All the guests have been extremely worried about the press reports of the alleged work carried out in GERMANY on the atomic bomb. As they were so insistent that no

TOP SECRET Copy No. 1.

- 27 -

such work had been carried out, I suggested to them that they should prepare a memorandum setting out details of the work on which they were engaged, and that they should sign it. There was considerable discussion on the wording of this memorandum, in the course of which DIEBNER remarked that he had destroyed all his papers, but that there was great danger in the fact that SCHUMANN had made notes on everything. GERLACH wondered whether VOELKER had also made notes. From the conversation it did however appear that they had really not worked on a bomb themselves, but they did state that the German Post Office had also worked on uranium, and had built a cyclotron at MEINERSDORF(?). GERLACH stated that the GERNAB(?) Group also had some uranium, and he remembered that the SS had come to him once and tried to obtain large quantities of heavy water. HARTECK also mentioned an SS Colonel whose name he could not remember, who had previously been with HENK(?), who had shown considerable interest in the subject. WIRTZ remarked that they should remember that there was a patent for the production of such a bomb at the KAISER WILHELM Institute for Physics. This patent was taken out in 1941. Eventually, a memorandum was drawn up and a photostat copy of it is attached to this report. WIRTZ, WEIZSACKER, DIEBNER, BAGGE and KORSHING at first did not want to sign it, but were eventually persuaded to do so by HEISENBERG.

Major.

FARM HALL,
GODMANCHESTER.

11 August, 1945.

Source: Transcript of Surreptitiously Taped Conversations among German Nuclear Physicists at Farm Hall (August 6-7, 1945). Operation “Epsilon.” National Archives and Records Administration, College Park, MD, RG 77, Entry 22, Box 164.