Forgotten Creators of the German H-Bomb

Dr. Todd H. Rider **thor@riderinstitute.org**

riderinstitute.org/revolutionary-innovation

Der Zelten Trug verschwindet,
Feuer brennen blau.
Doch über mir!
welch unerwartet Meteor?
Es leuchtet und beleuchtet
körperlichen Ball.

The illusion of dwellings vanishes;
the fires burn blue.
But overhead,
what sudden meteor is this?
It shines and illuminates
the whole world.

Johann von Goethe, *Faust II*, Act II,
Klassische Walpurgisnacht, Erichtho (1832)

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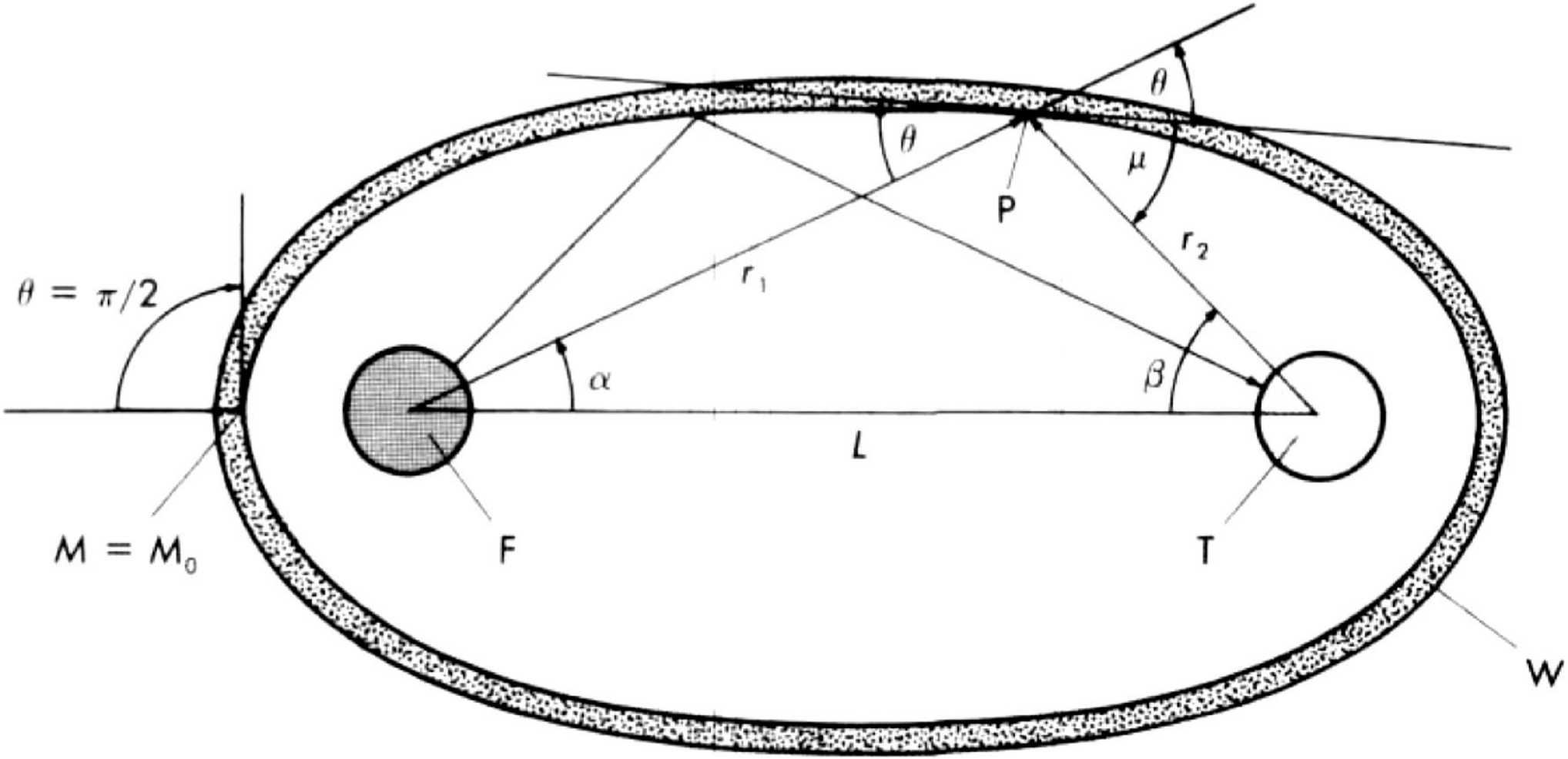

Acknowledgments

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Kevin, Cathy,
and Peter Wilson
Clive R. Woodley
Benjamin Zusman
My family for their
patience and support

This Work Only Uses Information from Unclassified Sources, Such As:

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Overview

As previously discussed, archival documents show that during WWII, Germany had a large and advanced program to produce fission implosion bombs, and that it apparently even tested fission bombs successfully.

Archival documents also demonstrate that German and Austrian scientists pioneered practical applications of fusion reactions for nuclear weapons:

1. **Neutron generators using fusion fuel and high voltage, suitable for initiating a neutron chain reaction in a fission bomb.**

2. **Small amounts of fusion fuel at the center of a fission implosion bomb, suitable for giving a "fusion boost" of many extra neutrons to greatly increase the number of fission reactions and the explosive energy yield.**

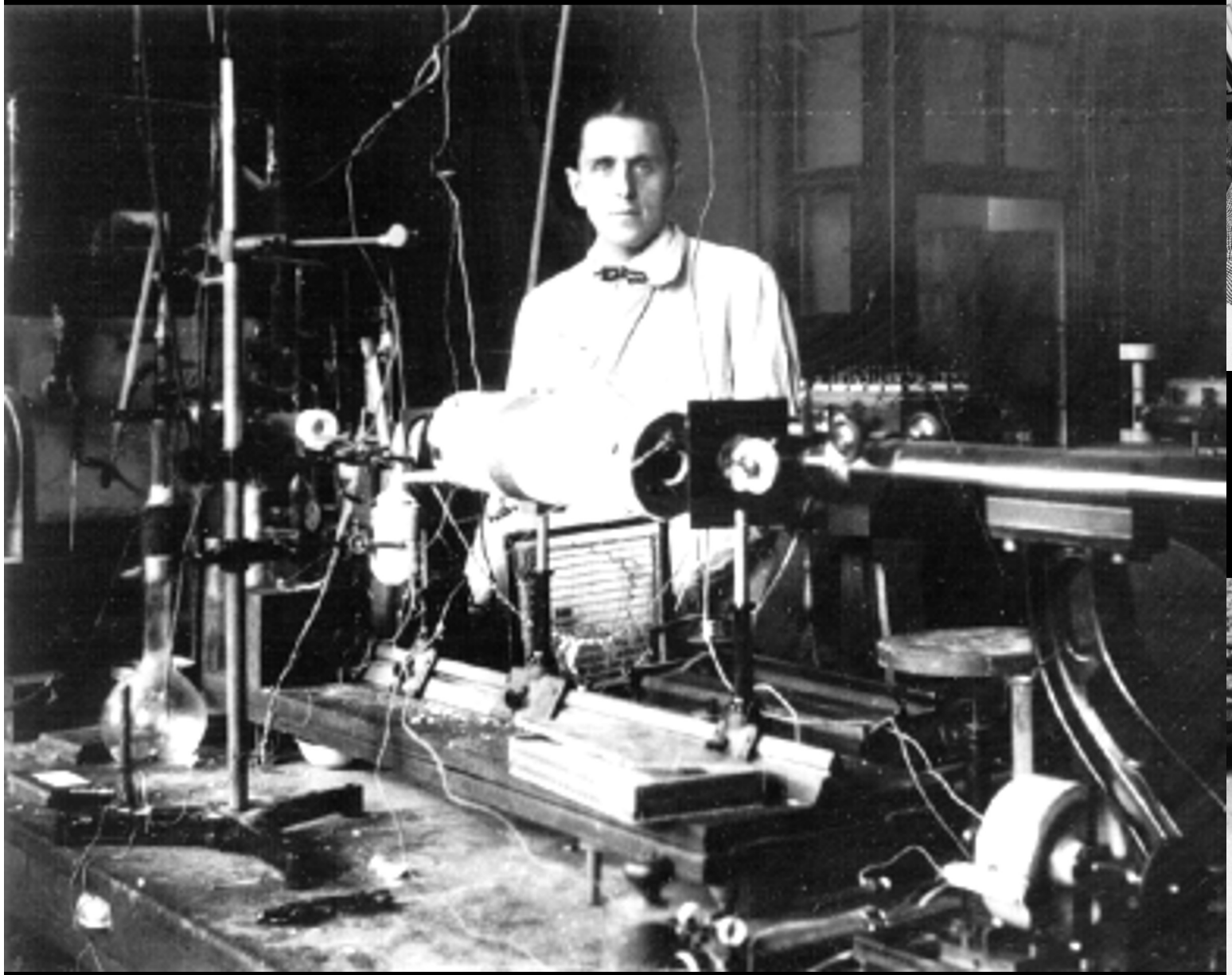
3. **Hydrogen bomb (H-bomb) designs, using a fission bomb to trigger a megaton-level explosion of solid, storable, lithium deuteride fusion fuel.**

4. **After the war, numerous German/Austrian nuclear experts went to the U.S. and other countries, exerting a large impact on postwar programs.**

1. High-Voltage Fusion Neutron Initiators

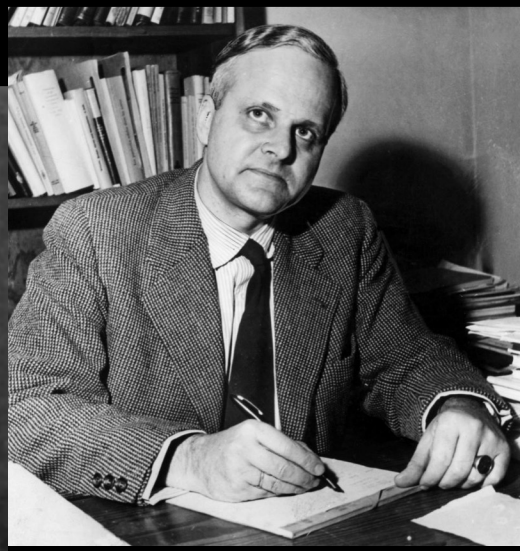
Fusion Reactions in Stars

Fritz Houtermans (1928 or earlier)

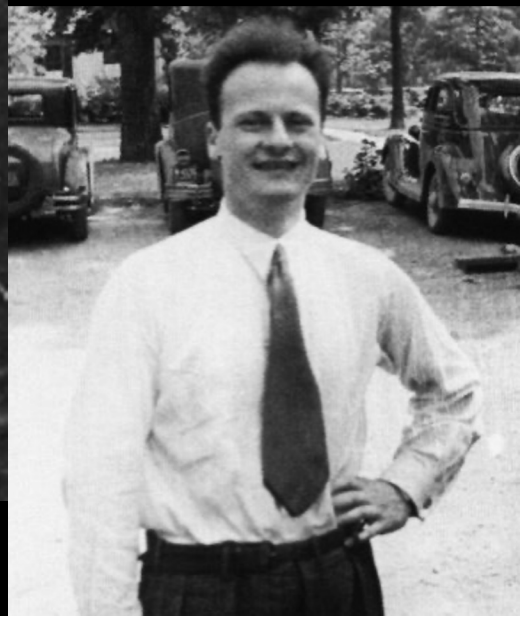


Georg Stetter (1928 or earlier)

Carl Friedrich von Weizsäcker



Hans Bethe (moved to U.S., first head of Los Alamos Theoretical Division)



AEG: Arno Brasch & Fritz Lange

AUSGEGEBEN AM
2. JULI 1938

REICHSPATENTAMT

PATENTSCHRIFT

№ 662036

KLASSE 40c GRUPPE 17

B 168181 VI/40c

Tag der Bekanntmachung über die Erteilung des Patents: 9. Juni 1938

Allgemeine Elektricitäts-Gesellschaft in Berlin*)

Verfahren zur Anregung und Durchführung von Kernprozessen

Patentiert im Deutschen Reiche vom 21. Dezembe 1934 ab

Die vorliegende Erfindung bezieht sich auf ein Verfahren, um Eingriffe in den Atomkern in erheblich größerem Umfange und vor allen Dingen mit größerem Nutzeffekt vorzunehmen, als dies bisher möglich war.

Erfindungsgemäß können nicht nur radioaktive Substanzen in wesentlicher Menge wirtschaftlich erzeugt werden, sondern es bietet sich auch die Möglichkeit, zur Energiegewinnung aus dem Atomkern zu gelangen.

Aus dem natürlichen Zerfall der radioaktiven Elemente ist zu ersehen, wie viel Energie grundsätzlich in 1 g Materie aufgehäuft sein kann und bis zum völligen Zerfall in mehr oder weniger langer Zeit entsprechend den jeweiligen Zerfallskonstanten frei wird.

Es sind dies Energiemengen, die etwa millionenfache Beträge dessen ausmachen, was beispielsweise bei der bisher üblichen Verbrennung unserer Treibmittel, Kohle, Öl usw., zur Wirkung gelangt.

Seit einigen Jahren beschäftigt sich die Physik damit, wenn auch bisher aus rein wissenschaftlichen Gründen, Atomumwandlungen unabhängig vom Spontanzerfall der relativ sehr seltenen radioaktiven Elemente auf künstlichem Wege zu erreichen. Diese Bestrebungen führten auch zum Erfolg, und zwar bisher dadurch, daß man auf elektrischem Wege Strahlen erzeugte, die den vom Radium ausgesendeten Strahlen gleich oder ähnlich waren und damit andere Stoffe bombardierte. Wenn auch die durch solche Versuche gewonnenen Erkenntnisse über die durch das Radium gezogenen Grenzen hinausgingen, so war doch grundsätzlich bisher an eine Energiegewinnung auf diesem Wege nicht zu denken, weil nur ein winziger Bruchteil der ausgesendeten Strahlen zum Kernprozeß führten.

Unter anderem eröffnete hier die kürzliche Entdeckung der Neutronen besondere Möglichkeiten, weil diese Teilchen Kernreaktionen mit 100 %igem Nutzeffekt erlauben.

So ist es jetzt möglich, damit künstliche Radioaktivitäten, die etwa denen 1 mg Radium gleich sind, zu erzeugen.

Wenn auch, wie bereits ausgeführt, die Neutronen Kerneffekte mit großer Ausbeute hervorrufen, so ist doch die Herstellung der Neutronen selbst vorläufig nur mit relativ sehr geringem Nutzeffekt möglich.

Die wesentlichen Methoden zur Erzeugung von Neutronen sind bisher:

1. Heliumteile werden auf Beryllium geworfen und lösen dort Neutronen aus.
2. Röntgen- oder Gammastrahlen von mehr als 1,5 Milionen Volt fallen auf Beryllium und rufen dort den gleichen Vorgang hervor.
3. Der kürzlich entdeckte sog. schwere Wasserstoff (Diplogen) wird auf Diplogen geschossen.

*) *Von dem Patentsucher sind als die Erfinder angegeben worden:*

Arno Brasch in New York, V. St. A.,

und Dr. Fritz Lange in Charkow, Union der Sozialistischen Sowjet-Republiken.

The temperatures and pressures which can be produced with these processes are now to be used according to the invention for initiating nuclear reactions. Particularly suitable for this purpose are elements of low atomic number, such as hydrogen, heavy hydrogen, lithium and boron.

The reaction to be initiated with the slightest aid is the reaction of a heavy hydrogen nucleus with another heavy hydrogen nucleus. In this case, therefore, either the Ramsauer method's gun barrel, into which one would shoot, would be filled with deuterium gas, or the spark would be discharged in heavy water, or perhaps a hydrocarbon, the hydrogen atoms of which are composed of heavy hydrogen. In this case, neutrons are formed, which can, of course, be used in a conventional manner to generate radioactive elements. It is also conceivable that reactions from the gas or the liquid are introduced with substances of the chamber wall or in the liquid of suspended particles. However, as is known, correspondingly higher temperatures are necessary for all processes with elements of higher order number.

Further reactions are the reaction of hydrogen with lithium and boron. If it is possible at all to reach such high temperatures as to cause nuclear reactions to take place, the possibility exists of reusing the energies released from these reactions in order to bring new quantities of matter to the necessary reaction temperature.

In the case of working with gases, it will be necessary to apply considerable pressures.

No later than Jan. 1938, the German military was actively recruiting scientists (including Jewish ones) to develop nuclear weapons. (Werner von Blomberg was Reichsminister of War May 1935–Jan. 1938.)

OPY

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SECRET

NARA RG 77, Entry UD-22A, Box 171,
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Wartime Positive Int. (Nov. 44-June 45)

DECLASSIFIED
Authority NND 917017

June 2, 1945

Old Line Book Company
P. O. Box 1172
Boston 3, Massachusetts

Dear Mike:

In connection with investigational work now underway relative to the development of Manhattan District projects by the Germans, a certain amount of information probably can be obtained from Mr. A. Brasch of the Electronized Chemical Corporation at 122 East 42nd Street, New York City.

Mr. Brasch is a former German citizen, and I am sure he has been thoroughly investigated. As an atomist physicist in 1938 he was approached by members of the general German staff to initiate research along lines of interest to the Manhattan District. Because of his connections with Siemens Halske and A. E. G. and the University of Berlin some information might be forthcoming if required at this late date.

Sincerely yours,

/s/ R. S. Malton

Tom Malton

This document consists of 1 pages
No. 1 of 5 copies, Series A

SECRET

ARMY SERVICE FORCES
MANHATTAN ENGINEER DISTRICT
INTELLIGENCE AND SECURITY DIVISION
BOSTON BRANCH OFFICE
P. O. BOX 2277
BOSTON, MASSACHUSETTS

IN REPLY
REFER TO EIDM MI-16
DSM bl-36351

14 June 1945

Subject: Positive Intelligence

To: Major Francis J. Smith, Washington Liaison Office, Washington, D. C.

1. Inclosed is copy of the letter submitted by Confidential Informant No. 16 of the Boston Branch Office.

2. Siemens Halske and A. E. G. referred to are the German branches of Westinghouse and General Electric respectively.

3. According to informant Brasch was asked personally by Marshall Werner Von Blomberg, German Chief of Staff in 1938, to remain in Germany to do atomic research. Brasch is Jewish and believed it wiser to leave the country.

4. Confidential Informant No. 16 is identified as Richard S. Morse of the National Research Corporation.

5. For your information and any action which you may deem necessary.

James E. Nolan

JAMES E. NOLAN,
2nd Lt., Corps of Engineers,
Intelligence Officer.

Incl.:
Ltr (cy)

Cc: DIO, w/incl

Allgemeine Elektrische Gesellschaft

Auer: Probably Nikolaus Riehl

Patented a deuterium-filled tube with 100,000 Volts that produced 7.6×10^8 neutrons/sec. Also covered lithium.

PATENT SPECIFICATION

Convention Date (Germany): Feb. 9, 1937.

Application Date (in United Kingdom): Feb. 7, 1938.

508,233

No. 3845/38.

Complete Specification Accepted: June 28, 1939.

COMPLETE SPECIFICATION

Method for Carrying out Nuclear Reactions

We, DEGEA AKTIENGESELLSCHAFT (AUERGESELLSCHAFT), of 16—19, Rotherstrasse, Berlin, O.17, Germany, a German Company, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Artificial nuclear reactions are initiated by the bombardment of nuclei with light elementary particles. With the use of charged particles (protons, α particles) energies of 10^5 to 10^7 volts are necessary for overcoming the coulombic repulsion powers, in order to ensure a sufficient yield for the penetration of the particles into the bombarded nucleus.

Such a repulsion does not exist for neutrons, so that neutrons of small speed can penetrate into nuclei and produce reactions, as experiments actually show.

Unfortunately, there are no direct sources producing neutrons; they arise, if nuclei, for example, Be, are irradiated with α-particles of high energies (about 10^6 volts) or γ-rays very rich in energy (about 2.10^6 volts) or by bombardment of certain nuclei with fast particles of the heavy isotope of hydrogen. As sources of α-particles of sufficiently high energy, only the naturally radioactive elements have hitherto been available. In the two other cases, for accelerating elementary particles it is necessary to have recourse to the use of very considerable amounts of energy. With the remaining hitherto known methods for the production of elementary particles rich in energy, which have been used directly, or indirectly through the production of very hard Röntgen rays, for the production of neutrons and generally for the initiation of nuclear reactions, there came to be used an acceleration of the desired particles in high vacuum. This method indeed produces definite speeds, but only at the expense of very heavy outlay in the matter of electro-technical apparatus for building up an increase in the current density of the accelerated particles, and also gives a greater absolute yield from the nuclear reactions. The output attained in this way probably corresponds, at best, to that of a few grams of radium. The method of repeated secondary acceleration by means of high frequency alternating fields (Cyclotron) certainly produces greater absolute yields than those just stated, but necessitates however a great increase in the expense of apparatus (extremely large magnets).

The present invention therefore proposes to allow the nuclear reactions to take place under completely different conditions, namely, in the gas phase, under a mean numerical concentration of more than 10^{19} molecules of the gas per cubic centimetre, and preferably under a concentration corresponding to a pressure of one atmosphere at normal temperature of 18° C. Since in this case, a selective acceleration of elementary particles is not possible, the attainment of a thermal equilibrium with very high temperatures (greater than 10^{7}° C.) is the objective. For reasons of energy consumption such conditions can only be maintained by extraordinarily high momentary outputs and only for very short times. Accordingly, this invention contemplates the production of energies of 100 watt seconds and more during intervals of 10^{-6} second and less, corresponding to momentary outputs of 100,000 kilowatts and more.

Theoretical calculations based on experiments with exploding wires, and also observations made in connection with mercury discharges in which the number of glowing atoms could be determined with some degree of certainty, lead to the conclusion that high temperatures of the order specified occur with condenser discharges in the gaseous phase. Such operating conditions have in themselves the advantage that because of the practically complete ionisation in the discharge canal the braking action of the electron cloud falls away, and therefore still larger yields of the nuclear reactions are to be expected than have been observed hitherto with neutral atoms. It is therefore proposed for the realisation of the operating conditions set forth above, to utilise condenser discharges. For this it is necessary that

1) the gas concentration (number of molecules per cubic centimetre) be so great that thermal equilibrium can be established within the time of discharge of the condenser.

2) the momentary output, which is given by the size and charging voltage of the condenser, be made so great that the equilibrium temperature becomes established at the desired level.

The experimenter is at liberty to increase the action of the individual extremely short condenser discharge (duration of 10^{-6} second), after the lapse of a certain time which might be approximately of the order of magnitude of 10^{-3} second by allowing a further condenser discharge to traverse the gas. In this way it is possible to intensify the total effect of the method within the limits imposed by the thermal resistance of the discharge vessel used. A discharge rate of 5 discharges per second is probably about as high a rate as can normally be expected to be endured by a glass vessel.

The deciding factors given by these two conditions, viz., gas concentration and the size and charging voltage of the condensers, can be calculated for each individual process.

This calculation has been carried out for the production of neutrons by means of condenser discharge in heavy hydrogen gas. It gives, for about 1 atmosphere pressure, $C = 50{,}000$ cm. $V = 10^5$ volts (C being the capacity of the condenser and V being the charging voltage) and with a discharge rate of 5 discharges per second, an efficiency which is equivalent to about 50 gms. Ra + Be. Similar results are obtained when using a mixture of heavy and light hydrogen gas.

The method is naturally not limited to the production of neutrons but is equally applicable to a great number of nuclear reactions which may be carried out in this manner on a large scale, for example, the production of helium. For this purpose a discharge of the nature described above may be effected in a mixture of lithium vapour and light hydrogen, the resulting reaction being typified by the following equations:

$$^{7}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{H} = {}^{4}_{2}\mathrm{He}; \quad {}^{6}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{H} = {}^{4}_{2}\mathrm{He} + {}^{3}_{2}\mathrm{He}$$

The pressures and outputs used are the same as in the above described reaction for the production of neutrons by condenser discharges in heavy hydrogen gas.

It is also possible to obtain helium indirectly through neutron irradiation in accordance with the following reaction formula:

$$^{10}_{5}\mathrm{B} + {}^{1}_{0}\mathrm{n} = {}^{4}_{2}\mathrm{He} + {}^{7}_{3}\mathrm{Li}.$$

For this purpose the vessel in which the neutron producing discharge takes place requires to be lined on the inside with a substance containing boron and hydrogen, e.g., $B(OCH_3)_3$, or the discharge vessel has to be arranged adjoining an outer flask filled with such substance.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Method of carrying out nuclear reactions in which the energy requisite for activating the elementary particles to be caused to participate in a desired reaction is produced in a gas discharge under a mean gas concentration of more than 10^{19} molecules per cubic centimetre, and energies of 100 watt seconds and more during intervals of 10^{-6} second and less are produced, corresponding to momentary outputs of 100,000 kilowatts and more.

2. Method as claimed in claim 1 wherein the reaction is carried out under a gas concentration which corresponds to a pressure of one atmosphere at normal temperature of 18° C.

3. Method as claimed in claim 1 for producing neutrons, wherein heavy hydrogen gas or a mixture of light and heavy hydrogen gas is utilised as reagent gas.

Dated this 7th day of February, 1938.

BARON & WARREN,

231, Strand, London, W.C.2,

Chartered Patent Agents.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

AEG and I.G. Farben: Hartmut Kallmann & Ernst Kuhn

Patented July 29, 1941 2,251,190

UNITED STATES PATENT OFFICE

2,251,190

METHOD OF PRODUCING NEUTRONS

Hartmut Israel Kallmann, formerly known as Hartmut Kallmann, Berlin-Charlottenburg, and Ernst Kuhn, Berlin, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany, a corporation of Germany

Application March 10, 1939, Serial No. 261,156
In Germany March 16, 1938

16 Claims. (Cl. 250—84)

This invention relates to a method for the production of neutrons, particularly by the interaction of deuterons.

In order to obtain neutrons with the aid of ions with relatively slight acceleration (for instance 300 kv.) the nuclear reaction

$$D+D=He_3+n$$

is employed. The procedure in this connection is to bombard a layer containing heavy hydrogen nuclei with heavy hydrogen ions or deuterons. For the layer containing hydrogen, use is often made of ice, sal ammoniac, phosphoric acid and similar substances in which ordinary hydrogen is replaced by heavy hydrogen. These layers very rich in hydrogen have the disadvantage that they conduct heat and electricity poorly and are therefore easily destroyed by ionic bombardment. It would be better if more resistant layers were used, for instance, metallic layers. That is possible, however, only when metals that contain large amounts of dissolved or adsorbed hydrogen are employed. These are a few such metals, but they have the disadvantage that they gradually give off hydrogen in the vacuum. It would be still better therefore if substances could be used that contain hydrogen adsorbed only on the surface or in a surface layer but give it off to the outside less easily. These substances placed in the ion stream give only a small output of neutrons when impinged on vertically since the thickness of the adsorbed hydrogen layer is very small in comparison with the range of the ions projected into the metal. Nuclear processes can occur therefore only in a fractional portion of the path of the ions. In case, however, the path of the ions is maintained as nearly as possible entirely within the thin hydrogen layer, a large neutron output is obtained with the aid of these thin adsorbed hydrogen layers.

A principal purpose of the invention is the provision of a highly efficient method for the production of neutrons by the interaction of deuterons. According to the invention this is attained by allowing the stream of ions to impinge on the layer at an angle,—preferably in as grazing a manner as possible.

The adsorption layer containing hydrogen need not consist of pure hydrogen. It might under certain conditions be more advantageous if the adsorption layer consists of gases or vapors containing hydrogen, for instance, methane or water. This is particularly satisfactory when these substances are adsorbed especially strongly.

The body impinged on by the ions is preferably made of a substance that strongly adsorbs the molecules containing heavy hydrogen and at the same time possesses only a slight retarding capacity for the impinging ions. Carbon and beryllium have been found useful for these reasons. It is especially desirable to employ substances that adsorb the molecules containing hydrogen in as thick a layer as possible. This can be accomplished for instance by using, as adsorption body, a substance that is porous or roughened at least at the surface.

The surface of the adsorbing body is heated up by the energy of the impinging ions. In this way the giving off of the adsorbed substance is promoted. It is, therefore, advisable to cool the adsorbing body. This cooling has the advantage, moreover, that at low temperature the adsorbed layer adheres much more firmly. A reduction of the temperature of only 10° C., for instance from 20° C. room temperature to 10° C., can produce a considerable improvement. In many cases, it is advisable to use solid carbon dioxide or even liquid air for the cooling.

The adsorbed layer can be produced in the usual way, for instance by taking up heavy hydrogen or molecules containing heavy hydrogen from the surroundings, for instance from the gas chamber; but it may also be produced by bombarding the surface with heavy hydrogen ions. It is advisable to free the surface intended for the adsorption of heavy hydrogen as far as possible from other adsorbed molecules, such as ordinary hydrogen, for example, by heating in vacuum.

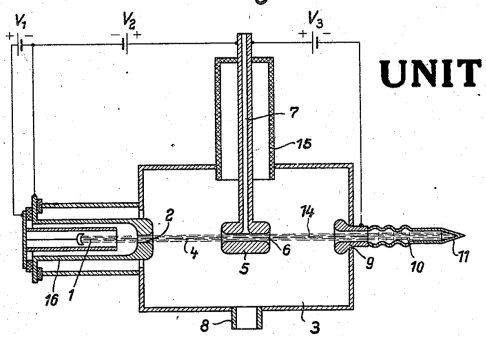
The replacement of the hydrogen given off during the ion bombardment can be accomplished, for instance, by simultaneous or subsequent bombardment with ions containing heavy hydrogen. This bombardment can be accomplished, for instance, with advantage from a different direction, for example, from the back or at a more acute angle from the front, than the bombardment for producing neutrons. The replacement of the heavy hydrogen may be accomplished, for example, by diffusion or by adsorption from the surroundings.

The principles of the invention are illustrated in the accompanying drawing in which:

Fig. 1 is a diagrammatic representation of apparatus embodying the principles of the invention; and

Fig. 2 is a partial diagrammatic representation of a modified embodiment of the invention.

Fig. 1



High-voltage tubes for fusion reactions, neutron production, and tritium breeding

Patented July 7, 1942 2,288,717

UNITED STATES PATENT OFFICE

2,288,717

METHOD FOR THE INVESTIGATION OF SUBSTANCES WITH THE AID OF NEUTRONS

Hartmut Israel Kallmann, Berlin-Charlottenburg, and Ernst Kuhn, Berlin, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany, a corporation of Germany

Application January 31, 1940, Serial No. 316,698
In Germany March 10, 1939

17 Claims. (Cl. 250—65)

The present invention relates to improvements in methods of, and means for, investigating objects or substances with the aid of neutrons.

It has already been suggested to investigate substances by depicting them with the aid of neutrons. This investigation may be carried out by directing a beam of neutrons through the body or substance under investigation and causing the neutrons that emerge from it to encounter a layer in which heavy charged particles or electrons (+ and —) or gamma rays are produced under the action of the impinging neutrons upon an element, contained in said layer, which is reactive toward neutrons. These particles are in turn caused to act upon a layer of fluorescent material, or an adjacent photographic layer or a combination thereof, thus depicting the investigated body or substance visibly or photographically. Neutron reactive layers particularly suited for this purpose are, for instance, such containing lithium or boron. In these two substances the following reactions take place under the influence of the impinging neutrons:

1. $n_0^1+Li_3^6=He_2^4+H_1^3$

2. $n_0^1+B_5^{10}=Li_3^7+He_2^4$

In the lithium or lithium compounds existing in nature the contents of the effective Li_3^6 amounts only to about 10%, and in the boron and boron compounds existing in nature the contents of the effective B_5^{10} amounts only to about 20%. The main mass of these elements consists of Li_3^7, or B_5^{11}, respectively.

It is an object of the present invention to increase the sensitiveness of the above-mentioned method of depicting objects by means of neutrons. Another object of the invention is to provide improved means for depicting objects by means of neutrons.

This inventive object is attained by using as neutron reactive layer containing an element in which the neutron reactive sort of isotopes is enriched beyond the proportion corresponding to the natural distribution of this isotope in the respective element. Using the above mentioned special reactions the neutron reactive sorts of isotopes being artificially enriched are Li_3^6 or B_5^{10}. The enrichment may be accomplished by any of the known methods for separating or concentrating isotopes, i. e. diffusion, mass spectrograph, electrolysis and chemical processes.

With a given intensity of the neutron radiation the number of the emitted heavy particles and therewith the blackening of the photographic plate, or the excitation of the fluorescent screen respectively, is, determined not by the thickness of the intermediate layer, but by the range of the heavy particles liberated from said layer if the thickness of said intermediate layer is larger than said range. The number of the heavy particles emitted per neutron is the greatest if within a layer adjacent to the surface the thickness of which corresponds to the range as many neutrons as possible cause the emission of heavy particles by collision with neutron reactive atomic nuclei. As in general within a layer the thickness of which being equal to the range of said particles only a small fraction of the neutrons passing through liberate heavy particles, it is extremely important, as regards the output, to provide in said layer as many neutron reactive atomic nuclei as possible. An increase of the number of the neutron reactive atomic nuclei is obtained, by artificially enriching the intermediate element with Li_3^6 or B_5^{10}, respectively, beyond the proportion of its natural distribution in the respective element.

This method can advantageously be used also in connection with intermediate layers which do not emit heavy particles, but which emit electrons or gamma rays under the action of impinging neutrons, if the mixture of isotopes of the respective element, as existing in nature, is not the most favorable one for one of said neutron reactions. Therefore, the present improved method is not restricted to boron and lithium, but it will prove advantageous with every other neutron reactive element if only a fraction of all neutrons passing through the neutron-reactive layer is being absorbed in it, or if very thin neutron-reactive layers are used, or if the neutrons in the neutron-reactive layer are also absorbed by atomic nuclei which only contribute very little to the blackening of the photographic layer, or to the excitation of the fluorescent screen respectively by the emission of particles or gamma rays. The present improved method becomes particularly important if the neutron reactive element is applied as an emulsion upon the photographic layer or upon the fluorescent screen. Such emulsions are able to contain a small concentration of the neutron reactive element only. If, therefore the element contained in the emulsion is artificially enriched with the effective sort of isotopes beyond the proportion of its nature distribution in the respective element, an extraordinarily great increase of the sensitiveness can be attained.

Also neutron reactive layers containing cadmium may be used in which the cadmium is ar-

I. G. Ludwigshafen
Ammoniaklaboratorium Oppau

An

Herrn

Dr. W i e t z e l ,

Ammon.-Labor.

Ihre Zeichen	Ihre Nachricht vom	Unsere Nachricht vom	Unser Hausruf	Unsere Zeichen	Ludwigshafen a. Rh.
				Dr. Schä/Me — Lu 949 —	den 16.6. 43

Betreff

Der Stand der Neutronenanlage in Lu/949
Anfang Juni 1943 ist folgender :

Die Leistung unserer Neutronenanlage wurde an der Herstellung von künstlich radioaktivem Phosphor $^{32}_{15}P$ geprüft. Vorteilhaft benützt man hierzu folgenden Kernprozess :

$$^{32}_{16}S + ^{1}_{o}n = ^{32}_{15}P + ^{1}_{1}H$$

Für unsere Anlage empfiehlt sich eine Bestrahlung von Schwefel in Form von CS_2 mit den schnellen Neutronen der D - D Reaktion.

$$^{2}_{1}D + ^{2}_{1}D = ^{3}_{2}He + ^{1}_{o}n$$

Dieser Kernprozess wird in dem Neutronenrohr dadurch realisiert, dass man die in einer Kanalstrahlionenquelle erzeugten Deuteronen mit einer Spannung von einigen hundert Kilovolt nachbeschleunigt und den energiereichen, durch Fokussierung gebündelten Deuteronenstrahl auf eine deuteriumhaltige Substanz, in unserem Falle eine dünne Schicht von schwerem Eis, D_2O Target genannt, fallen lässt.

Die freiwerdenden schnellen Neutronen treten aus dem Neutronenrohr aus, treffen die S - Atome des CS_2 und der dabei gebildete, in unwägbarer Menge vorliegende aktive Phosphor kann von dem CS_2 durch bekannte Methoden abgetrennt werden. Die Stärke des gewonnenen aktiven Phosphorpräparates wird mit einem Geiger-Müller-Zählrohr+), das auf die beim radioaktiven Zerfall emittierten Elektronen anspricht, gemessen.

+) Nebenher wurde noch ein Zählrohrverstärker mit Netzanschluss und einem Thyratronkippkreis in der Endstufe gebaut. Die letztere empfahl sich, da das vorhandene mechanische Zählwerk von Wilichowsky -Göttingen nur bei Impulsen gleicher Grösse einwandfrei arbeitet, was durch den Kippkreis erreicht wird.

Beim ^{32}P geschieht der Zerfall mit einer Halbwertzeit von 14,3 Tagen. 15 Zuverlässig messbare Bruchteile des angereicherten Präparates, das als Ammoniumphosphat vorlag, wurden auf Streifen Filtrierpapier gebracht und um den Zählrohrmantel gelegt. Die am Zählrohr in der Zeiteinheit gemessenen Ausschläge sind ein Mass für die Stärke des Präparates. Das Zählrohr gestattet Aktivitäten von etwa 5 Elektronen in der Minute noch nachzuweisen.

Bei 1 stündigem Betrieb der Anlage bei 200 KV an der Nachbeschleunigungsstrecke und 200 μA Deuteronenstrom, der, um eine bei elektrischer Messung des Stromes leicht auftretende Täuschung durch Sekundäreffekte zu vermeiden, kalorimetrisch bestimmt wurde, erhielten wir bei Bestrahlung von 0,5 Ltr CS_2 eine Präparatstärke des gebildeten aktiven Phosphors von ca 10^3 Elektronen/min. Durch Bestrahlung von grösseren Mengen CS_2 (5 - 10 Ltr.) könnte man bei 10 stündigem Betrieb Präparate von 10^5 Elektronen/min herstellen.

Es mag hier erwähnt werden, dass bei Verwendung der aktiven Phosphorpräparate als radioaktive Indikatoren manche Untersuchungen mit Präparaten von 10^4 Elektronen/min +) mit Erfolg durchgeführt werden können.

Bei Steigerung der Spannung auf 250 KV ist unter den gleichen sonstigen Bedingungen eine Steigerung der Neutronenausbeute und damit auch der Ausbeute an rad.Phosphor um 60% zu erwarten. Versuche ergaben aber vorläufig nur eine Zunahme von 30%. Dies ist darauf zurückzuführen, dass die mit flüssigem Stickstoff gekühlte D_2O - Schicht, die Belastung mit 50 Watt (250 KV, 200 μA) nicht mehr aushält. Durch Verringerung der spezifischen Belastung, also eine Vergrösserung des Brennfleckes ist eine Steigerung der Gesamtbelastbarkeit zu erreichen. Sollte auch dann die Belastbarkeit eines D_2O - Targets nicht hinreichend sein, so empfiehlt sich die Verwendung eines Targets mit Lithiummetall, der sicher genügend belastbar ist, aber den Nachteil einer geringen Ausbeute bei den in Frage kommenden Spannungen gegenüber einem Target mit schwerem Eis hat. Beim Li-Target wird zur Neutronenerzeugung folgender Kernprozwss benützt :

$$^{7}_{3}Li + ^{2}_{1}D = ^{4}_{2}He + ^{1}_{o}n$$

Das Neutronenrohr wurde auch mit 320 KV und 200 μA kurze Zeit betrieben, doch liegen noch keine Ausbeutemessungen vor. Es ist gegenüber 200 KV eine Steigerung der Neutronenausbeute bei einem D_2O - Target um 150% zu erwarten. Bei diesen hohen Spannungen treten infolge der entstehenden Sekundärelektronen harte Röntgenstrahlen in einem Masse auf, sodass ohne geeigneten Schutz gegen diese Strahlung, deren Intensität die Toleranzdosisleistung überschreitet, weitere Versuche bei hohen Spannungen nicht ausgeführt werden können. Daher müsste noch ein hinreichender Schutz in Form von 1 cm dicken Pb - Schirmen angebracht werden.

+) O.Meyerhof, P.Ohlmeyer, W.Gentner u.H.Maier, Leibnitz, Biochem.ZS. 298, 396-411, 1938 :
Studium der Zwischenreaktionen der Glykolyse mit Hilfe von radioaktivem Phosphor.

I.G. Farben Ludwigshafen D+Li Fusion Experiments

1. Bild Neutronenrohr.

2. Bild Kaskadengenerator von Siemens & Halske - 400 KV, 5m A.

Plasma Fusion (???) Experiments at AEG Hennigsdorf in 1944

SECRET

C.S.D.I.C.(U.K.)
S.I.R. 1095

THIS REPORT IS SECRET

Report on information obtained from PW KP/126263 Gren CHRIST, Fest Inf Bn 1408, captured at ECHINGHEN nr BOULOGNE 19 Sep 44

NOTES ON ALLGEMEINE ELEKTRIZITATS GESELLSCHAFT (AEG) HENNIGSDORF NEAR BERLIN, AND THE FOREIGN WORKERS' COLONY

PREAMBLE

1. PW is 40 years old and has been with the German Army for three months only. He was born in CZECHOSLOVAKIA and served with the CZech Army during 1924 and 1925. Shortly after the annexation of the SUDETENLAND PW was ordered to GERMANY and was employed in the lacquer factory of the AEG HENNIGSDORF near BERLIN. Late Feb 41 he was taken from the factory to occupy a post as an interpreter and supervisor among the Czechs in the newly-established Foreign Workers' Camp of the AEG, HENNIGSDORF. From that date until Jul 44 PW has been an active and observant official of this camp. He is very cooperative and the information is considered reliable.

I. NOTES ON AEG AND EMPLOYEES

LOCATION

2. The AEG plant in question is located at the Southern outskirts of HENNIGSDORF (GSGS 4414. 3345/7061 and 7062). (Popl approx. 18,000). This plant is one of ten or eleven branches of the AEG in BERLIN and ever since PW can remember new buildings have been added, and today the plant comprises an estimated area of 800 x 400 m.

TAILPIECE

EXPERIMENTAL STATION GSGS 4414/3345: 69826018

62. A 2-storey ordinary wooden barrack hut 8 x 8 m has been seen by PW, and on two occasions he had the opportunity of entering the building and talking to the electrician who takes care of the equipment. This electrician did not talk of the purposes of the station, and PW believed that it was most secret, but did mention several times that a voltage of one million must be reached before great results could be expected. By the end of Jun 44 they had come up from 120000 to 420000 volts.

63. Once or twice a week two professors and an engineer arrived at the station and during each visit PW saw the four 1½ inch cables from the building to the steel mast approx 80 m away begin to glow in various colours, usually, however, changing from bluish to green, accompanied by a low hum of great intensity. The visitors stayed for 1½ to 2 hours, the test itself lasting approx 15 mins. Shortly after a test PW went to see his friend, the electrician, and heard him say that each test cost RM 24 in electricity alone. Then PW watched him cleaning spherical containers, removing heavy metal bars from each one and putting them into troughs of acid. Each container had a mirror fixed on top which stood at an angle of 45° and which turned through 90° the line of sight from a telescope some 10 feet away to the small mica covered opening at the top of each container.

64. There were four such spherical containers of different sizes and PW states that he observed that the smallest one, approx 1 m in diameter, was used that day in Jun 44. The size of the others ranged between approx 1 m to 2 m in diameter but otherwise they were identical. The cables leading from an amplifier to each one of the spheres were about the same size but the cables leading from the spheres to heavy insulator and apparently farther to the steel mast were considerably heavier from the 2 m sphere than from the 1 m sphere.

65. Upon being prompted PW suddenly remembered that the electrician at the station had used the terms cyclone and atom splitting.

Information received in ALSOS Mission by Dr. W. F. Colby from Scientific Branch, MIS 11-11-44

Major Smith

SECRET

C.H.F. Müller Produced High-Voltage Fusion Neutron Generators During the War

These high-voltage fusion neutron generators produced up to 2.0×10^{11} neutrons/sec.

C.H.F. Müller "delivered" at least five neutron generators during the last two years of the war.

Other companies also produced high-voltage fusion neutron generators.

C. H. F. Muller A.-G., working in cooperation with, and under the direction of, the M. V. Research Association (M. V. Forschungs-Vereign), at Wrist, completed the construction of a 15 megavolt betatron about the first of this year. This betatron operates on 50 cycles. The average current of the high voltage electron beam is approximately .03 microamperes. The output of gamma radiation was reported to be approximately equivalent to one kilogram of radium. This betatron is now installed at Wrist.

In December, 1944, the M. V. Research Association completed the calculations and layouts of a 200 megavolt betatron, to operate on 50 cycles. It was estimated that the average electron beam current of this betatron would be in the order of one milliampere. The total weight was expected to be approximately 30 tons. This betatron was to be constructed by Brown Boveri and Cie A.-G. in Heidelberg. It is understood that Brown Boveri completed detailed construction drawings of this betatron about the first of March of this year.

Dr. W. Müller, of C. H. F. Müller, recently constructed a very small 2 megavolt betatron which weighed less than 100 pounds. This betatron operated on 50 cycles and had a sealed off tube but the output was only sufficient to increase a Geiger counter to about three times its normal rate.

Two betatrons had recently been constructed and were being tested at the Siemens-Reiniger plant in Erlangen. The first of these betatrons to be completed operates on 500 cycles and provides an electron acceleration of 6 megavolts. The second, most recently constructed, betatron operates on 50 cycles and provides an electron acceleration of 7 megavolts. Plans were being made at this plant to construct a 50 cycle, 15 megavolt betatron. Siemens reported that their particular interest in betatron development was in order to provide a means for experimental work with electron beam cancer therapy.

Prof. Bierman of A.E.G., in Berlin, was reported to be working on the design of a 20 megavolt betatron.

During the past two years, C. H. F. Muller has constructed and delivered five "neutron generators". Three of these were rated at 1.5 megavolts, one at 1.2 megavolts, and one at .9 megavolts. They have on order, but have not yet completed, one additional neutron generator rated at .9 megavolts and another rated at 2.4 megavolts. These "neutron generators", or "deutron accelerators", accelerate ionized heavy hydrogen against a beryllium or a lithium target. The neutron output at .9 megavolts when using a beryllium target was estimated to be equivalent to the neutron output of 2 kilograms of radium plus beryllium; when using a lithium target, 3 kilograms; when using a beryllium target at 1.5 megavolts, 13 kilograms; when using a lithium target, 8 kilograms.

The Phillips "cascade" circuit was used for these neutron generators. Although the electrical output of these generators could be as high as 5 ma., the ion source limited this equipment to 0.8 ma. for continuous operation, regardless of voltage.

At 0.8 ma. the ripple was about 1%, at 5 ma., about 5%.

C.H.F. Müller Neutron Generators

~~CONFIDENTIAL~~

INTERROGATION OF DR. HANS RITZ

MANAGING DIRECTOR OF C.F.H. MULLER AT RONTGENSTRASSE,

FUHLSBUTTEL, HAMBURG

May 11, 1945

In November and December 1944, Ritz was experimenting in the manufacture of infra red tubes to be installed in a mobile set for use by the Wehrmacht. Though all three services were probably interested in his production Ritz came into contact only with the army. He was working in conjunction with the firm of A.E.G. Berlin and delivered to them and to the Wehrmacht itself. His factory is located in Greiz, Thuringen. In December he returned to Hamburg and remained in touch with Griez which carried on production until, he thinks, about April when our bombing of communications virtually paralysed it.

Ritz would at first not commit himself on the use of his infra red tubes, insisting that they could be built in to almost any kind of set and stating that his job was merely to produce them. Eventually however, he became so keen to show how advanced this type of research in Germany had become that he gave his opinion on their application. Stressing the compactness of the set whose vital part he had produced Ritz explained how tanks blind and tactically useless at night could when fitted with infra red be enabled to "see in the dark" - this by means of an infra red receiver and an infra red searchlight (thelatter either fitted to the tank or vehicle - of. Leigh Light - or independently operated from a flank of. "Artificial moonlight".) Ritz gave the impression that this was the actual intention of the Wehrmacht by his eagerness to convince his hearers that with a little more time this might have been a weapon for which, used for example in a night attack at the start of the counter offensive, it would have been difficult to find an immediate antidote. He assumes that if it was never used in action the reason could only be that in order to take full advantage of the element of surprise the German Army had decided to delay its appearance until sufficient had been produced to equip a large number of vehicles. Discussing other applications Ritz mentioned the detection of aircraft and Naval gunnery control at night. The latter cases did not, however, seem to interest him so deeply and it is considered that he was not, so far as his knowledge goes, working on a set destined for use by the Navy.

Range of the set when relying on radiated heat as opposed to "recording" and image illuminated by an infra red lamp is given as 10-15 Kilometers under good conditions. Ritz expressing the hope that the benefits of his work fell into the hands of the Americans and not into those of the Russians, states that the sets must still be available at Greiz (sic)

Production figures he estimates roughly as being between 50-100. A.E.G. Berlin are, according to Ritz, the big infra red people. He recommends Dr. Meyer of Berlin as a man with most expert knowledge of the subject. Kugler the Berlin director, is more the organizer. The firm also has a factory at Freiburg in Schlesien.

Ritz also proudly stated that he had been engaged on research work connected with splitting the atom and hinted that this was far enough advanced for the Europeans to combine forces and develop this "terrific" potential energy for use in any future War with the Asiatics. The subject was not pursued owing to the complete lack of knowledge on the part of the interrogator.

Informant denied all knowledge of export of infra red to Japan. He did not consider it likely that the Germans would part with any new apparatus in this line though admitted that elementary material such as was used by the Italians may well have been sent without his knowledge.

I.O.'s note. Though now inclined to co-operate with British and Americans, Ritz cannot get rid of the idea that by giving us information which we might pass on to the Russians he is stabbing Europe and Civilization in the back. Professes however to have no love for the Japs, so this appears to be the line. Probably has an exaggerated idea of the importance of his work but it is strongly recommended that he be interrogated by an expert. He is at present in custody in the factory at Fuhlsbuttel. If released he will be available at short notice.

(signed)
S. Wheeler, Capt. R.M.

SECRET

AMERICAN EMBASSY
Office of the Military Attache
London, England

Paris Office
7 June 1945

Subject: Interrogation of Dr. Hans Ritz, Managing Director of C. F. H. Müller at Röntgenstrasse, Fuhlsbuttel, Hamburg.

To : Lt. Colonel John Lansdale, Jr., and Major Francis J. Smith, Room 5119, New War Department Building, Washington, D. C.

1. The interrogation of Dr. Hans Ritz revealed that Ritz was experimenting in the manufacture of infa-red tubes which was his main scientific research project. However, the following is quoted from a CIOS report of 11 May 1945 made by S. Wheeler, Captain, R. M. (It should be recalled that Müller had a small tonnage of U_3O_8).

"Ritz also proudly stated that he had been engaged on research work connected with splitting the atom and hinted that this was far enough advanced for the Europeans to combine forces and develop this "terrific" potential energy for use in any future war with the Asiatics. The subject was not pursued owing to the complete lack of knowledge on the part of the interrogator."

R. R. FURMAN,
Major, CE.

CONFIDENTIAL

PROF.SIZOO of the VRIJE UNIVERSITEIT AMSTERDAM
(Laressestraat 174)
Had to provide a Neutron Generator.

II. PROF. SIZOO of the VRIJE UNIVERSITEIT AMSTERDAM supplied the following information regarding BUTCHER:

BUTCHER'S early work was on light alloys and he had been making X ray investigations. PROF. VON STOKAR, the former German head of Education in APELDOORN had told Prof. SIZOO that BUTCHER was working in Holland because a very important institute in Germany had been bombed (thought to be an S.S. institute) and BUTCHER apparently had great plans for rebuilding this institute in Doetinchem. STOKAR also said that BUTCHER was working under the auspices of a research organisation controlled by GORING. When asked about the nature of the work, STOKAR would give very little information but did say to Prof. SIZOO "Das hangt mit neuem Waffen zusammen" (It has to do with new weapons). When asked by Prof. SIZOO why his Neutron generator must be taken by BUTCHER, STOKAR had inferred that the Germans were getting as many of these generators as they could; he also said that the installation of Prof. JOLIOT in PARIS (Mme. Curie Laboratory) was being used by the Germans, mentioned installations in COLOGNE and BERLIN and also said that two Neutron generators working with 1,000,000 Volts had been made in HAMBURG (MULLER factory) but one of them had been destroyed. Prof. SIZOO was impressed by the fact that STOKAR - a classical scholar - should know so much about the distribution of these equipments in Europe, and concluded that the S.S. placed high importance on obtaining Neutron generators.

Prof. SIZOO'S own opinion on the subject generally was that neither the German nor Dutch expert scientists considered the discovering of a powerful new weapon using atomic energy likely in the near future, but that the German S.S. had great faith in such a discovery eventually, thence they were trying to promote the maximum of research work in this direction. The propaganda value of the investigations was also probably very high in certain circles in Germany. Prof. SIZOO had not a very high opinion of BUTCHER'S capabilities and was certain that he had not achieved any measure of success either at LEIDEN or DOETINCHEM. It was suggested by Prof. SIZOO that information regarding the attitude of the S.S. to the subject generally and also further information on what has been done in producing NEUTRON and CYCLOTRAN generators could be obtained from the former Chief of the Rontgen dept. of PHILIPS, Dr. BOUWERS now with the OPTISCHE INDUSTRIE, OUDE DELFT.

DATE OF ASSESSMENT 14 May 1945.

ASSESSOR'S (NAME'S) F.W. Trenouth, Capt. REME. Army Group 21.

"BÖTTCHER was working in Holland because a very important institute in Germany had been bombed (thought to be an S.S. institute) and BÖTTCHER apparently had great plans for rebuilding this institute in Doetinchem…

When asked about the nature of the work, STOKAR would give very little information but did say to Prof. SIZOO 'Das hängt mit neuem Waffen zusammen' (It has to do with new weapons).

When asked by Prof. SIZOO why his neutron generator must be taken by BÖTTCHER, STOKAR had inferred that the Germans were getting as many of these generators as they could;

he also said that … two neutron generators working with 1,000,000 Volts had been made in HAMBURG (MÜLLER factory) but one of them had been destroyed…

[T]he S.S. placed high importance on obtaining neutron generators."

Examples of High-Voltage Fusion Neutron Generators Used During the War

Fritz Houtermans to Werner Czulius. 28 November 1944. AMPG, I. Abt. Rep. 34, Nr. 53, Bl. 1-2.

If you cannot measure it yourself, I have chosen one from the Tuve-Hafsad values of artificial sources which extrapolating corresponds to a primary neutron spectrum with a similar upper limit (I believe D+D, forward, approximately). For Li + D, we have found 1/B = 10.8 cm, also forward, which is quite the same as for Ra+Be, which shows that the energy dependence does not matter very much.

G-298. Karl Zimmer and Otto Peter. Radiobiological Investigations with Fast Neutrons. 1944.

Biological effects were compared with 180 kV x-ray and Li + D fast neutron total body irradiations on blood, haemopoietic organs and male gonads of rats.

G-387. Siemens & Halske Corporation. Cost Estimates for the 1000 kV Neutron Generator for the University of Vienna. 1941–1942.

Blueprints, photographs, and cost estimates for a neutron generator for the Institute of Radioactivity Research of the University of Vienna are included in this report.

CIOS X-13 Appendix B

Appendix B

Armament Research Dept.
Halstead Place,
Halstead,
Nr.Sevenoaks, Kent.

Developments in Germany of Radiological Apparatus and Applications

Very little real information was known at Philips, Eindhoven, Holland, or in German occupied countries but the following points were notes as being potentially interesting:-

1. The Broere Foundry, situated in Amsterdam opposite the Blookers Cocoa Factory, Omval, had X-ray industrial equipment delivered early last year on the very highest priority. It was thought to be in connection with V 2 projectiles.

Similar apparatus was delivered to Warsitz Werke, Valckenierstraat 69-87. Amsterdam.

2. Ruhrstahl., Annen., Witten-Armen (Ruhr) Commisair Lindner is stated to have special X-ray plant for the examination of V 2 parts.

3. Dr. Böttcher, Research Station at Doetinchem, Holland, is stated to have collected ultra-high voltage X-ray apparatus up to 5 million volts.

4. F. Kirchner (Köln) is reported to have built a 5 million volt Van de Graaff machine.

5. Mattanch & Hahn. Kaiser Wilhelm Institut (Berlin-Dahlem) are said to have built similar machines.

The same Institute is reputed to have in operation a 2 million volt Müller Cascade generator.

6. K.W. Institut fur Hirnforschung (Berlin Buch)

Dr. Karl Zimmer, is known to have been working on a neutron generator of 600 k.v. and in one of his laboratories there was seen in July, 1943, a few boxes (20 x 30 x 30 cms) filled with Uranium.

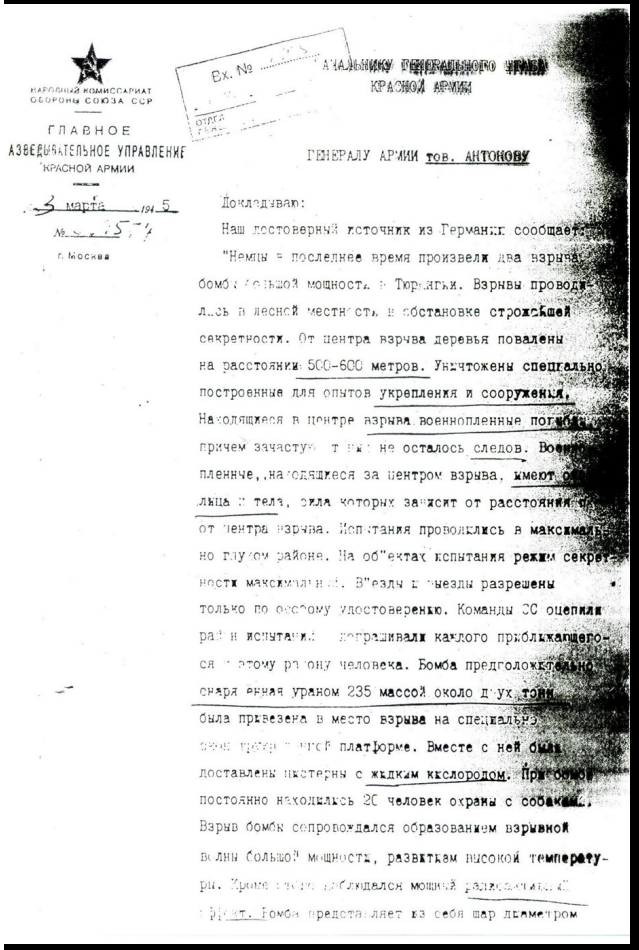
It is not known whether any work was done on the separation of isotopes of Uranium.

7. Dr. W. Heisenberg, Siemens, Berlin Dahlem, said to have built special H.T. plant.

8. Dr. W. Bothe, Heidelberg & Dr. G. Herk, Siemens - Gesellschaft said to be operating several cyclotrons.

9. Dr. K. Clisius, Breslau, said to be engaged on the problem of separating isotopes of Uranium.

Fission Bomb Design: 23 March 1945 Letter from General Ivan Ilyichev (Head of GRU) to Joseph Stalin



НАРОДНЫЙ КОМИССАРИАТ ОБОРОНЫ СОЮЗА ССР
ГЛАВНОЕ РАЗВЕДЫВАТЕЛЬНОЕ УПРАВЛЕНИЕ КРАСНОЙ АРМИИ

Вх. №

НАЧАЛЬНИКУ ГЕНЕРАЛЬНОГО ШТАБА КРАСНОЙ АРМИИ

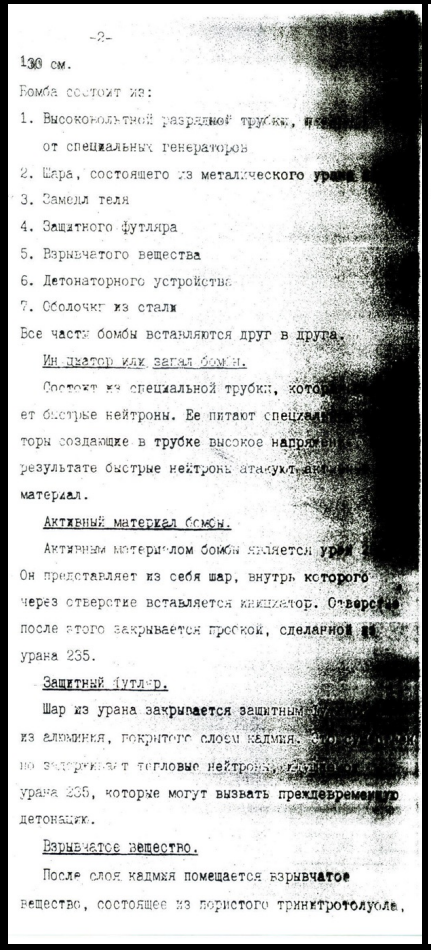
ГЕНЕРАЛУ АРМИИ тов. АНТОНОВУ

3 марта 1945
№ 25/ш
г. Москва

Докладываю:

Наш достоверный источник из Германии сообщает:

"Немцы в последнее время произвели два взрыва бомб большой мощности в Тюрингии. Взрывы проводились в лесной местности в обстановке строжайшей секретности. От центра взрыва деревья повалены на расстоянии 500-600 метров. Уничтожены специально построенные для опытов укрепления и сооружения. Находящиеся в центре взрыва военнопленные погибли, причем зачастую от них не осталось следов. Военнопленные, находящиеся за центром взрыва, имеют ожоги лица и тела, сила которых зависит от расстояния их от центра взрыва. Испытания проводились в максимально глухом районе. На об"ектах испытания режим секретности максимальный. В"езды в районы разрешены только по особому удостоверению. Команды СС оцепили район испытаний и проверяли каждого приближающегося к этому району человека. Бомба предположительно снаряженная ураном 235 массой около двух тонн была привезена в место взрыва на специальной [illegible] платформе. Вместе с ней были доставлены цистерны с жидким кислородом. Территория постоянно находилась 2С человек охраны с собаками. Взрыв бомбы сопровождался образованием взрывной волны большой мощности, развитием высокой температуры. Кроме этого наблюдалось мощное радиоактивное [illegible]. Бомба представляет из себя шар диаметром



-2-

130 см.

Бомба состоит из:

1. Высоковольтной разрядной трубки, [illegible] от специальных генераторов
2. Шара, состоящего из металического урана
3. Замедл теля
4. Защитного футляра
5. Взрывчатого вещества
6. Детонаторного устройства
7. Оболочки из стали

Все части бомбы вставляются друг в друга.

Ин циатор или запал бомбы.

Состоит из специальной трубки, кото ет быстрые нейтроны. Ее питают специа торы создающие в трубке высокое напря результате быстрые нейтроны атакуют ядр материал.

Активный материал бомбы.

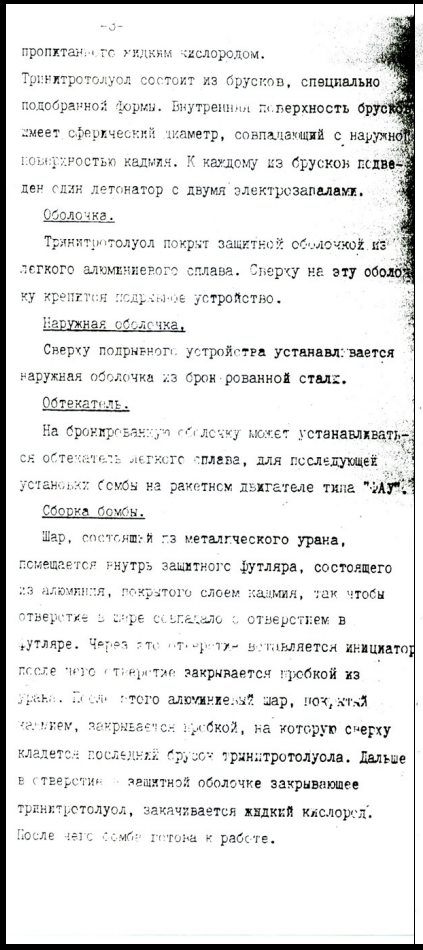
Активным материалом бомбы является ура Он представляет из себя шар, внутрь которого через отверстие вставляется инициатор. Отверс после этого закрывается пробкой, сделанной из урана 235.

Защитный футляр.

Шар из урана закрывается защитным из алюминия, покрытого слоем кадмия. но задерживает тепловые нейтроны, урана 235, которые могут вызвать преждевременную детонацию.

Взрывчатое вещество.

После слоя кадмия помещается взрывчатое вещество, состоящее из пористого тринитротолуола,



-3-

пропитанного жидким кислородом.

Тринитротолуол состоит из брусков, специально подобранной формы. Внутренняя поверхность брусков имеет сферический диаметр, совпадающий с наружной поверхностью кадмия. К каждому из брусков подведен один детонатор с двумя электрозапалами.

Оболочка.

Тринитротолуол покрыт защитной оболочкой из легкого алюминиевого сплава. Сверху на эту оболочку крепится подрывное устройство.

Наружная оболочка.

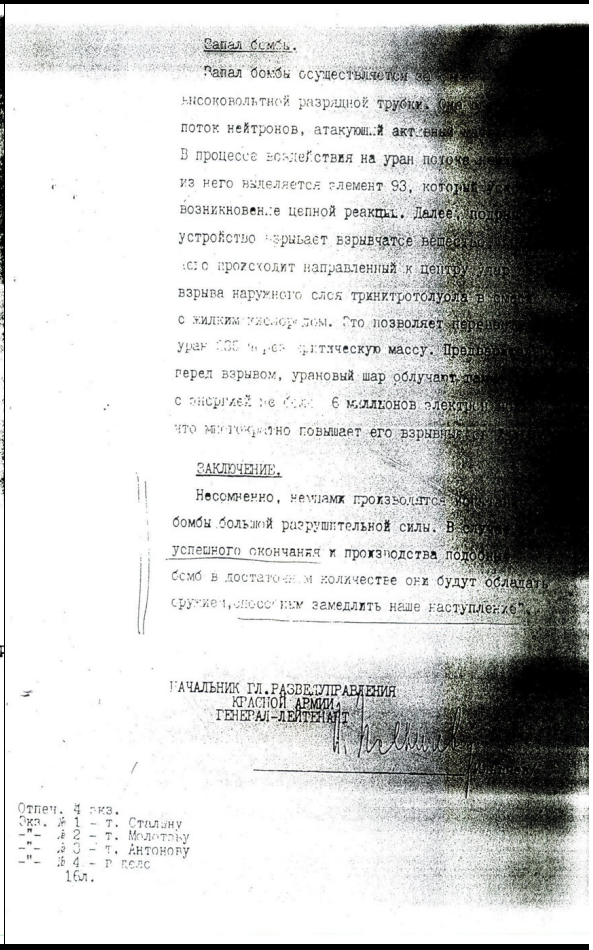
Сверху подрывного устройства устанавливается наружная оболочка из бронированной стали.

Обтекатель.

На бронированную оболочку может устанавливаться обтекатель легкого сплава, для последующей установки бомбы на ракетном двигателе типа "ФАУ".

Сборка бомбы.

Шар, состоящий из металического урана, помещается внутрь защитного футляра, состоящего из алюминия, покрытого слоем кадмия, так чтобы отверстие в шаре совпадало с отверстием в футляре. Через это отверстие вставляется инициатор после чего отверстие закрывается пробкой из урана. После этого алюминиевый шар, покрытый кадмием, закрывается пробкой, на которую сверху кладется последний брусок тринитротолуола. Дальше в отверстии в защитной оболочке закрывающее тринитротолуол, закачивается жидкий кислород. После чего бомба готова к работе.



Запал бомбы.

Запал бомбы осуществляется за высоковольтной разрядной трубки, ко поток нейтронов, атакующий акти В процессе воздействия на уран потока из него выделяется элемент 93, которы возникновение цепной реакции. Далее, по устройство срывает взрывчатое вещест его происходит направленный к центру взрыва наружного слоя тринитротолуола с жидким кислородом. Это позволяет перев уран 235 в сверхкритическую массу. Перед взрывом, урановый шар облучают с энергией не ме 6 миллионов электро что многократно повышает его взрывн

ЗАКЛЮЧЕНИЕ.

Несомненно, немцами произво бомбы большей разрушительной силы. В случае успешного окончания и производства подобных бомб в достаточном количестве они будут обладать оружием, способным замедлить наше наступление".

НАЧАЛЬНИК ГЛ.РАЗВЕДУПРАВЛЕНИЯ КРАСНОЙ АРМИИ ГЕНЕРАЛ-ЛЕЙТЕНАНТ

Отпеч. 4 экз.
Экз. № 1 - т. Сталину
-"- № 2 - т. Молотову
-"- № 3 - т. Антонову
-"- № 4 - в дело
16л.

Archive of the President of the Russian Federation, Fund 93, Division 81 (45), List 37. Found in 2003 by Rainer Karlsch.

The letter appears to be genuine. It is part of a paper trail of earlier and later documents, some of which were already published.

8. Fission Bomb Design: Ilyichev to Stalin, 23 March 1945

Our trustworthy source from Germany reports:

The Germans have in recent times carried out two large-capacity bomb explosions in Thuringia. The explosions took place in a forest area, under conditions of strictest secrecy. Trees fell at a distance of 500–600 meters from the center of the explosion. Buildings and fortifications specially constructed for the tests have been destroyed.

Prisoners of war who were near the epicenter of the explosion died, often without leaving a trace. Prisoners of war who were in the area beyond the center of the explosion have burns on their face and body, the strength of which depends on their position in relation to the epicenter of the explosion. The tests were carried out in a remote deserted area. The regime of secrecy at the test site was at maximum level. Entrance and exit from the territory are by special pass only. SS soldiers have surrounded the area of tests and interrogated any person approaching the area.

The bomb, supposedly filled with uranium 235 and weighing approximately two tons, was brought to the test site on a specially constructed truck. Dewars of liquid oxygen were delivered together with it. The bomb was permanently guarded by 20 guards with dogs. The bomb explosion was accompanied by a large explosive wave and high temperature. In addition, a massive radioactive effect was observed. The bomb is a sphere with a diameter of 130 cm.

The bomb consists of:

1. High-voltage discharge tube, which is charged by special generators
2. A sphere made of metal uranium 235
3. A delay mechanism [tamper]
4. Protective casing
5. Explosive substance
6. Detonating mechanism
7. Steel casing

All parts of the bomb fit inside each other.

8. Fission Bomb Design: Ilyichev to Stalin, 23 March 1945

Initiator or bomb fuse.

Consists of a special tube, which creates fast neutrons. It is charged by special generators, which create high voltage inside the tube. As a result, fast neutrons attack active material.

Active bomb material.

Active bomb material is uranium 235. It represents a sphere with an opening into which an initiator is inserted. Once this is done, the opening is sealed by a cork made of uranium 235.

Protective casing.

The uranium sphere is encased in a protective aluminum casing, which is covered by a layer of cadmium. This significantly impedes thermal neutrons emanating from uranium 235, which can cause premature detonation.

Explosive matter.

After the layer of cadmium it is placed inside explosives that consist of porous TNT saturated with liquid oxygen; TNT is made up of bars of a specially chosen shape. The inner surface of the bars has a spherical curvature, which is the same as that of the external surface of the cadmium layer. Each of the bars is supplied with one detonator or two electrical fuses.

Casing.

TNT is covered by a protective layer made of a light aluminum alloy. A blasting mechanism is attached on top of this casing.

Exterior casing.

An exterior casing of armored steel is installed above the blasting mechanism.

Fairing.

A fairing made of a light alloy can be installed on top of the armored casing for future installation on a rocket of the V-type.

Bomb assembly.

The sphere, which consists of metal uranium, is placed inside a protective casing, which consists of aluminum, covered in a layer of cadmium, so that the opening in the

8. Fission Bomb Design: Ilyichev to Stalin, 23 March 1945

sphere coinciding with the opening is sealed off by a uranium cork. After this the aluminum sphere, covered in cadmium, is sealed off by a cork, on top of which the last bar of TNT is placed. Next, liquid oxygen is pumped through the opening inside a protective casing, which covers the TNT. After this the bomb is ready for deployment.

Bomb ignition.

The bomb ignition is carried out with the help of a high-voltage discharge tube. It forms a flow of neutrons, which attack the active material. When the flow of neutrons impacts upon uranium, element 93 fissions, which speeds up the creation of a chain reaction. Next, the detonating mechanism detonates the explosive matter, after which a shock from the explosion of the external layer of TNT mixed with liquid oxygen takes place, which is directed toward the center. This allows the uranium to reach a critical mass.

Ahead of this, before the explosion, the uranium sphere is irradiated with gamma-rays, the energy of which does not exceed 6 million electron volts, which many times increases its explosive qualities.

CONCLUSION.

Without doubt, the Germans are carrying out tests of a bomb of high destructive force. In the event of their successful conclusion and production of such bombs in sufficient quantities, they will have weapons capable of slowing down our advance.

Marshal Georgy Zhukov. 2 October 1945. Report to Joseph Stalin. Archive of the President of the Russian Federation, Fund 93, Division 77 (45), List 4-11.

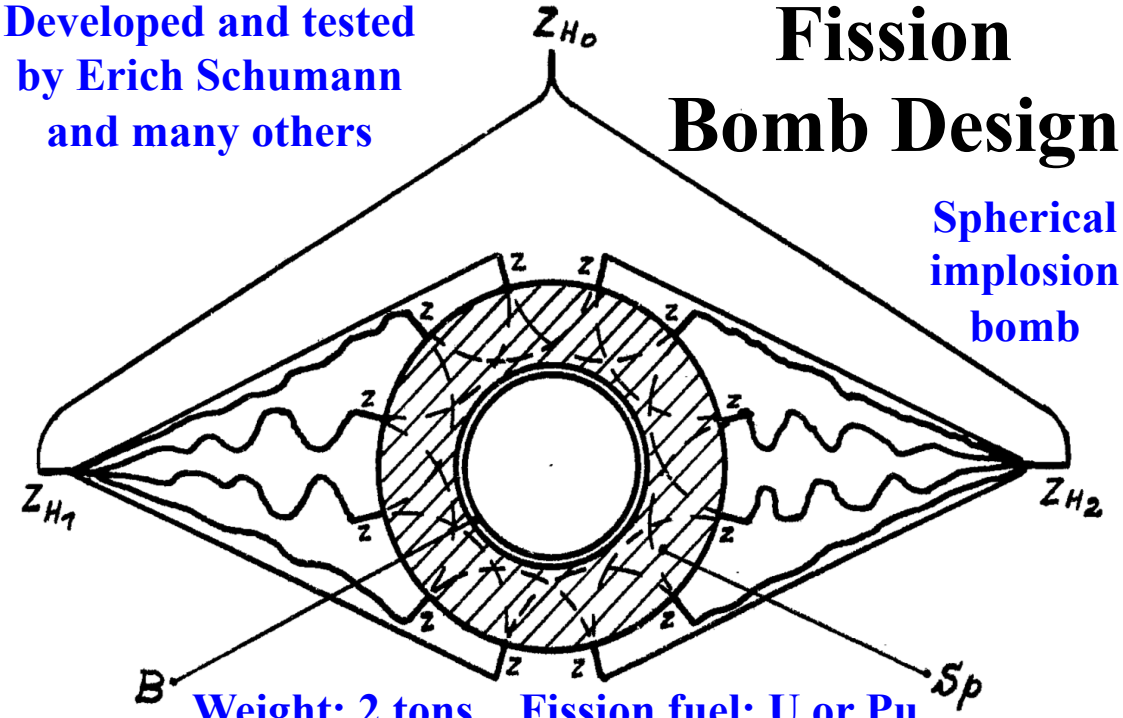
Based on the collected materials, it can be concluded that the German scientists in the field of theoretical and practical research and application of atomic energy have achieved good results up to the creation of the atomic bomb.

2. Fusion Boosting for Fission

Fission Bomb Design

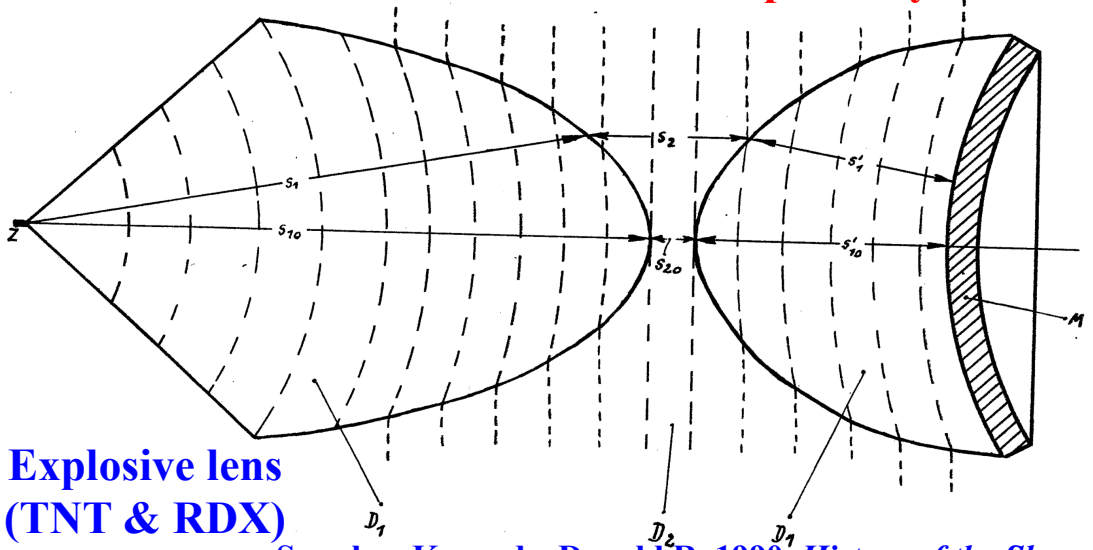
Developed and tested by Erich Schumann and many others

Spherical implosion bomb

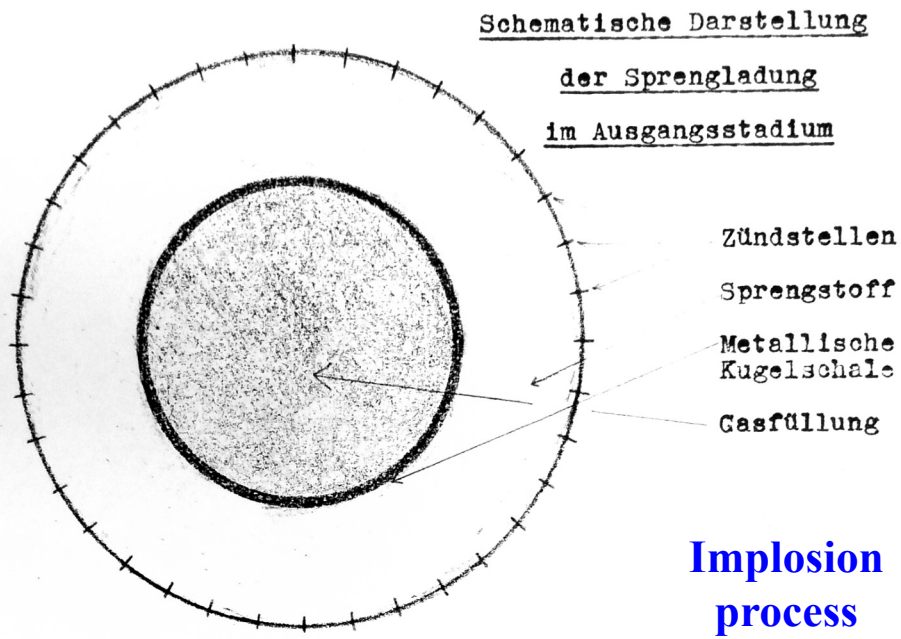


Weight: 2 tons Fission fuel: U or Pu

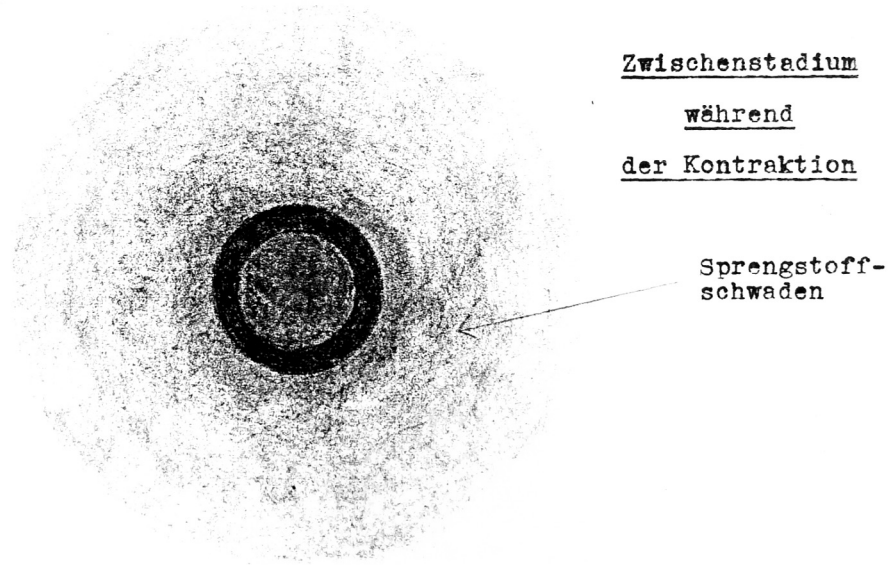
Fusion fuel in center to boost the explosive yield



Explosive lens (TNT & RDX)



Implosion process



See also: Kennedy, Donald R. 1990. *History of the Shaped Charge Effect: The First 100 Years.* https://apps.dtic.mil/dtic/tr/fulltext/u2/a220095.pdf

Krehl, Peter O. K. 2009. *History of Shock Waves, Explosions and Impact: A Chronological and Biographical Reference.* Berlin: Springer.

Nagel, Günter. 2012. *Wissenschaft für den Krieg.* Stuttgart: F. Steiner.

Patent DE 977825

AMPG, Abt. III, Rep. 83, Nr. 286

№ 977 863
KLASSE 21 g GRUPPE 21 21
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gem Prozentsatz im Uran enthaltene Isotop abzutrennen oder um das ihm gleichwertige Plutonium zu gewinnen.

Bei diesem Sachverhalt ist es von großer Bedeutung, daß außer den Spaltungen der wenig stabilen schweren Kerne, z. B. des Uran 235 oder des Plutoniums, noch andere Kernprozesse existieren, bei denen ebenfalls große Energiebeträge frei werden, wobei jedoch die Ausgangsprodukte dieser Prozesse viel häufiger vorkommen und mit verhältnismäßig geringem Aufwand, z. B. aus Wasser, rein dargestellt werden können.

Es handelt sich hier im Gegensatz zu den Spaltprozessen der schweren Kerne, welche am Ende des periodischen Systems der Elemente stehen, um Reaktionen zwischen den Kernen der leichtesten Elemente, z. B. leichter und schwerer Wasserstoff, Lithium, Beryllium und Bor.

Bei der Vereinigung eines Protons mit einem Lithiumkern und gleichzeitiger Entstehung zweier Heliumkerne

$$^{7}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{H} = {}^{4}_{2}\mathrm{He} + {}^{4}_{2}\mathrm{He} + (\Delta m),$$

weisen z. B. die Endprodukte eine um $\Delta m = 0{,}0185$ Masseneinheiten geringere Masse auf, die als kinetische Energie der Heliumkerne in Erscheinung tritt. Letztere besitzen eine sehr hohe Geschwindigkeit, die der mittleren Geschwindigkeit der Moleküle eines Gases der Temperatur von ungefähr 1 Billion Grad entspricht.

Auch bei den beiden Reaktionen zwischen den Kernen des schweren Wasserstoffs

$$^{2}_{1}\mathrm{D} + {}^{2}_{1}\mathrm{D} = {}^{3}_{1}\mathrm{Tr} + {}^{1}_{1}\mathrm{H}$$

und

$$^{2}_{1}\mathrm{D} + {}^{2}_{1}\mathrm{D} = {}^{3}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$$

werden ungeheure Energien frei, so z. B. bei der Umsetzung von 4 g Deuterium nach der ersten Reaktion rund 100 Millionen kcal.

Wollte man denselben Energiebetrag bei der Detonation eines brisanten Sprengstoffs, z. B. von Trinitrotoluol, frei machen, so müßte man 100 000 kg, das ist der 25millionenfache Betrag der genannten Deuteriummenge, anwenden.

Dabei ist die Ausgangssubstanz, der schwere Wasserstoff, überall auf der Erde in uneingeschränkter Menge vorhanden. Seine Gewinnung aus dem gewöhnlichen Wasser gelingt verhältnismäßig einfach und wird ohne besondere Schwierigkeiten in technischem Maßstab durchgeführt. Die Durchführung der Deuteriumreaktionen im Umfang wägbarer Massen übertrifft deshalb den Weg der Gewinnung von Atomenergien vom Ausgangspunkt Uran her bei weitem an Bedeutung.

Dabei ist besonders zu beachten, daß damit auch eine äußerst intensive Neutronenquelle zur Verfügung steht, was im Hinblick auf die medizinische und biologische Forschung noch weit wichtiger erscheint als die Erschließung der gewaltigen Atomenergien beispielsweise für Kriegszwecke.

Da den beiden Deuterium-Kernreaktionen etwa die gleiche Wahrscheinlichkeit zukommt, erhält man bei der Umsetzung von vier Deuteronen durchschnittlich ein Neutron, d. h. auf 8 g umgesetztes Deuterium 1 g Neutronen, das sind etwa $0{,}6 \cdot 10^{24}$ Neutronen.

Um diese Neutronenmenge z. B. nach der Reaktion

$$^{7}_{3}\mathrm{Li} + {}^{2}_{1}\mathrm{D} = 2\,{}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$$

mit Hilfe einer Hochspannungsanlage zu erzeugen, welche bei einer Spannung von 1,5 MV einen Strom von 0,5 mA liefert, das wäre eine sehr große Anlage, müßte diese 1 Billion Sekunden, das sind rund 30 000 Jahre, laufen.

Die vorliegende Erfindung bezieht sich nun auf die Anwendung des in dem Patent 977 825 beschriebenen Verfahrens zur Erzeugung höchster Drucke und Temperaturen zur Einleitung von Atomkernreaktionen, insbesondere zwischen den Kernen leichter Elemente.

Wird z. B. $^1/_2$ Kubikmeter schweren Wasserstoffgases vom Anfangsdruck 0,1 at, das sind rund 9 g, nach den Reaktionsgleichungen

$$^{2}_{1}\mathrm{D} + {}^{2}_{1}\mathrm{D} = {}^{3}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} + 3{,}3\ \mathrm{MeV}$$

und

$$^{2}_{1}\mathrm{D} + {}^{2}_{1}\mathrm{D} = {}^{3}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} + 4{,}0\ \mathrm{MeV}$$

vollständig umgesetzt, so wird ein Energiebetrag von rund 10^{19} erg, entsprechend etwa 250 t Trinitrotoluol, frei. Da dies in einer Zeit von der Größenordnung 1 zehntausendstel sec geschieht, ergibt sich für die je Sekunde frei werdende Energie größenordnungsmäßig 10^{23} erg/sec.

Vergleicht man dies mit der je Sekunde erfolgenden Energieabwanderung durch die Innenoberfläche einer das Gas umschließenden Hohlkugel, so ergibt sich, daß selbst wenn mit einer sehr hohen Wärmeleitzahl von 10^{16} bis 10^{18} gerechnet wird, die Verluste durch die Wärmeabwanderung noch von der Energienachlieferung von innen her bestritten werden.

Ein Blick in das Wärmeleitzahl-Diagramm lehrt, daß dann an der Innenfläche selbst bei den hierfür verhältnismäßig niedrigen Drücken von 100 bis 250 Millionen at eine Temperatur von rund zehn Millionen Grad angenommen werden kann.

Danach ist anzunehmen, daß die Reaktion von selbst weiterlaufen wird, wenn nur an einer Stelle — in der unmittelbaren Umgebung des Mittelpunktes — die Temperatur von 10 bis 20 Millionen Grad erreicht wird, denn dann steigt die Temperatur im Innern immer mehr an, wobei die Reaktionen immer wahrscheinlicher werden, bis schließlich die Energieabstrahlung überwiegt oder das Deuterium erschöpft ist.

Ferner ist zu beachten, daß bei den dann erreichten hohen Temperaturen auch andere Kernprozesse genügend wahrscheinlich werden, so daß sie mit zur Energieerzeugung herangezogen werden können.

Bei Anwesenheit von Protonen wird z. B. auch die sehr energiereiche Reaktion

$$^{3}_{1}\mathrm{Tr} + {}^{1}_{1}\mathrm{H} = {}^{4}_{2}\mathrm{He} + 20\ \mathrm{MeV}$$

stattfinden, welche nach den Deuteronenprozessen die wahrscheinlichste Kernreaktion ist, oder bei Anwesenheit von Lithium die Reaktionen

$$^{7}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{H} = 2\,{}^{4}_{2}\mathrm{He} + 17\ \mathrm{MeV}$$

und

$$^{6}_{3}\mathrm{Li} + {}^{2}_{1}\mathrm{D} = 2\,{}^{4}_{2}\mathrm{He} + 22{,}5\ \mathrm{MeV}$$

sowie

$$^{7}_{3}\mathrm{Li} + {}^{2}_{1}\mathrm{D} = 2\,{}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} + 15\ \mathrm{MeV},$$

welch letztere wiederum Neutronen befreit.

Die Deuteronenprozesse spielen dann vergleichsweise die Rolle des leicht entzündlichen Zündholzes, das die schwerer entzündlichen Brennstoffe anzündet.

Diesem Umstand kann man gemäß der Erfindung dadurch nutzbringend Rechnung tragen, daß man zugleich mit der Füllung der anzuwendenden Druckzellen mit Wasserstoff, insbesondere schwerem Wasserstoff, andere leichte Elemente, z. B. Lithium, Beryllium, Bor oder auch leichten Wasserstoff als Elemente oder in Form von chemischen Verbindungen an der Innenwand der Druckzellen oder auch in der Wand der Druckzellen, durch dünne Schichten vom Innenraum getrennt, zur Anwendung bringt. So empfiehlt sich beispielsweise die Verwendung von schwerem Lithiumhydrid (LiD).

Insgesamt wird so die Befreiung eines Energiebetrages möglich, der die zur Einleitung dieser Kernreaktionen aufzuwendende chemische Energie des Sprengstoffes (ungefähr 10^{16} erg) sehr beträchtlich überschreitet.

Auch die bei der einen der D-Kernreaktionen frei werdenden Neutronen können zur weiteren Befreiung von Energie herangezogen werden. Die Reaktion

$$^{6}_{3}\mathrm{Li} + {}^{1}_{0}\mathrm{n} = {}^{3}_{1}\mathrm{Tr} + {}^{4}_{2}\mathrm{He}$$

würde z. B. auf Grund der Massenbilanz die Energie von 4,7 MeV befreien, oder die entsprechende Reaktion mit Bor

$$^{10}_{5}\mathrm{B} + {}^{1}_{0}\mathrm{n} = {}^{7}_{3}\mathrm{Li} + {}^{4}_{2}\mathrm{He}$$

würde ungefähr 3 MeV freisetzen.

Ferner kann man die bei der Deuteronenreaktion frei werdenden Neutronen dazu benutzen, die Spaltung des U^{235} in dem natürlichen Uran, also dem gewöhnlichen Isotopengemisch, vorzunehmen.

Wenn die Innenwand der das Deuterium enthaltenden Druckzelle mit einer genügend starken Graphitschicht ausgekleidet wird, auf die eine Schicht Uran folgt, werden die frei werdenden Neutronen mit sehr hohem Energiegehalt auf thermische Neutronen abgebremst, ehe sie die Uranschicht erreichen. Dort werden sie dann nicht vom U^{238} eingefangen, sondern können an dem U^{235} die Spaltung hervorrufen. Man müßte dann nur, wie in allen Fällen, in denen die frei werdenden Neutronen herangezogen werden sollen, durch eine geeignete Außenhülle der anzuwendenden Druckzellen ein Entweichen nach außen verhindern, ähnlich wie dies bei den Atombomben durch den sogenannten »Tamper« geschieht.

Man kann auch die frei werdenden Neutronen aus den D-Kernreaktionen zunächst zu einer unmittelbaren Temperatursteigerung im Zentrum der Druckzelle benutzen, indem man dort eine winzige Menge Cadmium anbringt, welches die Neutronen unter Erhitzung absorbiert.

Wesentlich wichtiger als die Befreiung von Atomenergie zu militärischen Zwecken ist die Herstellung und Verwendung von Neutronen für friedliche Aufgaben.

Auf die Bedeutung und die große Intensität der bei der Umsetzung von Deuterium entstehenden Neutronenstrahlung wurde bereits weiter vorn hingewiesen. Hier sei nur noch hinzugefügt, daß selbst, wenn mit Hilfe des beschriebenen Verfahrens nur eine Temperatur von 2 Millionen Grad erreichbar wäre, aus nur 2 g schwerem Wasserstoff während 1 zehntausendstel sec nach den Resultaten von Bethe sowie Gamow und Teller ungefähr $3 \cdot 10^{21}$ Neutronen frei gemacht werden, was etwa 10^{18} Curie bzw. einer Radium-Berylliumquelle von rund 1 Milliarde kg entspricht. Eine starke Hochspannungsanlage würde 350 Jahre benötigen, um diese Neutronenmenge zu erzeugen.

Derartige Neutronenintensitäten sind bisher nur in den »Uran-piles« beobachtet worden. Ihre Erzeugung erfordert dort jedoch einen unvergleichlich größeren Aufwand, als er bei dem vorgeschlagenen Verfahren erforderlich ist.

PATENTANSPRÜCHE:

1. Vorrichtung nach Patent 977 825 zur Behandlung von Material mit hohen Drücken und Temperaturen, **dadurch gekennzeichnet,** daß die Wandung der Wasserstoff, insbesondere schweren Wasserstoff, enthaltenden Druckzelle leichte Elemente, wie Lithium, Beryllium, Bor oder leichten Wasserstoff als Element oder in gebundener Form aufweist.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die leichten Elemente die Innenwand der Zelle bedecken.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die leichten Elemente durch eine dünne Schicht abgedeckt sind.

4. Vorrichtung nach Anspruch 1 oder folgenden, dadurch gekennzeichnet, daß die Wand wenigstens teilweise aus Uran, insbesondere natürlichem Uran, besteht.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß das Uran durch Graphit abgedeckt ist.

In Betracht gezogene Druckschriften:

Französische Patentschrift Nr. 922 877;
»Wehrtechnische Monatshefte«, 1957, Bd. 54, S. 392 bis 394.

Kurt Diebner: Fusion-Boosted Fission Bomb

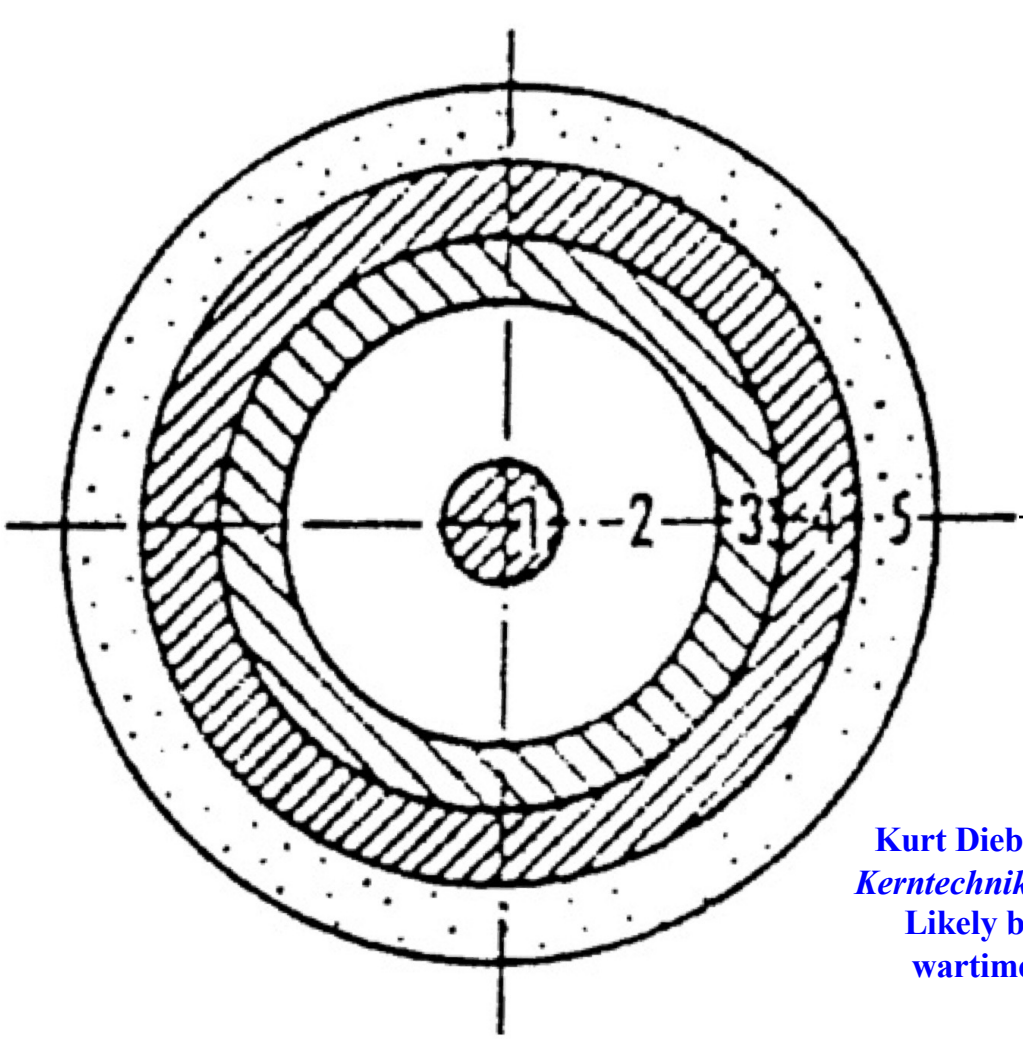
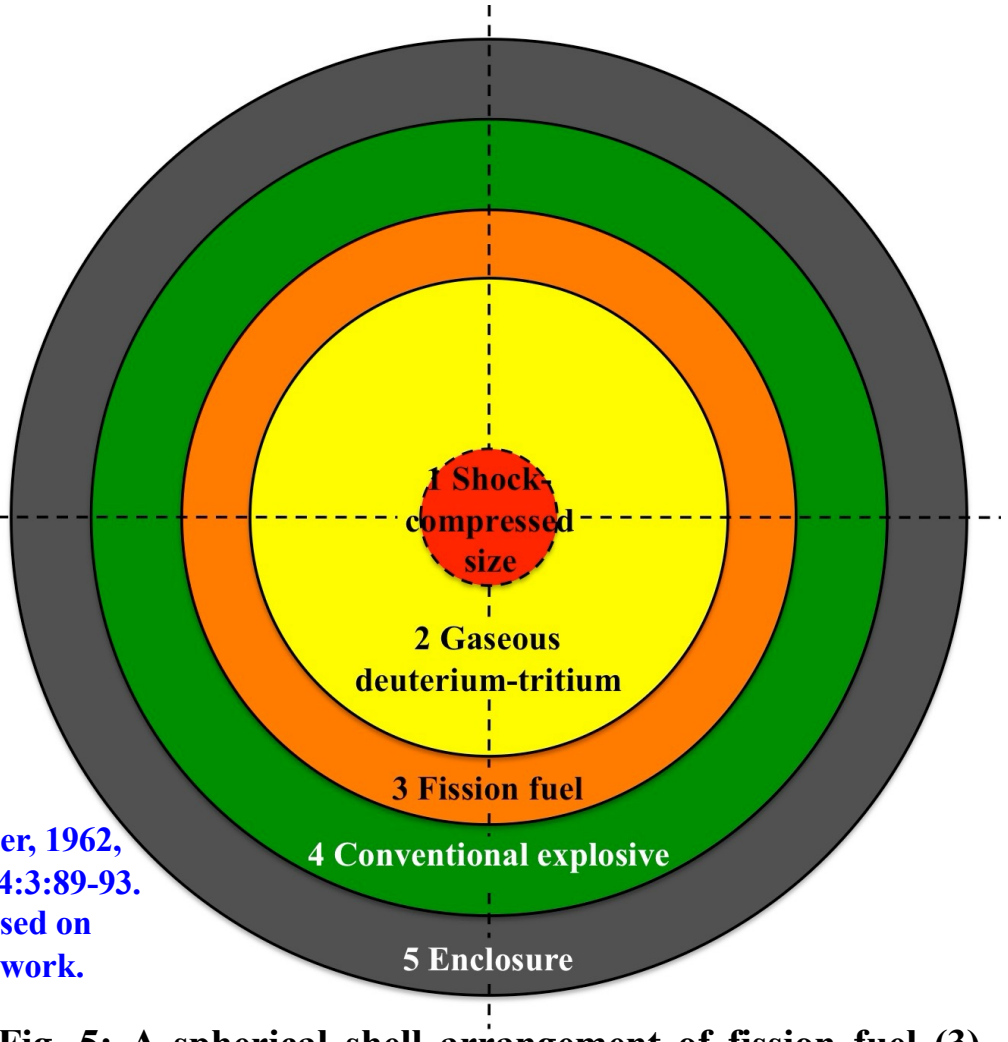


Abb. 5: Kugelschalenanordnung von Kernspaltstoff (3) und gewöhnlichem Sprengstoff (4), die in einer Verdämmung (5) eingeschlossen sind. Im Hohlraum (2) der Schichtfolge befindet sich gasförmiges Deuterium bzw. ein Deuterium-Tritium-Gemisch. Das Reaktionsvolumen der Stoßwelle ist wieder (1). Die Schale (3) ist so dimensioniert, daß der Kernspaltstoff erst dann eine kritische Anordnung darstellt, wenn durch Detonation der Schale (4) eine Stoßwelle die Hohlkugel in der Nähe des Konvergenzzentrums zu einem kompakten Gebilde zusammenschiebt



Kurt Diebner, 1962, *Kerntechnik* 4:3:89-93. Likely based on wartime work.

Fig. 5: A spherical shell arrangement of fission fuel (3) and conventional explosive (4) which is enclosed in a casing (5). In the central cavity (2) of the sequence of layers, there is gaseous deuterium or a deuterium-tritium mixture. The reaction volume of the shock wave is (1). The shell (3) is dimensioned in such a way that the fission fuel is only a critical assembly when, by detonation of the layer (4), a shock wave compresses the hollow sphere into a compact structure around the convergence center.

Kurt Diebner: Implosion Bomb with Central Compartment for High-Voltage Fusion Neutron Initiator and Fusion Boosting

Postwar patent, likely based on wartime work.

PATENT SPECIFICATION

DRAWINGS ATTACHED **841,387**

Date of Application and filing Complete Specification: Nov. 20, 1957.

No. 36108/57.

Application made in Germany on Nov. 30, 1956.

Complete Specification Published: July 13, 1960.

Index at acceptance:—Class 39(4), P3E.

International Classification:—G21.

COMPLETE SPECIFICATION

Thermonuclear Reactions

I, KURT DIEBNER, of Eppendorfer Stieg 8, Hamburg 39, Germany, of German nationality do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method for the ignition of the thermonuclear fuels deuterium and tritium.

Amongst known attempts for the generation of very high temperatures, two in particular promise to be successful, of which each one currently permits when using a suitable arrangement, the attainment of temperatures of the order of 10^5 °K to 10^6 °K and over. One of these methods is the generation of converging shock waves through suitable ignition of an explosive in the form of a hollow body at its outer shell. The other method consists in generating highly ionised gases by concentrated discharges and making use of the pinch-effect in a restricted space. One possible method of execution recorded in the literature is given by an electric arc burning between two carbon electrodes, between which a condenser battery of high capacity and with a high voltage charge is briefly short-circuited.

The present invention consists in a method for the ignition of the thermonuclear fuels deuterium and tritium, to initiate thermonuclear reactions, wherein converging compression shock waves are produced in a hollow body by solid or liquid explosives, the generation of high temperatures in the centre of convergence of the shock waves being combined with an increase of temperature generated by concentrated electrical discharges in the fusionable nuclear fuels so that the temperature-raising effects are superimposed and temperatures necessary for fusion processes are produced at the centre of the converging shock wave.

The invention further consists in a method for the ignition of thermonuclear fuels to promote thermonuclear reactions therein, which consists in detonating an explosive charge in the form of a hollow body surrounding the thermonuclear fuel, thereby generating a converging shock wave in the interior thereof, and creating a concentrated electrical discharge in the thermonuclear fuel at the centre of convergence of the shock wave in order to attain a temperature sufficient for the ignition of the thermonuclear fuel.

In the accompanying drawings:—

Figure 1 is a diagrammatic view of apparatus for carrying out the method according to the present invention, and

Figure 2 shows a wiring diagram for the apparatus of figure 1.

In carrying the invention into effect according to one convenient mode by way of example, reference 1 (figure 1) denotes an explosive body of spherical shell shape provided with two openings in the shape of a truncated cone, in which a spherically shaped high pressure container 5 is embedded for the uptake of the deuterium 2, perhaps in gaseous form under very high pressure. The spherically shaped high pressure container can however also be dispensed with, and the deuterium can be incorporated directly under pressure into the explosive material. The explosive body 1 can be surrounded by a further spherical shell 6, which tamps the explosive body towards the outside. Two insulated electrodes, for example lithium (lithium 6), between which an electric arc 4 can burn, are introduced into the high pressure container 5. For this purpose the electrode material should have a low nuclear charge number and be as thin as possible in order to maintain at a low level the larger proton reflection with its related higher nuclear charge number. Lithium 6 is furthermore particularly suitable because with it tritium is formed in the thermonuclear combustion process.

An example is shown in Figure 2 of an electric connection for the electric arc and the connected condenser, in which C represents a condenser. S is a suitable switch which can connect the condenser to the electric arc. V is the source of tension for the working of the electric arc 4. The release of the thermonuclear reaction in the deuterium gas 2 is now to proceed as follows:

The explosive material is so ignited at the boundary surface between 6 and 1, that a converging shock wave results, which after exceeding the boundary surface 5, runs towards the centre of the electric arc 4, and there contributes to an increase of the temperature of the already burning electric arc. The electric arc burns thereby in a gas of high pressure, so that under these circumstances it can already operate on its own at temperatures of the order of 10,000 degrees and more.

The height of the temperature to be reached in the moment when the shock wave reaches the centre of convergence 4, depends amongst other things on the geometry of the arrangement, and on the explosive material used (trinitrotoluol or hexogen or others). It also depends on whether a high pressure container 5 is used, and the material from which it is composed, as well as finally on the temperature, power and shape of the electric arc.

When the shock wave has reached the centre of convergence, further suitable measures are provided according to Figure 1, which permit further considerable heating of the gas (plasma) which is under the highest pressure and which has thereby become highly conductive. Because of this in the example provided, a further additional heating of the deuterium by the electric spark follows, directly before the compression shock reaches in its last phase the centre of convergence. Through this combination of the various methods in an appropriate sequence it is possible to attain the highest temperatures during the arrival of the shock wave in the centre of convergence. A further condition is that the electrodes are still active at the moment of the setting in of the discharge. Since it is an electrical process which is being dealt with, when the condenser C which has been charged with high voltage is suddenly discharged, and since on the other hand the deuterium gas in the electric arc 4 is already extensively pre-ionised, it is possible to add at least partially, to the convergence centre, the energy accumulated in the condenser. Furthermore, at the moment of connecting the condenser, because of the magnetic effects in the discharge path, an adiabatic contraction of the highly ionised plasma in the sense of the pinch-effect takes place, which has the effect of raising the temperature. In the given circumstances it is merely a question of the amount of energy accumulated in the condenser and which is available for the continuation of the working process, and the temperature in the convergence centre 4 can be increased additionally to such an extent, that the added energy is great enough to allow the thermonuclear ignition of the deuterium gas to take place.

Besides the given example, temperature effects can be superposed or supplemented, additional consideration being taken of an adiabatic compression and suitable temporal sequence with combination of gas discharges, spark discharges, a mechanically or chemically generated adiabatic compression, detonation wave or some of them, which are suitable for producing the temperatures necessary for the ignition of the gaseous, liquid, and if need be solid thermonuclear fuels. It is also possible for example, to fill the space 7 with liquid deuterium, tritium or D_2O, in the manner that the deuterium 2 serves as initiator for further larger quantities of thermonuclear fuel. Installations with hall spherical-hollow bodies can also be constructed, which can also cause the ignition of the thermonuclear fuel, in the convergence centre,—such a fuel corresponding to the deuterium 2—and/or to use the latter for the initial ignition of further quantities of the same or of other thermonuclear fuels. Any other form of hollow body which permits the production of a suitable converging compression shock under suitable ignition is also admissible according to the purposes for which the ignited thermonuclear fuel is to be used, whereby it is particularly to be noted, that these installations can also be used to produce thermonuclear reactions which do not lead or need not lead to ignition.

It is also conceivable, for example, for deuterium enclosed in a volume, to be preheated by adiabatic compression, electrical discharges or any other means, and then to be ignited by a linear and/or if necessary converging compression shock, or else to achieve this with adiabatically pre-heated thermonuclear fuel, using concentrated electrical discharges. Such installations as mentioned in the last example are suitable when their intermittent activity is controlled for the production of mechanical energy. The process explained in Figure 1 can also be carried out in a large pressure container and thus be suitable for maintaining in this large boiler, pressures and/or temperatures required for energy withdrawal or energy generation for certain purposes. This can take place during the intermittent or continuous running of several such processes, respectively repeated any number of times, whereby temperatures and/or pressures can be added to any desired purpose, such as heat engines, the drive of turbines, and others.

WHAT I CLAIM IS:—

1. A method for the ignition of the thermonuclear fuels deuterium and tritium, to initiate thermonuclear reactions, wherein converging compression shock waves are produced in a hollow body by solid or liquid explosives, the generation of high temperatures in the centre of convergence of the shock waves being com-

Fig. 1

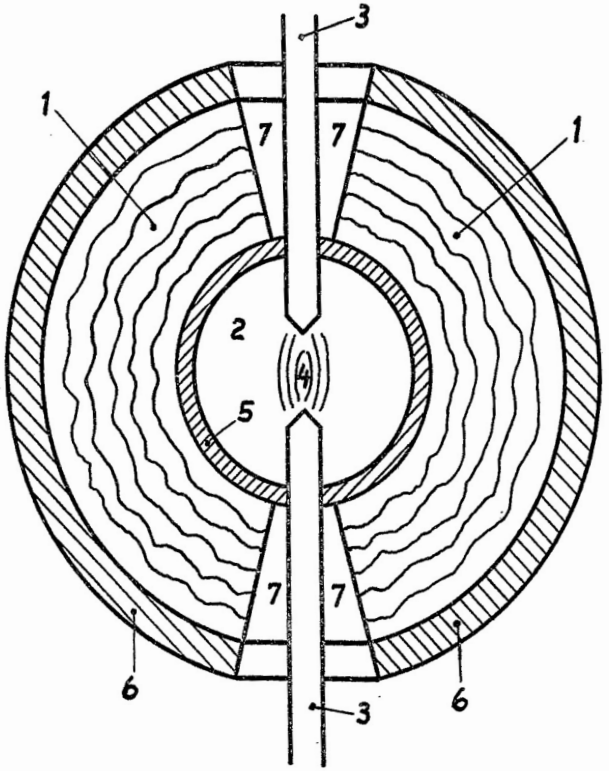
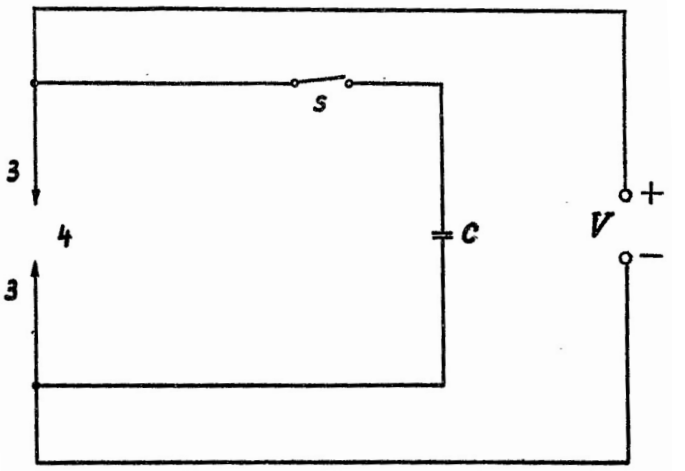
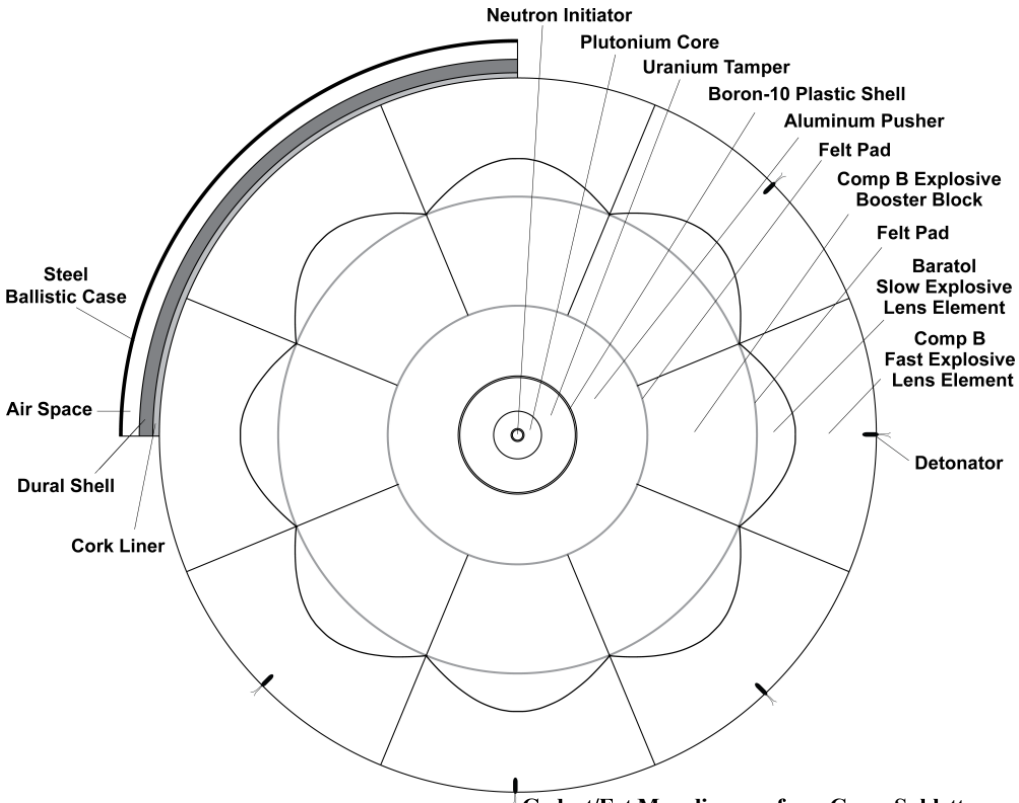


Fig. 2



Fission Bomb, Mass 2000 kg, Yield 10s of kT, Tested 1944-45



Gadget/Fat Man diagram from Carey Sublette nuclearweaponarchive.org/Nwfaq/Gadget2_sm.png

Component	Gadget/Fat Man	Thuringian Device
Neutron initiator	~ 7 g beryllium/polonium-210 "urchin" 1.25 cm radius	Deuterium + lithium with high voltage ~ 1.25 cm radius and/or external 6 MeV betatron
Pit	6.2 kg ^{239}Pu 4.6 cm radius	**For test:** <1 kg inner layer of ^{235}U with ~ 5–10 kg natural or low-enriched U outer layer **For deployment:** ~ 5–10 kg ^{235}U ~ 5 cm radius
Tamper/ reflector	108 kg natural U 11.1 cm radius	~ 100 kg natural U ~ 11 cm radius
Neutron absorber	Boron-10 plastic 3.2 mm thick	~ 1.3 kg cadmium ~ 1 mm thick
Pusher	130 kg aluminum 23.5 cm radius	~ 130 kg aluminum ~ 23 cm radius
Explosive	Composition B and baratol 2500 kg, segmented ~ 70 cm radius	TNT, RDX, and liquid oxygen ~ 1400 kg, segmented ~ 63 cm radius
Explosive case	~ 180 kg aluminum 72.5 cm radius	~ 140 kg aluminum ~ 64 cm radius
Ballistic case	Steel 4.5 mm thick 75 cm radius	~ 190 kg steel ~ 4.5 mm thick 65 cm radius
Overall radius	75 cm	~ 65 cm
Total mass	3000 kg (bomb only) 4670 kg (with shell and fins)	~ 2000 kg
Delivery system	Boeing B-29 heavy bomber	A-4, A-9, or A-9/A-10 ballistic missile
Explosive yield	20 kilotons	**For test:** < 1 kiloton **For deployment:** ~ 5–100 kilotons

A number of sources reported at least four successful test explosions from October 1944 to March 1945.

Test explosions were likely kept as small as possible by using just enough fuel to briefly achieve criticality, both to conserve weapons-grade fuel and to minimize the mess made in German territory.

With enough fuel, fielded versions could have had larger explosive yields than the first U.S. fission bombs.

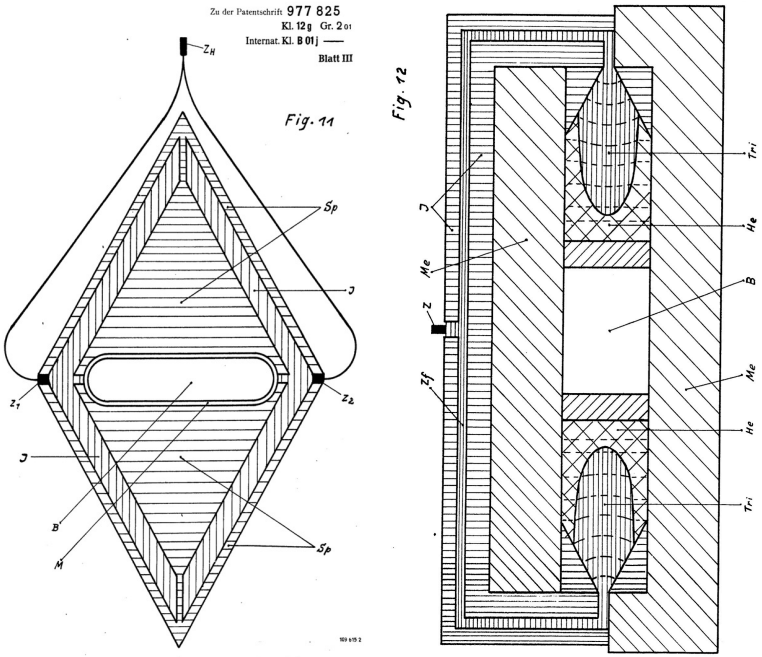
For more information, see *Forgotten Creators* D.8 and D.15.

Sources:

J. C. Clark. 18 September 1945. KO-29365. NARA RG 77, Entry UD-22A, Box 165, Alsos Material.
Kurt Diebner. Patent GB 841,387. 30 November 1956.
Kurt Diebner. 1962. *Kerntechnik* 4:3:89-93.
Werner Grothmann, 2002. Jonastalverein Archive, Arnstadt. pp. 9, 18.
Gottfried Guderley. 1942. *Luftfahrtforschung*, 19:302.
Caperton Horsley. 1945. CIOS XXVIII-31. Investigation of the X-Ray Industry in Germany.
Ivan Ilyichev. 15 November 1944. GARF, Fund 93, Division 81 (45), List 37.
Ivan Ilyichev. 23 March 1945. GARF, Fund 93, Division 81 (45), List 37.
Irene König. 16 July 2004 interview by Heiko Petermann.
Igor Kurchatov. 30 March 1945. GARF, Fund 93, Division 81 (45), List 24-25.
Frederick Loofbourow. 28 Oct. 1943. NARA RG 226, Entry 125, Box 6, Folder 78.
Ordnance Technical Intelligence. Aug. 1945. NARA RG 498, Microfilm MP63-9_0137, frames 623-626.
Erwin Respondek. 6 November 1945. NARA RG 226, Entry A1-210, Box 447, Folder WN 16162-16171.
Erich Rundnagel, in Remdt and Wermusch. 2006. *Rätsel Jonastal*. 2nd ed. Heinrich Jung. pp. 125-126.
Erich Schumann. 2 October 1940. Bundesarchiv Militärarchiv Freiburg N822/17.
Erich Schumann. 1943. HEC 5919. Imperial War Museum Duxford Archive.
Erich Schumann and Gerd Hinrichs. 1943. HEC 2590. Imperial War Museum Duxford.
Erich Schumann to Ernst Telschow. 2 April 1948. AMPG, Abt. III, Rep. 83, Nr. 286.
Erich Schumann and Walter Trinks. Patent DE977825. 13 August 1952.
Erich Schumann and Walter Trinks. Patent DE977863. 13 August 1952.
Walter Trinks. 1945. NARA RG 319, Entry A1-134B, Folder XE098301 Trinks, Walter.
Walter Trinks. Patent DE977839. 13 August 1952.
Walter Trinks. Patent DE977862. 13 August 1952.
U.S. Embassy Warsaw. 7 March 1946. NARA RG 77, Entry UD-22A, Box 160, Folder 205.2.
Germans Are Still Striving to Perfect New V Weapons. *New York Times*. 22 October 1944, p. E5.
V-3? *Time*, 27 November 1944, p. 88.

Fission Bomb, Mass ~300 kg, Yield <1 kT, Tested 1944-45?

Erich Schumann and Walter Trinks. DE977825.



T. J. Betts and R. P. Linstead. 15 Sept. 1945. AFHRA A5186 pp. 904–1026.

Certain items have been omitted because of security considerations… Of particular significance were the statements, made by German experts in the rocket and controlled missile field, that much of the priority accorded their work by the German High Command was in anticipation of the use of atomic explosives. These authorities stated that KWI had repeatedly assured Hitler that an atomic explosive would be available for use within a comparatively short time. During the last months of work by the Peenemünde staff, V-weapons were designed with much smaller war-heads. Quite possibly this trend was in anticipation of the successful development of a German atomic explosive.

Werner Grothmann. 2002. pp. 9, 18.

What I know is the actual preparation for the prototype production of the two fully constructed atomic bomb types for uranium and plutonium… I was not allowed to know anything about it, so I can only say that there were two standard types for use against cities and two more of a different size, which were supposed to be tactical and contain smaller charges. I learned only after the war that one of the two smaller ones would have had a charge equivalent, that is a comparable explosive material quantity, of I believe 130 tons. This was supposed to be used against railway tunnels, port facilities and military installations. The point was that the small weapons required only very little material, which overcame first of all the shortage [of fission fuel]… I know that the smaller was about the size of the SC 250, but the weight was higher.

Distribution: 27 Mar 45
fr Merck
Lt Col Cole (2)
SGO
NDD
OSS
OSRD
ETOUSA
Col Paget
Dr. Maas
Scien.Br.
Col Pash

SECRET

WAR DEPARTMENT
Military Intelligence Service
Washington

26 March 1945

BW INFORMATION

SOURCE: MFIU No 1, 13 March 45, (From CPM) PW Intelligence Bulletin No 1/47 Desperation Warfare

EXTRACT

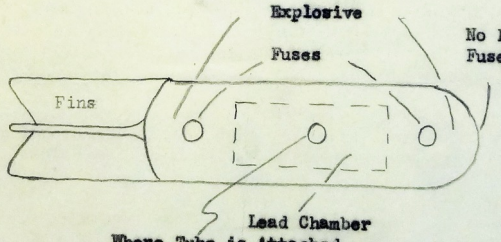
* * * * * * * * *

16. Microbe Bombs

PW (captured 1 Mar vic AMMERN) saw appr one hundred 250 kg bombs stored in a hall at Flughorst Ost, MAGDELBURG. PW was told that these were microbe bombs.

As described to PW, the bomb has two detonating chambers (one in front and one in back) with 2 side fuzes. In the center of the shell is an empty lead lined chamber with threaded opening on the side into which a tube is screwed. The opening has 8 threads and when the tube is screwed into the last thread it is opened and the microbes which have been stored in the tube escape into the chamber. The opening is smeared with a gelatinous substance to prevent the escape of germs.

PW thinks the germs are of cholera type.



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G-2 COMMENT:

This (250kg) seems quite large for a single BW bomb. Further interrogation is contemplated, and information will be forwarded.

NARA RG 165, Entry NM84-187, Box 137, Folder BW 55

DECLASSIFIED
Authority NND 750122

Small prolate warhead with two-point ignition, similar to (but less powerful than) postwar U.S. designs such as W45.

For more information, see *Forgotten Creators* D.8, D.15.

3. The German H-Bomb: The “Six-Ton Bomb”

9. Over 30 Sources: LiD H-Bomb with Fission Primary, Radiation Implosion, Total Mass 6000 kg, ~1.6 Megaton Yield, Expected Test 1945-46

Werner Grothmann, 2002: "The hydrogen bomb. That was also worked on… Himmler once mentioned in a small circle that the first prototype of this could come at the earliest between June and October 1946… It must have looked like a swollen bomb… By the way, what the physicists told Himmler in their private lecture on the hydrogen bomb had really electrified him, because he heard that the explosive effect would be a hundred times greater than that of the uranium bomb."

Wolfgang Ferrant, 1945: "Our purpose was to produce, within an extensive reaction area which contains a very large number of atoms capable of reacting, a temperature or an almost entirely uncoordinated heat motion, such as prevails on the stars. At the same time, the density of the reacting material should be as great as possible. Under these circumstances atomic reactions will occur... Lithium D hydride is well suited as the choice of substance… Our method, therefore, results directly in the creation of a source of neutrons of greatest intensity… If the purpose is to obtain energy alone, the neutrons formed will be utilized in splitting the uranium atom; and in that manner extraordinary amounts of energy will be liberated, as a first product, by way of the neutrons. The lithium-D-hydride, recipient, therefore, will be surrounded by a coat of uranium. Quite possibly a special advantage could be obtained by adding a quantity of uranium D compound to the ``large particles" and to the recipient mass; because in this manner a considerable amount of energy will be given off by uranium fragments located within the reaction area, and this state of affairs might possibly result in further increases of temperature within the reaction area. ... There will result an explosion of the entire LiD mass, since the external reaction zone is capable of enlarging itself on the strength of its own energy production."

Hans Thirring, 1946: "In a 'super atom bomb' it would be possible to use on the order of tons of lithium hydride compared to kilograms of plutonium [for fission], in such a way as to produce an effect several thousand times as large as before. God have mercy on the country over which a six-ton bomb of lithium hydride is made to explode! If the idea is realizable at all, the former uranium bomb or plutonium bomb would only play the role of a sparkplug in such a super atom bomb."

Heiko Petermann, discussion notes with Alfred Klemm, 5 March 2004: "Main focus of the work was the production of Li6 by separation of Li7. This was achieved very well in the electrolytic process. From 1942--43. Klemm pointed out that he was probably the first to achieve the separation by means of electrolysis… He also confirmed that the tritium problem (disintegration of Li6 into tritium) was already discussed before 1945."

Immigration of Austrian Scientists to Soviet Zone, ca. 1949: "SCHINTLMEISTER, Dr Josef Peter… During war, succeeded in isolating Transuranen to Transuranen 104… In September 1948 he reportedly contacted JOLIOT CURIE on problem of extracting plutonium. Censorship intercept indicates subject is currently interested in lithium hydride bombs, originally begun with STETTER."

U.S. Army CIC, 29 September 1953: "Karl Lintner… was Dr. Georg STETTER's assistant in the Second Physical Institute during World War II, when STETTER was working on the splitting of the lithium nucleus... All of STETTER's research material and notes fell into the hands of the Soviets in 1945..."

Assistant Chief of Staff, US Army G-2, 6 April 1954: "During the war, the nuclear physicists of the Second Institute of Physics in Vienna engaged in a research project of releasing high amounts of energy through nuclear reactions of the lithium hydride crystal *Li H*. The research was carried out mainly by Dr. Karl LINTNER under the supervision of Prof. Dr. Georg K. F. STETTER."

Air Intelligence Report, 15 June 1946: "Heavy Hydrogen Bomb. In Germany a letter was picked up by the American censors. It had been written by a German desirous of exchanging information for an opportunity to go to the United States. The writer professed knowledge of 'heavy water' research in Germany and of an 'even more deadly weapon than the atomic bomb'."

For complete quotes and sources, please see *Forgotten Creators* D.9 and D.14.

9. Over 30 Sources: LiD H-Bomb with Fission Primary, Radiation Implosion, Total Mass 6000 kg, ~1.6 Megaton Yield, Expected Test 1945-46

Edmund Tilley, 13 July 1946: "KÄSTNER told Lt. GUTMANN of a new radio-active bomb, weighing six tons. This bomb has no fins and is lowered by parachute… In July 1944 a small group of the Forschungsstaffel was sent to Northern Finland [to map a test site]…"

Eugen Sänger and Irene Bredt, 1944: "As an example of area attack with single propulsion and full turn, we use the attack on New York at a range of 6500 km. For c=4000 m/sec, the bomb load is 6 tons, and the detailed attack runs as follows…"

***New York Times*, 4 December 1946: "Wernher von Braun… revealed today that before the war ended the Nazis were building a 100-ton rocket to strike at the United States… He said it would have carried a 'pay-load' of six tons and would have traveled thousands of miles to strike the United States."**

Hermann Zumpe, 7 November, 1946: "…the maximum weight allowable for the motor, fuels, and shell was 20 tons, leaving 6 tons for the warhead."

Allen Dulles, 14 March 1944: "Length 15 to 17 meters, weight of explosive 4 to 6 tons. Rocket consists of over 1000 parts…"

Gordon Gaskill, March 1945: "The leading V-2 authority for the United States Strategic Air Forces in Europe [Donald Putt]… has calculated for me approximately what kind of rocket might hit New York. Leaving Germany, it would weigh 63 tons, mostly fuel. Its war head would be 7 tons of high explosive."

Charles Chamberlain, 9 February 1946: "Another atom scientist in the British occupation zone of Germany---Prof. Paul Harteck of the Kaiser Wilhelm institute of physics in Berlin---said that the light rays thrown out during the enormous explosion of an atomic bomb added greatly to the destructive force… This frees an amount of light which is beyond the visible spectrum. Only a few people know that the reflection of beams of light on solid bodies also exerts a mechanical pressure. This pressure is so small where our normal light is concerned that it is not noticed. The amount of light freed by an atomic bomb is so great it destroys walls."

Rodolfo Graziani, 1948: "Everybody can say what they want about the matter of secret weapons; but the fact is that secret weapons in Germany were there: they were there in the most absolute way… There was the V-1 and there was the V-2, but it went all the way up to the V-10 which destroyed within a ten-kilometer radius every element of life."

***Pittsburgh Press*, 7 August 1945: "21ST ARMY GROUP HEADQUARTERS, Germany, Aug. 7 (UP)… The bomb, it was calculated, would wipe out everything within a radius of six miles. A famous German research scientist [Wilhelm Groth, in] charge of the experiments was flown immediately to Britain at the time. He estimated his work would have been completed by October [1945]."**

***Daily Mail*, 30 October 1944: "Immense concrete works on top of a hill in Artois, near Saint Omer, were intended as a launching place for flying bombs, which, the Germans boasted, would wreck New York… German engineers told local French people that when the vast machinery was installed and ready to fire, the district would have to be evacuated for six miles around."**

Goffredo Coppola, 16 February 1945: "The Germans have found the means to disintegrate the atom… The disintegration occurs in successive cycles and covers vast areas of tens of kilometers. In the laboratories work is at full capacity."

For complete quotes and sources, please see *Forgotten Creators* D.9 and D.14.

H-Bomb, Mass 6000 kg, Yield ~MT, Expected Test 1945-46

Primary sources for hydrogen bomb design

	Sänger 1944	*Daily Mail* 44	*Evening Std.* 45	Kober 1945	Ferrant 1945	Schumann 1945-52	Kästner 1946	Sorg 1946	Thirring 1946	von Braun 1946	Zumpe 1946	U.S. Intel 1946-51	Klemm '47, '04	Granziani 1948	Jetter 1950	Grothmann 2000-2002
Bomb mass	6 tons					Tons	6 tons	6 tons	6 tons	6 tons	6 tons				Tons	"Swollen bomb" (apparently very large)
Explosive energy		6-mile blast radius (~1.6 mega-tons)	6-mile blast radius (~1.6 mega-tons)	10^6 greater than nitro-glycerin (mega-tons)	Mega-tons poten-tially	Megatons potentially						"Even more deadly weapon than the atomic bomb" (>>20 kilotons)		6-mile blast radius (~1.6 mega-tons)	Mega-tons	"100x greater than that of the uranium bomb" (megatons)
Method of action	H-bomb implied by bomb mass and priority	H-bomb implied by blast radius	"Atomic" reactions; H-bomb implied by blast radius	H-bomb with lithium hydride (LiD?)	Explosive with lithium deuteride (LiD) and fission fuel	H-bomb with lithium deuteride (LiD) and fission fuel	Radio-active; H-bomb implied by bomb mass and parachute	H-bomb implied by bomb mass and priority	Lithium hydride (LiD?) H-bomb with fission bomb trigger	H-bomb implied by bomb mass and priority	H-bomb implied by bomb mass and priority	H-bomb with lithium hydride, deuterium and/or tritium	Highly secret military project using lithium -6 and tritium	H-bomb implied by blast radius	H-bomb with lithium deuteride (LiD) & fission bomb trigger	Hydrogen bomb; fission bomb as trigger
Vehicle	Rocket	Rocket					Parachute from plane	Plane		Rocket	Rocket	Rocket		Rocket		
Ready			Oct. 1945	"Test site" by 1945				Later 1945						Soon		1946
People involved	Aus-trian scien-tists		Groth	Stetter, other Austrian scientists, Gerlach, Toma-schek, AEG scientists	Ferrant, AEG scientists, Austrian scientists (implied)	Schumann, Trinks	Kästner, Petersen, Sorg, Austrian nuclear scientists, Schulz-Kampf-henkel	Peter-sen, Sorg	Jentschke and other Austrian nuclear scientists	von Braun, SS and Kammler (implied)	(Likely Puru-cker and his car full of bomb plans)	Stetter, Jentschke, Lintner, Mattauch, Ortner, Czulius, Schintl-meister	Klemm, Mattauch, Austrian nuclear scientists (implied), production elsewhere		Jetter	Himmler, SS, Kammler (implied), Austrian nuclear scientists
Places	Austria	French launch site	Celle	Austria, Berlin, Munich	Berlin, Austria	Berlin area	Austria	Austria and Baltic coast	Austria	Baltic coast		Austria	Tail-fingen, Berlin, Austria			Austria, Berlin

For more information, see *Forgotten Creators* D.9 and D.14

Heinrich Himmler's Adjutant, Werner Grothmann

2000-2002 interviews by Wolf Krotzky, Jonastalverein Archive, Arnstadt

[p. 31:] There were three different directions:

First the uranium bomb, which was Ohnesorge's main passion and on which Diebner also worked.

Second the plutonium weapon, on which Ohnesorge had worked on the fundamentals, and which was also researched in Austria, along with other directions. Incidentally, the use of other materials besides plutonium was also investigated.

Third the hydrogen bomb. That was also worked on; to my knowledge, it was rather an academic project, and Himmler once mentioned in a small circle that the first prototype of this could come at the earliest between June and October 1946.

[p. 9:] What I know is the actual preparation for the prototype production of the two fully constructed atomic bomb types for uranium and plutonium.

[p. 18:] It was true, however, that there were two entirely different constructions; of a third, about which I do not know anything else, I did not hear much. It must have looked like a swollen bomb.

[p. 42:] By the way, what the physicists told Himmler in their private lecture on the hydrogen bomb had really electrified him, because he heard that the explosive effect would be a hundred times greater than that of the uranium bomb.

NARA RG 238, Microfilm M1270, Interrogation Records
Prepared for War Crimes Proceedings at Nuernberg, Roll 24

DECLASSIFIED
Authority: NND 760050 (1945-1949); NND 760050 (1945-1949)
By: NARA NARA Date: 1976

~~C O N F I D E N T I A L~~

Ref No SAIC/FIR/15
27 Jul 45

SEVENTH ARMY INTERROGATION CENTER
APO 758

NOTES ON HIMMLER AND HIS STAFF
BY WILHELM FUEHRER, ADJ TO HIMMLER
Final Interrogation Report

4. PERSONALITIES

a. HIMMLER's Field Hq

GROTHMANN	SS-OSTUBAF (Lt Col)	Adj to HIMMLER from 1941 to the last; supervised military matters of WAFFEN-SS. Born HAMBURG; 39 years old; blue eyes, 1,75 m tall.

c. Scientific Personalities

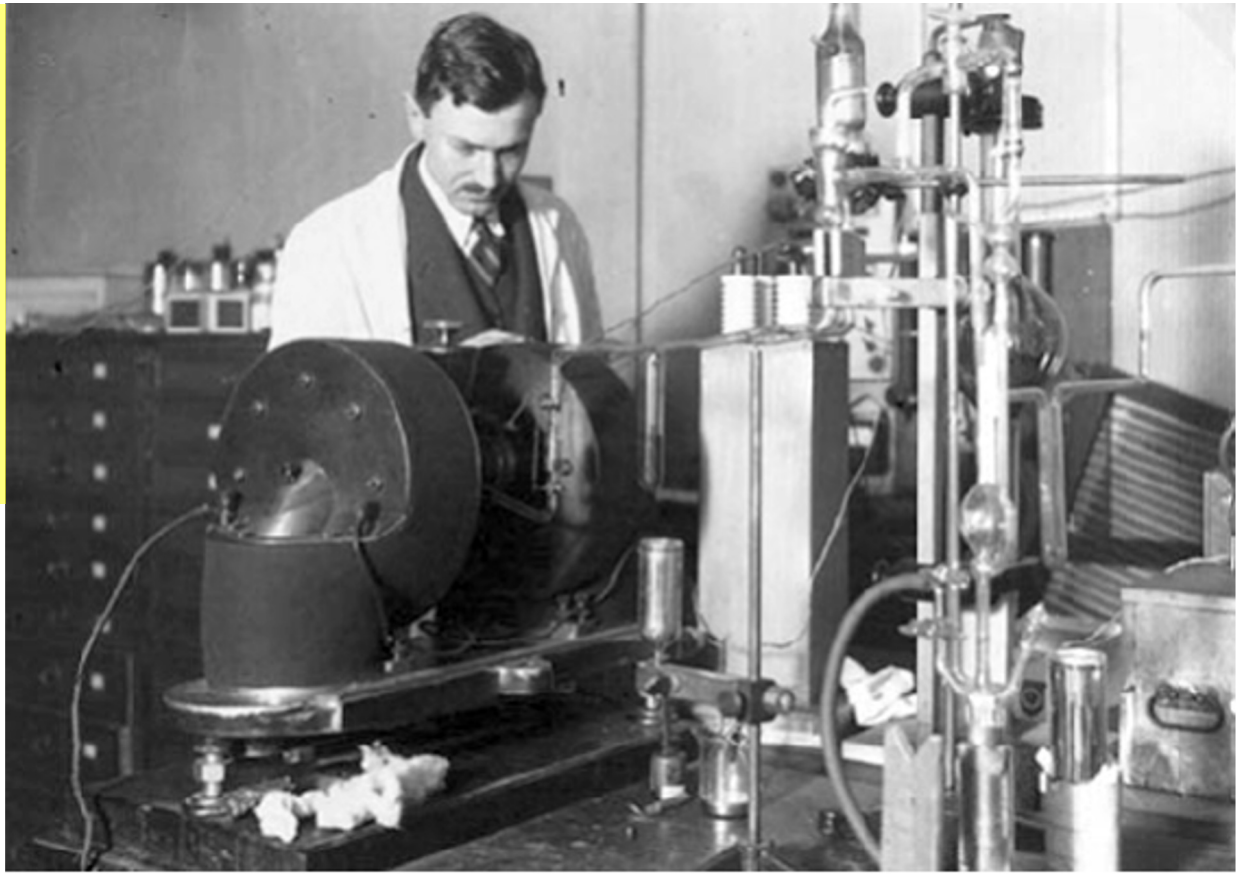
SCHUMANN, Prof	nuclear	Director, First Physics Institute, University of BERLIN, and of HEERESWAFFENAMT (Army Ord Dept).
GERTHSEN, Prof	nuclear	Director, Second Physics Institute University of BERLIN; atom research.
GEIGER, Prof	nuclear	Director, Physics Institute, TECHNISCHE HOCHSCHULE (Technical College), BERLIN; atom research.
GERLACH, Prof	nuclear	Physics Institute, University of MUNICH.
TOMASCHEK, Prof	nuclear	Physics Institute, TECHNISCHE HOCHSCHULE, MUNICH.
VON UND ZUR MUEHLEN, Prof		Geological Institute, TECHNISCHE HOCHSCHULE, MUNICH. Expert on Geology of Russia.
SCHMAUSS, Prof		Meteorological Institute, MUNICH.
VON FICKER, Prof		Meteorological Institute, VIENNA.
GUTHNICK, Prof		Observatory, BERLIN-BABELSBERG.
HECKMANN, Prof		Director, Observatory, HAMBURG-BERGEDORF.
KIRCHNER, Prof	nuclear	Director, Physics Institute, University of COLOGNE. Expert on atom physics.

Himmler, Grothmann, and the Nuclear Program

Russian Department of the Archives of the State Cooperation of Atomic Energy, Austria 2, pp. 302–304, Expert opinion of Kokin on a statement by Dr. Kober, 21 August 1945.

Prof. Stetter from Vienna, who is concerned with the disintegration of the nucleus of lithium hydride, has discovered that this reaction is not stable, that is, that it continues automatically after the beginning; exceptionally large energy of the nucleus is released, and the whole experimental facility explodes (experiment at the test site). Prof. Bethe regards this reaction as a source of solar energy. In addition, this reaction brings about a change in the technique of explosives because the strength of the explosion is 10^6 times greater than in the case of nitroglycerin. This reaction was studied in many institutes, with the participation of professors Gerlach and Tomaschek–in Munich. Prof. Stetter from Vienna has developed a theory that this reaction should begin at the temperature of 10^6 °C. If this theory is correct, a test facility that can use this energy for practical purposes is easy to build. [...] Dr. Kober asks permission to do so, and pointed out that AEG has already patented this issue.

Georg Stetter led a large group of talented nuclear scientists in Austria. In 1939, he filed a patent on both fission and fusion reactions and devices. Throughout the war, Stetter and his colleagues worked on fission and fusion reactions and bombs.



G-378. Georg Stetter. Technische Energiegewinnung mit Hilfe von Kernreaktionen. FA 002/0762. Deutsches Museum Archive, Munich. Early 1939.

Die Massenbestimmung von Atomtrümmern aus Aluminium, Kohlenstoff, Bor und Eisen.

Von **Georg Stetter** in Wien.

Mit 6 Abbildungen. (Eingegangen am 22. März 1927.)

Mit dem früher beschriebenen Massenspektroskop für schnelle und seltene Korpuskularstrahlen werden nach entsprechender Weiterbildung der Methodik Spektralkurven der Sekundärteilchen aus den Elementen Al, C, B und Fe aufgenommen und außer α^{++}- und α^{+}-Teilchen in allen vier Fällen H-Teilchen (Fehlergrenze 5%) einwandfrei festgestellt; somit auch die Zertrümmerbarkeit dieser vier Atomkerne endgültig bewiesen. Die über Zahl und Reichweite der Atomtrümmer sich ergebenden Daten stimmen mit früher in Wien gefundenen Resultaten im großen und ganzen überein.

Einleitung. Vor etwa $1^1/_2$ Jahren habe ich in dieser Zeitschrift[1]) einen Apparat zur Massenbestimmung schneller und seltener Korpuskularstrahlen beschrieben, wobei hauptsächlich an die e/m-Bestimmung der bei der Atomzertrümmerung beobachteten „H^s"-Partikeln gedacht war. In derselben Arbeit konnte ich noch über erfolgreiche Messungen an α-Strahlen aus Polonium sowie an natürlichen H-Strahlen (aus Paraffin) berichten, später auch an α-Strahlen anderer Herkunft[2]). Anfang 1926 gelangen die ersten einwandfreien Versuche an Atomtrümmern aus Aluminium, die zusammen mit einer Diskussion der zahlenmäßigen Beziehungen im Massenspektroskop an anderer Stelle veröffentlicht sind[3]). Gelegentlich von noch nicht abgeschlossenen Untersuchungen an Actinium, die gemeinsam mit Frl. E. Rona unternommen wurden, trat infolge Platzens einer sehr dünnwandigen Kapillare eine starke radioaktive Verseuchung des Apparates auf, die trotz gründlichster Reinigung nicht völlig beseitigt werden konnte und diesen auf längere Zeit unbrauchbar machte. Er mußte fast zur Gänze neu gebaut werden, um die Versuche mit Atomtrümmern, bei denen wegen der minimalen Ausbeute auch eine schwache Verseuchung einen Erfolg unmöglich macht, fortsetzen zu können.

Für die weitere Arbeit war zunächst beabsichtigt, womöglich andere Nachweismethoden zu verwenden, von denen die von G. Ortner und dem

[1]) ZS. f. Phys. **34**, 158, 1925.
[2]) Phys. ZS. **27**, 735, 1926 (Vortrag, geh. a. d. Düsseldorfer Naturf.-Vers.); Verh. d. D. Phys. Ges. **7**, 34, 1926.
[3]) Mitt. a. d. Inst. f. Radiumforschung Nr. 181. Wien. Ber. **135** [2a], 1926; Ark. f. Mat., Astr. och Fys. **19** B, Nr. 10, 1926.

In the main we have to differentiate between the induction of nuclear reactions by ionizing, that is rapidly moving charged particles, and the analogous effect of (uncharged) neutrons. In the first case, it is important to avoid the loss of energy occurring during ionization, that is, the total energy released by the individual particles must be retained by the system, as speed of other particles (nuclei), at least in the main, for further nuclear reactions to be exploited. This is made possible by highest spatial and temporal concentrations of the process; the same must therefore be performed on a small volume and approximately adiabatically, because the very high temperature condition can exist only for a very short time. As an example, a high-voltage capacitor discharge by highly compressed deuterium gas is considered: high-energy, short-term discharge (about 1 million volts surge), small electrodes of low heat capacity, if necessary also from fissile material, discharge volume of a few mm expansion at such pressure that the resulting ionizing particles (^{1}H, ^{3}H, ^{3}He) practically run into each other. The arrangement results in an explosion of tremendous energy development. However, a slow burning off is not possible because, as already indicated, temperatures at which these reactions still sufficiently occur cannot be maintained for longer periods of time. An advanced technical application would be to think about successive periodical explosions.

Postwar U.S. Intelligence on Wartime Work on LiD Bomb

Air Intelligence Report No. 100-13/1-100, Significant Developments and Trends in Aircraft and Aircraft Engines, Antiaircraft Guided Missiles (15 June 1946). p. 93. NARA RG 38, Entry 98C, Box 11, Folder TSC # 3001–3100.

DECLASSIFIED Authority NND 963059

g. Heavy Hydrogen Bomb. In Germany a letter was picked up by the American censors. It had been written by a German desirous of exchanging information for an opportunity to go to the United States. The writer professed knowledge of "heavy water" research in Germany and of an "even more deadly weapon than the atomic bomb".

Robert A. Snedeker, CIC Sub-Det "C" (Vienna). Agent Report. Dr. Georg Stetter's Patent Concerning Production of Atomic Energy, Technical Intelligence, Vienna. 29 September 1953. NARA RG 319, Entry A1-134B, Box 749, Folder 23 Nov 95 Georg Stetter XA001081.

DECLASSIFIED Authority NND 007017

On 23 September 1953, Dr. Karl Lintner, Second Physical Institute of the University of Vienna, was interviewed by Informant 1063 and stated the following:

Source was Dr. Georg STETTER'S assistant in the Second Physical Institute during World War II, when STETTER was working on the splitting of the lithium nucleus. STETTER intended to have certain processes patented, in connection with splitting nucleii, but Source is unaware of the result of this intention. All of STETTER'S research material and notes fell into the hands of the Soviets in 1945 and to Sources's knowledge STETTER has not concerned himself with nuclear research since that date. Source considers STETTER the best nuclear physicist in Austria. STETTER, before obtaining a position with the Second Physical Institute, University of Vienna, was affiliated with the United Austrian Iron and Steel Works and the Austrian Nitrogen Works.

(F-3)

Immigration of Austrian Scientists to Soviet Zone. NARA RG 319, Entry A1-134A, Box 31, Folder 02/006 430.

NARA RG 330, Entry A1-1B, Box 103, Folder Lintner, Karl.

DECLASSIFIED Authority NND 013039

K SCHINTLMEISTER, Dr Josef Peter - USSR. Born 15 June 1903. Nuclear physicist. Listed on National Scientific Intelligence Requirements - Nuclear Energy - USSR, 23 July 1947. Reportedly anti-communist and had requested that he brought into contact with British. Released as Chief of Physics Institute because of NSDAP membership. Formerly associated with GRIMER, STETTER, MATTAUCH, CZULIUS and JENTSCHKE. During war, succeeded in isolating Transuranen to Transuranen 104. In summer of 1945, subject with other members of Radium Institute, fled to Thumersbach. In 1946 he accepted Soviet employment and was taken to Moscow. In September 1948 he reportedly contacted JOLIOT CURIE on problems of extracting plutonium. Censorship intercept indicates subject is currently interested in lithium hydride bombs, originally begun with STETTER.

DECLASSIFIED Authority NND 983021 By SL NARA Date 8/18

AGENCY REMARKS

According to information received in Aug 1949 from an untested source, one Dr. Karl LINTNER was assistant to Prof Karl PRZIBAM at the Second Institute of Physics in Vienna. Source declared PRZIBAM to be pro-Russian and believed without being sure that he was in Moscow early 1949. PRZIBAM had been carrying out infra-red research for the Russians. During the war, the nuclear physicists of the Second Institute of Physics in Vienna engaged in a research project of releasing high amounts of energy through nuclear reaction of the lithium hydrite crystal *Li H*. The research was carried out mainly by Dr. Karl LINTNER under the supervision of Prof. Dr. Georg K. F. STETTER. The project failed because according to source, it was impossible to procure strong enough electrodes and equipment sufficiently resistant to heat.

Assistant Chief of Staff, G-2
Department of the Army
Washington 25, D. C.

SIGNATURE

SECRET

6. MOIC-S-4412, dated 11 May 1949, Subject: "Schintlmeister Josef Dr., Nuclear Scientists Currently in the U.S.S.R," indicated that SUBJECT collaborated with Prof. Georg Stetter on the problem of releasing the energy or accomplishing the atomic fission of the Lithium Hydrite (LiH) crystal. SUBJECT was listed as an assistant at the University of Vienna, Physics Institute II. His political orientation was uncertain. Information in this report was obtained from Prof. Stetter.

AEG and Austria: Wolfgang Ferrant

Wolfgang Ferrant, 1945, report G-367 written for U.S. occupation forces in Austria, Deutsches Museum Archive FA 002/700.

tubes H_1^1 H_2^1 H_3^1 ... The first of these cascade is operated with a frequency of v, and the second with a frequency of 2v. Under this procedure, the higher frequency is produced from the lower by means of frequency-doubling, so that the two cascades vibrate in dependency on one another. The frequency-doubling and the coupling of the cascades is effected in the usual, familiar manner.

V. THE TYPES OF ATOMIC PROCESS

1. Suitable Substances

Our purpose was to produce, within an extensive reaction area which contains a very large number of atoms capable of reacting, a temperature or an almost entirely uncoordinated heat motion, such as prevails on the stars. At the same time, the density of the reacting material should be as great as possible.

Under these circumstances atomic reactions will occur; and these reactions will enjoy the advantage of optimum exploitation of the energies present, since there is no possibility of energy losses from the thrusting atoms, due to the fact that all of the atoms present have as an average the same kinetic energy. Consequently it cannot happen that any of the thrusting atoms of great energy collide continually with particles possessed of lower energy, thus constantly losing energy even if no atomic reactions occur. If the mass within the reaction area is ionized, the thrusting atoms, again, are no longer capable of giving off ionization energy.

Formation of an ionized reaction area presupposes the existence of a fairly large area containing a great number of atoms which likewise are in a condition of thermic movement.

It is worth mentioning, briefly, and by way of contrast, how unfavorable conditions are when the ordinary experimental arrangement is adopted. Thus if α particles, deuterons, or protons are greatly accelerated, and these rays are

The decision in this matter involves an additional demand we must make upon the reacting mass: the demand that this mass should be ionizable in its totality with the lowest possible expenditure of energy.

2. THE PROBLEM OF KEEPING THE WORK OF IONIZATION AT A MINIMUM

However, the choice is in fact restricted to lithium, the latter being a substance which does not carry more than three enveloping electrons. Moreover, the lithium readily combines with heavy hydrogen to form a hydride: LiD. The compound, that is the lithium D hydride, contains a total of only four electrons, so that the total work of ionization is, at worst, only of small amount.

All aside from other considerations, lithium D hydride is well suited as the choice of substance both for the "large particles" and for the recipient substance, not only because the heavy hydrogen participates in the atomic reaction, but also because the lithium, likewise, participates. The following reactions are to be anticipated: $_1^2D(d,\alpha)_2^3He$; $_1^2D(d,p)_1^3H$ and $_3^6Li(d,p)_3^7Li$; $_3^6Li(\alpha,\alpha)_2^4He$; $_3^7Li(d,\alpha)_2^4He$.

There occurs in the reaction area a formation of charged particles α, p, but also a formation of neutrons that can easily split off. Our method, therefore, results directly in the creation of a source of neutrons of greatest intensity.

This method, consequently, has nothing to do, directly, with the splitting of the uranium atom.

Advantage will be taken, of course, of Hahn's discovery; especially when the purpose is to obtain pure energy, and not merely to obtain neutrons and an incidental supply of energy.

If the purpose is to obtain energy alone, the neutrons formed will be utilized in splitting the uranium atom; and in that manner extraordinary amounts of energy will be liberated, as a first product, by way of the neutrons.

AEG and Austria: Wolfgang Ferrant

Wolfgang Ferrant, 1945, report G-367 written for U.S. occupation forces in Austria, Deutsches Museum Archive FA 002/700.

The lithium-D-hydride, recipient, therefore, will be surrounded by a coat of uranium.

Quite possibly a special advantage could be obtained by adding a quantity of uranium D compound to the "large particles" and to the recipient mass; because in this manner a considerable amount of energy will be given off by uranium fragments xxx located within the reaction area, and this state of affairs might possibly result in further increases of temperature within the reaction area. Of course, a tremendous energy is required to obtain complete ionization of the uranium atom. Unfortunately I am unable correctly to estimate at this time whether an admixture of uranium would in the end be profitable or not. 1) Because it might happen that the energies to be expended in complete ionization of the uranium admixture are of such magnitude that temperatures in the reaction area would drop to a point where the reaction could not xxxxxx get under way.

1) To make such forecast, it would be necessary to have on hand the requisite tables and numerical data, such as could be obtained, for instance, from the tables of nuclear physics. But these tables are no longer obtainable. This defect, I hope, will not prove highly detrimental, however, so far as the basic ideas for our method are concerned.

VI LOCALIZATION OF THE ENERGY

1. Extent of the Ionized Areas; Walls of the Reaction Area.

It is of the very essence of our method to concentrate the energy upon a small, but not too small area; and this purpose is achieved by making use of the "large particles."

Now the question arises whether a completely ionized reaction area is in any way stable.

Moreover, the path radii obtained are smaller than the reaction area, so that the localization of energy is actualy effected.

4. SELF HEATING

Under this subject it will be necessary to distinguish between two types of cases: Self heating of the reaction area, and self heating in the reaction field outside the reaction area proper.

1) If a very great number of atomic reactions comes about within the reaction area itself, the particles charged as a result of these reactions (α, p) will produce heat within the reaction area, increasing the latter's temperature until the entire material within the reaction area is consumed.

2) The alpha rays and protons of high energy resulting from the atomic reactions will pass through the reaction area, penetrating to the latter's "wall;" and they will penetrate much more deeply than the D and Li atoms, since the alpha rays and protons are much richer in energy.

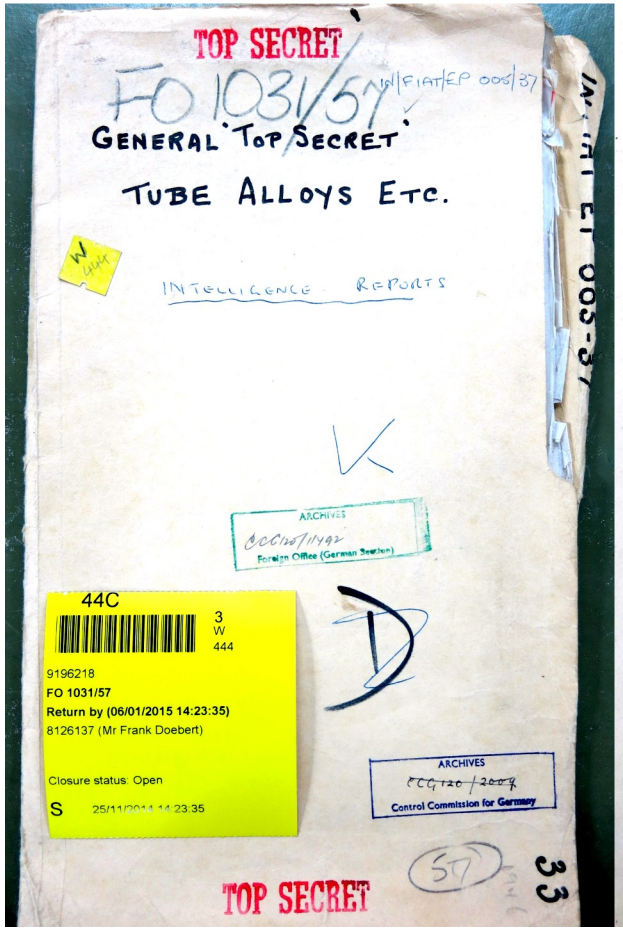
If the alpha,p particles occur in such large numbers about the environs of the reaction area become ionized and heated, there will be formed an external reaction zone within which atomic reactions may likewise occur. Finally, the outer reaction zone will assume such dimensions that even the alpha rays and protons forming the reactions no longer leave that zone, and are compelled by the magnetic field to move along circular paths. 1)

If an external reaction zone of this nature is developed, there will result an explosion of the entire Li D mass, since the external reaction zone is capable of enlarging itself on the strength of its own energy production.

1) Always understood in large quantities, since particles moving in the direction of the magnetic field strength are capable of leaving the reaction area.

6-Ton Radioactive Bomb That Must Be Dropped with a Parachute (~Megaton Yield)

Planned Test Site in Northern Finland



TOP SECRET

Enemy Personnel Exploitation Section
FIELD INFORMATION AGENCY TECHNICAL
Control Commission for GERMANY (BE)
B.A.O.R.

13th July 1946

SUBJECT : Secret Missiles.

FROM : Major E. TILLEY.

TO : Lt.Col. P.M. WILSON.

1. Lt. F.T. GUTMANN, of 2940th Engineer Technical Intelligence Team (R), U.S. Army, has just returned from Austria with three of SCHULZ-KAMPFHENKEL's assistants, all of the Forschungsstaffel.

2. Lt. GUTMANN went into the Russian Zone in Austria and saw a gendarme, Anton KÄSTNER, in EURATSFELD near AMSTETTEN, in Lower Austria. KÄSTNER told Lt. GUTMANN of a new radio-active bomb, weighing six tons. This bomb has no fins and is lowered by parachute. KÄSTNER himself claims to have been connected only with the fuze part of this new secret missile.

3. Colonel PETERSEN was said to have been in charge of this secret missile at OKW. KÄSTNER claimed that Colonel PETERSEN's papers and documents were left by him at Kloster ANDECHS in AMMERSEE, Upper Bavaria. Colonel PETERSEN is presumed to be in Spain.

4. A Hauptmann(Captain) SORG is said to have been Colonel PETERSEN's Chief Administrative Officer and also in charge of organization. SORG is still living at UTTING on the AMMERSEE.

5. Lt. GUTMANN believed that this new radio-active bomb may not be unconnected with the "Wärmesuchgerät" described by SCHULZ-KAMPFHENKEL. This must be a very secret instrument, for SCHULZ-KAMPFHENKEL did not tell any of the Americans about its existence and would not reveal it to us at OBERURSEL until a high pressure was exerted on him. He continues to call it "Wärmesuchgerät", which means heat searching or finding instrument, but he describes it as an aircraft instrument for measuring temperatures on the ground during the flight of the aircraft. If this were all, the instrument would be called "Wärmemessgerät" or "Temperaturmessgerät".

6. SCHMITTHÜSEN has been indicated as the man in the Forschungsstaffel who knows most about this "Wärmesuchgerät". I shall interrogate him with Lt. GUTMANN on Monday, 15th July. He is likely to prove stubborn for I saw him for a moment outside FIAT and asked him to prepare immediately a list of all hide-outs for Top Secret documents. He did not know that we had found the boxes at HARBURG which he himself had dug into the ground. He was informed smilingly that 20 years behind barbed-wire were awaiting him if he continued to deny

...TO SHEET 2...

TOP SECRET

such well-known facts. He quickly agreed to let me have a complete list by Monday.

7. PILLEWIZER is the glacier expert of the Forschungsstaffel. He has written two reports for us at Lt. GUTMANN's request. The most significant sentence at the beginning of the second report, on the activities of the Forschungsstaffel in Lappland in 1944, reads as follows :

"In July 1944 a small group of the Forschungsstaffel was sent to Northern Finland in order to demonstrate, by practical experiment, the feasibility of quick map-making in the swamps and primeval forests of Lappland, i.e. to make maps quickly for topographical evaluation of hardly explored territory."

The rest of the report explains more fully the real purpose of this expedition for the work was started in VUOTSO and PARKKINA, both in the Artic Circle, and was continued there after the Germans had evacuated all Southern Finland. Later they photographed the SAARENPAEAE area in West Lappland (ENONTOEKIOE area). It is hardly likely that such an important and secret group of scientists could have been left in the Artic Circle as late as November 1944. After completion of the work PILLEWIZER returned with his group, via NARWIK and OSLO, to Germany, where he arrived in mid-December 1944.

This expedition may have served the same purpose as other expeditions of SCHULZ-KAMPFHENKEL, i.e. obtaining data of the effect of new deadly weapons or submitting data to enable the High Command to carry out such experiments with such missiles.

8. Lt. GUTMANN, who has not had much sleep for the last few days, will give me a copy of his report on this new missile on Monday and I shall show it to you before I go to DUSTBIN with Lt. GUTMANN.

E. Tilley

E. TILLEY.
Major, GS.

Where are the mentioned reports and other related documents?

TOP SECRET

TNA (Kew)
FO 1031/57

Notes on an Interrogation of Edmund Sorg at Dustbin. 7 August 1946. TNA (Kew) FO 1031/112.

REGARDING 6 TON BOMBS

I never made any tests with 6 ton bombs and have never heard of them.

Major Edmund Tilley to Lt. Col. P. M. Wilson. October 1946. TNA (Kew) FO 1031/112.

Information was received in Austria late summer 46 that a Captain SORG had hidden V-2 documents in Kloster ANDECHS on the Ammersee in Spring 45 and that Captain SORG was the administrative officer of Colonel PETERSEN.

[...] the return of Colonel PETERSEN from the United Kingdom where he had been interrogated. [...] Both SORG and Colonel PETERSEN claim to have revealed all their secrets to the Americans and British. Neither of them has admitted hiding documents in Kloster ANDECHS; therefore we may safely assume that both of them are still in possession of secrets which, for reasons best known to themselves, they are still withholding from us. [...]

SORG refuses to admit any knowledge of the contents until after he had collected the boxes [...] He also remembers that 2 flat ammunition boxes contained the records of the E-7 Stellen (on Luftwaffe bombs and fuzes, probably also on a 6-ton bomb which he himself tested).

The 6-Ton Bomb

Hans Thirring. 1946. *Die Geschichte der Atombombe.* Vienna: Neues Österreich. p. 134. (Based on information from Willibald Jentschke from Georg Stetter's research group.)

The energy which can be obtained by the formation of helium from LiH is almost three times as great as that produced by nuclear fission from the same quantity of U-235. In this case, lithium is not a rare element, so that in a "super atom bomb" it would be possible to use on the order of tons of lithium hydride compared to kilograms of plutonium, in such a way as to produce an effect several thousand times as large as before. God have mercy on the country over which a six-ton bomb of lithium hydride is made to explode!

If the idea is realizable at all, the former uranium bomb or plutonium bomb would only play the role of a sparkplug in such a super atom bomb.

Intercontinental Missiles Designed for a Special 6-Ton Bomb

Eugen Sänger and Irene Bredt. 1944. *Über einen Raketenantrieb für Fernbomber.* UM 3538. Ainring: Deutsche Luftfahrtforschung. English translation (*A Rocket Drive for Long Range Bombers*, 1952) pp. 148, 152.

As an example of area attack with single propulsion and full turn, we use the attack on New York at a range of 6500 km. For c=4000 m/sec, the bomb load is 6 tons, and the detailed attack runs as follows: the motor starts to work 36 seconds after the take-off at 12 km. distance from the take-off point, and consumes the total fuel supply of 84 tons in the next 336 sec. At the end of the climb process, the aircraft reaches a velocity of 6370 m/sec, an altitude of 91 km, a distance of 736 km. from the point of take-off, and a weight of 16 tons. Using only its store of potential and kinetic energy, the bomber flies on to the point of bomb release, 5550 km. from the take-off point, and 950 km. in front of the target. At this point, which is reached 1150 sec. after take-off, the velocity has decreased to 6000 m/sec, and the stationary altitude to 50 km. After the bomb release the weight is 10 tons. Then the aircraft goes into a turn and in 330 sec. goes through a turn-spiral 1000 km. in diameter…

Nazis Planned Rocket to Hit U.S. *New York Times.* 4 December 1946.

Wernher von Braun, 34-year-old German scientist who invented the deadly V-2 supersonic rocket, revealed today that before the war ended the Nazis were building a 100-ton rocket to strike at the United States.

Von Braun told reporters that the 100-ton rocket was on the drawing board when the Allies overran Europe. He said it would have carried a "pay-load" of six tons and would have traveled thousands of miles to strike the United States.

J. P. E. Peters. Interrogation of Dipl. Ing. Hermann Zumpe at F.I.A.T. (Main) on 7th November, 1946. TNA (Kew) AIR 40/2832.

14. ZUMPE also had in hand a new project for a rocket motor on the same principles as the new C2, but developing a thrust of 50 tons for use in a 26 ton rocket of the A4 type. This project was still in the early stages; the only decision made was that the maximum weight allowable for the motor, fuels, and shell was 20 tons, leaving 6 tons for the warhead.

Blast Radius of 10 Kilometers, or 6 Miles (Energy of at Least 1.6 Megatons)

G. Ward Price. Fly-bombs Were Meant for U.S.: Huge Ramp Found. *Daily Mail*. 30 October 1944.

Immense concrete works on top of a hill in Artois, near Saint Omer, were intended as a launching place for flying bombs, which, the Germans boasted, would wreck New York.

Thousands of workmen were employed in tunnelling and building a cylindrical cupola on top of the hill, 250 ft. in diameter.

Lorries, and even trains, could drive right into the heart of the hill.

German engineers told local French people that when the vast machinery was installed and ready to fire, the district would have to be evacuated for six miles around.

Frequent attacks by the R.A.F. kept on delaying work until the Allied advance from Normandy obliged all the enemy engaged on it to pack up hurriedly.

Nazis Five Months from Completion of Atomic Bomb. *Pittsburgh Press*. 7 August 1945 p. 14.

21ST ARMY GROUP HEADQUARTERS, Germany, Aug. 7 (UP)–Germany was within five months of completing her own atom bomb when the European war ended.

A British task force four months ago discovered that German scientists almost had completed work on the bomb in a two-room laboratory in the heart of a small silk factory north of Hannover.

The bomb, it was calculated, would wipe out everything within a radius of six miles.

A famous German research scientist [Wilhelm Groth, in] charge of the experiments was flown immediately to Britain at the time. He estimated his work would have been completed by October.

He said the German Government had given him unlimited funds and equipment and had not demanded any immediate results.

Bruno Spampanato. 1974. *Contromemoriale.* Rome: Centro Editoriale Nazionale. pp. 917, 1116.

Something like this was said to us by Goffredo Coppola, who had been in Germany at a scientific congress representing the government and then came back. […] This Coppola told us on 16 February 1945: "The Germans have found the means to disintegrate the atom. And an electronic discovery. The disintegration occurs in successive cycles and covers vast areas of tens of [square] kilometers. In the laboratories work is at full capacity." [...]

Among the Italians the most in contact with the highest German military circles was Marshal [Rodolfo] Graziani. And it was Graziani himself in his self-defense before the Special Court in Rome [1948] who testified: "Everybody can say what they want about the matter of secret weapons; but the fact is that secret weapons in Germany were there: they were there in the most absolute way[….] There was the V-1 and there was the V-2, but it went all the way up to the V-10 which destroyed within a ten-kilometer radius every element of life."

What Design Did the 6-Ton German H-Bomb Use?

Was it a sloika design?

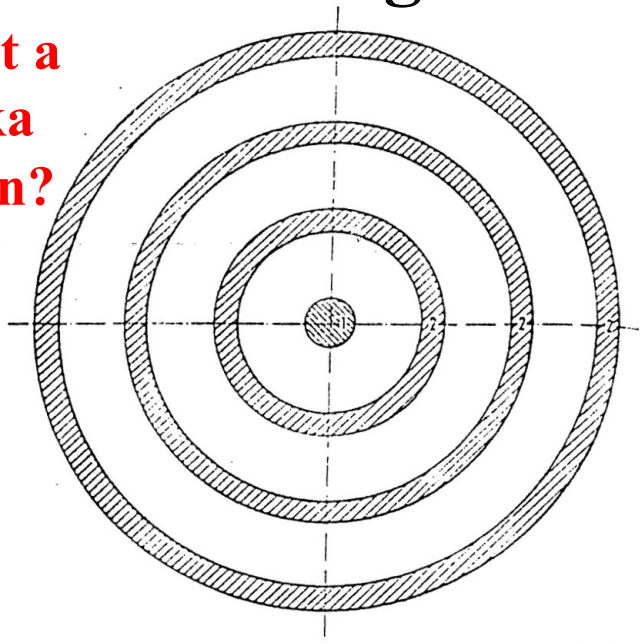


Abb. 3: Eine der Abb. 2 entsprechende schematische Anordnung mit einer Folge von ineinandergefügten Sprengstoffschalen (2) zur Verstärkung des Effektes; (1) bedeutet wieder den Fusionsreaktionsraum

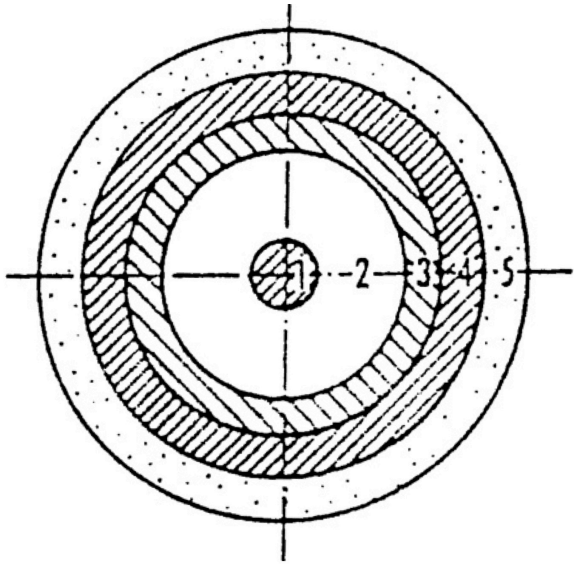
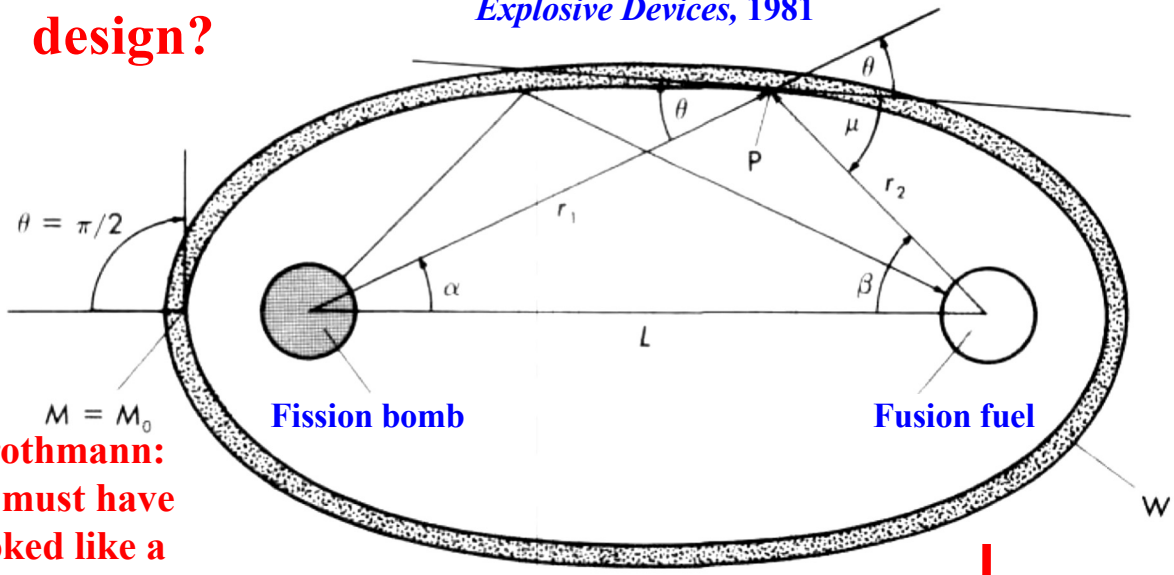


Abb. 5: Kugelschalenanordnung von Kernspaltstoff (3) und gewöhnlichem Sprengstoff (4), die in einer Verdämmung (5) eingeschlossen sind. Im Hohlraum (2) der Schichtfolge befindet sich gasförmiges Deuterium bzw. ein Deuterium-Tritium-Gemisch. Das Reaktionsvolumen der Stoßwelle ist wieder (1). Die Schale (3) ist so dimensioniert, daß der Kernspaltstoff erst dann eine kritische Anordnung darstellt, wenn durch Detonation der Schale (4) eine Stoßwelle die Hohlkugel in der Nähe des Konvergenzzentrums zu einem kompakten Gebilde zusammenschiebt

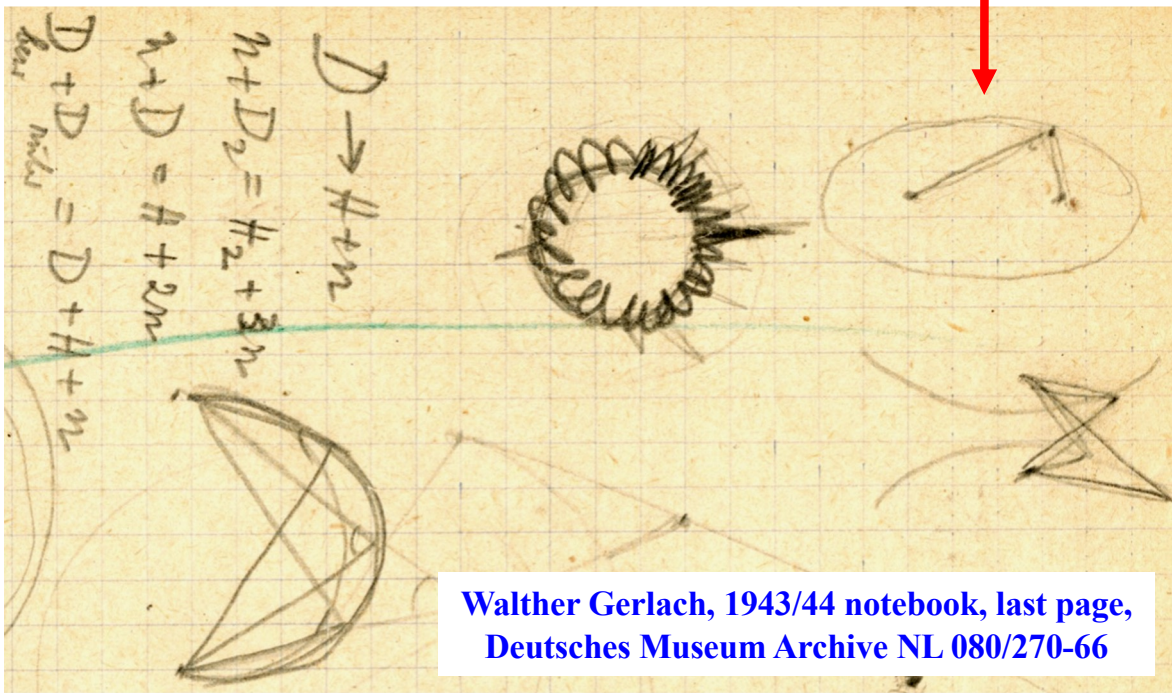
Kurt Diebner, 1962, *Kerntechnik* 4:3:89–93

Was it a two-stage design?

Kurt Diebner's student Friedwardt Winterberg, *The Physical Principles of Thermonuclear Explosive Devices*, 1981



Grothmann: "It must have looked like a swollen bomb."



Walther Gerlach, 1943/44 notebook, last page, Deutsches Museum Archive NL 080/270-66

The Principle of Radiation Implosion

Another atom scientist in the British occupation zone of Germany—Prof Paul Harteck of the Kaiser Wilhelm institute of physics in Berlin—said that light rays thrown out during the enormous explosion of an atomic bomb added greatly to the destructive force

The splitting of the atom causes a temperature of more than 10 000 000 degrees and serial shurs which destroy everything' Harteck said

This frees an amount of light which is beyond the visible spectrum Only a few people know that the reflection of beams of light on solid bodies also exerts a mechanical pressure This pressure is so small where our normal light is concerned that it is not noticed The amount of light freed by an atomic bomb is so great it destroys walls

Charles Chamberlain. Germans Failed to Split Atom: Experiments With Heavy Water Futile. AP: Minden, Germany. *Council Bluffs Nonpareil*, 9 Feb. 1946, p. 1. www.newspapers.com/article/the-daily-nonpareil/1957966/

Kenneth W. Ford. 2015. *Building the H-Bomb: A Personal History.* pp. 67, 70.

Let me explain what was special about the radiation-implosion idea (the 1951 insight of Edward Teller and Stan Ulam […])[….]

The energy in a given volume of radiation goes as the fourth power of the temperature. […] The energy of one cubic meter of radiation at a temperature of 30 million K is, in the units favored by weaponeers, 15 kilotons. And its pressure is correspondingly elevated, to 2 billion atmospheres. […]

At the temperatures characteristic of nuclear explosions, radiation is "stuff," full of enormous energy and capable of pushing like a giant piston.

At Least 27 Reported Heavy Water (D_2O) Production Sites

C. Chamberlain. Reveal Allied Capture of Nazi Atom Factory. *Chicago Daily Tribune.* 9 Aug. 1945.

The largest heavy water plant in Germany, where Nazi scientists were working feverishly to perfect an atomic bomb, was captured almost intact by the allies three months ago in a heavily wooded section four miles from Kiel. Cobwebs of plastic pipes connected eight huge vats holding thousands of gallons of plain water for processing into heavy water. I stumbled onto the factory two weeks after it was taken over by American and British technicians. Altho they gave me freedom to roam around the grounds, I was called on the carpet the next day for entering without authority from high officials and was required to pledge not to reveal what I had seen until it was released.

OSS London. 5 December 1944. T-2805-a. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-3.

GERMANY: ATOMIC PHYSICS Heavy Water Experimental Station. Heavy water experiments are being carried out at the Dräger Werke, Lübeck, which is reported to be the largest gas factory in Germany.

https://www.cia.gov/readingroom/document/cia-rdp81-01028r000100080011-0

The dismantling of the Leuna Plant in Merseburg, Thuringia, Germany (Soviet Zone), was initiated in March 1946… 3. The following large installations were dismantled:… (j) The heavy water installation operating at atmospheric pressure was dismantled and possibly placed in a building near the Agricultural Exhibition Grounds in Moscow. (k) The heavy water installation operating at 700 atmospheres was taken to the Karpov Institute were it was being installed when we left in July 1948.

Interrogation of PW MAYER. 14 July 1944. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-2.

PW is an educated man in his late thirties, a physical chemist by profession[...] PW believes that D2O (Heavy Hydrogen) is manufactured principally at GRIESHEIM ELEKTRON in fairly large quantities for distribution to research and scientific establishments.

B.K. Hough to L. Groves. 9 December 1943. NARA RG 77, Entry UD-22A, Box 166, Folder 32.22-1.

Dr. E. P. Wigner of Chicago mentioned to Dr. Urey that he has had reports of heavy water plants now in production in Germany.

Karl Cohen to F. Smith. 23 February 1945. Subject: Status of Enemy Separation Projects. NARA RG 77, Entry UD-22A, Box 166, Folder 32.22-1.

Heavy Water Production… Factories: Rjukan (now dismantled) Müggenberg, I. G. Farben

Ferdinand Cap. 23 November 1950 report.

At the invitation of Colonel Colonel GOUSSOT, Innsbruck, I had the opportunity to visit Mr. Werd's [wartime] heavy water extraction test facility in Weer near Wattens in Tyrol on 21 November 1950.

Stig Edfast. Sveriges Radio. 10 July 2015. https://www.sverigesradio.se/artikel/6209697

Ulf Sundholm has written books about the history of Ljungaverk and he now wants to open a museum. "They produced heavy water here in the factory during the war. It is a story that many older people have known about, but it has not been talked about," says author Ulf Sundholm. For six years he has been researching information and putting together a puzzle and can now show that heavy water from Fosfatbolaget in Ljungaverk was transported to Germany in containers during the Second World War… "The containers with heavy water went from Ljungaverk by train. They were transferred in Gällö to German transport trains."

Siegfried Knappe. 1992. *Soldat: Reflections of a German Soldier 1936-1949*. Orion. pp. 265-268.

Hitler had declared Breslau a fortress city, which meant that it was to be defended to the last man, even if it was surrounded and totally isolated… A factory for making heavy water for atomic experiments had been abandoned east of Breslau, and we had to plan and conduct a counterattack to destroy it and keep its secrets from falling into the hands of the Russians.

U.S. Embassy, Warsaw. 12 Aug. 1947. MIS-390731. Subject: Plants producing heavy water. NARA RG 319, Entry 85A, Box 2534, Folder 390731–390740.

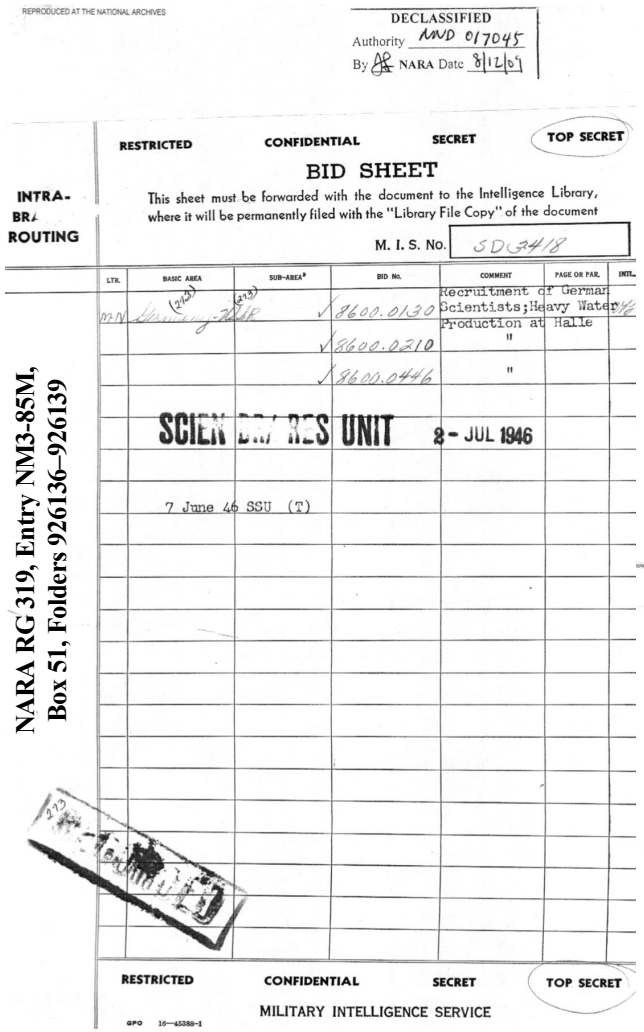
It is believed that no plants designed specially for the production of heavy water exist in Poland [in 1947]. It is reliably reported that the Germans built one such plant near OSWIECIM (Auschwitz) but that it was destroyed or moved out by the SOVIETS in 1945.

R. W. Kirkman. 28 January 1944. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-1.

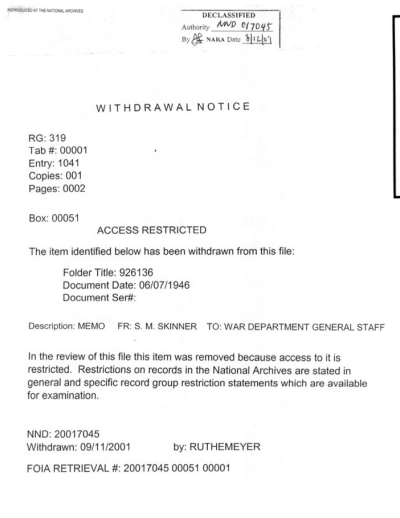
According to Major Furman, the substance of the conversation referred to was to the effect that Degussa was producing heavy water at two plants located at Rheinfelden and Weissenstein on the Drau River, Austria.

At Least 27 Reported Heavy Water (D_2O) Production Sites

- **Why were at least 27 plants reportedly producing D_2O, despite other urgent wartime needs?**
- **Was that D_2O needed for breeder reactors, electronuclear breeders, fusion fuel, etc.?**
- **Why are Allied reports on those plants still classified, or entirely missing from archives?**



NARA RG 319, Entry NM3-85M, Box 51, Folders 926136–926139



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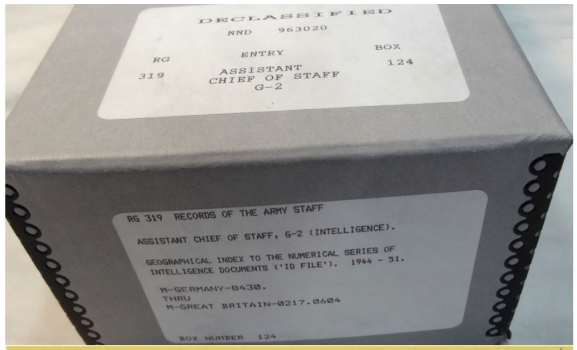
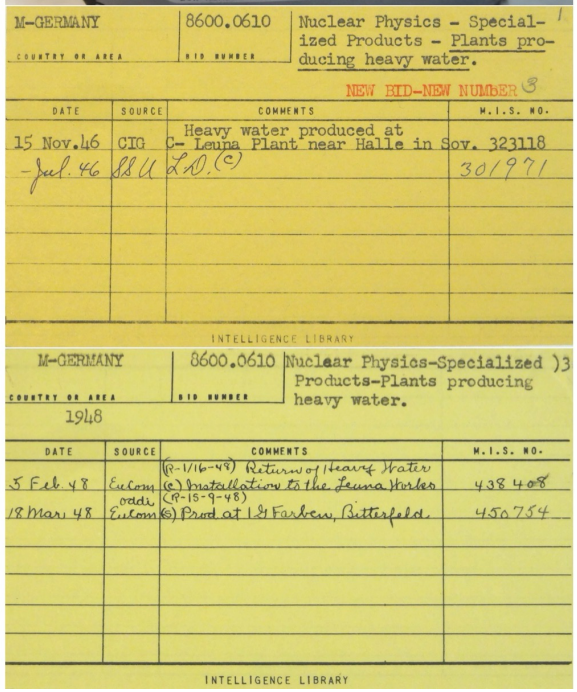
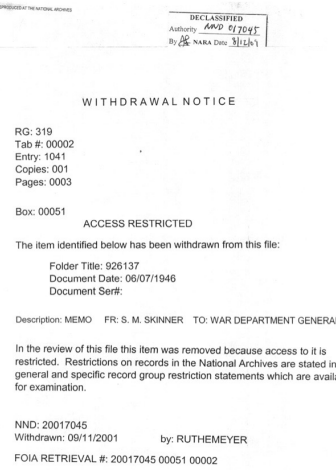
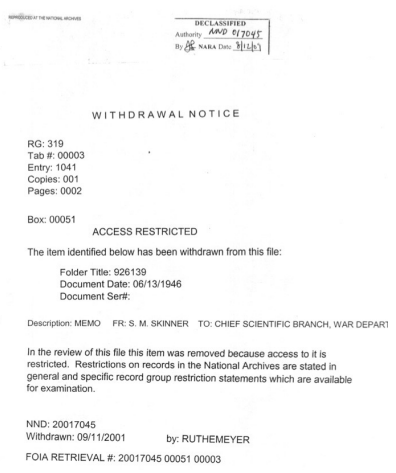








NARA RG 319, Entry A1-84E, Box 124

For more information, see *Forgotten Creators* D.7

Reported Fission Reactors (Could Breed Tritium)

H. K. Calvert. 29 January 1945. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-3 GERMANY: US Wartime Positive Int. (Nov. 44–June 45). [I. G. Farben was producing uranium hexafluoride, heavy water, graphite, aluminum, calcium, etc.]
At the LEVERKUSEN I G Farben Works, PW learned through an uncle, who is a director, that a special department has been installed in concrete structures like pillboxes, to which access is gained only through special passes, even high-ranking officers being refused admission under a special order issued 18 Nov by factory police. There is heavy A.A. defence of all calibers, and the general belief is that experiments are being made with special weapons of some kind.

Richard P. Fischer. June 1945. Report on German Supplies of Uranium-Bearing Raw Materials. NARA RG 77, Entry UD-22A, Box 163, Folder Australia.
About 50 to 60 tons of strongly radioactive "tarnsand" was delivered to the German Army… More likely the ``tarnsand" was prepared from material in which the radioactivity has been artificially induced.

Leverkusen

F.A.C. Wardenburg and J.A. Lane. 5 April 1945. Interrogation of Dr. Kohl, Works Manager of Degussa Plant No. 2, Frankfurt. NARA RG 77, Entry UD-22A, Box 166, Folder 32.22-1.
Metallic uranium was mixed with coal dust (carbon?) and with Tragacanth gum as a binding material and pressed into blocks, approximately 50% by weight of coal and uranium. The blocks were approximately 5 cm x 5 cm x 6 cm. About five tons as metallic uranium in total were delivered in this form.

S. McClintic 6 Jan 1945. AFHRA A5734 p. 1092
At UNTERRADERACH, near FRIEDRICHS-HAFEN, there is a large semi-underground factory which was constructed early last winter where strange experiments were taking place. Heavy clouds of smoke filled the sky in the day and at night a red glow. The experiments caused the earth to shake. These experiments are with atoms and when the experiments proved successful the plant went into operation. Workmen were not allowed to leave the factory.

Unter-raderach

Gerhard Dessauer to Leo Szilard. 6 July 1942. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-1 GERMANY: US Wartime Positive Int. (July 42-June 44).
I learned that the chain reaction of the uranium isotope is now successful. It is not explosive, but there is now the prospect of technical utilization.

MED Foreign Intelligence. 3 April 1944. Activities from 13 March to 31 March 1944. NARA RG 77, Entry UD-22A, Box 170, Folder 32.60-1.
Mr. Chapin reported successful detection experiments and requested aircraft study.

F. J. Smith. 30 July 1945. NARA RG 77, Entry UD-22A, Box 163, Folder Australia.
Mr. Parks, a geologist for the Engineers who has recently returned to the States, was interviewed and he stated that there was sizeable pile of material that originally came from the Belgian-Congo now at Hamburg. The material was being used by the KWI and even though we don't know his interpretation of a sizeable pile, we believe it would be worthwhile looking into.

Hamburg

Dahlem→ Haigerloch

Lichterfelde

Gottow →Stadtilm

Leipzig

Thuringia underground

Krizik/ Bodenbach

Gusen

Königsberg

Wolfgang G. Schwanitz. *H-Soz-u-Kult, H-Net Reviews.* Feb. 2009.
After 1945 the Grand Mufti said that the enemy espionage by "Jewish, English and American intelligence services" caused "the greatest damage." They were able to discover the locations of "atomic reactors" in East Prussia.

RAF Bomber Command. Campaign Diary. webarchive.nationalarchives.gov.uk/ukgwa/20070706054833/http://www.raf.mod.uk/bombercommand/aug44.html
29/30 August 1944 189 Lancasters of No 5 Group carried out one of the most successful No 5 Group attacks of the war on Königsberg at extreme range. Only 480 tons of bombs could be carried because of the range of the target but severe damage was caused around the 4 separate aiming points selected.

Joint Intelligence Committee. Exploitation of German Scientists and Technicians. 5 January 1946. J.I.C. 317/10. Appendix C. [NARA RG 218, Entry UD-1, Box 475, Folder CCS 471.9... (5-1-45)... Sec. 3.
Practically the entire staff of the German "URANMOTOR" Project at KRIZEK in Czechoslovakia under Prof. HUETTIG is working for the U.S.S.R.

NARA RG 319, Entry A1-134B, Folder Focke, Franz.
There was once a report of an atomic pile operated by Russians at Bodenbach, CSR…

Edward M. Pickett to Assistant Chief of Staff, G-2, USFET. 4 March 1946. Additional Supply of Uranium Oxide. NARA RG 77, Entry UD-22A, Box 169, Folder 32.32. Germ. Ind. TA.
Additional quantities of Uranium Oxide have been located in the amount of approximately five and one-half tons at Bad Tölz and Munich… Dr. Fritz REHBEIN stated during investigation that the Uranium Oxide is very active and can be extremely injurious to personnel not qualified in its handling.

E. P. Dean to W. R. Shuler. 1 April 1946. Shipment of Uranium Compounds. NARA RG 77, Entry UD-22A, Box 169, Folder 32.32. Germ. Ind. TA.
G-2 moved very slowly and we had to prod them on three successive occasions... On the other hand, G-2 moved extremely quickly re the five tons of uranium oxide recently discovered at Bad Tölz.

Breeding Tritium, ^{239}Pu, or ^{233}U in Electronuclear Systems

Germany produced particle accelerators from the Netherlands to Czech territory for a secret, high-priority program

Werner Grothmann, 2002, Jonastalverein Archive, Arnstadt, p. 41:

It was attempted to produce plutonium without having a reactor. […] In the summer of 1944, when the uranium program had already been developed properly, decisive measures were taken, because there was evidence that plutonium could be produced, albeit with difficulty and in very small quantities. It was Himmler who commissioned us to use our technical capabilities to build the first machines for it. The construction drawings for it were not from our [SS] people. […] In addition, the Reichspost had its own very secret research facility nearby, but I do not know anything about it. The equipment for the plutonium matter was manufactured by Austrian companies and in the [Czech] Protectorate. This was so because Austrian scientists had better contacts to their own companies, which did excellent work by the way. The operation of the facility was supposed to be organized such that we [SS] provided the facility and also the construction of the underground rooms. The technicians there should operate them for us and Ohnesorge's people would provide the technical supervision. […] After the war I heard that we had material for one or two plutonium bombs.

Air Raid, Sabotage Held Up Nazi Work on Atomic Bomb, AP 1945:

PRAGUE, Aug. 23---(AP)---A shattering American air raid, Czech sabotage and an accident frustrated German experiments in Czechoslovakia seeking to develop an atomic bomb, newspaper accounts said here today. A German engineer named [W.] Isenbeck worked with the problem of releasing atomic energy in a radio plant at Vysocany, the accounts said. A blast and fire at the plant in 1943 followed by an American raid [25 March 1945] halted work soon after the plant resumed operations. Some mysterious apparatus was dispatched to the Imperial Research Institute in Berlin, but Czech workers believed they managed to damage the delicate mechanism before it was shipped, the stories said.

Georgy Flerov, 1983 interview, www.gornictwo.walbrzych.pl/news-91-Tajemnice_kopalni_Walbrzycha.php:

Nobody knows everything, because the Germans destroyed a lot of documents and experimental materials, and the Allies, the Americans, took a lot. […] I was in Waldenburg, but just before I came back from Germany to Moscow. […] Stalin and Kurchatov sent me there. There were reports that the Germans were conducting atomic tests. I went there as a representative of the Ministry of Light Machines. It turned out on the spot that the Germans were more advanced in the tests than one could have imagined. […] I found out that in Dresden the "Service" [NKVD] had captured a German scientist, a physicist, who told me about secret experiments in Waldenburg, so I took him with me and we went there, but he knew too little. […] You see, the Germans had a lot of research groups. My German worked in an institute in Dresden that belonged to the Postal Ministry. He was in Waldenburg only one time to install equipment, because that institute belonged to the SS. […] He was there only once. The car that carried him from the railway station drove around the city for a long time until the German had forgotten the way. Then they drove into the mine and drove him underground. He sat there for two days, worked, ate, and slept underground. When he finished, the car drove him around the city again, before he reached the station. And that is why the German could not find anything with me. […] He said that when he was there for the first time he was also afraid. He said that SS people were guarding everywhere; he described them as "sharp." He said they had strange emblems on their uniforms that he had never seen before. […] He said that with his colleagues he had installed a cyclotron there, but it turned out that it was the second one, because one was already there. They installed the second one. He told us that the mine had been specially adapted. There were trolleys, tables, all the necessary equipment, and at the entrances there were locks and guards. He could not enter because he did not have a special pass.

Requirements for an Electronuclear Breeder

$$\text{Production rate} = 3.15\times10^{4}\ \frac{N\ I\ \eta\ A}{e\ N_A}\ \frac{kg}{year}$$

N = number of particle accelerators
I = beam current per accelerator
η = number of bred atoms per accelerated charged particle
A = atomic mass of product
$e = 1.602\times10^{-19}$ Coulombs/proton
$N_A = 6.022\times10^{23}$ Avogadro's number

$$\text{Production rate} = \begin{cases} 0.78\ kg/year\ ^{239}Pu\ or \\ 0.76\ kg/year\ ^{233}U\ or \\ 9.8\ g/year\ tritium \end{cases}$$

For N=10 accelerators, $I = 10^{-3}$ Amp, and η = 1 bred atom per accelerated particle

Higher production rates are possible:

- The German program could have built and operated more than 10 particle accelerators in parallel. (The United States built and operated 3120 calutron ion beams at Oak Ridge for ^{235}U enrichment.)
- Increasing the beam current by a factor of 2 or 3 would increase the amount of bred fission fuel by the same factor.
- If the accelerators began operation two years before the end of the war, twice as much fuel could have been produced.
- The efficiency could be as high as η ~ 100 by using the highest possible beam energy, using charged deuterons for the beam, and employing a neutron-multiplying target. A neutron-multiplying target would essentially be a small, subcritical fission reactor, for example chunks of unenriched uranium metal immersed in heavy water and surrounded by a beryllium reflector.

Germany Produced Large Amounts of Lithium During WWII

FIAT 750. *Rare and Minor Metals*, pp. 8--9

FIAT 295. *Lithium Extraction and Uses*, p. 9

LITHIUM

The use of lithium apparently has progressed further in Germany than in the United States, especially its use in special alloys of light metals as well as lead. Much of the consumption has been in ordinary Bahnmetall which contains .04 percent lithium; the new alloys of the MGS series contain only .02 percent lithium. After 1938, however, there was a substantial consumption in connection with two zinc alloys of sheets and strip. Both of these alloys contained .01 percent lithium in addition to a maximum of .04 percent lead (L 21) and .8 percent lead (Mi 38). Beginning in 1942-1943, however, the use of these alloys was restricted as part of the zinc alloy simplification program. Small amounts are used in gas free metals, especially copper (Liothorsokupfer) and for hardening aluminum. Lithium salts are used in heat resisting glass and ceramic ware inasmuch as they lower the thermal expansion coefficient. Lithium carbonate is the starting point for certain pharmaceutical products including various medicinal purposes for rheumatism, arthritis, and kidney and gall bladder ailments. Lithium chloride is found in soldering and welding fluxes, especially those used for aluminum and its alloys and for de-humidifying air. Lithium hydrate is used in alkaline storage batteries. The Hans Heinrich Hütte, G.m.b.H., Langelsheim/Harz is listed as the only producer of lithium metal in Germany, the metal actually being extracted by DEGUSSA, in Rheinfelden. Dr. L. C. Marquart, Bend a/R., produced lithium salts. Total production in Germany for specified years follows:

Year	Metal in kg.	Salts in kg.	Total in kg.
1935	855	2,326	3,181
1939	1,920	8,076	9,996
1940	1,404	10,272	11,676
1941	1,308	9,804	11,112

Lithia mica or zinnwaldite is the principal raw material. It is obtained from the tailings from Saxon tin ores by flotation and/or magnetically. Imported amblygonite (principally) from Southwest Africa) has also been employed as raw material. Chemical treatment, involving roasting, leaching, and filtering (as well as the production of metal by electrolysis of LiCl-KCl), are described in FIAT Final Report No. 395 by Motock, who also gives the analytical method employed for plant control.

The price of the metal declined from RM 140 per kg. before the war to RM 115 in 1940.

pressures, filtered and evaporated in rubber line (0.1 mm thick) iron container, to a 55% Lithium Hydroxide liquor; which can be concentrated to 98% by vacuum drying.

LITHIUM FLUORIDE is not made by Metallgesellschaft. Metallgesellschaft produced in 1942:

11637 kilograms Lithium from Lithium Mica
1702 " " Amblygonite in form of

	1942	1941.
Lithium Carbonate	18987 kgr.	12130 kgr.
Lithium Chloride	12630 "	13725 "
Lithium Hydroxide	40506 "	38003 "
Lithium Metal	1230 "	505 "

Lithium Carbonate and Hydroxide were sold to Merk and other chemical concerns to make medical salts, and Lithium Fluoride. Lithium Hydroxide is also used for storage to batteries. All the Lithium Chloride was used entirely for making Lithium metal.

LITHIUM SALTS EXTRACTION FROM AMBLYGONITE.

The Dr. Marguardt A.G. unit of Degussa (Deutsche Gold and Silber Scheide Anstalt) produces Lithium salts from Amblygonite imported from U.S.A., Spain, South Africa or Finland and from Lithium mica that they can get from the Metallgesellschaft.

The amount of Lithium mica received from Metallgesellschaft were:

Year	Tons
1943	530
1st half 1944	293
July-Sept 1944	149

Marguardt A.G. plant in Beuel, near Bonn produced the following Lithium salts in:

July 1944:

1000 Kilograms Lithium Carbonate, technical
1025 " " " pure
3140 " Lithium Chloride, technical
2580 " " " pure
1373 " Lithium Fluoride

Alfred Klemm demonstrated methods of separating ^{6}Li and ^{7}Li during the war, and published them after the war. He worked closely with Josef Mattauch (of U. Vienna) and Walther Gerlach.

Dr. Alfred K l e m m (14) Tailfingen, 16.3.1945
Krs. Balingen/Württ.,
Postfach 86

Reichsforschungsrat
Bevollm. für Kernphysik
Eing. 29.3.45
9 Anl.

An den
Bevollmächtigten des Reichsmarschalls für Kernphysik,
Herrn Professor Dr. W. G e r l a c h ,
B e r l i n - D a h l e m
Boltzmannstr. 2o

Eing. 26.3.45

Sehr verehrter Herr Professor Gerlach !

Da am 31.3.45 die vorgesehene Zeitspanne zur Durchführung meines Forschungsauftrages Nr. II.oo7.44 abläuft, möchte ich Ihnen mitteilen, wie weit die Arbeit seit meinem letzten Bericht an Sie vom 16.11.44 fortgeschritten ist.

Herr Dr. Hoernes und ich haben weiter zahlreiche Elektrolysen mit Schmelzen durchgeführt, wobei immer andere Versuchsbedingungen ausprobiert wurden. Von diesen Versuchen haben wir Lithium- und Bleiproben gewonnen. Zu einer Isotopen-Analyse der Proben ist es aber leider noch nicht gekommen. An unserm Institut ist Herr Dr. Hintenberger damit beschäftigt, sein Massenspektrometer für Lithium herzurichten. Wir werden Ihnen wohl bis Ende April das Ergebnis bei Lithium mitteilen können. Für die Untersuchungen des Bleis und anderer Metalle ausser Alkalien besteht an unserem Institut zurzeit wenig Aussicht, denn das Massenspektrometer von Dr. Hintenberger funktioniert vorläufig nur für Alkalien und mit dem Massenspektrographen von Dr. Ewald werden keine Häufigkeitsmessungen durchgeführt, sondern genaue Massenbestimmungen.

Herr Dr. Hoernes und ich bemühen uns inzwischen weiter, die jetzigen Bedingungen bei der Elektrolyse zu verbessern und damit bessere Proben der Metalle Lithium, Blei, Silber und Spezialmetalle zu gewinnen.

Sehr schade ist es, dass wir kein Thallium haben, von dem wir etwa 1 kg bräuchten. Wir haben schon mehrmals bei der Reichsstelle für Chemie darum angefragt, jedoch erhielten wir keine Antwort, obwohl mit gleichem Brief beantragtes Lithium bewilligt wurde. Das Thallium wäre für einen Versuch der Anreicherung von Spezialmetallen sehr wichtig.

Von den für meinen Forschungsauftrag bewilligten RM 3000.- habe ich bis jetzt ca. 1200.- verbraucht. Die Abrechnungen darüber gehen Ihnen mit gleicher Post zu. Ich möchte Sie bitten, mir den Forschungsauftrag auf ein weiteres Jahr zu verlängern.

Da durch Feindeinwirkung die Geschäfte meines Vaters so geschädigt sind, dass ich von dieser Seite keine Zuschüsse mehr erhalten kann, bin ich jetzt darauf angewiesen, meine Familie, bestehend aus Frau und drei Kindern, selbst zu ernähren. Ich habe mir darum vom Institut angeben lassen, dass mir als Assistent im 9. Dienstjahr nach Hochschultarif 600.- RM monatlich zustünden. Ich möchte Sie daher bitten, mir ein Stipendium in dieser Höhe für das kommende Jahr zu bewilligen.

Mit vorzüglicher Hochachtung verbleibe ich

Ihr

Alfred Klemm

Anlagen: 5 Sonderdrucke.

1 Abrechnung mit dem RFR

Anreicherung der schweren Isotope von Li und K durch elektrolytische Ionenwanderung in geschmolzenen Chloriden

Von Alfred Klemm, Heinrich Hintenberger und Philipp Hoernes
Aus dem Kaiser-Wilhelm-Institut für Chemie, Tailfingen

(Z. Naturforschg. **2a**, 245—249 [1947]; eingegangen am 26. Januar 1947)

Durch elektrolytische Ionenwanderung wurde an der Grenzfläche zwischen geschmolzenem LiCl mit 2 Molprozent KCl einerseits und geschmolzenem $PbCl_2$ andererseits bei einer Stromdichte von 5 A/cm² in 48 Stdn. K stark angereichert, das Mischungsverhältnis $[^7Li]/[^6Li]$ von 12,3 auf 44,3 und das Mischungsverhältnis $[^{41}K]/[^{39}K]$ von 0,0714 auf 0,0885 verschoben. Als Quotienten der Ionenwanderungsgeschwindigkeiten wurden gefunden: $w_{Li}/w_K = 1{,}156$, $w_6/w_7 = 1{,}021$ und $w_{39}/w_{41} = 1{,}016$. Faßt man diese Quotienten als Trennfaktoren einer Stufe auf, so bedeuten die angegebenen Anreicherungen eine wirksame gesamte Trennstufenzahl von 61,5 bei den Li-Isotopen und 13,4 bei den K-Isotopen. Für den Masseneffekt $\mu = \ln (w_j/w_k)/\ln (m_j/m_k)$, ($m$ = Isotopenmasse), folgt $\mu = -0{,}135$ für Li und $\mu = -0{,}32$ für K. Der große Masseneffekt und die kleine Trennstufenzahl beim K kann durch dessen geringe Konzentration erklärt werden.

Nachdem sich bei zwei Diffusionsversuchen (H diffundierte in Pd[1], Cu diffundierte in α-Ag_2S[2]) und bei einem Versuch mit elektrolytischer Ionenwanderung (Ag^+ wanderte in α-AgJ[3]) gezeigt hatte, daß die leichten Isotope in festen Körpern eine größere Beweglichkeit haben als die schweren, sollte in der vorliegenden Arbeit untersucht werden, ob der gleiche Effekt bei elektrolytischer Ionenwanderung in Schmelzen auftritt.

Im Gegensatz zu dem Überführungsversuch in α-AgJ wurde diesmal die Anreicherung der weniger beweglichen Kationen nicht im Anodenraum, sondern vor einer wandernden Grenzfläche studiert, und zwar an der Grenzfläche zwischen LiCl, das zufällig etwas KCl enthielt, einerseits und $PbCl_2$ andererseits. Die Stromrichtung war dabei so gewählt, daß die Alkali-Ionen voraus und die Blei-Ionen hinterher wanderten. Da die Alkali-Ionen eine größere Beweglichkeit haben als die Blei-Ionen, bleibt bei dieser Stromrichtung die Grenzfläche scharf, während bei der umgekehrten Stromrichtung eine Vermischung der Alkali- und Blei-Ionen eintreten würde. Für die Anreicherung der schweren Alkali-Ionen ist es belanglos, ob der mit den Alkalichloriden erfüllte Raum anodenseitig durch die Anode selbst oder durch die beschriebene wandernde Grenzfläche begrenzt ist, da in beiden Fällen jene Grenze für Chlor passierbar und für Alkalien unpassierbar ist. Ist diese Bedingung erfüllt, dann tritt bei Stromfluß der beabsichtigte Vorgang ein, daß diejenigen Alkali-Ionen zur Grenzfläche hin verschoben werden, deren Wanderungsgeschwindigkeit w_i im Chlor kleiner ist als die Geschwindigkeit w_0, mit der das Chlor durch die Grenzfläche aus dem Raum der Alkali-Ionen austritt, während sich diejenigen Alkali-Ionen, bei denen w_i größer ist als w_0, von der Grenzfläche weg verschieben. An der Grenzfläche stauen sich also die schweren und verarmen die leichten Alkali-Ionen, wobei die Gesamtkonzentration der Alkali-Ionen aus Raumladungsgründen konstant bleibt. Die Gradienten der Partialkonzentrationen sind um so größer, je größer die Stromdichte und je kleiner die Diffusionskonstante und die eventuell vorhandene Konvektion ist. Die durch Raumladungskräfte erzwungene Konstanz der Gesamtkonzentration ist bei dem Verfahren wesentlich. Nähme nämlich die Gesamtkonzentration im Stauraum infolge der Überführung zu, so würde zwar die gleiche Überschußmenge der anzureichernden Komponente in den Stauraum eintreten wie im Falle konstanter Gesamtkonzentration, aber es würde zusätzlich eine große Menge nicht angereicherten Gemisches in den Stauraum eintreten, wodurch die tatsächliche Entmischung verschlechtert würde.

Nach dem gleichen Prinzip muß die Anreicherung leichter Isotope möglich sein. Z. B. ist anzu-

[1] W. Jost u. A. Widmann, Z. physik. Chem. (B) **45**, 285 [1940].
[2] A. Klemm, Z. physik. Chem. Abt. A **193**, 29 [1943].
[3] A. Klemm, Z. Naturforschg. **2a**, 9 [1947].

Lithium Isotope Separation

Heiko Petermann, Discussion notes with Prof. Alfred Klemm, Mainz, Saarstr. 23, Max Planck Institut für Chemie. 5 March 2004. 06131-305-223

Klemm looked very nervous and always gave up my questions. He tried to get rid of me as soon as possible.

During the war, Klemm concentrated exclusively on isotopic separation and was, so to speak, his own master. The electrolytic process he developed did not work with uranium hexafluoride. […]

Main focus of the work was the production of ^{6}Li by separation of ^{7}Li. This was achieved very well in the electrolytic process. From 1942–43. Klemm pointed out that he was probably the first to achieve the separation by means of electrolysis (scientific priority, see also *Z. f. Naturforschung* 2a, pp. 245 ff, 1947, with the collaboration of H. Hintenberger and P. Hoernes)

He knew about the tritium problem, but it was not his job at the time. (Whose then?) […]

He also confirmed that the tritium problem (disintegration of ^{6}Li into tritium) was already discussed before 1945.

Pavel V. Oleynikov. 2000. German Scientists in the Soviet Atomic Project.

After 1950, Hertz moved to Moscow where, together with Werner Schuetze, he started to work on analysis of lithium and purification of tritium.

Documents about German scientists who helped the Soviet Union develop an atomic bomb. 29 October 2019. www.mbs.news/2019/10/documents-about-german-scientists-who-helped-the-soviet-union-develop-an-atomic-bomb.html

Manfred von Ardenne, the scientific director of the A kurulan institute, established in another sanatorium in the USSR, was also awarded the Stalin Prize twice in 1947 for inventing the electronic microscope and in 1953 for obtaining the lithium 6 isotope necessary for the creation of nuclear warheads.

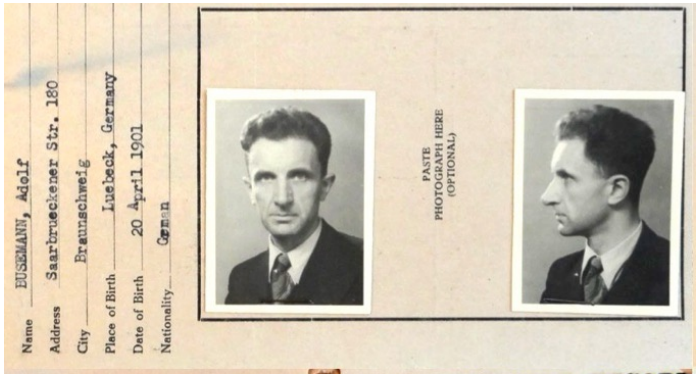
[Did Gustav Hertz, Werner Schuetze, and Manfred von Ardenne have expertise with lithium-6 and tritium from wartime work?]

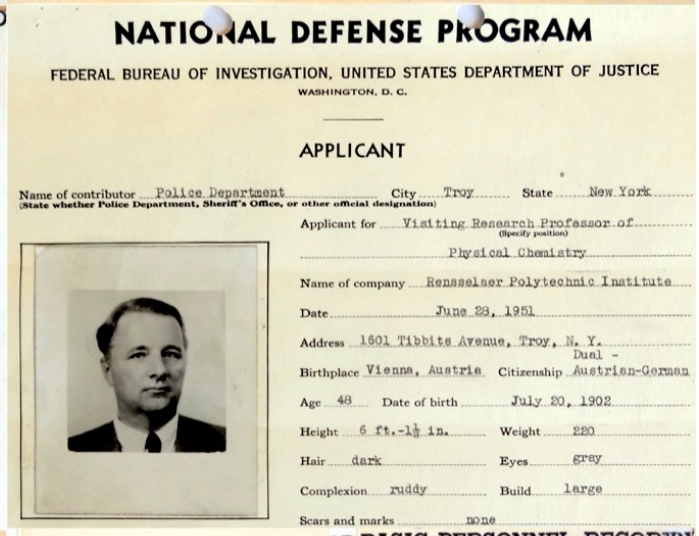
4. Postwar Exploitation of German/Austrian Nuclear Experts by Other Countries

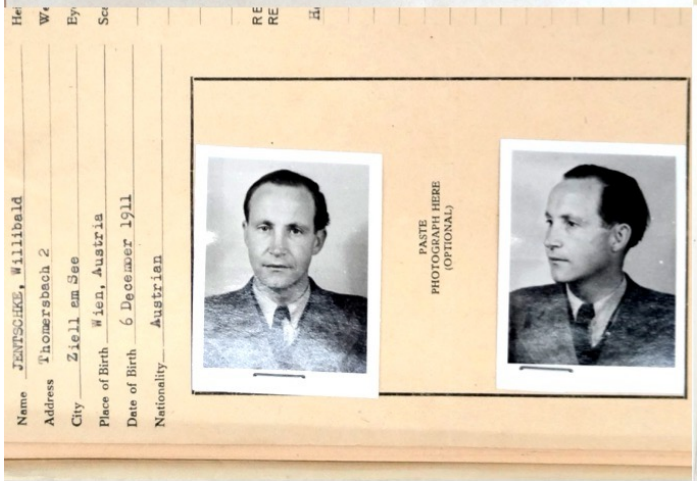
Dozens of experts with knowledge of German nuclear program (including H-bombs) were brought to U.S./U.K. after WWII

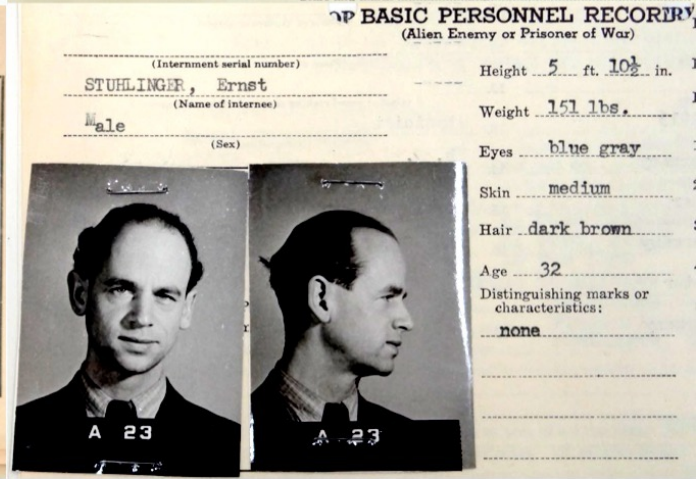
Where are the interrogation transcripts and reports???

Karl-Friedrich Bonhoeffer
Wernher von Braun
Rudolf Brill
Adolf Busemann
Walter Dornberger
Rudolf Edse
Krafft Ehricke
Wilhelm Eitel
Gerhard Falck
Karl Fiebinger
Wolfgang Finkelnburg
Rudolf Fleischmann
Siegfried Flügge
Walter Glaser
Wilhelm Groth
Gottfried Guderley
Paul Harteck
Otto Haxel
Richard Herzog
Johannes Hans Jensen
Willibald Jentschke
Ulrich Jetter
Georg Joos
Hartmut Kallmann
Hans Kammler
Gerald Klein
Stanley Kronenberg
Heinz Maier-Leibnitz
Werner Maurer
Hugo Neuert
Walter Nielsch (?)
Edgar Petersen
Heinz Schlicke
Erich Schumann
Otto Schwede
Edmung Sorg
Kurt Starke
Ernst Stuhlinger
Hans Suess
Herbert Wagner
Wilhelm Westphal
Friedwardt Winterberg
Karl Wirtz
Gernot Zippe
Etc.









NARA RG 330, Entry A1-1B, Boxes 1-186.
JIOA Foreign Scientist Case Files [Paperclip].

Siegfried Flügge published detailed calculations of fission reactors and fission bombs in June 1939. During the war, he worked for the Reichspost, Heereswaffenamt, University of Berlin, Kaiser Wilhelm Institutes, Reichsforschungsrat, University of Königsberg (reported to have fission reactors), and Gusen SS facility.

Siegfried Flügge: Top Theoretical Physicist of the German Nuclear Program

thermische Neutronen einen Einfangquerschnitt von nur $1{,}3 \cdot 10^{-24}$ cm² fanden. Zählt man hierzu die von FERMI angegebenen $2 \cdot 10^{-24}$ cm² für die Spaltung, so erhält man für die gesamte Absorption erst etwa $^1/_7$ des angegebenen Gesamtquerschnitts und nicht die Hälfte. Es ist daher nicht unmöglich, daß bei der Messung noch Resonanzneutronen mitgewirkt haben, durch die das Resultat beträchtlich verfälscht wird. Immerhin können wir aus dem Versuch wohl entnehmen, daß Streuquerschnitt und Einfangquerschnitt bei langsamen Neutronen vergleichbar sind.

3. Das Auftreten von Reaktionsketten. Wir wollen die Frage, ob eine Reaktionskette zustandekommen kann, zunächst ganz ohne Berücksichtigung des Diffusionsproblems angreifen. Es sei n die Anzahl der Neutronen, die in einer Substanz von großem Volumen insgesamt enthalten ist. Wir nehmen zunächst an, diese Neutronen seien gleichmäßig dicht über die ganze Substanz verteilt. Ferner sollen verschiedene Arten von Atomen, unterschieden durch den Index i, anwesend sein, an denen Reaktionen stattfinden können, unterschieden durch den Index k, die jeweils ein Neutron zum Verschwinden bringen, also Einfang oder Umwandlung. Bezeichnen wir die Anzahl von Atomen der Art i im Kubikzentimeter mit ϱ_i, die Wirkungsquerschnitte mit σ_{ik}, und ist v die mittlere Geschwindigkeit der Neutronen, so nimmt die Gesamtneutronenzahl in der Zeiteinheit ab um

$$\frac{dn}{dt} = -n v \sum_{ik} \varrho_i \sigma_{ik}.$$

Eine Ausnahme von dieser Regel machen allein die Spaltungsprozesse am Uran, solange wir Thorium ausschließen, das noch nicht so gut untersucht ist, und Neutronenenergien unterhalb 8 MeV fordern, so daß noch keine $(n, 2n)$-Prozesse auftreten können. Ist der Spaltungsquerschnitt σ_{sp} und die Zahl der bei jeder Spaltung abgedampften Neutronen ν, so haben wir unsere Gleichung zu erweitern zu

$$\frac{1}{n}\frac{dn}{dt} = v\{-\sum_{ik} \varrho_i \sigma_{ik} + \varrho_U \sigma_{sp}(\nu - 1)\}. \qquad (4a)$$

Die Neutronenzahl nimmt also so lange zu, wie in der Klammer ein positiver Ausdruck steht. Streuprozesse sind nicht mitzuzählen, weil sie die Zahl der Neutronen nicht verändern.

Als Beispiel betrachten wir zunächst die Verhältnisse an reinem Uranmetall. Für schnelle Neutronen besteht kein merkbarer Einfangquerschnitt; wir haben außer $\sigma_{sp} = 0{,}1 \cdot 10^{-24}$ cm² nur noch Streuprozesse mit rund $6 \cdot 10^{-24}$ cm². Metallisches Uran (Dichte 8,6) enthält rund $2{,}2 \cdot 10^{22}$ Atome je Kubikzentimeter; es wird dann bei einer Neutronengeschwindigkeit von $2 \cdot 10^9$ cm/sec, entsprechend einer mittleren Energie der frei gesetzten Neutronen von 2 MeV:

$$\frac{1}{n}\frac{dn}{dt} = 0{,}44\,(\nu - 1) \cdot 10^7 \text{ sec}^{-1}. \qquad (4b)$$

Die Integration dieser Differentialgleichung ergibt

$$n(t) = n_0\, e^{0{,}44\,(\nu-1)\cdot 10^7 t}.$$

Läßt man die Reaktionskette mit $n_0 = 1$ Neutron zur Zeit $t = 0$ anlaufen und nimmt man den wahrscheinlichsten Wert $\nu = 2$, so findet man, da je Spaltung $3 \cdot 10^{-12}$ mkg frei werden, folgende Energiebeträge: Nach 10^{-7} sec: $4{,}7 \cdot 10^{-12}$ mkg, nach 10^{-6} sec: $2{,}4 \cdot 10^{-11}$ mkg, nach 10^{-5} sec: $3 \cdot 10^{+7}$ mkg und nach 10^{-4} sec: $3 \cdot 10^{+78}$ mkg. Die letzte Zahl hat natürlich keinen Sinn mehr; sie bedeutet nur, daß in weniger als 10^{-4} sec das gesamte Uran umgesetzt wird. Die Energiebefreiung geschieht also in einer so kurzen Zeit, daß wir es mit einer außerordentlich heftigen Explosion zu tun haben*.

Es ist gut möglich, daß diese Abschätzung noch in folgendem Sinne zu korrigieren ist: Der Streuquerschnitt für schnelle Neutronen ist rund 60mal so groß wie der Spaltungsquerschnitt, d. h. ein Neutron wird 60mal gestreut, ehe es ihm gelingt,

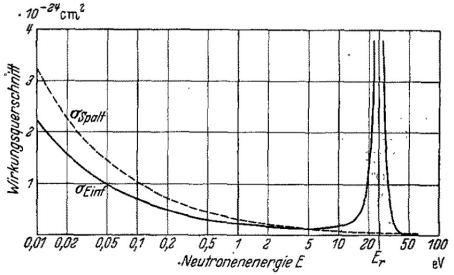


Fig. 1. Einfang- und Spaltungsquerschnitt von Uran für langsame Neutronen. Die Energie E ist in logarithmischer Skala gezeichnet.

einen Urankern zu spalten. Ist nun ein erheblicher Teil dieser Streuung unelastisch, was wir nicht wissen, so wird eine beträchtliche Verlangsamung eintreten. Obwohl bei jeder Spaltung schnelle Neutronen erzeugt werden, dürfen wir dann so rechnen, als ob wir es mit langsamen Neutronen zu tun hätten.

Den Verlauf von Spaltungs- und Einfangquerschnitt für langsame Neutronen zeigt Fig. 1. Dann tritt an Stelle von Gl. (4), wenn wir wieder $\nu = 2$ setzen,

$$\frac{1}{n}\frac{dn}{dt} = v\varrho_U(\sigma_{sp} - \sigma_{Einf}).$$

Die Neutronenproduktion wird also überall dort den Einfang überwiegen, wo der Spaltungsquerschnitt größer ist als der Einfangquerschnitt, d. h. überall außer in der Zone von etwa 5 eV bis 40 eV. Zur Durchlaufung dieser Zone sind vielleicht 4 oder 5 unelastische Streuungen notwendig, da-

* Infolge der Verarmung an Uran läuft die Reaktion allmählich langsamer. Auch dürfte sie nach Umsetzung eines kleinen, aber durchaus wägbaren Bruchteils abbrechen infolge konkurrierender Prozesse an den gebildeten Spaltungsprodukten.

DECLASSIFIED
Authority NND 907017

NARA RG 319, Entry A1-134B, Box 202, Folder XE196681 Siegfried Fluegge

The following information was received by phone from L&S Office Marburg, Wednesday, 17 Sept 47, thru Mrs. Steinbacher:

F l ü g g e, Siegfried, Dr.

Date of birth:	16 March 1912
Place of Birth:	Dresden, Saxony, Germany
Present address:	Marburg/Lahn, Wilhelm Roser Str. 33 A
Present employment:	as professor at University of Marburg (ordentlicher Professor)
Special Field:	Nuclear Physics (Struktur der Materie)
Background information:	from 1918 - 1921: attended elementary school, Dresden
	" 1921 - 1929: " high school (Gymnasium) in Dresden
	" 1929 - 1930: attended Technical High School, Dresden.
	" 1930 - 1933: at University in Göttingen
	X 1933 Doctor of Physics at University of Göttingen.
	" 1933 - 1935: worked at University of Frankfurt as Scientific Assistant.
	" 1935 - 1937: lectured at University of Leipzig
	1937 to Berlin
	" 1937 - 1942: worked in chemical department of the Kaiser-Wilhelm-Institute in Berlin, Dahlem.
	" 1942 - 1944: assistant at the Institute of Scientific Research of the Reichspost, Berlin
	" 1940 - 1944: lectured at the University of Berlin
	" 1944 appointed professor (ausserordentlicher) at the University of Königsberg.

After the surrender, he went to Göttingen, where he was employed as Professor for History of Physical Science from 1945 to 1947.

He was not called to Military Service during the War, because he worked as a Scientist of Physics for the "Heereswaffenamt", Berlin, and was later exempted of any Army Service by the Reichsforschungsrat in Berlin.

At the urgent request of Edward Teller, Siegfried Flügge was brought to the U.S. to work on a project of "importance to the national security."

NARA RG 330, Entry A1-1B,
Box 43, Folder Flügge, Siegfried

EXOS:ONR:N421:UL:kcm

COPY

Serial No. 14654

NAVY DEPARTMENT
Office of Naval Research
Washington 25, D.C.

July 18, 1947

From: Chief of Naval Research
To: Chief of Naval Intelligence

Subj: Foreign Scientists, Request for assistance on.

1. Professor Edward Teller, Physics Department, University of Chicago, is supervising under contract to this Office a research program on various phases of research in physics of the solid state. This program is of interest and importance to the national security. Professor Teller is very desirous to obtain the services of the German physicist, Dr. Siegfried Flugge, who can be of marked assistance in carrying out the aforementioned program.

2. Professor Teller has requested the Office of Technical Services, Department of Commerce, to obtain Dr. Flügge from Germany. It is requested that the Joint Intelligence Objectives Agency be informed of the Navy's interest in this case, and asked to provide such assistance as is possible to Professor Teller in aiding Dr. Flügge to come to this country.

/s/ C.M. Bolster
Capt., USN
Acting Chief of Naval Research

cc: Mr. Robert Frye, OTS, Dept. of Commerce
Professor Edward Teller, Physics Dept.
University of Chicago

Pending 201 (Flügge)

EUCOM
SPECIAL PROJECTS TEAM
OFFICE OF MILITARY GOVERNMENT FOR HESSE

APO 633
Wiesbaden
17 Sep 47

SUBJECT: Information on F l ü g g e, Siegfried, Dr.

TO : Hq., EUCOM, O.D.D.I., Special Projects Sec., Control Br. (Attn: Mr. Horn)

Regarding your request for information on F l ü g g e, Siegfried, Dr., attached report is forwarded.

Robert A. Shankman
ROBERT A. SHANKMAN
1st Lt. Cav.

Incls: a/s

Tel: Wiesbaden 8341-7
Ext: 298

Fwd. to WD by cable on 24/9/47

NARA RG 319, Entry A1-134B, Box 202,
Folder XE196681 Siegfried Fluegge

When not working in the United States, Flügge was placed on the Top Secret JIOA K "hot list" and constantly monitored until at least the mid-1950s, on the direct orders of Lt. Col. George R. Eckman, formerly of the Alsos Mission.

NARA RG 319, Entry A1-134B, Box 202, Folder XE196681 Siegfried Fluegge

TOP SECRET

HEADQUARTERS
7970TH COUNTER INTELLIGENCE CORPS GROUP
EUROPEAN COMMAND

S: 10 February 1949

APO 757
7 December 1948

D: 196681
III-HI-2368
X-12368

SUBJECT: FLUEGGE, Dr. Siegfried

REGRADED CONFIDENTIAL
31 JAN 1957
(Date or Event)

TO : Commanding Officer
CIC Sub-Region MARBURG
APO 872, US Army

1. Subject is listed on JIOA Special (hot) List (see letter, this headquarters, file D-212210, dated 21 September 1948 and letter, this headquarters, file D-247540, dated 5 October 1948).

2. As outlined in above referenced letters, it has become increasingly important that CIC be aware of every movement and activity of persons residing in the U.S. Zone or the U.S. Sector of BERLIN, who are listed on the JIOA Special (hot) List. Every effort to prevent subject from leaving his area of residence without this organization's knowledge must be made. The following are the minimum requirements:

a. The placing of the subject on intermittent mail and telephone watch list. Done

b. The obtaining of subject's schedule of daily habits (regarding time he goes to work, to lunch, etc.), including addresses frequented and persons contacted. Recording of this schedule is necessary to definitely ascertain subject's location at any time.

c. Description and, where possible, pictures of subject's residence and place of business or employment.

d. Names and descriptions of persons occupying or frequenting subject's residence or place of business. (For use as informants.)

e. All available background information on subject.

3. It is desired that a report on the above requirements and your comments regarding the use of the persons described in sub-paragraph d, above, be forwarded to this headquarters by 10 February 1949.

BY ORDER OF LT. COLONEL ECKMAN:

James L. Stafford
for CARL S. BROWNING, JR.
Major, Infantry
Director, Plans, Operations and Training

CIC-TS-LOG
NO. C- 1330

Lt CARTER/gos/7250
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TS-X P- 1959

DECLASSIFIED Authority NND 007017

FLUEGGE, Siegfried Wilhelm (Dr.) 25 April 1952

File D-196681

Res: MARBURG, Wilhelm Roserstrasse 33a

Priority 1, (JIOA Personality on the "K" List)

REF: D-137899 Secret ltr dtd 31 Jan 52 file X-272
SUB: Custodial Detention
CS

FLUEGGE, S. (Professor) 4 Nov 54

Flügge was closely monitored by the U.S. until after the Soviet Union had perfected its own H-bomb (1955)

Employed by subject. Now in MARBURG.

Ref: D-284237 BfV Report dtd 26 Aug 53 File: BR53-11-91
Sub:German Academy of Sciences of BERLIN F-3
Re: Nuclear Physics Institute
CS GERNAND

Ulrich Jetter worked on mysterious research programs for the German government during the war, published a book and articles on the scientific details of H-bombs after the war, and was brought to Washington, D.C. as a "cultural exchange fellow" before the U.S. produced its first H-bombs.

1950 *Physikalische Blätter* article

Die sogenannte Superbombe

Von Dr.-Ing. Ulrich Jetter, Stuttgart

Die beiden Reaktionen (5) und (6) „gehen" ungewöhnlich gut: das leichte Lithiumisotop hat einen sehr großen Wirkungsquerschnitt gegenüber Neutronen, und die Reaktion von Triton und Deuteron hat gegenüber der D-D-Reaktion eine tiefere Energieschwelle und bei gleicher Temperatur die rund hundertfache Ausbeute. Sofern also genügend Tritonen oder Neutronen zugegen sind, wird der Zyklus

$$\begin{array}{ccccc} n + {}^6Li & \longrightarrow & {}^4He + Tr \\ \uparrow & & \downarrow \\ n + {}^4He & \longleftarrow & D + Tr \end{array}$$

die Hauptreaktion bilden. In Konkurrenz damit stehen die Reaktionen (1)

1952 book, *Nuclear Weapons: Use, Mode of Action, Protective Measures*

Ulrich Jetter

Mitarbeiter des Instituts für Demoskopie Allensbach. Physik und Sozialwissenschaften. * 1914. Nach Abitur 2 Jahre Industriearbeit. 1935/40 Stud. d. Physik in Stuttgart. 1937/38 Foreign Exchange Fellowship Passadena, Master of Science. 1939 Dipl.-Ing. 1941 Dr.-Ing. TH Stuttgart. Bis 1945 KWI für Metallforschung. Militär- und Wetterdienst, Funk-Meßgeräte-Entwicklung. 1945/51 Schriftleiter Phys. Blätter. 1951 Cultural Exchange Fellow Washington und Ann Arbor. Ab 1951 Inst. f. Demoskopie.

1954 *Physikalische Blätter* article

Die Zeitgenossen der Wasserstoffbombe

Postwar Evaluations of Georg Stetter and His Group

1.0 Introduction.

The material presented here on the activities of the Second Physics Institute of Vienna University was obtained from Prof. Stetter, as the result of my visit to Thumersbach and to Zell-am-See between October 10 and 13, 1945. The primary purpose of the visit was to establish the contribution of the Institute to the atomic work on the so-called "Uran-Motor" project, and to determine the work of the Institute on radiation absorption materials. Two days were used for interviews with Prof. Stetter and his associates, at the end of which a series of reports were obtained, the English translation of which is attached herewith, as Appendix I.

Although some of these reports, and additional documents, were removed from the Institute earlier by Prof. Smyth of the Alsos Mission, the reports obtained were translated and are released herewith as a matter of record. The original German reports were turned over to the Naval Intelligence Division, Navy Department, Washington, D. C.

2.0 General Observations on the Institute and its Work.

2.1 The Institute.

The Institute, with its present component parts, was the largest and the most important research organization in Austria. Before the war, it was involved primarily in the so-called pure research. During the war, it became engaged in certain special problems, of which the Uran-Motor project was one. In addition, the problems relating to the radar field, high frequency development work on testing equipment and the radiation absorption materials, received a certain amount of attention. A very brief review of these activities is undertaken below. A series of the reports prepared by the members of the Institute is attached for a more searching study.

2.2 Work in Nuclear Physics.

Not having been intimately connected with the work on atomic energy release, I am not in a position to fully evaluate the importance of the Institute's work in this field. The significance of the work of the Institute, from the point of view of the potential utilization of its research, was very sketchily discussed in my reports on "Atomic Bomb Research in the Russian Zone of Czechoslovakia", dated October 26, 1945, and on "Problems of Displaced Scientists Now Residing in the American Zone of Austria", dated October 26, 1945.

Contrary to the statements, attributed by the U. S. newspapers to the various U. S. atomic experts, that it "would take

the Germans some 100 years to solve the problem of atomic disintegration on an explosive basis" (for the manufacture of bombs), the opinion of the members of the Institute themselves was that, given a supply of radium and uranium, and permitting their return to Vienna, where certain of their materials and equipments are stored, they would be able to "complete their work" in some 3 to 6 months. Some small scale experiments were claimed to be performed successfully by the Institute before the end of the war in Europe.

That these claims of the Institute are not to be disregarded too readily would follow from the fact that Prof. Smyth spent considerable time with the Institute, revisited them several times, and thought it necessary to insist on the most stringent type of control over the scientific activities of the group, as well as on close individual observations. Perhaps equally significant are the indications of the substantial interest of the Russians in several members of the Institute.

Incidentally, the following list of materials was obtained from Prof. Stetter, as held in Vienna by Prof. E. Haschek* of the Vienna University: a mass-spectograph, amplifiers, oscillographs, an X-ray equipment, various testing devices for work on nuclear physics, 200 kg. of Wolfram, some Beryllium, Heavy water, 500 kg. of Lead, a small quantity of Uranium, (most of the Uranium had been removed by the Russians from the laboratories of the University).

As the result of the forced idleness, the group has occupied itself with the problens of Uranium split-up on a considerably more concentrated basis than they were able to do in Vienna. They also managed to attract the attention to this problem of other members of the scientific body in the region around Zell-am-See. I am inclined to think that, given an opportunity, such as their return to Vienna, and some sort of inducement, the Institute would concentrate on this problem to the exclusion of other activities, with a good chance of success.

2.3 Radiation Absorption Material.

This problem, and the contribution of the group to it, was discussed in a separate report on "Radar Camouflage-Radiation Absorption Material".

2.4 Radar and Radio Frequency Work.

This was definitely a side-show with the Institute. My conclusion is that the results of their work has no intelligence value to us.

*____5 Poltzman Gasee, IX Bezirk, Vienna.

Georg Stetter's wartime group also developed radar-absorbing coatings (used on stealth aircraft) and the correct theory of superconductivity (electron pairs). Postwar Allied interrogators such as T. M. Odarenko, a senior scientist from Bell Telephone, took the results of Stetter's group back to the U.S. Much later those were announced as "new" discoveries by the United States. Stetter's group never received any credit or payment.

RESTRICTED

U.S. Group Control Council

Germany

Office of the Director of Intelligence

RADAR CAMOUFLAGE
RADIATION ABSORPTION MATERIALS

Reported by:

T. M. ODARENKO
Consultant, JIOA, Communication

Report on Investigation for the Communications
JIOA Subcommittee

Prepared by Direction of

FIELD INFORMATION AGENCY, TECHNICAL (U.S.)

USFET (Main)

INDUSTRIAL BRANCH

APO 757

NEW YORK, N. Y.

FIAT 61 and FIAT 63, NARA RG 319,
Entry NM3-82, Boxes 1264-1275

Supplement 3.

Idea for a New Model for Super-Conductivity

by

Josef Schintlmeister

Point of departure of the theory is the idea that the super-conducting electrons do not follow the Fermi statistics but follow Bose statistics and thereby for practical purposes it possesses the Maxwell velocity distribution. Two electrons unite during the forming of the super-conducting electrons when activated by a force in all three directions with easily-computed quantum-mechanical penetration of the potential barrier to a very loosely bound "bielectron". The binding is possible, since the magnetic attraction surpasses the Coulomb repulsion as early as a distance of 50-fold, classical electron-radii. Similar to the thermic disassociation of two-atomic gases, the temperature dependence of the number of super-conducting electrons can be reckoned. The zero energy point of the electrons which become free at the change of statistics with Ferni statistics is the cause of the increase of the specific heat in the super-conducting state; from this the momentary number of the super-conducting electrons can be determined in agreement with this computation. The disappearance of all the components of the electrical resistor (residual resistance, contact resistance, thermic part of the resistance) is explained by the considerably larger electron wave-length of the super-conducting electrons; the electron wave-lengths are considerably larger due to the low zero-energy point. A sufficiently strong magnetic field directs the magnetic moment and thus destroys the binding. For the magnetically insensitive super-conductors (e.g. PbBl,PbHg), the magnetic energy to be used at the absolute zero-point is equal to the thermic energy kT at the elastic point. Sufficiently inhomogenous electrical fields destroy or loosen the binding. Thus the super-conducting electrons cannot take part in the construction of the electron orbit of the atoms and the periodic, electrical field in the interior of the crystal lattice is decisive for the height of the elastic point and also decisive for the contingency of whether super-conducting electrons can be formed or not. The bielectrons have all the properties which were pre-supposed in the electrodynamic theory of super-conducting electrons by London and vonLaue. This theory makes very obvious: the screening of external magnetic fields due to the induction of the permanent current, the finite depth-penetration of magnetic fields, the individual influence of the self-induction of the conductors for the current strengths in the branchings and also, if one takes into consideration the temperature dependence of the density of the super-conductor electrons and the Meissner-Ochsenfeld-Effect.

/a/ Josef Schintlmeister

Georg Stetter was kept under virtual house arrest by U.S. agents in Austria from 1945 until the 1950s.

NARA RG 319, Entry A1-134B, Box 749, Folder 23 Nov 95 Georg Stetter XA001081

DECLASSIFIED Authority NND 907017

COUNTER INTELLIGENCE CORPS
(430th CIC Detachment)
LAND SALZBURG SECTION
U. S. ARMY
APO 541

CONFIDENTIAL

CIC Salzburg
Ref. No. S-2315

Zell am See Subsection
16 July 1948

SUBJECT: STETTER Prof. Dr. Georg (20th Bi-Weekly Report)

FROM : CIC, Land Salzburg Section, Zell am See Subsection

TO : Chief, CIC, Land Salzburg Section

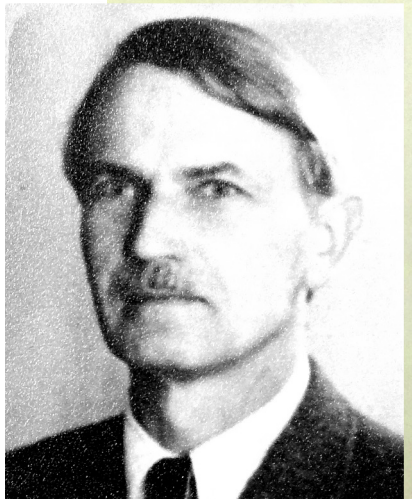
1. Subject is currently residing at the Park Hotel, Thumersbach, Bezirk Zell am See, with his wife. His daughter is attending school in Innsbruck, French Zone, Austria.

2. Recently Subject started to write a book on Nuclear Physics (Kernphysik), however, he is having difficulties as he does not have access to a library.

3. Subject's work on the device to remove dust from the air in coal mines is currently at a standstill as he does not have money to build a final model. A copy of the report Subject sent to the Salzburg Land-Government concerning his tests is attached to this report as Appendix "A".

4. Except for the fact that his rheumatism is apparently getting worse, even under treatment in Salzburg, Subject appears to be in a cheerful state of mind.

CHARLES W FOSS
Special Agent, CIC



Classification Cancelled or Changed to Confidential by Authority of Originator, by H. F. Mincin

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SECURITY INFORMATION

AGENT REPORT
(SR 380-320-10)

1. NAME OF SUBJECT OR TITLE OF INCIDENT
STETTER, Dr. Georg,
Patent Concerning Production of Atomic Energy (TIM 700), Technical Intelligence, Vienna

2. DATE SUBMITTED
9 November 1953 mh

3. CONTROL SYMBOL OR FILE NUMBER
HO 01081
V-36742

4. REPORT OF FINDINGS

On 26 October 1953, Informant 1063 submitted the following information to this Office:

On 22 October 1953, Informant interviewed Prof. Dr. Georg STETTER at the First Physical Institute of the University of Vienna, concerning STETTER's atomic energy patents. STETTER stated that he owned no patents concerning atomic energy and that he did not contemplate applying for any. STETTER further stated that he had worked with nuclear physics during World War II, but that his notes and papers were seized by the Soviets in 1945 and that he had not worked with nuclear physics since 1945. STETTER is currently employed as head of the First Physical Institute of the University of Vienna and experimenting with dust particles. (C-3)

On 29 October 1953, the files of this Region were examined, concerning Georg STETTER and revealed the following information:

A/R V-34833, STETTER, Dr. Georg, dated 20 March 1953, reveals that STETTER accepted a position at the University of Vienna as head of the First Physical Institute. (C-3)

A/R V-33629, dated 23 January 1953, Subject: "STETTER, Georg", reveals that STETTER was flown to Vienna on 26 October 1952 for the purpose of arranging employment at the University of Vienna. (B-3)

STETTER is listed in numerous files of the Region as a prominent Austrian scientist and a former member of the NSDAP who was removed from his position as head of the Second Physics Institute at the University of Vienna because of NSDAP membership. STETTER is also listed on the Austrian Objective List of the JIOA. (C-3)

Stetter was closely monitored by the U.S. until after the Soviet Union had perfected its own H-bomb (1955)

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5. TYPED NAME AND ORGANIZATION OF SPECIAL AGENT
ROBERT A. SNEDEKER, S/A CIC
430th CIC Region "C" (Vienna)

6. SIGNATURE OF SPECIAL AGENT
Robert A. Snedeker

DA FORM 1 APR 52 341 REPLACES WD AGO FORM 341, 1 JUN 47, WHICH MAY BE USED. AGL (1) 12-52-200M-30093

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SECURITY INFORMATION

Some Key Participants in the German H-Bomb Program

Administrative

Heinrich Himmler (sponsor, SS)	
Hans Kammler (chief manager, SS)	interrogated by U.S.
Walther Gerlach (chief scientific administrator)	
Rudolf Tomaschek (working with Gerlach)	
Siegfried Flügge (chief theoretical physicist)	taken to U.S.

University of Vienna + other sites in Austria

Georg Stetter	interrogated by U.S.
Willibald Jentschke	taken to U.S.
Karl Lintner	interrogated by U.S.
Josef Schintlmeister	interrogated by U.S.
+ many others	interrogated by U.S.

AEG

Arno Brasch (early work)	moved to U.S.
Fritz Lange (early work)	
Hartmut Kallmann	taken to U.S.
Ernst Kuhn	
Wolfgang Ferrant (also worked in Austria)	interrogated by U.S.

Kaiser Wilhelm Institutes

Ulrich Jetter	taken to U.S.
Josef Mattauch (longtime colleague of Georg Stetter)	
Alfred Klemm	
Heinrich Hintenberger	
Philipp Hoernes	

University of Hamburg

Paul Harteck	taken to U.S.
Wilhelm Groth	taken to U.K.

Army Ordnance Office

Erich Schumann	files taken to U.S.
Kurt Diebner	student (Winterberg) to U.S.
+ many others	

Other scientists

Adolf Busemann	taken to U.S.
Anton Kästner	interrogated by U.S. and U.K.
Manfred von Ardenne	
Gustav Hertz	
Werner Schuetze	

Testing

Edgar Petersen	interrogated by U.S. and U.K.
Edmund Sorg	interrogated by U.S. and U.K.
+ many others	interrogated by U.S. and U.K.

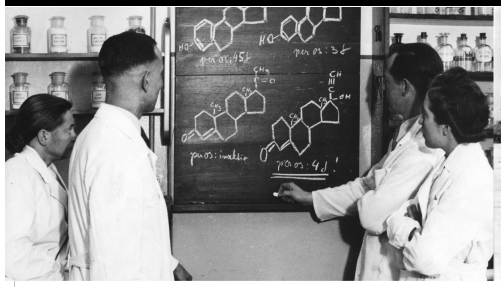
Delivery vehicles

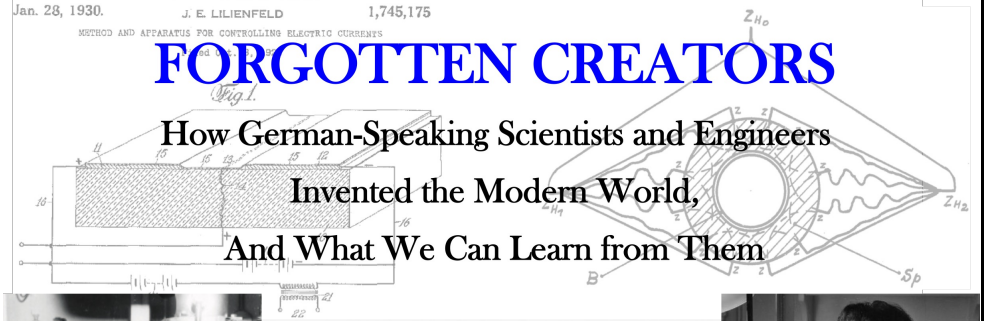
Wernher von Braun	taken to U.S.
Walter Dornberger	taken to U.K. and U.S.
Eugen Sänger	
Irene Bredt	
+ many others	taken to U.S.

- **How far did the wartime German nuclear weapons programs get?**
- **How much did they influence postwar U.S. (and other) programs?**
- **The answers must be in U.S. files. Can they be located and released?**

We want you…
to dig!

Modern society runs on revolutionary innovations from the predominantly German-speaking scientific world ~1800–1945

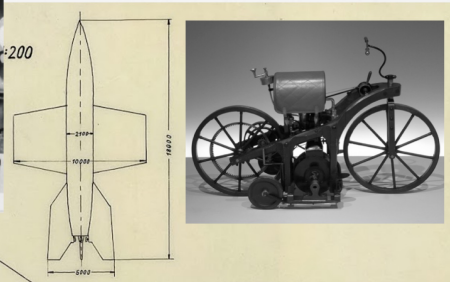


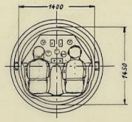


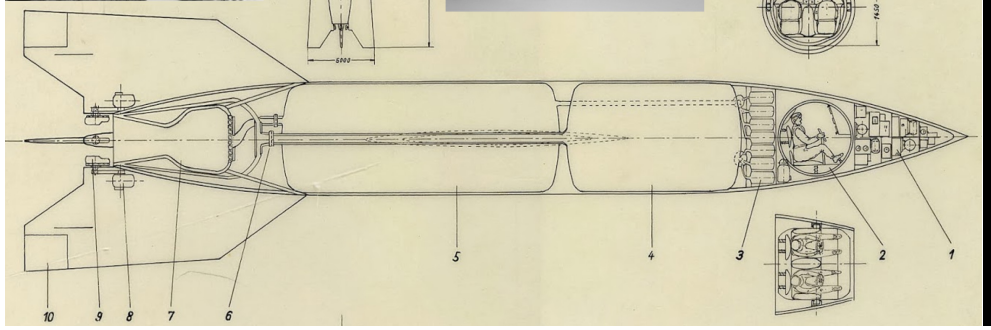
FORGOTTEN CREATORS

How German-Speaking Scientists and Engineers Invented the Modern World, And What We Can Learn from Them

Todd H. Rider







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- **Systemic factors that promoted so much innovation in that place and time**
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- **What we can learn that could improve innovation in the modern world**
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- **>400 pages of bibliography**

Reviewed by European and American historians and scientists

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Short version—but click the links!

8.8 Nuclear Engineering in the Third Reich

This section presents evidence which suggests that the World War II German nuclear program was much larger and much more advanced than has previously been generally understood. While this claim may seem controversial, much of the relevant archival evidence has only been declassified and rediscovered in recent years, and was not publicly available when earlier historical assessments were made. The evidence presented here covers:

For a far more detailed presentation of the currently available evidence, see Appendix D. As explained in Section 8.8.15, much more work is needed to uncover and evaluate evidence regarding the true history and extent of the wartime nuclear program.

8.8.1 Flaws in the Conventional Historical View of the German Program

The conventional historical view that has been held from 1945 to the present is that the World War II German nuclear program was very small and poorly funded, that Germany was still trying to complete its first prototype fission reactor when the war ended, and that Germany never even made a serious attempt to develop nuclear weapons.[6] This view is based on three categories of evidence, although each category has its own limitations as summarized below and in Section D.1:

[6] E.g., Goudsmit 1945; Goudsmit 1947; Groves 1962; Hentschel and Hentschel 1996; Hoffmann 2023; Irving 1967; Pash 1969; Popp 2016; 2021; Powers 1993; Rhodes 1986; Rose 1998; Walker 1989; 1995; 2020; 2024a; 2024b.

Long version of nuclear program

Available for free at:
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Appendix D

Advanced Creations in Nuclear Engineering

Der Welt Erbe gewänne zu eigen,
wer aus dem Rheingold schüfe den Ring,
der maßlose Macht ihm verlieh'.

The whole world can be possessed by one
who from the Rhinegold forges the Ring,
which can bestow immeasurable power.

Richard Wagner. 1854. *Das Rheingold.* Scene I. Wellgunde.

As discussed in Chapter 8, contributions by the German-speaking research world to fundamental nuclear science are very well documented.[1] Wilhelm Röntgen discovered X-rays in 1895, and Ludwig Zehnder was making detailed whole-body X-ray photos of humans by 1896. Hans Geiger and Walther Müller developed accurate radiation meter designs (Geiger counters or Geiger-Müller tubes) during the period 1908–1928 that are still in use today. Nuclear fission reactions were first proposed by Ida Tacke Noddack in 1934, and demonstrated and explained by Otto Hahn, Fritz Strassmann, Lise Meitner, and Otto Frisch in 1938–1939. Nuclear fusion reactions were proposed by Fritz Houtermans and his student Robert Atkinson in 1928–1929, and refined by Carl Friedrich von Weizsäcker and Hans Bethe in 1938. Detailed mathematical models of the nucleus, essential for accurately predicting nuclear decays and reactions, were first developed by von Weizsäcker in 1935 and ultimately finalized by Otto Haxel, Johannes Hans Jensen, Maria Goeppert Mayer, Hans Suess, and Eugene Wigner by 1949.

[1] See for example: Bethe 1991; 1997; Blatt and Weisskopf 1952; Brown and Lee 2006; Otto Hahn 1968; Irving 1967; L'Annunziata 2016; Nachmansohn 1979; Rife 1999; Schweber 2012; Sime 1996; Szanton 1992; Wigner 1967.

Some Reviewers' Comments on *Forgotten Creators*

"Todd H. Rider's *Forgotten Creators* is an encyclopedic consideration of Germany's central place in the advancement of science and technology between 1800 and 1945. Drawing upon a wide range of sources, Rider has summarized that effort in a survey that will impress the reader just as much for the breadth of German intellectual achievement as for the influence that achievement has had upon the modern world."

George W. Cully, retired Director, Office of History at Air University, Maxwell Air Force Base, Alabama

"Todd H. Rider's *Forgotten Creators* is a monumental treatise about and an exciting intellectual journey through the contributions of scientists and technologists in Germany and other Central European countries and German-speaking areas to universal progress. It is thoroughly researched, meticulously documented, and presented in an easy-to-perceive way. The pre-war and pre-Nazi German system of science support has lessons that would be difficult to emulate but worthy to ponder about even today. The long-range tragic consequences in science caused by National Socialism are well demonstrated as are the benefits in the West and in the East from the exodus of Jewish scientists before and the importation of others from Germany following World War II. The book is a virtually bottomless well for mining reliable information in the history of science and technology. The 'forgotten creators' are no longer forgotten. Todd is to be congratulated for his accomplishment and thanked for sharing it so generously with the international community."

István Hargittai, Professor Emeritus of Chemistry, Budapest University of Technology and Economics, author of *Buried Glory, Candid Science, Drive and Curiosity, Great Minds, Judging Edward Teller, Martians of Science,* and *The Road to Stockholm*

"The book *Forgotten Creators* is a really impressive book, as Todd H. Rider tries to mention all relevant German-speaking scientists and engineers and their scientific fields up to 1945 in this mammoth project. In this form, nobody has dared to do this before. The author deserves my full respect for this. I am pleased that we were able to support him in his research."

Thomas Köhler, Peenemünde Historical-Technical Museum historian and head of the archive

"*Forgotten Creators* is an examination of mid-twentieth-century German science and technology, studying the question of how this era came to be so productive. Using extensive reproduction of original materials and source accounts, the author is not only able to provide an overview of what is known about wartime activities, but is also able to indicate avenues for future historical research. The careful and comprehensive referencing permits the materials presented to be used in academic studies. A notable feature of this work is the fluid format provided by online publication, allowing revisions and new materials to be added. An especially important emphasis of the book is what can be learned from both the German-speaking scientists and the World War II era in general that could improve scientific productivity and creativity now."

Thomas Kunkle, Los Alamos National Laboratory, retired

"With his work, based on very comprehensive, thoroughly researched sources, Todd Rider has presented an astonishing study of the history of German science, especially in the first half of the twentieth century, which also reveals many connections that have been unjustly forgotten or little noticed. This also applies to numerous persons whose achievements are hardly known."

Günter Nagel, author of *Wissenschaft für den Krieg, Himmlers Waffenforscher, Atomversuche in Deutschland,* and *Das geheime deutsche Uranprojekt 1939-1945*

"A very valuable part of the book is devoted to the development of nuclear weapons in Germany during WWII, 1939-1945. While the histories of both the US/British Manhattan Project and the Soviet atomic project have been to a large extent declassified, little is actually known about the German work. Rider has done historians a favor by marshalling all of the evidence he could find in US, German, and Russian archives regarding the German atomic project. The inescapable conclusion is that the Germans were much farther advanced in nuclear weapons development than is generally thought."

Lee Pondrom, Professor Emeritus of Physics, University of Wisconsin-Madison, author of *The Soviet Atomic Project: How the Soviet Union Obtained the Atomic Bomb*

"*Forgotten Creators* by Todd Rider is an extraordinary work of detailed research and new insights into the technological advances contributed by German-speaking scientists. His lengthy and in-depth study of history often overlooked or not even seen in more cursory reviews is a refreshing read. His attempt to create the fullest account possible has resulted in a fine reference book that also serves to introduce new research for the reader. Rider's contention, right up front in the Executive Summary—that inventions and discoveries had their highest concentration of revolutionary innovations from scientists and engineers from the German-speaking central European research world in the nineteenth and early twentieth centuries—demands the reader's attention. He then fills an enormous amount of over 4,000 pages with supporting details. Amazing subject matter and new revolutionary insights dug up through meticulous research make *Forgotten Creators* a 'must read' for serious historians and curious researchers alike."

D. Ray Smith, Oak Ridge National Lab Historian, retired

"This truly voluminous study provides an in-depth overview of techno-scientific achievements and innovations which originated from the German-speaking world. It is a rich and fascinating history of the transnational circulation of knowledge over a period of no less than two centuries."

Helmuth Trischler, Head of Research, Deutsches Museum, Munich

"A most important and deserving book. Todd Rider's research on the German rocket and nuclear programs in World War II is especially impressive because of the number and depth of the sources cited and the meticulousness of their evaluation. Really pioneering work has been done here!"

Matthias Uhl, Deutsches Historisches Institut, Moscow, author of *Stalins V-2: Der Technologietransfer der deutschen Fernlenkwaffentechnik* and *Die Organisation des Terrors: Der Dienstkalender Heinrich Himmlers 1943-1945*

"Todd Rider has produced a meticulously researched and cogently argued *tour de force* on the men and the circumstances that drove the modern German Renaissance in science and technology. Brought out of the long shadow of the Third Reich, the story of this Golden Age of human enquiry is convincingly shown to have as much relevance to our present times as it did then. A remarkable achievement."

Stephen Walton, Senior Curator, U.K. Imperial War Museum

Dr. Todd H. Rider

riderinstitute.org

Fundamental Limitations on Plasma Fusion Systems Not in Thermodynamic Equilibrium

by

Todd Harrison Rider

S.M., Nuclear Engineering, MIT, 1994
S.M., Electrical Engineering and Computer Science, MIT, 1991
S.B., Electrical Engineering, MIT, 1991

Submitted to the Department of Electrical Engineering and Computer Science in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1995

Signature of Author
Department of Electrical Engineering and Computer Science
May 19, 1995

Certified by
Lawrence M. Lidsky
Professor of Nuclear Engineering
Thesis Supervisor

Accepted by
Frederic R. Morgenthaler
Chairman, Department Committee on Graduate Students

JOURNAL OF PROPULSION AND POWER
Vol. 13, No. 3, May–June 1997

Fundamental Constraints on Large-Scale Antimatter Rocket Propulsion

Todd H. Rider*
Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

Nomenclature

I. Introduction

A B Cell–Based Sensor for Rapid Identification of Pathogens

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Broad-Spectrum Antiviral Therapeutics

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Abstract

Introduction

Relativistic Quantum Field Theory

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Any suggestions for improvements would be greatly appreciated.

Three quarks for Muster Mark!

–James Joyce, *Finnegans Wake (1939)*

I think I can safely say that nobody understands quantum mechanics.

–Richard Feynman, *The Character of Physical Law* (1965)

Overview

Relativistic quantum field theory (or field theory, for short) combines special relativity, which describes very fast things, and quantum mechanics, which describes very small things. The resulting theory correctly predicts the behavior of fundamental particles, which are small and often move at high speeds (or are in bound states with relativistic energies). A "toy theory" of spinless particles will be used to first introduce some of the basic techniques and results of field theory, since the spin of real particles makes calculations more complicated. Field theory will then be applied in succession to each of the four fundamental forces. Quantum electrodynamics is a field theory describing the electromagnetic force; it is relevant to phenomena such as Compton scattering and electron-positron annihilation. The field theory of the weak nuclear force describes phenomena such as the decay of neutrons (beta decay) and muons. Quantum chromodynamics describes the strong nuclear force and thus is relevant to the behavior of the quarks that compose particles like protons, neutrons, and pions. Finally, it will be shown that general relativity is equivalent to applying field theory to gravitation, although there remain obstacles to developing a complete quantum theory of gravity.

Fundamental limitations on plasma fusion systems not in thermodynamic equilibrium

Todd H. Rider

I. INTRODUCTION

United States Patent [19] Rider

Patent Number: 4,723,736
Date of Patent: Feb. 9, 1988

[54] ROCKET STAGING SYSTEM

[76] Inventor: Todd H. Rider, 501 W. "A" St., North Little Rock, Ark. 72116

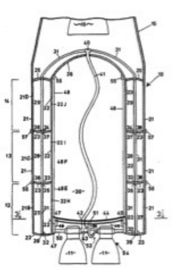
[21] Appl. No.: 898,010

[22] Filed: Aug. 18, 1986

[57] ABSTRACT

An improved rocket staging system for missiles and the

15 Claims, 9 Drawing Figures



United States Patent [19] Rider

Patent Number: 6,087,114
Date of Patent: Jul. 11, 2000

[54] OPTOELECTRONIC SENSOR

[75] Inventor: Todd H. Rider, Acton, Mass.

[73] Assignee: Massachusetts Institute of Technology, Cambridge, Mass.

[21] Appl. No.: 08/987,410

[22] Filed: Dec. 9, 1997

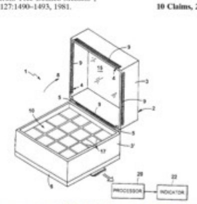
References Cited

U.S. PATENT DOCUMENTS

OTHER PUBLICATIONS

[57] ABSTRACT

10 Claims, 2 Drawing Sheets



United States Patent Rider

Patent No.: US 7,566,694 B2
Date of Patent: *Jul. 28, 2009

(54) ANTI-PATHOGEN TREATMENTS

(75) Inventor: Todd H. Rider, Littleton, MA (US)

(73) Assignee: Massachusetts Institute of Technology, Cambridge, MA (US)

(21) Appl. No.: 11/503,416

(22) Filed: Aug. 11, 2006

(57) ABSTRACT

6 Claims, 86 Drawing Sheets

Biochemistry

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Any suggestions for improvements would be greatly appreciated.

Near the further end a low arched passage branched away from it and led to the chemical laboratory. This was a lofty chamber, lined and littered with countless bottles. Broad, low tables were scattered about, which bristled with retorts, test-tubes, and little Bunsen lamps, with their blue flickering flames. There was only one student in the room, who was bending over a distant table absorbed in his work. At the sound of our steps he glanced round and sprang to his feet with a cry of pleasure. "I've found it! I've found it," he shouted to my companion, running towards us with a test-tube in his hand. "I have found a re-agent which is precipitated by hoemoglobin, and by nothing else." Had he discovered a gold mine, greater delight could not have shone upon his features.

"Dr. Watson, Mr. Sherlock Holmes," said Stamford, introducing us.

–Arthur Conan Doyle, *A Study in Scarlet* (1887)

"It was all done that evening and night. While I was still sitting under the sickly, drowsy influence of the drugs that decolourise blood, there came a repeated knocking at the door... It was my landlord, with a notice of ejectment or something... For a moment he gaped. Then he gave a sort of inarticulate cry, dropped candle and writ together, and went blundering down the dark passage to the stairs... I shall never forget that dawn, and the strange horror of seeing that my hands had become as clouded glass, and watching them grow clearer and thinner as the day went by, until at last I could see the sickly disorder of my room through them, though I closed my transparent eyelids. My limbs became glassy, the bones and arteries faded, vanished, and the little white nerves went last. I gritted my teeth and stayed there to the end. At last only the dead tips of the fingernails remained, pallid and white, and the brown stain of some acid upon my fingers... I went and stared at nothing in my shaving-glass, at nothing save where an attenuated pigment still remained behind the retina of my eyes, fainter than mist. I had to hang on to the table and press my forehead against the glass. It was only by a frantic effort of will that I dragged myself back to the apparatus and completed the process."

–Griffin, in H. G. Wells' *The Invisible Man* (1897)

Overview

Biochemistry covers the chemical molecules and reactions that are important in biology. Most biological molecules fall into five categories: (1) nucleic acids such as deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and their component nucleotides; (2) proteins and their component amino acids; (3) lipids such as fatty acids, triglycerides, and cholesterol; (4) carbohydrates such as simple sugars and various polymers composed of them; and (5) iron- or magnesium-containing porphyrins in hemoglobin, chlorophyll, etc. Most biochemical reactions have many steps, each of which is catalyzed by different enzymes, proteins that act as specialized molecular machines to greatly speed up and control reactions. Some major types of biochemical reactions include the synthesis (production) or catabolism (degradation) of proteins, nucleic acids, lipids, carbohydrates, and porphyrins. Other important biochemical reactions include respiration, in which energy is produced by combining hydrogen from biomolecules with oxygen from the air to form water; fermentation, in which smaller amounts of energy are extracted from biomolecules without oxygen; and photosynthesis, basically respiration run in reverse so that light energy is absorbed and stored by splitting water into more oxygen for the air and more hydrogen in biomolecules.

Fluid Mechanics and Aerodynamics

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Any suggestions for improvements would be greatly appreciated.

On aircraft:

"There is as much pressure exerted by a substance against the air as by the air against the substance.

"Observe how the beating of its wings against the air suffices to bear up the weight of the eagle in the highly rarefied air which borders on the fiery element! Observe also how the air moving over the sea, beaten back by the bellying sails, causes the heavily laden ship to glide onwards!

"So that by adducing and expounding the reasons of these things you may be able to realize that man when he has great wings attached to him, by exerting his strength against the resistance of the air and conquering it, is enabled to subdue it and to raise himself upon it."

On parachutes:

"If a man have a tent made of linen of which the apertures have all been stopped up, and it be twelve braccia across and twelve in depth, he will be able to throw himself down from any great height without sustaining any injury."

On helicopters:

"I find that if this instrument made with a screw be well made–that is to say, made of linen of which the pores are stopped up with starch–and be turned swiftly, the said screw will make its spiral in the air and it will rise high."

Advice for test pilots:

"This machine should be tried over a lake, and you should carry a long wineskin as a girdle so that in case you fall you will not be drowned."

–Leonardo da Vinci, *The Notebooks* (ca. 1500)

Overview

Fluid mechanics and aerodynamics concerns the motion of liquids and gases or their interactions with objects such as pipes or aircraft. One fundamental factor affecting how to model the behavior of a fluid is whether the fluid is compressible, or in other words whether its density changes significantly when its pressure its increased. Another fundamental factor is viscosity, or whether the particles of the fluid seem to stick to each other and pull on each other. Therefore, it is most convenient to divide models of fluid behavior into four categories: (1) incompressible, inviscid fluids, (2) incompressible viscous fluids, (3) compressible inviscid fluids, and (4) compressible viscous fluids. Important applications of fluid mechanics include the design of ships and submarines, as well as helicopters, airplanes, parachutes, and spacecraft reentering the atmosphere. Other applications include fluids in pipes and lubricants in machinery, pressure and circulation in the ocean and atmosphere, and sound waves and shock waves.