Forgotten Creators of the German Atomic Bomb Dr. Todd H. Rider thor@riderinstitute.org riderinstitute.org/revolutionary-innovation

Der Welt Erbe gewänne zu eigen, wer aus dem Rheingold schüfe den Ring, der maß lose 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, Das Rheingold, Scene I, Wellgunde (1854)

# Forgotten Creators of the German Atomic Bomb Dr. Todd H. Rider thor@riderinstitute.org riderinstitute.org/revolutionary-innovation



American Institute of Physics Bohr Library & Archives (Maryland) Archiv der Max-Planck-Gesellschaft (Berlin-Dahlem) Archiv der Österreichischen Akademie der Wissenschaften (Vienna) **Atomkeller Museum (Haigerloch) Bayerische Staatsbibliothek (Munich) Bornholm Defence Museum Bornholm Museum Bundesarchiv Militärarchiv (Freiburg) Deutsches Historisches Institut (Moscow) Deutsches Historisches Museum (Berlin) Deutsches Museum (Munich) Deutsches Technikmuseum (Berlin)** Foundation Centre for German Communication (Netherlands) Franklin D. Roosevelt Presidential Library (Hyde Park, NY) Gedenkdienstkomitee Gusen (Austria) Historisch-Technisches Museum Peenemünde Historisch-Technisches Museum Versuchsstelle Kummersdorf Jonastalverein (Arnstadt) **KZ-Gedenkstätte Mittelbau-Dora (Nordhausen)** Nationaal Archief (The Hague, Netherlands) National Air and Space Museum (Washington, DC) Norwegian Industrial Workers Museum (Vemork) Sachverständigenbüro Staude (Limbach-Oberfrohna) **Schweizerisches Bundesarchiv (Bern)** Schweizerische Nationalbibliothek (Bern) Staatsarchiv, Staatskanzlei Obwalden (Sarnen, Switzerland) Standortübungsplatz (Truppenübungsplatz) Ohrdruf **Technisches Museum Wien (Vienna)** U.K. Imperial War Museum Archive (Duxford) **U.K. National Archives (Kew) University of Vienna** U.S. Air Force Historical Research Agency (Alabama) **U.S. Combined Arms Research Library (Kansas)** U.S. Holocaust Memorial Museum (Washington, DC) **U.S. Library of Congress** U.S. National Archives at Atlanta (Morrow, Georgia) U.S. National Archives at Boston (Waltham, Massachusetts) U.S. National Archives at College Park (Maryland) U.S. National WWII Museum (New Orleans) Villa Folke Bernadotte (von Ardenne house, Berlin) Yad Vashem Holocaust Resource Center (Israel)

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

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# **Complete set of slides and more available at riderinstitute.org/revolutionary-innovation**

- 1. Conventional view of the wartime German nuclear program
- 2. Origins and organization of the German nuclear program
- 3. Sources of uranium and thorium
- 4. Enrichment of uranium-235 (<sup>235</sup>U)
- 5. Breeding plutonium-239 (<sup>239</sup>Pu) or uranium-233 (<sup>233</sup>U) in fission reactors
- 6. Breeding <sup>239</sup>Pu or <sup>233</sup>U in electronuclear systems
- 7. Production of heavy water (D<sub>2</sub>O) and other nuclear-related materials
- 8. German fission bomb design (explosive yield ~ tens of kilotons)
- 9. German hydrogen bomb design (explosive yield ~ megatons)
- 10. October 1944 test explosion on the Baltic coast
- 11. ~November 1944 test explosion in Poland
- 12. March 1945 test explosions in Thuringia
- 13. Wartime/postwar Axis belief in the reality of German nuclear weapons
- 14. Wartime/postwar Allied belief in the reality of German nuclear weapons
- **15. Conclusions and further work**

#### **1. Conventional View of German Program: Alsos**

At the end of the war, the U.S.-led Alsos Mission searching for nuclear work found an incomplete fission reactor at Haigerloch, some papers on basic nuclear physics, and apparently not much else, according to the public accounts.





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The man who as wartime head of the entire atomic energy program exercised unprecedented power and responsibility here gives an accounting of his actions and decisions as he reveals for the first time the full inside story of the Project.

LESLIE R. GROVES

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Alsos failed to properly investigate numerous specific organizations, scientists, and locations that could have revealed a more advanced nuclear program.

If any more advanced nuclear work had in fact been discovered, that information would have been automatically classified at the time, and could remain classified or buried in archives and unreleased to this day.



#### **1. Conventional View of German Program: Farm Hall**

10 scientists (Erich Bagge, Kurt Diebner, Walther Gerlach, Otto Hahn, Paul Harteck, Werner Heisenberg, Horst Korsching, Max von Laue, Carl Friedrich von Weizsäcker, and Karl Wirtz) were kept under house arrest July 1945–January 1946 at Farm Hall, U.K., where their conversations were secretly recorded.

The transcripts record the scientists' surprise at news of the 6 August 1945 Hiroshima bombing and do not reveal significant apparent knowledge of nuclear weapons design and development.





TRODUCTION BY DAVID CASSIDY

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NTRODUCTION BY DAVID CASSIDY

A huge number of relevant nuclear scientists were not at Farm Hall.

Those who were there suspected surveillance and presumably conducted their conversations accordingly.

The preserved transcripts document only a small fraction of the discussions that would have occurred among ten people and their British attendants during those six months.

The transcripts are English translations, which may not accurately reflect the original German conversations.

Oddly, both the original recordings and the original German transcripts just happen to have been completely lost.

### **1. Conventional View of German Program: Public Remarks**

In their public interviews and writings in the years after the war, German nuclear scientists professed a lack of desire, plans, materials and/or political support to produce nuclear weapons for the Third Reich.



#### Physics and Beyond Encounters and Conversations



World Perspectives

Edited by Ruth Nanda Anshen



# Atomenergie und Atomzeitalter

#### Zwölf Vorlesungen

Fischer



# **1. Conventional View of German Program: Public Remarks**

In their public interviews and writings in the years after the war, German nuclear scientists professed a lack of desire, plans, materials and/or political support to produce nuclear weapons for the Third Reich. Only a small number of nuclear scientists went on the public record.

It was in their best personal interests to downplay the wartime German nuclear program, their knowledge of it, and their support for it.



1928: Fritz Houtermans and Georg Stetter began work on fusion in Germany and Austria				
1934	1935	1936	1937	<b>1938</b>

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Ida Tacke Noddack published theoretical predictions of uranium fission and plutonium production



**1934 1935 1936 1937 1938** 

1936

1937

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1935

#### 1934

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Rausch von Traubenberg began using surrounding neutron reflectors



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Germany took over Czech uranium mines, transported ore on planes









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**Otto Hahn and Fritz Strassmann** experimentally demonstrated neutron-induced uranium fission



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Siegfried Flügge published papers with calculations of fission reactors and bombs



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Carl Friedrich von Weizsäcker, Fritz Houtermans, and others proposed and calculated the suitability of plutonium-239 for bombs











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942-1945	NARA RG 238, Microfilm M1270, Interrogation Records Prepared for War Crimes Proceedings at Nuernberg, Roll 24				
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qi	SCHMAUSS, Prof	Meteorological Institute, MUNICH.			
	VON FICKER, Prof	Meteorological Institute, VIENNA.			
	GUTHNICK, Prof	Observatory, BERLIN-BABELSBERG.			
Ŭ	HECKMANN, Prof	Director, Observatory, HAMBURG- BERGEDORF.			
S	KIRCHNER, Prof nuclear	Director, Physics Institute, Uni- versity of COLOGNE. Expert on atom physics.			

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#### Siggfried 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.

Die Natur-406 Flügge: Kann der Energieinhalt der Atomkerne technisch nutzbar gemacht werden?

thermische Neutronen einen Einfangquerschnitt Die Integration dieser Differentialgleichung ergibt von nur 1,3 · 10<sup>-24</sup> cm<sup>2</sup> fanden. Zählt man hierzu die von FERMI angegebenen 2 · 10-24 cm2 für die Spaltung, so erhält man für die gesamte Absorption erst etwa 1/2 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 ndie 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  $\rho_i$ , die Wirkungsquerschnitte mit  $\sigma_{ik}$ , 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 osp und die Zahl der bei jeder Spaltung abgedampften Neutronen v, so haben wir unsere Gleichung zu erweitern zu

$$\frac{1}{n}\frac{dn}{dt} = v\left\{-\sum_{ik}\varrho_i\sigma_{ik} + \varrho_U\sigma_{\rm Sp}(\nu-1)\right\}.$$
 (44)

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  $\sigma_{Sp} = 0.1 \cdot 10^{-24} \text{ cm}^2 \text{ nur}$ noch Streuprozesse mit rund 6 · 10-24 cm2. Metallisches Uran (Dichte 8,6) enthält rund 2,2 · 10<sup>22</sup> Atome je Kubikzentimeter; es wird dann bei einer Neutronengeschwindigkeit von 2.109 cm/sec, entsprechend einer mittleren Energie der frei gesetzten Neutronen von 2 MeV:

$$\frac{1}{n}\frac{dn}{dt} = 0.44 (v - 1) \cdot 10^7 \text{ sec}^{-1}.$$
 (4b)

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

Läßt man die Reaktionskette mit  $n_0 = I$  Neutron zur Zeit t = 0 anlaufen und nimmt man den wahrscheinlichsten Wert v = 2, so findet man. da je Spaltung 3 · 10<sup>-12</sup> mkg frei werden, folgende Energiebeträge: Nach 10-7 sec: 4,7 · 10-12 mkg, nach 10-6 sec: 2,4 · 10-11 mkg, nach 10-5 sec: 3. 10+7 mkg und nach 10-4 sec: 3. 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 60 mal gestreut, ehe es ihm gelingt, . 10<sup>-24</sup> cm<sup>2</sup>



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 v = 2 setzen.

$$rac{\mathrm{I}}{n} rac{dn}{dt} = v arrho_{\mathrm{U}} \left( \sigma_{\mathrm{Sp}} - \sigma_{\mathrm{Einf}} 
ight).$$

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 NND00701

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

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

gge, Siegfried, Dr.			
of birth:	16 March 1912		
of Birth:	Dresden, Saxony, Germany		
nt address:	Marburg/Lahn, Wilhelm Roser Str. 33 A		
nt employment:	as professor at University of Marburg (ordentlicher Professor)		
al Field:	Nuclear Physics (Struktur dor Materia)		
round 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	
	<b>X</b> 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	
	<sup>#</sup> 1937 - 1942:	worked in chemical department of the Kaiser-Wilhelm-Institute in Berlin, Dahlem.	
	" 1942 - 1944:	assistant at the Institute of Scienti- fic Research of the Reichspost, Berlin	
	" 1940 - 1944:	lectured at the University of Berlin	
	" 1944	eppointed professor (ausserordentliche at the University of Königsberg.	
	After the surrende employed as Profes from 1945 p 1947.	r, he went to Göttingen, where he was sor for History of Physical Science	

He was not called to Military Service during the War, be-

cause he worked as a Scientist of Physics for the "Heeres-

waffenamt", Berlin, and was later exempted of any Army

Service by the Reichsforschungsrat ih Berlin.

# 3. Sites of Known or Suspected Uranium/Thorium Mining

Brussels (from Congo) J

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Viseu &

Guarda

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Frend

Z

go) Schneeberg & Johanngeorgenstadt Thuringia Jachymov

Pribram

• Băița-Plai

**Buchovo** 

(Sofia)

### 3. Sites of Known or Suspected Uranium/Thorium Mining

From 1938 to 1945, Germany obtained at least (and likely far more than) 1500 tons of natural uranium ore and 1300 tons of thorium ore from at least ~11 sites.

> Vladimir L. Rychly, NARA RG 38, Entry 98C, Box 9, Folder TSC #2601—2700, 11 February 1946 & Box 12, Folder TSC #3301—3400, 5 December 1946:

"The Germans put [uranium] mining on a high priority and only mining was done throughout the 6 years occupation. The ore was delivered by special planes to Germany and Austria."

> "During the German occupation of Czechoslovakia, the Germans continued operations in this mine to the very last moment."



#### U.S. Embassy, Istanbul, 18 December 1943, AFHRA A1261 p. 27: O Băița-Plai



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Z

"In the course of a violent argument with a Bulgarian officer, an engineer of the Todt organization revealed in Sofia that the Germans now possess a new type of incendiary far surpassing anything yet used in warfare. The engineer intimated that London would suffer a fate worse than that of Berlin or Hamburg in the near future."

**Buchovo** 

(Sofia)





Heil Hitler!

Union Minière Brussels Leverkusen

G-157. I.G. Farben Leverkusen. 11 June 1942.

Kwasnik developed process whereby uranium oxide is carried through a rotating inclined nickel tube heated to  $650^{\circ}$ C through which a stream of fluorine gas is passed. The UF<sub>6</sub> thus formed is frozen by CO<sub>2</sub> in containers. About 500 grams UF<sub>6</sub> thus produced per hour. The UF<sub>6</sub> to be frozen in large crystalline block to reduce amount of adsorption of other gases. **3. Some Sites of Known** 

Uranium/Thorium 🕿

**Processing Facilities** 

Auer

Oranienburg

Degussa

Berlin

Pribram

reibacher

Althofer

Buchlei

Braunschweig

Degussa

Stadtilm

Degussa

Frankfurt

Maier

Villingen-

Schwenningen

10 October 1945 letter from Ivan Bakulin to Zdeněk Fierlinger, Národní archiv, Ústřední výbor KSČ, Klement Gottwald, sv. 81, aj. 1031



ПРЕМЬЕР-МИНИСТРУ ЧЕХОСЛОВАЦКОЙ РЕСПУЕЛИКИ

господину ФИРЛИНГЕРУ

В связи с Вашим любезным согласием, прошу дать необходимые распоряжения произвести передачу нам имеющихся в Пржибраме 38516,1 килограммов материалов, содержащих радиоактивные элементы.

Ваше скорое сообщение о навначении представителей, уполномоченных Вами произвести передачу, будет высоко оценено.

С совершенным почтением

( BAKYJINH

"/0 " октября 1945 г.

#### Auer Katowice

David Gattiker and George C. Davis. 16 May 1945. Report on visit to Joachimsthal. NARA RG 77, Entry UD-22A, Box 160, Folder APR 45--Dec. '45.

I and Davis entered Czechoslovakian target yesterday morning and spent three hours with Dr. Patzochke, German director of the mines. [...] These concentrates contain 60 per cent U<sub>3</sub>O<sub>8</sub> and were sent to Germany and Austria for radium extraction, and were divided equally between Auer, Buchler at Brunswick, and Goldschmidt at Treibach in Austria.

#### Ueber den Einfluss der Zentrifugalkraft auf chemische Systeme.

17:459 (1895)

 $\overline{\mathcal{T}}$ 

Chemie

**Physikalische** 

für

Zeitschrift

Von G. Bredig.

(Mit 3 Figuren im Text.)

#### Einleitung.

Die Frage, ob durch den Einfluss äusserer Kräfte, wie z. B. durch die Gravitation, sich in einem ursprünglich homogenen Gemenge Konzentrationsverschiedenheiten in der Richtung dieser Kräfte ausbilden, ist bereits im Anfange dieses Jahrhunderts diskutiert worden. So stellte bereits Gay-Lussac<sup>1</sup>) in den Kellern der Pariser Sternwarte Versuche darüber an, ob eine Salzlösung in einer vertikalen 2 m langen Säule unter dem Einfluss der Schwerkraft am unteren Ende der Säule eine andere Konzentration annehme, als am oberen Ende. Er erhielt ein negatives Resultat, was nach den neueren Berechnungen von Gouy und Chaperon<sup>2</sup>) auch verständlich wird, da diese Autoren thermodynamisch den Einfluss der Gravitation auf die Konzentration aus der Anderung der Dichte mit der Konzentration zu berechnen vermögen und denselben so klein finden, dass seine experimentelle Feststellung schwerlich ausführbar ist.

Die Theorie solcher Systeme ist bereits mehrfach, von J. W. Gibbs<sup>3</sup>), Gouy und Chaperon<sup>4</sup>), P. Duhem<sup>5</sup>), van der Waals<sup>6</sup>) und anderen gegeben worden.

Nun hat aber unlängst Herr Th. des Coudres in einer interessanten Abhandlung<sup>7</sup>) beiläufig darauf hingewiesen, dass man die Betrachtungen über den Einfluss der Schwere auf die Konzentration der Lö-

1) Ann. chim. phys. 11, 306 (1819). - Vergl. auch Ostwald, Lehrbuch der allg. Chemie 2. Aufl. I, 700. - Beudant, Ann. chim. phys. 8, 15. - Bischof, Lehrbuch der ch. und ph. Geol. II, 1712. -- Lieben, Lieb. Ann. 101, 77 (1857). <sup>2</sup>) Ann. chim. phys. (6) 12, 384 (1887).

<sup>8</sup>) Thermodynam. Studien S. 171 ff. Deutsch von Ostwald.

4) Siehe oben und Compt. rend. 105, 117.

<sup>5</sup>) Journ. de phys. (2) 8, 391 (1888.

6) Diese Zeitschr. 5. 157.

#### PATENTSCHRIFT

Nr. 906 094

KLASSE 12e GRUPPE 3 05 M 4147 IVb / 12e

Dr. Werner Kuhn, Basel (Schweiz) und Dr. Hans Martin, Kiel sind als Erfinder genannt worder

#### Dr. Hans Martin, Kiel

Vorrichtung und Verfahren zur Trennung von Gasgemischen durch Anwendung von künstlich erzeugten Schwerefeldern Patentiert im Gebiet der Bundesrepublik Deutschland vom 12. Juli 1938 an Der Zeitraum vom 8. Mai 1945 bis einschließlich 7. Mai 1950 wird auf die Patentdauer nicht angerechnet (Ges. v. 15.7.51) Patentanmeldung bekanntgemacht am 12. März 1953 Patenterteilung bekanntgemacht am 28. Januar 1954

Gas- oder Dampfgemischen, welche sich aus verschieden schweren Bestandteilen zusammensetzen, dadurch reichen kann, daß man das Gasgemisch in einen Flohkörper bringt und denselben mit hoher Umlaufzahl um eine Achse rotieren läßt. Durch das bei der hohen Umlaufzahl auftretende Schwerefeld wird eine Anreicherung der schwereren Bestandteile in den peri-pheren Teilen, eine verhältnismäßige Anreicherung der leichteren Bestandteile in den der Achse benachbarten Teilen des Hohlkörpers hervorgebracht. Es ist indessen bekannt, daß eine solche Trennung nur in recht ge-ringem Ausmaße erfolgt und daß sie nur dann merkliche Beträge annimmt, wenn das Molekulargewicht | Fraktion usf. Auf diese Weise können Fraktionen er

Es ist bekannt, daß man eine teilweise Trennung von | der in dem Gemische vorliegenden Bestandteile große 15 Unterschiede aufweist. Um auch bei kleinen Unterschieden im Molekulargewicht, wie sie z. B. bei Luft oder bei Isotopen-gemischen vorliegen, eine weitgehende Trennung herbeizuführen, ist es notwendig, die bei der Zentrifugie-rung anfallenden Gasfraktionen wiederholt zu zentrifugieren. Es ist dabei naheliegend, anstatt einer einzigen eine Reihe von Zentrifugen vorzusehen und diese durch Rohrleitungen derart zu verbinden, daß die zweite Zentrifuge mit der in der ersten anfallenden as schweren Fraktion gespeist wird, die dritte Zentrifuge mit der in der zweiten anfallenden noch schwereren

# 4. <sup>235</sup>U **Enrichment:** Centrifuges

Gas centrifuges were invented in Germany before 1895.

**By World War II**, uranium gas centrifuges were produced in: Kiel (2 groups) Munich Freiburg Göttingen Thuringia **Breslau/Wrocław** Netherlands Swiss factories (!) + more locations?

> For more information, see **Forgotten Creators D.4.2**

452

Angewandte

für .

Zeitschrift

(1904)Sektion veranlaßten vergleichenden Unter- stoffgehalte, welche mitunter niedriger als suchungen, welche auch Herr Gulden in seinem Artikel erwähnt, haben wenigstens gezeigt, daß die Hautpulvermenge, wenn im übrigen keine Fehler gemacht werden, das Resultat kaum beeinflußt. Wie erwähnt, halte ich es trotzdem für zweckmäßig, daß **Chemie 17:452** die Hautpulvermenge festgelegt wird. In diesem Punkte befinde ich mich also auch in Übereinstimmung mit Herrn Gulden; ich halte jedoch die Beweisführung, die er zur Begründung dieser Forderung heranzieht, nicht für richtig, was aber in Anbetracht der Tatsache, daß Herr Gulden kein Chemiker ist, entschuldbar ist. Zum Schluß möchte ich noch auf eine

Tatsache zurückkommen, welche Herr Gulden seinem Artikel ebenfalls anführt, und welche leicht Anlaß zu Mißverständnissen führen kann. Herr Gulden erwähnt, daß der "Verein deutscher Farbstoff- u. Gerbstoff-Extrakt-Fabrikanten\* kürzlich den Beschluß gefaßt hat, daß die zu gebenden Garantien von Extrakten wesentlich einzuschränken sind, und daß auf Grund von Analysen der Deutschen Versuchsanstalt für Lederindustrie bei flüssigen und teigförmigen Extrakten ein Mindergehalt von 3 % und bei festen Extrakten ein solcher von 4 % nicht zu Reklamationen Veranlassung geben darf, während bei anderen Laboratorien, deren Analysen von dem genannten Verein ebenfalls anerkannt werden, diese Zahlen mit 2, bezw. 3% festgelegt sind. Es soll an dieser Stelle nicht in eine Erörterung darüber eingegangen werden, daß diese Zahlen ziemlich hoch angenommen worden sind; ich möchte aber hervorheben, daß diese verschiedene Bemessung bei denjenigen, welche den wirklichen Sachverhalt nicht kennen, den Glauben er-wecken kann, als ob die Analysen der Versuchsanstalt weniger genau seien. Wie mir von seiten eines Vertreters dieses Vereins auf mein Befragen ausdrücklich versichert worden ist, liegt dem Beschlusse in der obigen Form folgende Tatsache zugrunde: Nach den Erfahrungen des genannten Ver-eins fallen bei den Analysen von Extrakten durch die Versuchsanstalt die Gerbstoffgehalte häufig um ca. 1 % niedriger aus, als bei einigen anderen Laboratorien. Diese Differenzen sind, wie ich auch an dieser Stelle hervorheben möchte, darin begründet, daß die Versuchsanstalt großen Wert darauf legt, daß zur Analyse nur vollständig klare

Filtrate verwendet werden, damit nicht Stoffe, welche unlöslich sind, und in der Lösung in fein verteilter Form sich vorfinden, als ger-bende Substanzen bestimmt werden. Auf diese Weise ergeben sich allerdings Gerb-

die anderer Laboratorien sind. Da die Vorschrift besteht, daß die Lösungen vollständig klar sind, so halte ich in solchen Fällen die niedrigeren für diejenigen, welche den Vereinbarungen entsprechen.

#### Prinzipien der Gasscheidung durch Zentrifugalkraft.

Von G. BREDIG und F. HABER. (Mitgeteilt von F, Haber.) (Eingeg, d. 8./1. 1904.) 1. Einleitung.

Seit zwei Jahren treten in technischen Zeitschriften Nachrichten über die großen Erfolge auf, welche Herr E. N. Mazza mit einem Apparate erzielt, in welchem er Gase durch Zentrifugalkraft scheidet. Auf die Mängel der bezüglichen Angaben ist wohl im Journal für Gasbeleuchtung und Wasserversorgung alsbald 1) hingewiesen worden, aber Herr Vittorio Calzavara, der technische Direktor der venetianischen Gasund Elektrizitätsgesellschaft und Leiter der Zeitschrift "Il Gaz", hat danach dem Kongreß Deutscher Gas- und Wasserfachmänner in Zürich 1903 einen Bericht vorgelegt, welcher die außerordentlichen Erfolge des Apparates nachdrücklich betont. Der Bericht führt das Zeugnis zweier Gelehrten an, welche die Anreicherung des Sauerstoffes in der mit diesem Apparat zentrifugierten Luft festgestellt haben sollen, und bringt Angaben über eine erstaunliche Kohleerspannis, welche in der Praxis mehrerer bedeutenden Fabriken durch Benutzung der zentrifugierten und dadurch an Sauerstoff angereicherten Luft erzielt worden ist. Die italienische Regierung hat den Apparat prüfen lassen, und das deutsche Patentamt hat das gleiche getan. Herr Calzavaraberichtet, daß beide Prüfungen zum Vorteil des Mazzaschen Gasscheiders ausgefallen sind: Das italienische Marineministerium hat einen solchen Apparat gekauft, das deutsche Patentamt ein D. R. P. (139210) darauf erteilt 2). Inzwischen haben die Herren G. Claude und E. Demoussy wissenschaftliche Versuche über den Gegenstand gemacht, deren Ergebnis3) durchaus zu Ungunsten der Sache ausgefallen ist. Aber Herr Goffi<sup>4</sup>), der technischer Leiter der italienischen Gasgesellschaft in Turin, tritt demgegenüber mit neuem Nachdruck und

<sup>1)</sup> März 1902, 9, 155.
 <sup>3)</sup> Das D. R. P. 139210 handelt nicht im speziellen von der Laftscheidung.
 <sup>9</sup> Claude und Demoussy Compt. r. d. Acad. d. seienees vom 27. Juli 1903, 260.
 <sup>4)</sup> J. de l'éclairage au gaz 20. Sept. 1903, 290.

PATENTSCHRIFT

Mr. 833 487

KLASSE 12e GRUPPE 3 05 G 414 IV b/ 120

Dr.-Jng. Helmuth Hausen, München-Solln ist als Erfinder genannt worden

Gesellschaft für Linde's Eismaschinen A.G., Höllriegelskreuth bei München

Verfahren und Vorrichtung zur Zerlegung von Gas- und Flüssigkeitsgemischen in Zentrifugen Patentiert im Gebiet der Bundesrepublik Deutschland vom 10. Juni 1939 an Der Zeitraum vom 8. Mai 1945 bis einschließlich 7. Mai 1950 wird auf die Patentdauer nicht angerechne (Ges. v. 15.7.51) Patentanmeldung bekanntgemacht am 26. Juli 1951 Patenterteilung bekanntgemacht am 7. Februar 1952

Es nat bisher nicht an versachen gereint, das-gemische durch. Zentifugieren zu zertegen. brauchbares Ergebnis konnte jedoch mit diesen Ver-fahren nicht erzielt werden, weil die Trennwirkung der bekannten Zentifugiererahren verhältnis der bekannten verstärkt. Ein solche Verstärkung durch fahren nicht erzielt werden, weil die Trennwirkung der bekannten Zentrifugierverfahren verhältnis-mäßig gering ist. Auch theoretisch läßt sich nach- mang geing ist. And normalish not somethick weisen, daß die Zerlegungswirkung einer nach den bekannten Verfahren betriebenen Zentrifüge selbst bei den höchsten heute möglichen Umfangs-so geschwindigkeiten und bei Gemischen mit großen Unterschieden im Molekulargewicht nur sehr gering ist.

Es hat bisher nicht an Versuchen gefehlt, Gas- | Nach der vorliegenden Erfindung läßt sich aber der Gase verstarkt. Eine solche Verstarkung durch Gegenstrom ist z. B. bei der Rektifikation bekannt. Die nur geringe Zerlegungswirkung eines einzelnen Rektifikationsbodens wird dadurch vervielfacht, ao daß man eine große Zahl von solchen Böden über-einander anordmet und Flüssigkeit und Dampf im Gegenstrom führt. Ebenso läßt sich grundsätzlich Trennwirkung einer Zentrifuge dadurch ver
Werner Schwietzke. 1947. National Archives of Australia. Series MT105/8, control 1/6/3094, barcode 934755.

Since the theoretical calculations of the stress distribution of the rotor rotating at high speed can only be carried out with a certain approximation, it was recommended that the precisely balanced rotor be subjected to a test run below the maximum rotational speed of 65,000 rpm, which was calculated as critical, and that any changes in the rotor be precisely determined by precision measurements after the run. After a considerable number of test series over several hours at 60,000 rpm a deformation of the rotor never could be detected, so that a constant operating speed of 56,000 rpm could be selected for the intended tests without danger. This ultracentrifuge, which requires little space and effort, has proven itself extraordinarily good in practice.

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S 917	S.	CONFIDENTIAL COPY NO. 66
NN		C.I.C. <u>75/295</u>
DEC Drity _		10 September 1945
Authe		
		COMBINED INTELLIGENCE COMMITTEE
		COMBINED INTELLIGENCE OBJECTIVES SUBCOMMITTEE EVALUATION REPORT 318 (13th August 1945)
		FRITZ HELLIGE & CO. FREIBURG - BREISGAU MANUFACTURERS OF ULTRAZENTRIFUGE
		Source: JOLLES, Friedrich Wolfgang (44, non Aryan, never in Party) Stecklenbergerstr. 34
÷		Thels/Harz Source was drafted for service with the Wirtschafts- gruppe
<u>10</u>		of the Group.
der 32. ne 194		1. Fritz Hellige & Co., were the makers of an ULTRAZENTRI- FUGE (ultra-centrifuge) which was designed to be used in the menufacture of a new explosite ten million times more destruc- tive and powerful than any heretofore known.
6, Fol 43Ju		2. The raw material used was pitchblende. The end product was a liquid which had to be charged in order to become an explosive.
ox 16 —(19		3. Only a few grams of the liquid had been produced by the spring of this year, which explains why the new explosive was never used against the Allies.
D-22A, B rch—TA-		4. In November 1944, the plent, originally located in a suburb of Freiburg/Breizgau, was completely bombed out. According to a Pruefungsbericht which Jolles saw, the plent was evacuated to Kandern, south of Freiburg, where the Ultra- centrifuge was set up in a little house about 300 meters from the main factory building.
htry U –Resea		5. Betriebsleiter FRITZENSCHAFT, who may be located in the suburb of Freiburg where the plant was originally located, or at Kandern, knows everything about the Ultracentrifuge and the new product.
, 77, F ANY-		6. Sourve also stated that the new explosive had important peacetime uses, since a quantity about the size of a match box contained enough energy to drive a motor car for twenty years.
RM/	-	7. Source believed that the new explosive was in some way related to the splitting of the atom.
<b>JE</b> I		CARDID
NA NA	Pro estate	E.L. Deuss H.R. Habicht CIOS Team VII
	A CONTRACTOR OF THE OWNER	9th U.S. Army

# 4. <sup>235</sup>U Enrichment: Centrifuges

By World War II, uranium gas centrifuges were produced in: Kiel (2 groups) Munich Freiburg Göttingen Thuringia Breslau/Wrocław Netherlands Swiss factories (!) + more locations?

> For more information, see *Forgotten Creators* D.4.2

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.

The main specialists in the field of isotope separation in Germany were Professor Harteck, Dr. Groth, who, together with the chief designer of the Anschütz company (Kiel, English zone), Dr. Beyerle, invented an ultracentrifuge built by the above company, as well as by the Hellige company (Breslau, USSR zone).

ANSCHÜTZ & CO. G. M. B. H. KREISELGERATE KIEL-NEUMÜHLEN BRIEFANSCHRIFT, KIEL, POSTSCHLIESSFACH	
BANKEN: REICHSBANK-GIROKONTO 811, VEREINSBANK KIEL, WILH, AHLMANN, KIEL	
An das	
Institut für Physikalische Chemie der Hansischen Universität	
z.Hd. Herrn Dozent Dr.W.Groth,	
Jungiusstr. 9,	
Hamburg 36.	
INRE ZEICHEN INRE NACHRICHT VOM UNSERE ZEICHEN TAG	
BETREFF 9.12.41. E.A.Dr.Bey/Rw. 11.12.1941	•

Herstellung einer Ultrazentrifuge, Oelkreislauf.

Für Ihr Schreiben vom 9.12.41 danken wir Ihnen bestens.

Die Firma Bosch G.m.b.H. teilt uns soeben mit, dass der in unserem Schema 03 21 02 - 1 <u>/Schem.1</u> bei 3) vorgesehene Einzylinder-Luftpresser nicht geliefert werden kann, dass aber Verdichter der Type SV/DRB 160 R 12 4 Wochen nach Auftragseingang erhältlich seien.

Wir haben unsere frühere Bestellung Nr. 82 11 vom 23.11.41 zurückgezogen undfanstelle dessen 2 Stück Verdichter der letztgenannten Type soeben mit der Bitte in Auftrag gegeben, die angegebene Lieferzeit von 4 Wochen einzuhalten. Gleichzeitig haben wir darauf hingewiesen, dass es sich dabei um ein Bauteil handelt, für dessen schnelle Lieferung Sie sich bereits an die Firma Bosch gewandt hatten.

> Heil Hitler ! ANSCHÜTZ u. CO. G.m.b.H. Entwicklungs-Abteilung

> > Men

i.A.

British Documents

DECLASTIFIED DOE 8803942A-HS American Documents DECLASSIFIED 812018 & MHC 18475 Dats 2/6/89



# How many uranium gas centrifuges did

**Germany produce?** 

#### MEMORANDUM

infor R. H. Furman

FROM H. T. Wensel

#### This memorandum will put on record the information which I gave you orally yesterday.

Dr. H. C. Urey of Columbia University was approached through a Professor Perrin, who was then an exchange Professor in the Chemistry Department at Columbia University. on hehalf of one Constantin Chilowsky. Chilowsky was desirous of selling an invention, the exact method never disclosed to us, for accomplishing the same purpose which the Manhattan District is seeking to. Protessor Vrey indicated that he was not interested in the matter but passed the information on to the OSRD, and I was asked to interview Chilowsky by Dr. Conant to see what I could find out. I used my oredentials as a member of the National Bureau of Standards and indicated to Chilowsky and Professor Perrin that I had no other government connection.

Chilowsky was a Swiss and refused to divulge even the approximate nature of his method but, insemuch as I indicated that the government would be spathetic to the idea until shown that something practical was involved, in order to "sell" me on the importance of the job, he indicated to so that the Germans were actively engaged on the same objective. In particular, he told me he had personally seen in a factory in Switzerland centrifuges which were being produced to be sent to Germany for the Germans' work on this field.

Chilowsky also told so that he had a moral and financial obligation to offer first orack at his invention to the British group of Halban. It seems that Halban and his group had some part in developing the invention in question. Halban is at present with the British team in Montreal, and it may be that Chilession's whereabouts can be traced through Halban if no other means of approach is available.



the NARA RG 227, Microfilm M1392, Bush-Conant File Relating to the Developme **Deutsches Museum Archive FA 002/811** 





Zum Projekt einer gröneren Anlage mit Ura., - Innenionenquelle



### 4. <sup>235</sup>U Enrichment: Electromagnetic **Separators (Calutrons)**

**Prototype calutron built and** demonstrated by 1941 by Manfred von Ardenne and the ELIN company [Russian archive, courtesy of Rainer Karlsch]

> Heinz Ewald's March 1942 final report on calculations for the optimal performance of calutrons [Deutsches Museum Archive G-139]



Pig. 5. Zum Auflösungsvermögen der Anordnung mit läseigung höherer Potensen von a.): Innenionenquelle.

see



Fig. 6. Zum Auflösungsvermögen der Anordnung mit Aussenionenquelle.

Punkte T, so dass der Kreis k<sub>II</sub> den Kreis o in T berührt. Die Endion der Kreise k und K seien o und p+40.Wenn wir für eine bestimmte Anordnung - gegeben seien die Endien rh und ra und die Winkeldivergens 2d - das Auflösungsvermögen angeben wollen, dann genügt es, das Verhältnis ?/ do für die beiden Kreise kun und Ky zu bestimmen. Denn aus der Bezichung

const. VM. U

für den Krümmungeradius von Ionen der Voltenergie U im Magnetfeld H folgt für das Auflösungsvermögen

$$\frac{M}{M} = \frac{1}{2} \frac{\rho}{\Delta \rho}$$

Wenn wir den Ursprung des Koordinatensystemes in den Mittelpunkt # der ganzen Anordnung verlegen (Fig. 7), haben die drei Kreise kII, KI und c die Gleichungen (unter Vernach-



## 4. <sup>235</sup>U Enrichment: Electromagnetic Separators (Calutrons)

Manfred von Ardenne. 1990. Die Erinnerungen. 10th ed. Munich: Herbig. p. 159

During visits to Dahlem and Lichterfelde in 1941, I had asked Professor Otto Hahn how many grams of pure uranium-235 would be needed to unleash a nuclear chain reaction in an instant. He answered me: "A few kilograms." In this absolutely confidential conversation, I expressed the opinion that it was technically quite possible to obtain uranium-235 in quantities of a few kilograms with the help of highly sophisticated magnetic mass separators (which we had previously designed and experimentally developed), if large electrical corporations were used for this purpose.

OSS. 9 June 1944. NARA RG 77, Entry UD-22A, Box Box 171, Folder 32.7003-1 GERMANY: US Wartime Positive Int. (July 42–June 44)

DECLASSIFIED Authority <u>NN 917017</u>

The Reichs Postal Administration under the direction of Pose have installed three new high tension laboratories of which the location is not known. Professors Fluegge and von Ardenn are in charge.

General Henry H. Arnold. 1949. *Global Mission*. New York: Harper. p. 491

The Germans were supposed to have perfected an electric machine which would make it possible to complete the development of the atomic bomb. I was then asked to have our bombers in England make special missions against the various branches of the Kaiser Wilhelm Institute in Berlin.

**Did Germany mass-produce and use calutrons during the war?** For more information, see *Forgotten Creators* D.4.3

# 4. <sup>235</sup>U Enrichment: Gaseous Diffusion

- Gustav Hertz invented gaseous diffusion separation in 1923.
- Hertz (allowed to work despite his Jewish ancestry!), Erika Cremer, Erich Bagge, and others worked on high-priority isotope separation programs throughout the war.
- Details of their wartime work have never been publicly released. Did they help to scale up gaseous diffusion <sup>235</sup>U enrichment?
- Hertz also played a leading role in the postwar Soviet nuclear weapons program.

For more information, see *Forgotten Creators* D.4.4



Leftover wartime factories in Neustadt an der Orla, Thuringia, were already perfectly set up to make high-quality nickel filters for gaseous diffusion <sup>235</sup>U enrichment for the Soviet Union. What exactly did they do during the war?

gency	20 17/52 * 3	
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l Intellig	Ama HILTON HOTEL	
Centra	3. Judurnal contents (ushow) uSSR	
e Notes:	* most nickel wie most for use as a	Former
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In September 1946, Leslie Groves sent Percival C. Keith, the chief engineer of the Oak Ridge K-25 gaseous diffusion plant, on a high-risk, two-week, Top Secret trip to Soviet-dominated Czechoslovakia. Was his mission to inspect or sabotage a former German enrichment plant?

Liota	WAR DEPARTMENT
ND 0	OUTGOING CLASSIFIED MESSAGE
ty N	TOP SECRET
Authori	PARAPERASE NOT REQUIRED. HANDLE AS TOP SECRET CORRESPONDENCE
	Maj Gen. L. R. Croves' Office Room 4166 78333 Major John C. Nattina
For more	10 September 1946
nformation	MILATTACHE AMMBASSY London England
soo	Number: WAR 99912
Forgottan	Loco Personal for Dean from Shuler signed Groves
Creators D.4.4	Mr P. C. Meith will be in Czechoslovakia from approximately 15 September to 28 September. The name of the Military Attache at Prague, Colonel Fgmont F. Koenig, has been given to Keith. It is important that Koenig be notified of visit of Keith into Czechoslovakia so that Koenig may extend to him every courtesy possible should the cocasion arise.
ox 160, p Secret	Wire Koenig immediately in Prague-Top Secret-priority- as follows and sign name of Dean: Mr P. C. Keith, President of U. S. Industrial Corporation, will be in Czechoslovakia on September 15th and may contact you personally. Important that every courtesy possible be shown him if occasion arises.
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#### DECLASSIFIED Authority NUD 867125

### 4. Sites of Possible Enrichment Facilities

493

October 28, 1945.

#### NEW GERMAN EXPLOSIVE \*\* SECRET WEAPON

Dr. Berg tells me that his friends know from countless sources that several factories and hundreds of workers have been transported from the Wiesental near Bale to northern Germany The workers' letters home are mailed from a great variety of towns-- but all these towns are on the peripherie of the Lüneburger Heide.

The story he hears is that they are all all working in vast undrground factories putting out a new explosive in aerial bombs. He has even heard that the container of the explosive is spherical.

A very large number of runways are being built in that region with calculated slowness and care to prevent detection from the air -- and these are to accomodate the planes that will eventually come to load up with the new bombs for an attack on England.

While I am gone he will assemble the details of this story for me -- what kind of factories were removed -- what kind of training the workers had had -- names of any chemicals they may have worked with. He heard some part of the explosive was previously manufactured in the Wiesental before the whole business was concentrated in Lüneburger Heide.

The concentration took place about 9 months ago.

Suggests we take a good look from the air.

NARA RG 226, Entry 125, Box 6, Folder 78, OSS report

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The concentration took place about 9 months ago.

Suggests we take a good look from the air.

OFFICE OF STRATEGIC SERVICES OFFICIAL DISPATCH May 4. 1944 DATE X PRIORITY FROM 1944 MAY 4 16 34 MACFARLAND IS ANBUL ROUTINE TO DEFERRED OFFICE OF STRATEGIC SERVICES IN-9026 DISTRIBUTION (FOR INFORMATION) (FOR ACTION) DIRECTOR, SFCRETARIAT, MAGRUDER SHEPARDSON 5. GOVERNMENT PRINTING OFFICE 16-37883-1 RECEIVED IN CODE OR CIPHER #332 AZUSA From Javelin to Shepardson and Cecil only. Istanbul-London (#93) We have been informed by Azusa-Dahlia that the component of a new explosive is being produced by the I.C. Farben factory in the vicinity of Tropau (called Opava by the Czechs). This factory has 30,000 employees. In the vicinity of Meahrisch-Ostrau (called Moravska=Ostrava by the Czechs) there is an identical factory. We evaluate the foregoing as D-3 and on April 29th, sent you Kenort D-1479 by pouch. Data supplied by this source regarding the Czech Protectorate is more dependable that it is for other regions. NARA RG 226, Entry A1-134, Box 219, Folder IN AZUSA Nov. '43 Sept. '45 "Azusa" = OSS code word for German nuclear program. **1944** Austrian train logbooks show that these locations made repeated shipments of a codenamed product to the SS Gusen facility, another suspected nuclear site. SECRET TOR: 14/44 7:36 am

DECLASSIFIED

Authority NND 857134

19 September 1943 OSS report: "Our sources claim that there are large explosive factories in Hiltersheim, Magdeburg district. These factories are said to have been moved here from Ludwigshafen. They are in underground, bomb-proof spaces. They are making a highdensity explosive here that is supposed to have an enormous explosive effect. [...] With one kilogram, everything should be literally razed away, or disintegrated to dust and ashes, within a radius of approximately four kilometers." [NARA RG 226, Entry 125, Box 6, Folder 78]

Box 6, Folder 78, OSS report

125,

[Day.mo.yr]	[From]
24.04.44	Salzgitter
26.04.44	Witkowitz
10.05.44	Oranienburg
15.05.44	Redl Zipf
20.05.44	Redl Zipf
23.05.44	Redl Zipf
27.05.44	Redl Zipf
06.06.44	Oranienburg
22.08.44	Fiebinger
23.08.44	Ohrdruf
23.08.44	Jambes Nord (Be
29.08.44	Witkowitz
04.09.44	Ing. Kammler
05.09.44	Oranienburg
06.09.44	Oranienburg
07.09.44	Salzgitter
07.10.44	Salzgitter
09.10.44	Auschwitz
10.10.44	Auschwitz
11.10.44	Oranienburg
12.10.44	Witkowitz
25.10.44	Nettingsdorf
28.10.44	Oranienburg
02.11.44	Nettingsdorf
25.12.44	Limburgerhof
31.12.44	SS Führungsstab
05.01.45	Auschwitz
09.01.45	Brömme
12.01.45	Brömme
14.01.45	Limburgerhof
24.01.45	Brömme
26.01.45	Oranienburg
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Witkowitz Ing. Kammler **SSWVHA** Eckermann Witkowitz **SSWVHA SSWVHA** Schachtbau/Böhm/Flügge Flügge, Böhm KZL KZL **SSWVHA** Eckermann Ing. Kammler **SSWVHA** Arnstadt **KZL** Crawinkel Crawinkel Kammler Crawinkel DEST DEST KDZ L Fiebinger **Kirchdorf/Tirol** DEST DEST **Redl Zipf Kirchdorf/Tirol** DEST

Mineralwasser Waffen Maschinen Maschinen Maschinen Pressluftrohre Mineralwasserflaschen Abwasserreinigungsanlage Scharfwasser Mineralwasser leere Flaschen Maschinen Maschinen **Baugeräte Baugeräte** Unterkunftgeräte Effekten **E-Teile** Mineralwasser Kessel **Maschinen 2 wgs** Kessel **Eisenteile** Maschinen 2 wgs Wehrmachtsgut 9 wgs **Baumaterial 3 wgs Baumaterial O.V. Eisenwaren** Ersatzteile Geräte **Zugladung 2 wgs** Eisen **Elektromaterial** Geräte **Agelin Tank** Stoffflaschen **Elektromaterial** 7653069 11 wgs

[Cargo (cover names)]

**Atomgruppen** [Domgruppen?]

Bagenkontrollbuch der Güterabfertigung begannen am 22245 1945 beendetan 28. April 1945 Some entries

from logbooks of train shipments to/from SS Gusen facility, Austria. Rudolf A. Haunschmied, Gusen Memorial Committee.

SECRET	÷.	/	<b>4.</b> En
SIRA/L Origi	inal Report No. FF-8	35	Jony S
Repo	rt from Paris	$\downarrow$	Tany S
OSS LONDON			Mo
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USEmb(G)Bartlett Value WASH Source	: B-4		Gorman factor fabrik (a com and 250,000 w
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Atom Smashing Secret W	Banon -		four months.
1. The Germans have completed a founded on the principle of the dismatter (Atomzertruenmerung). Experimperformed which have proved.conclustor this weapon is like that of a thread of a projection. 2. It would be possible to dirthis weapon in any given direction. 2. It would be possible to direction. weapon properly so-called. The rad supposed to be about three kilomete produced by this weapon is said to plans to use it only in the air, ag example. Nevertheless, the Germans necessity they will not hesitate to as well. This weapon seems to be rupon the battlefield, but it still form of a model. Germany needs - a absolutely certain - a delay of at Practically speaking, it seems that could the weapon be ready for use.	a weapon which is integration of ments have been ive. The effect metroli, naturally ect the effect of Possibly it is a rather than of a ius of action is- rs. The devastation be such that Hitler ainst planes, for say that in case of use it on the group eady, in fact, for exists only in the nd this appears to least three months only within five m	Entry UD-22A, Box 171, Folder 32.7003-2 US Wartime Positive Int. (July-Oct. 44)	out are all a accessories i the country, ion. Our tro does not matt a ny length resume our ov 5 5. Direc the same inve which they ha 6. Names interviews to Herr
3. Different conversations whi with industrial leaders in charge o production of German war materiel g that Germany has unlimited confiden this weapon, which is to bring them	ch have taken place f concentration of ive the impression ce in the use of a certain victory.	ARG 77,	Direct
SECRET	Declassified . Authority: 25353 By: Alan Lipton Date: 12-	ITT - 2004	ນາະຈ ຜູນ
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D COPY	NAUD 951210 HAMMAL 12	1.4/04	JHM / 1d

## richment Facilities: ites, Widely Dispersed, ostly Underground

Original No. FF-83- Page 2 CRET

Schneider, one of the directors of the ries called Deutsche Waffen u. Munitionsnbine representing some fifteen factories workers) declared with a smile: "We shall tory by new weapons, we are absolutely sure st now it is simply a case of gaining time. new arms will not be ready before three or Bombing cannot keep us from building them. t factories where the assembly is carried subterranean. An immense quantity of is made in small lots everywhere throughout so that bombing cannot interrupt the productcops may retire within our frontiers. That of time against these/weapons and we shall vorwhelming advance."

ctors of certain other factories have shown sterate optimism, aroused by the confidence ave in the effects of these new weapons.

s of cortain industrialists with whom the ook place:

> Schneider - Director of the Beutsche Waffe und Munitions-Fabrik. His German title is Wehrwirtschaftsbeauftragter (Superintendent of Armament Production) in the region of the Duchy of Baden and Wurtemberg. He has charge of the plants of the Karlsruhe region.

tor Dr. Buesse, who directs the DWM factories at Karlsruhe

ant, Administrator of a part of the DWM combine of factories.

> DECLASSIFIED Authority NN 917017

Manhattan District History. Book I, Volume 12, Part 2, Appendix C-7.

RESCTRIC FOURS CONSULTION ALD COSTS CLINTON FOO INEER WORKS

OCTOBER 1943 TOROUGH DECETBER 1946

Period	Consumed	Demand	Total Costa
1 November 1943	3.912.040	11,400	\$ 18.834.05
1 December 1943	9,105,000	18, 300	34, 171, 50
1 January 1944	8.365.000	18,300	33.061.50
1 February 1944	10.725.000	23,100	41.785.50
1 March 1944	17.105.000	31.200	60.103.50
1 April 1944	27.665.000	48,600	94.735.50
1 May 1944	33.970.000	64.500	121. 365.00
1 June 1944	41.478.000	73.800	142.671.00
1 July 1944	39.870.000	98.200	166,611,00
1 August 1944	46.140.000	104,200	182,496.00
1 September 1944	52,610,000	125,900	215,637,00
1 October 1944	63, 280, 000	144.450	251,676,00
1 November 1944	77.700.000	167.760	320,080,80
1 December 1944	90,370,000	222,050	376.119.00
1 January 1945	107,010,000	236,900	417.117.00
1 February 1945	123,668,000	242.633	448.295.64
1 March 1945	117,442,000	253.047	450, 203, 76
1 April 1945	150,950,000	290.487	540,900,96
1 May 1945	166,170,000	263.626	534.721.08
1 June 1945	179,160,000	269.866	560,945,28
1 July 1945	184.350.000	283.840	583,822,20
1 August 1945	198.870.000	291,800	614,199,00
1 September 1945	200.000.000	298.627	623, 267, 16
1 October 1945	117,920,000	292.867	493,926,36
1 November 1945	60, 290,000	116,227	216.710.16
1 December 1945	48,020,000	122.347	204.914.76
1 January 1946	63, 620, 000	145,100	252,888,00

Manhattan District History.	MLECTRIC	FOW	CONSUL	TION	ALD.	COSIS
Book I, Volume	Ci	INTON	FIC INES	R WOR	(8	
12, Part 2, Appendix C-7.	OCTOBER	1943	THROUGH	Dece	BRR	1946

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Ending	Consumed	Demand			Costs
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1 December 1945	48.020.000	122.347			204.914.76
1 January 1946	63.620.000	145,100			252,888,00

The Greater German Reich produced at least 22 GW of power. Including all other countries aiding Germany, the total was probably around ~44 GW.

#### BRIEF REVIEW OF THE ELECTRIC Bombing Survey. 1947. UTILITY INDUSTRY IN GERMANY German Electric Utilities

#### CENERAL.

#### Industry Report. p. 4.

**United States Strategic** 

1. Prewar Germany (including Austria and Sudeten territory) with a population according to 1939 census of 79,400,000 people and occupying an area of about 225,000 square miles, was largely industrial.

2. The principal industrial centers were:

The Ruhr and Saarland, for iron or steel production. Berlin, for general manufacturing. Bavaria and Prussia, for chemical manufacturing. Saxony, for textile manufacturing.

See also BIOS 342. The German

The main centers of power generation were:

Wartime Electricity Supply: Conditions, Development, Trends.

Rhine-Westphalia brown coal and hard coal areas. Southwestern German water power area (including Austria.) Central German brown coal area (including Leipzig and Berlin.) Silesian hard coal area.

3. From data obtained from the office of the National Load Dispatcher the total generating station capacity, both public utility and private plant, in 1944 was 22 million KW. From the German diagram of principal interconnecting transmission lines, dated 15 February 1945, Exhibit D, it appears that the distribution of the more important generating stations both public and private of 50,000 KW capacity and over was as follows:

Manhattan	ELECTRIC	FON	CONSUL	TION ALD	COSTS
District History. Book I. Volume	Cia	INTON	RHO INES	R WORKS	
12, Part 2, Appendix C-7.	OCTOBER	194 <b>3</b>	THROUGH	Dect Ber	1946

Period	K art	<b>V</b> .4		lotal.
Ending	Consumed	Demand		Costs
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1 May 1944	33,970,000	64,500		121, 365.00
1 June 1944	41,478,000	73,800		142,671.00
1 July 1944	39,870,000	98,200		166,611.00
1 August 1944	46,140,000	104,200		182,496.00
1 September 1944	52,610,000	125,900		215,637.00
1 October 1944	63,280,000	144,450		251,676.00
1 November 1944	77,700,000	167,760		320,080,80
1 December 1944	90,370,000	222,050		376,119.00
1 January 1945	107,010,000	236,900		417,117.00
1 February 1945	123,668,000	242,633		448, 295.64
1 March 1945	117,442,000	253,047		450, 203.76
1 April 1945	150,950,000	290,487		540,900.96
1 May 1945	166, 170,000	263, 626		534,721.08
1 June 1945	179,160,000	269,866		560,945.28
1 July 1945	184,350,000	283,840		583,822,20
1 August 1945	198,870,000	291,800		614,199.00
1 September 1945	200,000,000	298,627		623, 267.16
1 October 1945	117,920,000	292,867		493,926.36
1 November 1945	60,290,000	116,227		216,710,16
1 December 1945	48,020,000	122, 347		204,914,76
1 January 1946	63,620,000	145,100		252,888.00

Oak Ridge would have required 0.86% of the power of the Greater German Reich, or ~0.43% of the total power aiding Germany.

### The Greater German Reich produced at least 22 GW of power. Including all other countries aiding Germany, the total was probably around ~44 GW.

#### United States Strategic BRIEF REVIEW OF THE ELECTRIC UTILITY INDUSTRY IN GERMANY German Electric Utilities

#### GENERAL.

#### Industry Report. p. 4.

1. Prewar Germany (including Austria and Sudeten territory) with a population according to 1939 census of 79,400,000 people and occupying an area of about 225,000 square miles, was largely industrial.

2. The principal industrial centers were:

The Ruhr and Saarland, for iron or steel production. Berlin, for general manufacturing. Bavaria and Prussia, for chemical manufacturing. Saxony, for textile manufacturing.

See also BIOS 342. The German

The main centers of power generation were:

Wartime Electricity Supply: Conditions, Development, Trends.

Rhine-Westphalia brown coal and hard coal areas. Southwestern German water power area (including Austria.) Central German brown coal area (including Leipzig and Berlin.) Silesian hard coal area.

3. From data obtained from the office of the National Load Dispatcher the total generating station capacity, both public utility and private plant, in 1944 was 22 million KW. From the German diagram of principal interconnecting transmission lines, dated 10 February 1945, Exhibit D, it appears that the distribution of the more important generating stations both public and private of 50,000 KW capacity and over was as follows:

Manhattan	120 100 00 0 0	11/10/104	on on the	NET / 181 A. B. 18	(essile)
<b>District History.</b>	SLOUTILLU	FUN		TION ALL	0.919
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12, Part 2,	OCTOBER	1943	THROUGH	DECTBER	1946
Appendix C-7.					

Period	KaH	Ka	Total
Ending	Consumed	Demand	Costs
1 November 1943	3,912,040	11,400	\$ 18,834.05
1 December 1943	9,105,000	18, 300	34,171,50
1 January 1944	8,365,000	18,300	33,061,50
1 February 1944	10,725,000	23,100	41,785,50
1 March 1944	17,105,000	31,200	60,103.50
1 April 1944	27,665,000	48,600	94.735.50
1 May 1944	33,970,000	64,500	121, 365,00
1 June 1944	41,478,000	73,800	142,671.00
1 July 1944	39,870,000	98,200	166,611,00
1 August 1944	46,140,000	104,200	182,496.00
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#### BRIEF REVIEW OF THE ELECTRIC Bombing Survey. 1947. UTILITY INDUSTRY IN GERMANY German Electric Utilities

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**United States Strategic** 

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Other documents indicate that German enrichment was more efficient than Oak Ridge (centrifuges) and German bombs were more efficient than Little Boy (implosion), so Germany needed much less power than Oak Ridge.

3 April 1944

Summary of Information

SECRET

#### Germany: Silesian Synthetic and Power Plants.

1. A synthetic petrol plant has been built at Blechhammer. A power station of 100-250,000 KW is under construction.

2. A power station of about 260,000 KW is being built for the I.G. plant at Oswiecim. A 110 KV H.T. transmission line has been erected between Chorzow Malobadz and Jaworzno. Under construction there is a 110 kW line from Laziska to Oswiecim and from Jaworzno to Oswiecim.

3. The Schaffgott'she Oderthal power station had an output of 17 million k Wh in February. A total of 310 million kWh passed through Oderthal transformers for EWAG in 1942. From this the PE v received 105 million kWh. In February the EWAG received 31.5 million kWh of which 11.4 were OE v.

4. A new 40,000 kW turbo-generator has been mounted in Chorsow.

5. Four turbo-generators of 50,000 kW combined capacity have been installed in the Tarnow district, probably at Roxnow.

The information concerning the power lines to Oswiecim is confirmed by a recent report that the I.G. plant there was to be supplied with power from the Oberlasisk power station.

The extra power requirements in the Chorsow and Tarnow districts may be partly explaines by the new nitrogen plants there.

For purposes of comparison the power plants of other synthetic oil plants are estimated as follows:

SECRET

Blechhammer N.	250,000 km
s.	300,000 "
Böhlen	390,000 "
Bottrop Welheim	100,000 "
Deschowitz	75,000 "
Ruhland Schwarshei	de 60,000 "
Pälitz	300,000 "
Scholven	110,000 "
Syerkrade Holten	80,000 "

#### Germany: Blechaumer (Censorship)

In early November there was a big explosion in the works which killed several people.

#### Germany: Blechammer (British P/W)

Informant had worked at I. G. Hyydebreck until November 1942. He only did odd jobs in the Siemens section of the factory which made gas producer generators. The main factory made synthetic petrol and 15-20 tank wagons left the factory daily.

#### Germany: Reported Synthetic Oil Plant at Urdinger (Air Rec)

"The only significant new construction visible on available photographs of Krefelt/Urdingen, is the Plant near the I.G.F. works. The purpose of this plant is at present unknown and the plant itself appears quite unlike an oil plant. The surroughing district has also been examined, but no possible synthetic oil plant is present.

There may be a plant two or three miles distant from Krefeld/Urdingen, which has not been covered by photographs. If so the name will be misleading. It might however refer to an office address for a plant outside of town."

From : MID Military Attache Report, London - 1 Feb 44. Incl. dated 10 Jan 44. Enemy Oil Intelligence Committee Authority NND 919-013

Buna IV to Otto Ambros regarding I.G. Farben Auschwitz, 11 January 1941. Trials of War Criminals Before the Nuremberg Military Tribunals.

In addition, the water situation is very favourable because the draining works can be placed below the confluence of the Weichsel [Vistula], Przemsza, and Sola Rivers and sufficient water will be available, even with minimum outflow. [...] Coal can be procured from 3 sides; to wit, the Cracow district, the central district, and the coal deposits southwest of the building site, where the new Brzeszcze and Jawiszowitz shafts of the Hermann Goering Werke are located, and from the Silesia Shaft, near Dzieditz[....]

Joseph Borkin. 1978. *The Crime and Punishment of I. G. Farben*. New York: Free Press. p. 127.

From the bare records available, 300,000 concentration camp workers passed through I.G. Auschwitz of whom at least 25,000 were worked to death. The plants when completed were so enormous that they used more electricity than the entire city of Berlin. [...] Despite the investment of almost 900 million Reichsmarks and thousands of lives, only a modest stream of fuel and not a single pound of Buna rubber was ever produced.

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The Puzzle of Podmokly. *Time*. 12 November 1945.

When the Germans came to Podmokly (which they called Bodenbach) they seized the Krizek Works, Czechoslovakia's largest producer of copper wire, the area was rich in coal and hydroelectric power, and had excellent communication facilities. Later they imported French, Belgian and Russian laborers, and set them to work expanding the Krizek plants. Laboratories were built, buildings enlarged, new units erected. One of the new units was put underground, and was supersecret. It was known simply as "the Weser."

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F. A. Duwell. 5th Army POW Cage. 7 November 1944. AFHRA A5417 pp. 966-967 P/W claims that a number of underground factories located between are LANDSBERG and SCHONGAU on the west side of the RR line and main highway in a heavily wooded area. [...] He had his information from members of Organization TODT, who had helped with construction there. [...] Along the river LECH between LANDSBERG and SCHONGAU four electric power stations are located. [...] Dynamite A.G. Kaufering at Landsberg This plant was begun in 1939-40 and at that time curious civilians were informed that they need not be concerned as the project was of little importance. However, this did not quiet the suspicions that something highly secret was being performed. suspicions that are still rife today. In May 1943 there was a sudden increase in activity after which time the place was put under heavy guard. The entire complex is set in the woods and is heavily camouflaged. An extensive network of roads was built into and through the woods. P/W knew that about 30 large tanks were partially buried near the factory, painted green on top, and covered over with trees and shrubs. He also knew that [...] some sort of munitions were being manufactured. He describes the location as being at approximately 48 degrees 04'N -- 10 degrees 50'E.





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).

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.

II. G. Farben was also producing uranium hexafluoride, heavy water, graphite, aluminum, calcium, etc.]

S. McClintic. 6 January 1945. AFHRA A5734 pdf p. 1092.

I.G. Farben

Leverkusen

At UNTERRADERACH, near **FRIEDRICHSHAFEN**, 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.

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 GERMANY: Summary Reports (1944). Mr. Chapin reported successful detection experiments and requested aircraft study.

Dahlem > Hamburg (subcritical) Haigerloch Lichterfelde

amburg

Thuringia

Unter-

raderach

Gottow → Stadtilm

Leipzig (subcritical) Krizik/ underground **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/200707060548 33/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.

[T]here was once a report of an atomic pile operated by Russians at Bodenbach, CSR .....



### 5. Sites of Known or Suspected Reactors: Gusen, Austria 16 April 1945 U.S. aerial surveillance photo 15 March 1945 U.S. aerial surveillance photo of underground reactor complex (?) of underground reactor complex (?) sealed before U.S. forces arrive under construction or operational THIS PAGE IS UNCLASSIFIE **AFHRA** Indergrand HEADQUARTERS UNITED STATES AIR FORCES IN\_EUROPE Assistant Chief of Staff A-2 BA 350.0 SUBJECT Chief of Mission, Strategic Service Unit, War Depar United States Forces, Et

Walter Chmielewski, son of Gusen commandant, 2016:

There was the precise talk of a total (of about) 30–40 kilometers of tunnels which have been created and partly in fact on two levels. This came through in talks with SS people and there is now nuclear research being carried out there. Under high pressure there is research, which could still save the nation, so to speak; the atomic bomb could be constructed, so that the initiative can be recovered again, yes. This was clearly stated in conversations in Gusen, that this research is already taking place.



# **5. Requirements for a Breeder Reactor**

Characteristic	<b>Approximate value (scales linearly)</b>		
Thermal power	25 MW		
<b>Reactor core volume</b>	100 m <sup>3</sup>		
Moderator	150 tons of graphite, or 80 tons of heavy water, or some of both		
Natural uranium in reactor	25 tons		
<b>Replace uranium every</b>	100 days		
Uranium consumption rate	91 tons/year		
Plutonium production rate	6.9 kg/year (~1 bomb/year)		
Cost (1940s U.S. dollars)	\$6,000,000		

Based on: Office of Technology Assessment. 1977. Nuclear Proliferation & Safeguards. NTIS Report PB-275843. Appendix Vol. 2.



Oct. 23, 1951 R. WIDERÖE MAGNETIC INDUCTION ACCELERATOR 4 Sheets-Sheet 1 Filed June 4, 1947



### **Rolf Wideröe** (1902 - 1996)

**Invented &** developed particle accelerators (1923–)

#### NARA RG 319 Entry NM3-82A, Box 6, Folder ALSOS G-20

DECLASSIFIED Authority NND75500

Hamburg, den 4. 12. 1944

15/12/44 1419 Professor Dr. W. Gerlach (13b) München 22

#### Schr gechrter Herr Professor,

Herry

wir haben bei unseren Arbeiten eine Beobachtung gemacht, die ich Ihnen möglichst schnell berichten möchte:

Während des letzten Monats haben wir mit ziemlich starken Strahlintensitäten gearbeitet. Während dieser Zeit habe ich, nach unseren bisherigen Messungen gerechnet, wohl einige rit bekommen (Dr.Kollath etwas mehr). Diese Dosen sollten viel zu klein sein, um biologische Wirkungen hervorzurufen.

Bei der letzten Blutuntersuchung zeigten sich indessen bei mir deutliche struktuelle Veränderungen der Leucocyten. Dr.med.Kruse (Krankenhaus St.Georg) hat uns untersucht und verfolgt den weiteren Verlauf dieser Erscheinungen.

Die Erscheinung kann nur dadurch erklärt werden: 1) Daß unsere Meßinstrumente doch zu wenig angeben (Meberschläglige Berechnungen ergeben den Faktor 3 zu wenig )

2) Daß unsere Strahlung wesentlich stärkere biologische Wirkungen haben muß, als man annehmen sollte.

Wir bitten Sie, dies Erscheinungen den anderen mit ähnlichen Geräter arbeitenden Herren mitzuteilen, um Schäden durch Unvorsichtigkeiten zu vermeiden. Wir selbst werden sofort Maßnahmen zur Herabsetzung der Strahlengefahren vornehmen.



P.S. Wir erwarten in den nächsten Tagen den Besuch von Prof. Dänzer und Gentner, die verschiedene Fragen über die Elektronenschleudern mit uns besprechen wollen.

Max Steenbeck (1904–1981) Invented & developed particle accelerators (1927–)



Zu der Patentschrift 698867 Kl. 21 g Gr. 36





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

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.

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

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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.

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### 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 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.



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 <sup>235</sup>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  $\eta \sim 100$  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.

See for example: Chichester, David L. 2009. *Production and Applications of Neutrons Using Particle Accelerators*. INL/EXT-09-17312. Idaho Falls: Idaho National Laboratory. https://inldigitallibrary.inl.gov/sites/sti/sti/6302373.pdf Kemp, R. Scott. 2005. Nuclear Proliferation with Particle Accelerators. *Science and Global Security* 13:183-207. http://scienceandglobalsecurity.org/archive/sgs13kemp.pdf





# 7. Sites for Production of Heavy Water (D<sub>2</sub>O)

Norsk Hydro

Notodden

Deutsche

Werke

Kiel

I.G. Farben

Leuna (2)

Halle

Dräger

Lübeck

Berlin

Piesteritz

Bitterfeld

Breslau

Charles Chamberlain. Reveal Allied Capture of Nazi Atom Factory. Chicago Daily Tribune. 9 August 1945 p. 4.

KIEL, Germany, Aug. 8 (AP)-The largest heavy water plant in Germany, where Nazi scientists were working Vemork Såheim 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.

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12

Report on Interrogation of PW MAYER. 14 July 1944. NARA RG 77, Entry UD-22A, Box 171, Folder 32.7003-2 GERMANY: US Wartime Positive Int. (July-Oct. 44).

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.

U.S. Embassy, Warsaw. 12 August 1947. Report No. R-107-47, 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.

nesten Schmiedeberg Linde **Griesheim-Elektron** unich Frankfurt Weer Merano

**B9** Ouarz Roggendorf

Cotrone

Auschwitz

Ferdinand Cap. 23 November 1950 report [courtesy of Silke Fengler].

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.

# 7. Sites for Production of Heavy Water (D<sub>2</sub>O)

- Why were at least ~21 plants producing  $D_2O$ , despite other urgent wartime needs?
- That suggests the D<sub>2</sub>O was needed for breeder reactors, electronuclear breeders, fusion fuel, etc.
- Why are Allied reports on those plants still classified, or entirely missing from archives?

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HEADQUARTERS EUROPEAN THEATER OF OPERATIONS UNITED STATES ARMY Alsos Mission APO 887

5 April 1945

SUBJECT: Interrogation of Dr. Kohl, Works Manager of Degussa Plant No. 2, Frankfurt.

1. Dr. Kohl was interrogated in Frankfurt on 3 April 1945 by J. A. Lane and F. A. C. Wardenburg. Dr. Kessler, one of his assistants and also his secretary were present during the interrogation and were called on from time to time by Dr. Kohl on matters of detail.

2. Uranium metal, which was known by the code name of "Spezialmetall", was manufactured at the Degussa, Frankfurt plant. According to Dr. Kohl the material was required by the Reichsforschungsrat and all administrative matters were handled by Auer Gesellschaft in Oranienburg directly with RFR. Degussa acted as a sub-contractor for Auer. All deliveries from the Frankfurt plant were made either to Auer or to the RFR at Berlin-Dahlem. The use of the material was secret. Dr. Kohl believed that it had something to do with experiments in atomic physics. The material was manufactured in a purity of 98 to 99 percent from ammonium uranate which was converted to the oxide U<sub>3</sub>O<sub>8</sub>. The ammonium uranate was secured either from the Joachimstahl mines or from Katanga (Union Miniere du Haut katanga).

3. Earlier, 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. The material is now delivered as powdered metallic uranium, production being between one and two tons, making a total uranium production of between six and seven tons.

4. We visited the site of the plant which had been partially destroyed. The equipment was moved in December to a location in Markbrandenburg where Dr. Kohl believed the RFR had a branch. A part of the equipment was moved to the plant of the Chemische Fabrik Grunau at Grunau near Berlin. Dr. Kohl thought it might have been moved again but he did not know the exact location, but suggested somewhere in Thuringen as a probable evacuation address.

# 7. Graphite as a Moderator

If wartime Germany never used graphite as a moderator for fission reactors:

- Why was this Degussa plant producing at least 10 tons of blocks containing 50% uranium and 50% graphite?
- Why were both graphite and heavy water being mass-produced at:
  - I.G. Farben Bitterfeld
  - I.G. Farben Griesheim
  - Siemens Ratibor area
  - And other locations?

NARA RG 77, Entry UD-22A, Box 166, Folder 32.22-1 GERMANY–Research–TA (1943–June 1946)





DATE:19 July 1945

TO : Major F. J. Smith DATE: 17 July 1945 FROM : Major John E. Vance

SUBJECT: Possibility of acquiring foreign beryllium metal

 Major Kelley stated that Madison Square Area had been called upon to furnish increased quantities of beryllium metal. The single source of beryllium metal at this time is the Brush Beryllium Company of Cleveland, Ohio, whose facilities are to be enlarged. However, to assist in meeting the requirements, Major Kelley suggested that it would be extremely valuable if it were possible to acquire beryllium metal discovered in Germany.

2. To be useful to us, the metal should be massive, i.e., should be in pieces rather than in flakes and should contain more than 90% beryllium; it would probably not be advisable to place other specifications on the metal.

CONFIDENTIAL fice Memorandum • UNITED STATES GOVERNMENT

TO :Major F.J. Smith

FROM :H.S. Lowenhaupt

SUBJECT:Beryllium, re Memorandum to Major F.J. Smith from Major J.E. Vance, 17 July 1945

A cable to Major F.J. Smith, 17 May states that considerable bergllium was found in Germany by the AT Group. Whereabouts of this metal is not known at present.

A bill from the files (from Deutsche Gold und Silber Scheideanstalt Vormals Roessler, Degussa, Frankfort am Main, 7 May 1943 to the Heereswaffenamt, Berlin) is for 100 plates made of beryllium or 27.848 kg. at 140.20 marks per kg.

I suggest this firm be contacted by our people to see if they can still supply metalic beryllium, either through purchase, or as plunder.

Mineral trade notes no. 429, 3 July 1945, American Embassy, Rio de Janeiro, Brazil states that at present 800 tons of beryl, the best source of beryllium, is stocked in Brazil awaiting the untangling of international price difficulties. If the ore rather than the pure metal should be desired by Major Kelley, either now or in the future, Brazil could become an important supplier.

# 7. Beryllium

# **BIOS 158.** *Production of Beryllia and Beryllium at Degussa Plants.*

			vide and F	eryllium a	t the
Freduction	of Beryll	illim O.	t		
Cegussa fli	ant in ins				
V. ann	Berylli	ım (T	echn)	Berylliu	" (Flakes)
1010	about 2	00. kg		about 50	0 kg
1900	about 3	oo kg		about 20	0 kg
Sept	869.100	kg		None	
1940	3367.19	5 kg		1689.480	kg
1941	6305.68	) kg		214.094	kg
1942	3096.57	5 kg		1297.770	kg
1943	4224.50	) kg		601.620	kg
1944	947.00	) kg		302,605	kg
1945	None			None	
		Tot	als		
Froduction	before the	e war	500 kg	700 kg	
Production	during the	war	18810.050	kg 4105.	614 kg



NARA RG 77, Entry UD-22A, Box 163, Folder Australia

# 7. Production of Other Potentially Nuclear-Related Materials

Material	Non-nuclear applications	Nuclear applications	Wartime production
Deuterium/ heavy water	Isotope labeling of molecules	Producing tritium, neutrons, fusion; neutron moderator for reactor	At least ~21 production plants
Lithium	Glass, ceramics, metals	Producing tritium, neutrons, fusion	Hundreds of tons
Beryllium	Metal alloys	Neutron production/reflection	Tons
Boron	Glass, ceramics, metals	Neutron absorber	Large quantities
Graphite	Rocket rudders	Neutron moderator for reactor	Tens of thousands of tons
Fluorine	Industrial production	U hexafluoride for enrichment	Thousands of tons
Aluminum	Metal structures, packaging	Reactor fuel cladding, bomb casings	Thousands of tons
Calcium	Metal alloys	Th/U/Pu purification	Thousands of tons
Nickel	Batteries, alloys	<b>Resists corrosion by U hexafluoride</b>	Thousands of tons
Zirconium	High-temp. metals, ceramics	Reactor fuel cladding	Tons
Cadmium	Nickel-cadmium batteries	Neutron absorber	Thousands of tons

Some sites were producing multiple nuclear-related materials. I.G. Farben's Bitterfeld facility was producing heavy water, graphite, aluminum, and calcium, and perhaps other relevant materials.

Significant quantities of many of these nuclear-related materials were also shipped to Japan, along with at least 560 kg of (possibly enriched) uranium and other cutting-edge military technologies.

# 7. Disposal of Radioactive Waste at the End of the War

Hasso Ziegler. Die "Konzertsäle" von Asse sind strahlensicher: Endlagerung radioaktiver Abfallprodukte in 500-Meter tiefen Abbaukammern. *Hannoversche Allgemeine Zeitung*, 29 July 1974:

Extensive preparatory work is still going on for the highly radioactive waste, which will accumulate at the earliest from 1976 onwards in West Germany and be stored in Asse (mainly the residues from reprocessed fission products, for example reactor fuel rods). It is thought to sink them—vitrified beforehand—in special chambers (drill holes) to a depth of fifteen hundred meters.

Asked about the occasional bad news that appears every now and then regarding the supposedly dangerous storage of radioactive waste, Alwin Urff, mining engineer and deputy technical plant manager in Asse, only shook his head: "Here in the mine nothing can happen anyway. When we began storage in 1967, our company first sank radioactive waste from the last war, that uranium waste which arose in the preparation of the German atomic bomb. Specifically we had to get that out of concrete bunkers near Munich, where it had been deposited at the time, because back then one did not know where the devil one should leave the stuff...."



# 8. Testing Explosive Lenses (1940 Onward, Kummersdorf)



Abb. S 1: Versuchsaulbau des Körpers H 15/L

HEC 2590 (English translation). Erich Schumann and Gerd Hinrichs. March 1943.



Walter Trinks. 1945 letter to U.S. Army. NARA RG 319, Entry A1-134B, Folder XE098301 Trinks, Walter

At the end of the war I was occupied with experiments for producing extreme high pressures and temperatures, extreme velocities (up to 15 km/sec) and heavy swingings of the air [shock waves]. The practical use of these researches comprises:

1<sup>st</sup> for the war: the defense against V-weapons super- and atomic bombs by destroying them before they reach their target and the initiation of atomic bombs.

#### Uses of the Rontgenblitz

The uses to which the Germans put the Rontgenblitz equipment were learned by examining captured documents and by interrogation. These applications cover, (a) target cavitation produced by projectiles passing through wooden blocks and water targets, (b) the smashing of a lead bullet upon impact with various targets, (c) cavity charge phenomena studies, (d) detonation phenomena studies and (e) an interesting study of the arming of a nose fuze a short distance in front of the muzzle of the gun. With the exception of the studies on detonation of an explosive charge by Dr. Rudi Scholl, all work with the Rontgenblitz equipment was done by Schardin's group, working principally with Dr. Thomer. Only a few German documents covering the above work were available for examination by the author during the investigation of this subject but it is believed that a complete series of the reports of both Prof. H. Schardin's and Dr. Erich Schumann's groups have been recovered and forwarded through the proper military channels for filing and examination, (see Col. L. E. Simon's, U. S. Ord. Dept. report).

It was, however, definitely ascertained that the experimental techniques utilized to obtain flash radiographs of cavity charges and high explosive specimens were sensibly the same as those familiar to U. S. research workers. The German scientific groups recognized the value of

this technique because it was learned that at least eight more Rontgenblitz units were under construction at the Siemenswerke, Berlin.

Clark. 18 September 1945. Development and Use of Röntgenblitz. echnique by the German Scientists during Period 1938-45. Alsos Intelligence Report KO-29365. AFHRA B1763 frames 0252-0259.

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

GEOPONIA COMOSA CCE **FIABHOE** АЗВЕЕЫSATEЛЬНОЕ УПРАВЛЕНИЕ КРАСНОЙ АРМИИ 5 Mapta r. MOCKBR

Локлалуваю

EX. Nº

Наш лостоверный источник из Германии сообщает. "Немпы = послелнее время произвели два взрива. бомоч сольшой мощность : Тюрангых. Взривы провода л. сь в лесной местность в состановке строисьщей секретности. От центра взрчва деревья повалены на расстояния 500-600 метров. Уначтожены специаль построенные для опытов укрепления и сооружения. Наколящиеся в центре взрива военнопленные погно причем зачастую т ны не осталось следов. Вое пленнче, на одящиеся за центром взрыва, имеют льца : теля, скла которых зачисит от расстояния от чентра израва. Испатания проволклись в максимал но глуком районе. На об"ектах копытания режим сек максимллина. В"езли в чезлы разрешень только по осстому удостоверенью. Команды СС оцепили рай и испытания допразиваля каклого приблажащегося этому разону человека. Бомба предголожкательно снаря енная ураном 235 массой около д ух тон была привезена в место взрыва на спентальн окон програ п чисй платрорме. Вместе с ней окан лоставлены пистерны с жилкам кислородом. При с постоянно находились 20 человек охраны с собекси. Взрив бомбы сопровождался образованием взривной волны сольшо! мощностя, развыткам высокой температу-

ри. Ироме слово наблюдался мощный разловкамыни!

ричат. Номба предстанляет вз себя шар дваметром

ATALISHKKY DEPERATING TO THE

KPACHON APWIN

TENEPARY APMUN TOB. ANTOHOBY

#### 130 CM.

#### Бомба ссетоит из:

- 1. Высоконольтной разралной труска,
- от специальных генераторов 2. Шара, состоящего из металического
- 3. Заменл теля
- 4. Защатного футляра
- 5. Варывчатого вешества 6. Детонаторного устройств:
- 7. Ссолочк: из стали
- Все часть бомбы встанляются друг в пруга. Ин лиатор или загал бомен.
- Состокт ка специальной трубки, кот ет быстрые нейтроны. Ее питают специя. торы создающие в трубке высокое напряне результате быстрые нейтроны атакумт ак

#### Активны: матеркал божон.

Активным мотеричлом бойбы язляется ура Он представляет из себя шар, внутрь ксторого через отверстие вставляется книшиатор. Отверся после этого закрывается проской, сделарной урана 235.

#### Защетный бутлер.

материал.

Шар из урана закрывается защитными из алюминия, гокрытого слоем кадмия э задержнаят тегловые нейтрона. урана 235, которые могут вызвать преждеврем TETOHSUCK Варывчатое зещество.

#### После слоя кадмыя помещается варывчатое вещество, состоящее из пористого тринитротолуола,

пропятанното жидкям числородом. Тринитротолуол состоит из брусков, специально подобранной формы. Внутренных полерхность бруск имеет сферический циаметр, совпадающий с наружно повериростью кадмия. К каждому из брусков псдведен сдин летонатор с двумя электрозапалами. Оболочка.

Трянитротолуол покрыт защитной оболочной из легкого алюмениевого сплава. Сверку на эту оболо ку крепятоя подравное устройство.

#### Наружная оболечка.

Сверку подривного устройства устанавл: вается наружная оболочка из брон рованной стали.

#### Обтекатель.

На бронированную обслечку может устанавлявать ся обтематель легкого сплава, для последующей установки сомон на ракетном двигателе типе "ЗАУ" Сборка бомбы.

Шар, состоящей па металического урана, помещается внутрь защитного футляра, состоящего из алюмяния, покрытого слоем наамия, так чтобы отверстие в зире ссвпадало с отверстнем в утляре. Через это от еретие вставляется инициатор после чего стверстие закрывается пробной из урана. После стого алюминисьых шар, пок, ктый чаникем, закрывается пробкой, на которую снерху кладется последный брусоч тринитротолуола. Дальше в стверстие - зещитной оболочке закрывающее транитротолуол, закачивается жидкий кислород. После чего сомбя готона к работе.

#### Сапал бембь.

Рапал бомбы осуществляется з нисоковольтной разрящной трубку. поток нейтронов, атакующ... акт. в В процессе воздействия на уран пото из него налеляется слемент 93, которы возникновен.:е цепной реакцы. Лалее. устройство эриьает вэривчатсе в со происходит направленный к центр взрива наружного слея тринитротолуола в С ЖИЛКИМ УИСЛОР ЛОМ. СТО ПОЗВОЛЯЕТ НЕО уран ССС м рез сритическую массу. Прв. герел вэрывом, урановый шар облучант, с энсримей не боло 6 молльонов электиси MTO MECTOGRATHO ROBHWART CTO BODH

#### SAKINYEHNE.

ГАЧАЛЬНИК ГЛ. РАЗВЕЛУПРАВЛЕНИЯ КРАСПОЙ АРМИИ ГЕНЕРАЛ - ЛЕИТЕНАНТ

AHTOHOP

Несомненно, неудамя производать бомбы большой разрушительной силы. успешного окончаныя и производства бомо в достаточным количестве она будут обладать сружиеч, опосотным замедлять наше наступление"

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.

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 <u>500–600</u> 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 surrounded the area of have 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, <u>a massive radioactive effect was observed</u>. 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.

### <u>Initiator or bomb fuse.</u>

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.

#### <u>Explosive matter.</u>

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

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 gammarays, 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 <u>successful</u> <u>conclusion</u> and production of such bombs in sufficient quantities, they will have weapons <u>capable of slowing down our advance</u>.

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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.

# 8. Fission Bomb Design: Primary Sources

			Primary sources for fission bomb design									
		Guderley	Loofbourow	Time	Ilyichev	Kurchatov	Respondek	Schumann	Polish eng.	Diebner	Grothmann	König
		10/1942	10/1943	11/1944	3/1945	3/1945	11/1945	1945-1952	3/1946	1956-1962	2000-2002	2004
	Neutron initiator				1. Internal high-voltage fusion neutrons 2. External gamma rays (via betatron)	<ol> <li>Internal high-voltage fusion neutrons</li> <li>External gamma rays (via betatron)</li> </ol>	Neutron source	Fusion fuel	Neutron source (implied)	Fusion fuel	Ignition system	
	Pit		High-density, high-energy new material, laborious to produce	Uranium	U-235	U-235	U-235	Uranium	Fission fuel	Uranium	U-235	
ent	Reflector /tamper				``Delay mechanism'' that was apparently also uranium			Uranium				
<b>00</b>	Neutron absorber				Cadmium	Cadmium		Cadmium	Cadmium			
Im	Pusher				Aluminum			Aluminum				Aluminum
Cor	Explosive	Explosive designed for spherical implosion	Explosive designed for spherical implosion (implied)	Explosive designed for spherical implosion	Shaped segments of TNT with liquid oxygen, made lighter for rocket	Shaped segments of TNT with liquid oxygen, made lighter for rocket	Explosive designed for spherical implosion (implied)	Many shaped segments of TNT, RDX (explosive lenses) with simultaneous ignition		TNT and RDX	Complex explosive system with simultaneous ignition, made lighter for rocket	
	Explosive case	Spherical case	Spherical case	Spherical case	Spherical aluminum	Spherical case	Case	Spherical aluminum	Case	Spherical case	Spherical aluminum	Spherical aluminum
	Ballistic case				Steel case for rocket			Iron/ steel			Part of rocket	
	Position for test				Positioned in a test area	Positioned in a test area		Suspended a few meters above the ground			On metal scaffold	

Erich Schumann, Kurt Diebner, et al. February 1942 [1941 data]. Energiegewinnung aus Uran: Ergebnisse der vom Heereswaffenamt veranlassten Forschungsarbeiten zur Nutzbarmachung von Atomkernenergien. AMPG, I. Abteilung, Rep. 34, Nr. 105.

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Our sources claim that there are large explosive factories in Hiltersheim, Magdeburg district. These factories are said to have been moved here from Ludwigshafen. They are in underground, bomb-proof spaces. They are making a high-density explosive here that is supposed to have an enormous explosive effect. [...] With one kilogram, everything should be literally razed away, or disintegrated to dust and ashes, within a radius of approximately four kilometers.

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Erich Rundnagel, in: Gerhardt Remdt and Gunter Wermusch. 2006. Rätsel Jonastal. 2nd ed. Meiningen: Heinrich Jung. pp. 125-126.

I was mainly involved with Dr. Rehbein and engineer Rackwitz, with whom I came into a kind of relationship of trust. [...] Then he told me that something was being developed here that had a greater explosive power than anything I could imagine as an old pioneer. Rehbein just smiled and said the whole bomb was only a few decimeters tall, but weighs about eight kilograms. When I asked him if I could see the thing, he waved it off: "That could cost us both our heads."

## 8. Some Manufacturers of Suitable Bomb Components

D+Li fusion neutron initiator Betatron ( $e^- \Rightarrow \gamma \Rightarrow n$ ) initiator Uranium-235 fission pit Unenriched uranium tamper Cadmium-electroplated aluminum Pure TNT and RDX Explosive lenses (TNT + RDX) Simultaneous detonators Liquid oxygen C.H.F. Müller (Hamburg) and other suppliers Siemens-Reiniger (Erlangen) and other suppliers SS-controlled enrichment sites (discussed earlier) Auer/Degussa (Oranienburg and other locations) Kampschulte, Blasberg, Wilhelm Meyer, etc. WASAG (Allendorf and other locations) Heereswaffenamt (Kummersdorf/Hillersleben) Heereswaffenamt (Kummersdorf/Hillersleben) V-2 rocket program (Friedrichshafen, etc.)

C. H. F. Muller A.-G., working in cooperation with, and under the direction of, the M. V. Research Association (M. V. Forschunge-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 magarolt betatron, to operate on 50 orelas. 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 Cis 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. Muller, of C. H. F. Muller, recently constructed a very small 2 megavolt betatron which weighed less than 100 pounds. Th's betatron operated on 50 cycles and had a sealed off tube but 'he output mas 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 Siemans-Reiniger plant in Erlangan. 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 onis plant to construct a 50 cycles 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.

### CIOS XXVIII-31

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

During the past two years, C. H. F. Kuller 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 plue 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 Fhillips "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%.

### **BIOS 1615**

#### (A) Plating on Aluminium and its Alloys

Although aluminium is widely used in Gernany, no actual samples of nickel plus chromium plated aluminium were seen. Samples of lead plated battery lugs were encountered at Robert Bosch, Stuttgart and direct chromium plated aluminium at Elasberg's, Solingen. Numerous references are made to the plating of aluminium and its alloys, however, and the most popular treatment for plating on this metal appears to be a primary application of a zincate dip followed by either a copper or brass deposit and them final plating.

#### (B) Testing of Plated Coatings, etc.

The testing of the plated coating for thickness, porosity, corrosion resistance etc., was apparently seldom done and the platers seemed to be little concerned about these points. Testing of solutions was equally haphazard. PH was rarely controlled except by litmus and PH papers; comparators were

в.	CADINIUN		TARSCHULTE.						
	Ι.	Firm:	Kamr Donie	Cadmium Cyanide					
		Solution:	47.5 g/litre 5.0 g/litre 5.0 g/litre	Sodium Gyanide Sodium Chloride Turkey Red Oil					
	<u>Operating</u> Tempe Curre Volta		<u>Conditions</u> mature: ont Density: sge:	25 - 30°C. 10 ampa/dm <sup>2</sup> Not given					
	II.	Firm:	BLASBERG .						
		Solution:	50 - 120 g/li	tre Sodium Cadmium Cyanide					
			20 - 60 g/li 10 - 30 g/li	tre Sodium Cyanide tre Sodium Hydroxide					
			Nickel Salts	as bright addition agents.					

#### Operating Conditions

20 - 35°C. 0.5 - 1.2 amps/dm <sup>2</sup> Not given 10 - 60 minutes 12 - 13.5
12 - 13.5

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



Cross-section drawing of the Y-1561 implosion
sphere showing component placement.
Numbers in ( ) indicate quantity of identical
components. Drawing is shown to scale.
(Author)

A)	1773 EBW detonators inserted into brass
	chimney sleves (32)
~B)	Comp B component of outer lens (32)

- C) Cone-shaped Baratol component of outer lens (32)
- ---D) Comp B inner charge (32)
- E) Removable aluminum pusher trap-door plug screwed into upper pusher hemisphere
   F) Aluminum pusher hemispheres (2)
- G) Tuballoy (U-238) two-piece tamper plug
- H) Pu-239 hemispheres (2)
- ─-I) Cork lining <sup>---</sup>J) 7-piece Duralumin sphere
- K) Aluminum cups holding pusher hemisphere together (4)
- L) Polonium-Beryllium initiator
- <sup>~</sup>M) Tuballoy (U-238) tamper sphere <sup>~</sup>N) Boron plastic shell
- D) Felt padding layer under lenses and inner charges

"Atom Bombs: The Top Secret Inside Story of Little Boy and Fat Man," 2003, p 140. John Coster-Mullen drawing used with permission.

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

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

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

Erich Schumann and Walter Trinks. Patent DE977825.



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

Werner Grothmann (Himmler's adjutant). 2000. Jonastalverein Archive, Arnstadt. 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] front-usable 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.

R. P. Linstead & T. J. Betts (U.K. & U.S. CIOS chairs). 15 September 1945 final report. *The Intelligence Exploitation of Germany*. 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.



	Distribution: 27 Mar 4 SHOCRHT Fr Merck 4t Col Cole (2) S GO WAR DEPARTMENT NDD Military Intelligence Service Washington OSS OSRD	5 ETOUSA Col Page Dr. Maas Scien.Br Col Pash
	26 March 1945 BW INFORMATION	
	SOURCE: MFIU No 1, 13 March 45, PW Intelligence Bulletin No 1/47 (From CFM) Desperation Warfare	
	EXTRACT	
	* * * * * * * *	
16.	Microbe Bombs	

FW (captured 1 Mar vic AMMERN) saw appr one hundred 250 kg bombs stored in a hall at Flughorst Cst, MAGDELBURG. FW 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.



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

DECLASSIFIED Authority <u>AMD</u> 750122

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

					Pr	imary s	source	s foi	• hydr	ogen b	omb	desigr	1			
	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	<i></i>			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 <sup>6</sup> 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	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	1	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

# 10. Possible October 1944 Test Explosion on Baltic Coast

			Primary sources for October 1944 test										
		German PW Aug. 1944	Morrison Oct. 1944	Olmes May 1945	Zinsser Aug. 1945	Romersa 19552005	Grothmann 20002002	Mestlin 2004					
	Test date	Preparing for test as of ~July 1944	First half of October 1944	Sometime near the end of the war	Early October 1944	11:45 a.m. on 12 October 1944	First half of October 1944	12 October 1944					
	Test location	Near an estate in Pomerania (Baltic coast)	Baltic coast	Baltic coast	Baltic coast	Baltic Rügen island coast on Baltic coast		Rügen island on Baltic coast					
	People who were involved	Military	Military	SS, military, scientists (implied)	ary, ts Military Army Ordn d)		SS, Himmler, Kammler, Gerlach, Post Office, Diebner, Flügge	Military					
	Blast	Expected blast radius of kilometers	Suspiciously large explosion(s)	Blast kilometers wide	Bright fireball, mushroom cloud, shockwave that grew to >9 km wide	Blinding flash; heat and shockwave in bunker 2 km away; mushroom cloud; vaporized animals, trees, buildings	Successful nuclear test, possibly ~3 kilotons	Violent explosion, big dust cloud, visible from kilometers away					
Details	Radio- activity	Development related to use of heavy water		Demonstrated atom splitting	Ionized glowing mushroom cloud, severe radio interference	Had to remain inside bunker for over 5 hours after explosion, then wear protective suit to visit test site	Nuclear fission						
	Device design	New weapon that was an extremely powerful explosive and was extremely secret	Possibly an atomic bomb test	Atomic bomb with ~1 kg of fuel	Atomic bomb	Atomic disintegration (i.e., fission) bomb mounted above the ground	<ul> <li>&gt; 1 m dia. sphere</li> <li>Very heavy</li> <li>Aluminum case</li> <li>A little U-235</li> <li>for test</li> <li>More U-235 for</li> <li>deployment</li> <li>Ignition by</li> <li>special system</li> <li>Tested on a stand</li> </ul>	Something that produced an extraordinarily large explosion					

Creators For more information, see Forgotten

# 10. Possible October 1944 Test Explosion on Baltic Coast

1945. and Practical Use of the German Atomic Bomb. NARA RG 38, Entry 98C, Box 9, Folder TSC # A.P.W.I.U. (Ninth Air Force) 96/1945. 19 August 1945. Investigations, Research, Developments, October Secret Top Secret to aded from Upgr -345. 340pp. 2601--2700; AFHRA B-5737



46. The problem of harnessing the released energy in the sense of using it as power for engines, factory machines, transportation (ground, water, air), has not been practically solved as yet. This side of uranium research is clearly a post war problem.

47. A man named ZINSSER, a Flak rocket expert, mentioned what he noticed one day: In the beginning of Oct. 1944 I flew from Ludwigslust (South of Luebeck), about 12 to 15 km from an atomic borb test station, when I noticed a strong, bright illumination of the whole atmosphere, lasting about 2 seconds.

48. The clearly visible pressure wave escaped the approaching and following choud formed by the explosion. This wave had a dianeter of about 1 km when it became visible and the color of the cloud changed frequently. It became dotted after a short period of darkness with all sorts of light spots, which were, in contrast to normal explosions, of a pale blue color.

49. After about 10 seconds the sharp outlines of the explosion cloud disappeared, then the cloud began to take on a lighter color against the sky covered with a gray overcast. The diameter of the s still visible pressure wave was at least 9000 meters while remaining visible for at least 15 seconds.

50. Personal observations of the colors of the explosion cloud found an almost blue-violet shade. During this manifestation feddishcolored rins were to be seen, changing to a dirty-like shade in very rapid succession.

51. The combustion was lightly folt from my observation plane in the form of pulling and pushing. The appearance of atmospheric disturbance lasted about 10 seconds without noticeable clinax.

52. About one hour later I started with an He lll from the A/D at Ludwigslust and flew in an ensterly direction. Shortly after the start I passed through the allost couplete overcast (between 3000 and 4000 meter altitude). A cloud shaped like a rushroon with turbulent, billowing sections (at about 7000 meter altitude) stood, without any seeming connections, over the spot where the explosion took place. Strong electrical disturbances and the impossibility to continue radio communication as by lightning, turned up.

53. Because of the P-38s operating in the area Wittenberg-Merseburg I had to turn to the north but observed a better visibility at the bottom of the cloud where the explosion occured. Note: It does not seen very clear to ne why these experiments took place in such crowded areas.

FOR THE COMMANDING OFFICER:

peline, Huile gi HELENES T. FREIBERGER Captain AC

John Hooper, 30 September 2005, Author Fuels Row Over Hitler's Bomb, *The Guardian*, www.theguardian.com/world/2005/sep/30/books.italy:

Mussolini provided him [Luigi Romersa] with letters of introduction to both Josef Goebbels, the Nazi propaganda chief, and Hitler himself. After meeting both men in Germany, he was shown around the Nazis' top-secret weapons plant at Peenemünde and then, on the morning of October 12 1944, taken to what is now the holiday island of Rügen, just off the German coast, where he watched the detonation of what his hosts called a "disintegration bomb".

"They took me to a concrete bunker with an aperture of exceptionally thick glass. At a certain moment, the news came through that detonation was imminent," he said. "There was a slight tremor in the bunker; a sudden, blinding flash, and then a thick cloud of smoke. It took the shape of a column and then that of a big flower.

"The officials there told me we had to remain in the bunker for several hours because of the effects of the bomb. When we eventually left, they made us put on a sort of coat and trousers which seemed to me to be made of asbestos and we went to the scene of the explosion, which was about one and a half kilometres away.

"The effects were tragic. The trees around had been turned to carbon. No leaves. Nothing alive. There were some animals sheep—in the area and they too had been burnt to cinders."

On his return to Italy, Mr Romersa briefed Mussolini on his visit. In the 1950s, he published a fuller account of his experiences in the magazine *Oggi*. But, he said, "everyone said I was mad".

DISTRIBUTION:

# **10.** Possible October 1944 Test Explosion on Baltic Coast

- Rügen island on the Baltic coast of Germany was used for the "most secret research" during the war, according to U.S. wartime intelligence documents.
- In particular, the isolated Bug peninsula was used as a military base 1935–1945.
- It may have been the location of a nuclear test explosion in October 1944.



# 11. Possible ~November 1944 Test Explosion in Poland

			Р	rimary sou	rces for ~	-Novembe	r 1944 te	est	
		Polish engineer March 1946	Jackson June 1946	Rumor cited by Hahn Dec. 1946	Mansfeldt Dec. 1946	Edmund Tilley August 1947	Kersten 1947	Wulff 1973	Grothmann 2000-2002
	Test date	Prior to end of war (implied)	Late 1944?	~November 1944	Prior to January 1945	Prior to January 1945 (implied)	1944	1944	~November 1944
	Test location		Near Auschwitz	Somewhere in Poland	Associated with Auschwitz	Somewhere in Poland (implied)	Near Auschwitz	Near Auschwitz	Location would provoke negative public reaction [war crimes]
	People who were involved	German-run industry in Poland	SS	SS (implied)	SS	SS, I.G. Farben, German-run industry in Poland	SS	SS	SS, Himmler, Kammler, Gerlach, Post Office, Diebner, Flügge
S	Blast		Immediately vaporized entire test village with 400-500°C [4000-5000°C?]	Like Hiroshima but smaller			Single burst of 6000°C incinerated entire test village	Explosion, heat of 6000°C incinerated entire test village in a flash	Highly explosive, ~3 kilotons?, detonated in air over test site
Detai	Radio- activity	Atomic	Atomic	Like Hiroshima but smaller	Atomic	Nuclear fission	Atomic	Atomic	Nuclear fission
	Casu- alties		20,000 Jewish prisoners in specially constructed test village	Like Hiroshima but smaller			20,000 Jewish prisoners in specially constructed test village	20,000 Jewish prisoners in specially constructed test village	
	Device design	Atomic bomb with a layer of cadmium in the case	Newly invented atomic weapon of mass destruction	Atomic bomb	Atomic bomb	Atomic bomb with a 1-5 kg pit of U-235 or Pu-239	Atomic bomb detonated above the test site	Atomic bomb detonated above the test site	<ul> <li>&gt; 1 m dia. sphere Very heavy Aluminum case Larger amount of U-235</li> <li>than other tests Ignition by special system Dropped over the test site on a parachute</li> </ul>

# 11. Possible ~November 1944 Test Explosion in Poland

Robert Jackson (chief U.S. prosecutor at the Nuremberg trials), cross-examination of Albert Speer, 21 June 1946, avalon.law.yale.edu/imt/06-21-46.asp:

**MR. JUSTICE JACKSON: And certain experiments** conducted certain researches also and were conducted in atomic energy, were they not? [...] Now, I have certain information, which was placed in my hands, of an experiment which was carried out near Auschwitz and I would like to ask you if you heard about it or knew about it. The purpose of the experiment was to find a quick and complete way of destroying people without the delay and trouble of shooting and gassing and burning, as it had been carried out, and this is the experiment, as I am advised. A village, a small village was provisionally erected, with temporary structures, and in it approximately 20,000 Jews were put. By means of this newly invented weapon of destruction, these 20,000 people were eradicated almost instantaneously, and in such a way that there was no trace left of them; that it developed, the explosive developed, temperatures of from 400 to 500 [4000 to 5000?] centigrade and destroyed them without leaving any trace at all. Do you know about that experiment?

Letter of Prof. Dr. Gezo Mansfeldt, Professor of Physiological Institute of the University of Budapest (former inmate of the Rajsko camp) to Dr. Hans Münch (during the war at the SS-Hygiene Institute in Rajsko), 5 December 1946, US Holocaust Memorial Museum, RG-15.169M (1998.A.0247) microfilm reel 8:

The next day was uneventful, and on 27 January [1945], 4:00 in the afternoon the first Russian vanguard marched through the Auschwitz camp. Thus we approximately 3,000 men—physicians, nurses, and patients—were free. [...] I was the only living who knew about the Hygiene witness Institute information and so I was at least 2-3 times weekly interviewed and had to drive to Raisko several times, but now in the fine car, and show everything there. The various scientific commissions were difficult to convince that poison gas and the like was not produced there, and what was actually suspected was clear to me only much later, when I learned of the atomic bomb tests.

# **Possible ~November 1944** Polan **Fest Explosion in**



# 12. Possible March 1945 Test Explosions in Thuringia

		Primary sources for March 1945 test									
		llyichev 11/1944	Ilyichev 3/1945	Kurchatov 3/1945	Flerov 5/1945	Döpel 1946	Werner 1962	Wachsmut 1962	Rundnagel 1966	Koch 1960s	Grothmann 2000-2002
Details	Test date	Preparations at fastest pace	Two in ~March 1945	~March 1945	Recent months	Prior to end of war	Evenings of 4 & 12 March 1945	4 March 1945	Work from 1944 to end of war	Early March 1945	4 March 1945
	Test location	Thuringia Wooded area Very remote	Thuringia Wooded area Very remote	Remote area (implied)	Wooded area Very remote	Truppen- übungs- platz military base	Behind Röhrensee from Wachsenburg	Near Ringhofen estate	Thuringia near Diebner lab, possibly other installations	Thuringia Wooded area Near research installation	Thuringia near Ohrdruf base, SS lab, Diebner lab, bomb production
	People who were involved	SS	SS			SS (implied) scientists (implied)	SS, Post Office, Research Council	SS, Kammler, Post Office, Research Council, special doctors	Diebner's scientists, SS (implied)	SS (implied), scientists (implied)	SS, Himmler, Kammler, Gerlach, Post Office, Diebner, Flügge, special doctors
	Blast	Large destructive power	High temp., large blast, buildings/trees in 500-600 m radius	Several hundred meter radius		Atomic bomb test	Bright flash and strong wind from kilometers away	Stinging flame to edge of forest		Far larger than normal bomb, destroyed test site, knocked down trees	$\begin{array}{l} \text{Deployed:} \geq 3 \text{ kt} \\ \text{Tested:} \geq 0.13 \text{ kt} \\ \text{but} << 3 \text{ kt,} \\ \text{larger than} \\ \text{expected} \end{array}$
	Radio- activity	Probably atomic	Massive radioactive effect	Probably atomic	Test for residual radioactivity	Atomic bomb test	Radiation sickness in surrounding towns	Protective gear, decon., radiation sickness			On-site production Horrible test effects Doctors had to help surrounding areas
	Casu- alties	Rapid SS construction → many POWs likely present	Many POWs vaporized, killed, and burned		POWs present		Many bodies to be collected	~450-700 POWs killed or burned; more than expected		People in the area would have been killed	Many workers at test site killed, doctors had to help surrounding areas
	Device design	Probably atomic, 1.5 m diameter, several nested hollow spheres	1.3 m dia.2 tonsAl caseU-235 fuelIgnition byneutronsDetailedimplosiondesignDesignedfor rocketUsed LOX toreduce weight	Spherical U-235 fuel Ignition by neutrons Implosion design Designed for rocket Used LOX to reduce weight	Probably atomic bomb	Uranium bomb	Something new that will make world history	Something new of which the whole world will speak	Atomic bomb capable of killing >100,000 people. At least two bombs. 8 kg fuel each, small enough to store in safe.	New and unusual weapon	<ul> <li>&gt; 1 m dia. sphere</li> <li>Very heavy</li> <li>Aluminum case</li> <li>A little U for test</li> <li>More U-235 for</li> <li>deployment</li> <li>Ignition by</li> <li>special system</li> <li>Designed for rocket</li> <li>Integrated design</li> <li>to minimize weight</li> <li>Tested on a stand</li> </ul>

# 12. Possible March 1945 Test in Thuringia

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12







# 12. Possible March 1945 Test Explosions: Radioactivity Then












~100 km<sup>2</sup> region with **Radioactive fallout in region** significant fallout ~0.15–0.26 Gy/hr at 1 hour, or (depending on local ~1.1–2.0 Gy for the first 24 hours winds/topography) (causing radiation sickness but not short-term lethality) Blast radius 500-600 m (vield ~200–350 tons TNT) Lethality radius ~500 m for prompt radiation **Prompt** radiation at the test site and the **Radioactive fallout at test site** ~4.5–7.9 Gy/hr at 1 hour, or ~34–59 Gy for the first 24 hours **Radioactive** fallout (lethal doses that may help account from the test would for the lack of later witnesses) emit 80% of its total radiation within the first 24 hours

radioactive fallout at the test site and in nearby towns within 24 hours fit Ilyichev's description that a "massive radioactive effect was observed"

After 79+ years, the radioactivity of the fallout would have dropped to  $\sim 2x10^{-9}$  of its radioactivity 1 hour after the explosion [Glasstone and Dolan 1977, p. 393], or  $\sim 2.6$ – 4.6x10<sup>-6</sup> Gy/yr averaged over the region and  $\sim 7$ –14x10<sup>-5</sup> Gy/year right at the test site.

The residual radioactivity at the test site would be at least ~10–30 times smaller than the natural background radiation (~1– $2x10^{-3}$  Gy/yr) and hence extremely difficult to detect.

After 79+ years of water, wind, and human activity, the fallout could easily have become scattered over a significantly larger area than the 100 km<sup>2</sup> assumed here, and/or become buried to varying depths in the ground, making it even harder to detect.

Therefore modern measurements of residual radioactivity cannot prove or disprove whether the March 1945 Thuringian nuclear tests (or other possible tests) occurred.

Other scientific methods may or may not be able to detect signs of the tests:

- Using mass spectrometry, particle-induced X-ray emission, neutron activation analysis, or other highly sensitive methods.
- Looking for <sup>238</sup>U from the tamper.
- Comparing data at and away from the test sites to eliminate background signals.

Hitler visiting the Reichswerke Hermann Göring at Linz, Austria (near Gusen) on 4 April 1943, apparently surrounded by nuclear scientists



Hitler visiting the Reichswerke Hermann Göring at Linz, Austria (near Gusen) on 4 April 1943, apparently surrounded by nuclear scientists

Bayerische Staatsbibliothek, Munich

Kurt Diebner



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Otto Hahn, 1968, Mein Leben, p. 200:

Professor Staudinger wrote me that an officer had given him his word of honor that three German nuclear bombs had been ready for deployment in the Lüneburg Heath shortly before the end of the war.

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Benito Mussolini, 20 April 1945 interview. Gian Gaetano Cabella, 1948, *Testamento politico di Mussolini*, p. 45:

The famous destroyer bombs are going to be prepared. I have, still a few days ago, received very precise news. Perhaps Hitler does not want to strike the blow except in the absolute certainty that it is decisive. It seems that there are three of them, these bombs, and of astounding effectiveness. The construction of each is tremendously complicated and time-consuming.

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Erwin Bartmann, 2013, *Für Volk und Führer*, pp. 160–161, 231:

'As you know, I am responsible for making the telephone connections when calls are made to and from the Air Ministry. Listen to this—the other day I made a connection between Göring and the *Führer*. [...] Göring asked the *Führer* for permission to use three special bombs but he refused. "If I use them in the east they will get us from the west," said the *Führer*.' [...]

After the war, I became friends with Rochus Misch, a fellow *Leibstandarte* veteran and communications officer in the *Führerbunker* until the final days of the *Reich*. The topic of the special bombs came up in conversation. 'Three bombs,' he said, 'where did you hear that? There were nine.'

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Henry Picker, 2009, *Hitlers Tischgespräche im Führerhauptquartier*, 2nd ed., pp. 42, 493:

[...] the small-pumpkin-sized "uranium bombs" (with their full destructive energy in a 3-km radius), which according to Schaub's information had been developed to ready prototypes at the Reichspost's research office in Lichterfeld [...] According to Schaub, the "terrible weapons" meant above all the "uranium bomb" with the size of a small pumpkin which was to be produced in an underground SS plant in the southern Harz region (with a production capacity of 30,000 workers). The plant was relocated to the USSR by the Red Army in 1945 after Germany's unconditional surrender.

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Edmund Tilley. Brief Operational Report on [censored] and Other Germans and Italians Connected with Project Abstract. 19 August 1947. NARA RG 319, Entry A1-134A, Box 29, Folder Operation Oberjoch:

25. Prof. Dr. NIELS [Walter Nielsch?], now said to be in the United States, was, according to [censored,] concerned with chemical and atomic problems at TUCHELER HEIDE and produced a number of atomic bombs, weighing from 1 to 5 kilograms. NIELS should be traced and questioned in detail.

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Werner Grothmann, 2002 interview, Jonastalverein Archive, pp. 31–32:

It is known to me that there were four atomic tests. The first still in 1943 in the autumn in the North Sea, which failed. Then two in 1944 in the autumn and the late autumn. One of them on the ground, that is on a small stand, the later one in the atmosphere on a parachute. That one in winter 1944 in the air was highly explosive and the charge [fuel] was also larger. That could have been in November. The last test was then again with a small charge in March 1945. [...] I can definitely declare that I was told of six atomic bombs that came from three different research installations. All were prototypes. In addition, there were some very small devices that were intended for laboratory experiments.



3. Intercontinental jet bombers

The nuclear triad was NOT originated by the U.S. and Soviet Union after World War II. The nuclear triad was originated by Germany during WWII, then the tech was transferred. For more information, see *Forgotten Creators* Appendix E.

C.S.D.I.C. (U.K.) S.R.G.G. 1118. Information received: 10 Jan 1945. AFHRA A5415 frames 284-285. Secret recording of German generals Heinrich Kittel and Wilhelm von Thoma as prisoners of war in U.K.]

KITTEL: (Re atom bomb). It's a perfectly horrible thing. [...]

THOMA: Then he would have used it long ago.

**KITTEL:** No; he isn't using it, because the others have promised to retaliate with chemical warfare.

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Allen Dulles, 1 April 1945, Cable IN 9061 from Bern, Switzerland to Office of Strategic Services, NARA RG 226, Entry UD-90, Box 6, Folder 64 SUNRISE:

In his conversation with Kesselring, latter said to Wolff our situation is desperate, nobody dares tell truth to Fuehrer who surrounded by small group of advisers who still believe in a last specific secret weapon which they call "Verzweiflunge" weapon [Verzweiflungswaffe: desperation weapon]. Kesselring believed this weapon can prolong war but not decide it, but might cause terrible blood bath on both sides. Kesselring said if Fuehrer gave him order to use weapon he would surrender his command.

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Rochus Misch. 2014. *Hitler's Last Witness: The Memoirs of Hitler's Bodyguard*. Barnsley: Frontline Books. p. 60.

The Western Allies had threatened that, if Germany used the atom bomb, they would assemble 15,000 aircraft in North Africa and use them to drench all of Germany with poison gas.

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who still believe in a last specific secret weapon which	part of the enemy.
they call "Verzweiflunge" weapon [Verzweiflungswaffe:	Winston S. Churchill to General Hastings Ismay. 6 July 1944.
desperation weapon]. Kesselring believed this weapon	I WANT you to think very seriously over this question of poison gas. I would
can prolong war but not decide it, but might cause	not use it unless it could be shown either that (a) it was life or death for us, or
terrible blood bath on both sides. Kesselring said if	(b) that it would shorten the war by a year. [] I want a cold-blooded
Fuehrer gave him order to use weapon he would	calculation made as to how it would pay us to use poison gas, by which I mean
surrender his command.	principally mustard. [] If the bombardment of London really became a
Rochus Misch. 2014. <i>Hitler's Last Witness: The Memoirs of Hitler's Bodyguard</i> . Barnsley: Frontline Books. p. 60. The Western Allies had threatened that, if Germany used the atom bomb, they would assemble 15,000 aircraft in North Africa and use them to drench all of Germany with poison gas.	serious nuisance and great rockets with far-reaching and devastating effect fell on many centres of Government and labour, I should be prepared to do anything that would hit the enemy in a murderous place. [] We could drench the cities of the Ruhr and many other cities in Germany in such a way that most of the population would be requiring constant medical attention. [] I quite agree it may be several weeks or even months before I shall ask you to drench Germany with poison gas, and if we do it, let us do it 100%.

# 14. Allied Belief in German Nuclear Weapons: Wartime Intel



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# 14. Allied Belief in German Nuclear Weapons: Wartime Intel

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LINEMY PRODUCTION OF ATOMIC BOMBS - SUMMARY 1. Intelligence indicates that the enemy is working in the project field. It is likely that he has undertaken one or several of the various processes for the production of bombs on a small scale and to have organized an installation equivalent to our project on final utilization. (TAB A).

2. The various methods for the production of U-233, U-235 and Pu-239 have been considered in the light of scientific development, basic materials, and industrial effort required. (TAB B). The liquid thermal diffusion process for production of U-235 on a moderate scale and the pile process using heavy water for the production of Pu-239 on a small scale appear to be the most likely possibilities; the production of U-233 on a useful scale appears to be unlikely. Activities inferred from the intelligence and other reports indicate that these processes could have come into operation during 1943. (TAB C).

3. On the basis of the above analysis it is possible for the enemy to have at least one device in his hands now, but it is improbable for him to have more than three. Entry 22 . Bot 171

RG 77

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**32.60-2** Germany: Summary Reports (1945--1946) NARA RG 77, Entry UD-22A, Box 171, Folder

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NNU 917017 Authority

4-8-91cc

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION

### 9 Dec. 1944 Diary of Margaret Suckley, Franklin Roosevelt's Secretary

He [FDR] spoke very seriously at dinner about the German menace. He has just had a secret report from a German source which has been quite reliable in the past, to the effect that the Germans have a V3 bomb which will kill by concussion everything within a mile. They are planning to use it on New York for morale purposes—again, not seeming to realize that it will have the exact opposite effect to that which they expect. The entire Atlantic seaboard has relaxed all its dim-outs and airraid precautions, etc. & the Pres. sent word to the Gen. staff that all previous preparations of that sort should be reviewed on the chance that the report about the V3 may be true. He said that in the next war, the side which first uses these new explosives will undoubtedly win. The Germans are way ahead of us in that direction, though we are doing a lot of research trying to catch up to them.

FDR Library, Hyde Park, NY. Margaret L. Suckley Papers. Journal Group E. JE 208. 9 Dec. 1944.

flying off - He way he The one we have heard but not The day was unce eike other days accept That The mail plane was grounded by The weather at greenville SC. + The porced came on by sail + so did ut get here with after moon, sotthe routine was - little upset - after lunch, the Pres. took us for an openair drive in a n-w direction. going, we were on the dist road it going slowly - to one could enjoy the air · sund; but returning, we mant don'the concert + it was almost too cold. a quiet enomin by The fire. I think the Pres. Cooks a list la Weller but he needs a lot of quiet and sun. Just one week more. He spale ben seriendy at deman about The German menace. He has just had a secret report flow a german sounde which has be quite reliable in the past, to the affect that

Kill by consision everything written a wile They are planning to use it don her yosk for morelle purposes again, not beaun to realize that it will have the exact opposite affact to That which the expect. The entire Atlantic sealourd has relaxed acc its dimouts and air -raid precoming, etc + The Pres. Sant word to the gam. shaff That are previous preparations of That Sort should be neuronal in the chance but the report about The V3 may be true. He said this in the means war, The site which first uses These new explosing will undoubtedly in. The gamans are boy ahead of us in that direction, Though we are do a lot of research trying to catch to Them . We found on it. How unbeliebally horrible it all is. those mysterious books & report, almit "Sha - Vas" in The Himalinga luts, - is all prophes I keep wondering of they may not be entirely true, there reports and that the human races in our to deathey steall. only the faw is line in is deted placed may survive the faw is line in Dec. 10 Saturday, a heart if al day, and Polly has to leave tomorrow. The is such a vital person, so aline and mactine, we will wiss her tarribly -- I Think The holed here has done her de great deal of good, in forcing hay to be quiet at times. This is such a lovely place, on the hillsude, with

# Big Projectile Reported New Hitler Weapon

SOMEWHERE IN FRANCE, Sept. 23 (Delayed.) (P)-American are army troops have obtained information indicating that a 14-ton projectile with an explosive radius of three kilometers--almost two miles--is scheduled as the third in Hitler's series of vengeance weapons.

Times 30 Sept. 1944 p. 3

Metal of the Millennium: German scientists nearly succeeded in solving it. Since the surrender of the Nazi armies, Allied officers have revealed that Germany would have been able to strike with atomic bombs by January 1945, if the invasion had not come six months before. The highest Allied officials knew that such explosives could have won the war for the Axis.

## 14. Allied Belief in German Nuclear Weapons: Wartime Intel

George C. Marshall, 1 Sept. 1945, p. 132. history.army.mil/html/books/070/70-57/CMH\_Pub\_70-57.pdf

Victory in this global war depended on the successful execution of OVERLORD. That must not fail. Yet the Japanese could not be permitted meanwhile to entrench in their stolen empire, and China must not be allowed to fall victim to further Japanese assaults. Allied resources were searched through again and again, and strategy reconsidered in the light of the deficiencies. These conclusions seemed inescapable: France must be invaded in 1944, to shorten the war by facilitating the advance westward of the Soviet forces. At the same time German technological advances such as in the development of atomic explosives made it imperative that we attack before these terrible weapons could be turned against us. In addition, the pressure on the Japanese in the Pacific must not be relaxed. Communications with China must be reopened. Resources were allocated accordingly, The balance was extremely delicate but we had to go ahead.

Where are the official Allied reports???

# Major Robert Furman to LTC John Lansdale, 22 May 1945

Alsos position here now is complex. I might write you what I see happening, but it all results in confirming our present policy of hands off and no participation in their re-organization. Boris left here for home to try to convince authorities that the Alsos job is over. But in this theater, Betts, Conrad and Bowles are not agreeing that the job for which Alsos was set up to do is in any way completed. More scientists have now arrived. Frecision fuzes, BW and MACA investigations are now absorbing the energies of Tarryton equipment and personnel.

### **Boris = Boris Pash**

A great many TA reports still remain in Germany, as you know. Therefore, reports on installations are received weekly about which we do very little. We always try to pick up papers that are reported to exist, to remove them from TA = circulation but it is impossible to keep other agencies from finding out about Tube the German effort. For instance, in Osenberg's files, was found some of the Alloy essential reports which you had taken back to the states. (nuclear)

### NARA RG 77, Entry UD-22A, Box 168, Folder 202.2 LONDON OFFICE: Combined Intell Disc.

Betts and Linstead. 15 September 1945. *The Intelligence Exploitation of Germany. Report of Combined Intelligence Objectives Subcommittee*. AFHRA A5186, pp. 904–1026.

DECLASSIFIED Authority ND 91-1017

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 Peenemunde staff, V-weapons were designed with much smeller war-heads. Quite possibly this trend was in anticipation of the successful development of a German atomic explosive.

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GeneralGeneralMIT ProfessorThomasGeorgeEdward L. Bowles,J. Betts,Bryan Conrad,Advisor for AAFSHAEF G-2SHAEF G-2Gen. Henry Arnold



NARA RG 77, Entry UD-22A, Box 160, Folder APR 45--Dec. '45

From: Supreme Headquarters, Allied Expeditionary Forces, Forward, Frankfurt, Germany

To: War Department Nr: 422

31 May 1945

Multiple address. 3112000 May COSITINTREP nr 422, Part 1---Land, Section B. From HQ 12th Army Group from Bradley signed Eisenhower, ref nr QX 21736.

F. Uncovering of new or improved enemy weapons and equipment:

A laboratory containing equipment and documents related to experimental work on atomic bombs and AA rockets was located near Lofer, E 7399 by Third US Army.

Royal Army Ordnance Corps. October 1946. *R.A.O.C. Gazette* 28:5:150. U.K. Imperial War Museum LBY E. 14449. www.rlcarchive.org

Many interesting discoveries were made by Ordnance representatives *en route*. D.D.O.S. of 8 Corps found a factory engaged in production work for the German atomic bomb. The ammunition for Germany's largest gun was also located. Two of these massive guns had been captured by the Russians, but this was the first time their ammunition had been seen. At Belsen, the Ordnance service found itself faced with an unprecedented task.

### Where Are the Reports???

### AFHRA C5094 frames 0957-0958

HEADQUARTERS UNITED STATES AIR FORCES IN EUROPE (MAIN) Berlin Intelligence Party

CHARLES A. CROWLEY.

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SUBJECT: German V-1 and V-2 Personnel.

TO : Lt.Col. W.F. Heimlich, Executive, G-2, Berlin District Command, APO 755, U.S. Army.

1. In view of the fact that the wants of USAFE on V-1 and V-2 personnel have been satisfied, I am inclosing information on those men whose evacuation we have recommended. My memory of the conversation which we had a few weeks ago is to the effect that USFET was still anxious to either exploit or to know the exact location of these individuals. The list follows:

> g. <u>Gerald Klein (Dr.). Dipl.-Eng. Manager of LGW</u>. Address: Berlin-Dahlem, Hohe Ahren 10b. Specialty: Electrical flying control, V-2 control. A very efficient electrical engineer. Developed V-2 control devices. Worked at Peenemunde and later became group director of atomic devices in RLM. At present being used by the British. Evacuated by "T" Force.

RLM = Reichsluftfahrtministerium (Ministry of Aviation)

APO 755, U.S. Army. 31 August 1945.

# 14. Allied Belief in German Nuclear Weapons: Postwar Intel

#### THE CHEMICAL PROBLEM IN GERMANY

The picture in scientific and chemical fields of development has long been very competitive and often retarded by the lack of financial assistance. Many of the industries of the United States while progressive on the production line have been quite willing to accept the benefit of the research and development of others, but not bothering to maintain research units of their own.

Many of the chemical achievements now in use are the result of the research and development accomplished in other countries. While the United States enjoys the privilege of a school system that can and docs provide numbers of young scientists, well versed in their particular fields, few are employed by industry at salaries commensurate with their skill. Consequently, the young scientific mind resolves the problem as one of miss-selection, so therefore, seeks and obtains more remunerative positions outside of their field causing a complete dislocation of their academic achievements.

The German government and German industry had an entirely different attitude toward their scientifically trained men. The research and development work accomplished in the past decade will attest the value of subsidizing the scientists in the form of annuities and awards, not only for completed work but generous support of an idea from its embryonic imaginary state, through the laboratories, pilot plant, to the final production stage.

Spectacular accomplishment in uranium, nitrogen, oxygen recovery, plastics, nuclear physics and many other fields, have been uncovered in the investigation of the chemicals field alone.

Sulphonated oil fat liquors, comprising a complete range of oils: including animal, vegetable and synthetic were developed successfully. These



anti-radar devices, and piloted rocket missiles that they expected to cross the Atlantic in 17 minutes, to butter made from coal, the Office of War Information reported today.

How these German war secrets began to be unlocked by American and British experts long before V-E Day was officially revealed today. The announcement included a statement on the scope and value of some of the secrets disclosed. Many of them were being adapted by United States and British technologists for use against the Japanese when the war ended, OWI reported. The thoroughness of the search for German war secrets foreshadows a similar probe for the secrets now locked in Japan, OWI added.

Some of the more startling of the secrets that may be disclosed at this time, show that not only had the Germans made significant progress in the development of an atomic bomb and in the production of "heavy water" but they:

1. Had contemplated a piloted missile with a possible range of 3,000 miles. The designer envisaged commercial applications for trans-Atlantic passenger crossing in 17 minutes. See States

2. Were working on a formula for new war gases that they hoped would prove. more deadly than any chemical agent yet developed.

3. Had specifications and construction details for naval vessels of advanced design, including submarines with high underwater speeds and apparatus for eustained underwater operations.

4. Had developed a system of radar camouflage consisting of anti-radar coverings and coatings to be employed on submarines and other weapons.

5. Had highly advanced jet engine, rocket assisted take-off and aero-dynamics designs.

6. Had found new uses for many staples, as for example, coal. From coal the Germans were making a synthetic butter as well as alcohol of both beverage and industrial types, aviation lubricants, soap, and gasoline.

7. Had designs for various secret types of guns and gun sights, novel gear and transmission construction and air-cooled diesel engines.

Other German war secrets ranged from records on the location of German capital in neutral countries, and the status and composition of German cartels, to specifications of long-range Tocket developments that scientists describe as "sensational". In addition to the missile that they expected to have a range of 3,000 miles, the Germans had plans for V-type weapons much more advanced than those which they directed against the British Isles last year.

Where are the reports???

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### 14. Allied Belief in German Nuclear Weapons: Postwar Intel

### Col. George Bryant Woods [Intelligence, Air Technical Services Command during WWII; Assistant to the Undersecretary of the Air Force 1947–1950], 1946, *The Aircraft Manufacturing Industry*, p. 32.

Germany's Plans for the "A-9" with Atomic Bomb The range of the V-2 was only something over 200 miles but this was sufficient to reach all intended targets at that time. The German scientists, however, had not stopped with the V-2. During 1945 they had already built at Peenemunde (in the hands of the Russians since that time) several "A-9's". This was a winged V-2, either manned or unmanned,

and intended for a range of around 3,000 miles with the aid of a large auxiliary launching rocket. Together the launching rocket and the A-9 weighed 110 tons, as compared with 13½ tons for the V-2. After the auxiliary launching rocket had accomplished its purpose and dropped off, the A-9 was designed to continue under its own power wholly outside the earth's atmosphere at an altitude of approximately 150 miles, and at an estimated speed of 5,800 miles per hour. This obviously would mean an Atlantic crossing in well under an hour's time, and a launching ramp had already been constructed in Normandy prior to the Allied invasion.

In captured scientific German documents there are diagrams of the city of New York showing anticipated areas of destruction to be expected after perfection of such a weapon to carry an atomic war head, and it is well known that the Germans originally had hoped to have their atomic bomb developments completed by the end of 1944. The Germans had many other advanced developments in guided missiles, but the V-2 was an actual accomplishment and its further development for long range was just a matter of time. Meanwhile all the allied nations have recourse to the captured German documents describing their future plans for these weapons and many of the former German scientists responsible for these developments are known to be continuing their work in each of the allied countries. Adequate defense against such weapons as the V-2 and the A-9 will require highly ingenious and supersonic defensive weapons, and no country can afford to forego the necessary expense for basic and applied reasearch to that end.

### German Rocketeers: German Rockets and Guided Missiles Almost Won the War for the Nazis. *AAF Review* July 1946. Based heavily on information from Col. Donald Putt.

Also understandable now on the basis of our present knowledge is Germany's almost suicidal last-ditch stand after Allied forces had crossed the Rhine in overwhelming numbers. Assuming that the Nazis were completely whipped, the Allied populace could not understand why they would not give up and put an end to senseless, wholesale slaughter. But German commanders, it now appears, were aware that if they could hold out for just a short time longer they could very well effect at least a stalemate, if not a short-cut victory on the European battlefront.

It is now also fairly generally known that the atomic bomb race was close—again, closer than we care to think about. And paralleling the Nazis' research on atomic explosives was their accelerated development of the V-2 program. Linking these two projects together makes credible another theory which is current among Allied guided missile groups: namely, that it was the intention of Nazi technicians to put some sort of atomic device in the warhead of the V-2.

This, they point out, would then have made the V-2s economical beyond question. One of the facts which has puzzled observers is that the V-2, with its small-sized warhead permitting only one ton of conventional explosives, did not justify the tremendous cost of each missile. The damage achieved—actually less than that of the V-1 which was many times cheaper and took only 800 man-hours to make—did not begin to compensate for the 12,950 manhours required for the manufacture of every V-2. But if, as they now believe it had been originally planned, even a few of these supersonic V-2s could have carried atomic warheads, there is little doubt that they could have wiped our invasion ports off the map and reduced England to the shambles that are Nagasaki and Hiroshima.

Allied bombings of the Nazi heavy-water plants in Norway quite obviously retarded her atomic development, as did also the consistent subotage on the part of many Norwegian scientists. But it is still a matter of scientific conjecture just how many weeks—or days—it might have taken Germany to be ready with her atomic devices for the V-2s.

### Where are the reports???

### **Roy Fedden.** German Plans to Revolutionise Air Warfare. Daily Telegraph & Morning Post, 1 Oct. 1945, p. 4.

In these respects they were not entirely lying. In the course of two recent visits to Germany, as leader of a technical mission for Ithe Minister of Aircraft Production, 1 have seen enough of their designs and production plans to realise that if they had managed to prolong the war some months longer, we might have been confronted with a set of entirely new and deadly developments in air warfare

### Atomic Explosives

to believe There is some reason promised that Hitler had been atomic explosives by October of this year, and if Germany had been them the idea use IOI first to changing the whole course of the wat from a small base in the South German mountains is by no means so far-fetched. A new range of very high-speed German fighters and jet bombers was already flying, or within a few weeks of flying when the war ended Immense developments were under way with robot rocket weapons, some which had already started in production. They were simple and cheap to make, and with atomic explosives even a few such devices could have placed air warfare on a new nightmare plane of impersonal long-distance annihilation such as we have not so far contemplated.

Where are the reports???

> *Indianapolis* Times, 2 Aug. 1947, p. 4.

# **Reveal Nazis Planned Rocket** To Blast N. Y. at 6000 MPH

### A-9 Was Designed to Employ Booster Weighing 190,000 Pounds for Acceleration

WASHINGTON, Aug. 2.-The Germans planned a bomb to cross the Atlantic and blast New York. It was a rocket to be started on its long journey by another rocket which detached itself when its job was done.

This was revealed today by Brig. Gen. William L. Richardson of the U. S. army air forces.

Gen. Richardson, chief of the A. A. F. guided missiles and air defense division, spoke as a guest

of Watson Davis, director of Science Service, on "Adventures in Science," heard over the Columbia network.

several rockets known as the "A" series. The V-2, used against Lonit was the only one of this series to be used operationally in the last war, it is not hard to visualize what might have been in store for the allies had the Germans been given ments.

#### Acid Used in Fuel

as the V-2. The A-10 was the end serving its purpose. result toward which this whole program was directed. This is the weapon which the Germans expected to use in bombing New York.

fuel.

The A-10 was never actually constructed. However. all design studies and computations had been The Germans, he said, developed completed. It appears that it could have been built and used if the Germans had been given another don, was one of these. Although year of development and production.

#### Speed Put at 6000 M. P. H.

The total weight of the A-10 was to have been 190,000 pounds. The weapon was nearly 12 feet in sufficient time to complete develop- diameter and 25 feet long. The 29.000-pound A-9 was to have been accelerated to a speed of 2500 miles Each of the "A" series was de- per hour by the use of the A-10 as veloped primarily for research, with a launching rocket, which detached the exception of A-4, later known itself and would drop free after

It was the A-9 that would reach the target. Its rocket motor would be turned on when the A-10 dropped. This would increase its speed to The A-10 was described by him about 6000 miles an hour. It would as a booster rocket placed behind have carried a warhead of about the A-9, giving it two-step co-oper- 2000 pounds. This is a payload of ation to secure ranges of 3000 miles. only 1 per cent of the starting The A-9 was much like the A-4, weight of the weapon, but there is more familiarly called the V-2, with evidence to believe, he stated, that wings added to give increased range the Germans intended to utilize an and using acid as an oxidizer in its atomic warhead which would have made this weapon extremely deadly.


#### 14. Where Are the Reports on Postwar Inspections and Interrogations at Known or Suspected Nuclear Facilities? Bornholm R F Königsberg Kiel **Tucheler** Heide Hamburg Pomeranta **Bydgoszcz** Oranienburg Lüneburger Heide Espelkamp Berlin area Braunschweig Brussels Piesteritz Riese area Wroclaw Erzgebirge area Leverkusen ehesten Dresde Dečín+Liberec Katowice Thuringia Auschwitz Prague inderground Frankfur Stechovic **Opava+Ostrava Pilsen+Pribram** Dubnica lübingen Regensburg Ceské Mühldorf Linz+GusenMelk Floridsdorf Sigmaringen Redit Staul Stevr Sopron Bull PEST Ebensee Neustadt unich Lover all Unterraderach Tvrol-Graz am-See Althofen

### 14. Allied Belief in German Nuclear Weapons: Inspections



Where are the reports on postwar inspections/interrogations at these suspected nuclear sites?



About 50 to 60 tons of strongly radioactive "tarnsand" was delivered to the German Army, according to Mr. Futterkneck of the firm Geophysikalische Gerätebau. "tarnsand" was used to activate artifically the soil covering non-metallic mines, so that presence of a mine could be indicated with a mine detector sensitive to radioactivity. The detector and its use has been reported on by Mr. C. A. Hachemeister, Civ., OCE, and therefore will not be discussed in this report, but the nature of the "tarnsand" is of interest. The "tarnsand" was said to have been supplied by Auergesellschaft, to be the residue from the extraction of radium from pitchblende ore, and to have the same radioactivity as ore containing about 10 percent pitchblende. Preliminary tests made by R. P. Fischer show that the "tarnsand" has the equivalent radioactivity of ore containing 5 to 10 percent uranium in equilibrium with its disintegration products, confirming the last part of the above statement. Until the "tarnsand" is analyzed chemically, its exact nature cannot be determined. It is unlikely, however, that the "tarnsand" is actually the residue from the extraction of radium from ore, as reported, for such material should be only slightly radioactive. It also seems unlikely that the "tarnsand" is prepared directly from St. Joachimsthal crude ore, even though its radioactivity is about the same as the ore, for it is believed that the German requirements for radium and uranium were too important to use and dissipate the ore in the form of "tarnsand". More likely the "tarnsand" was prepared from material in which the radioactivity has been artificially induced. On the other hand, it is possible that the radioactivity of the "tarnsand" is derived from the thorium series rather than from the uranium series or from artificially induced radioactivity, for it is reported that Auergesellschaft treated monazite sands for rare earths and thus would obtain thorium as a by-product. The problem is of interest mainly in attempting to account for quantity of radioactive materials available to Germany.

### "Tarnsand"

Dr. Richard P. Fischer, a U.S. Geological Survey expert on radioactive minerals, wrote this report in June 1945.

If Fischer was correct, wartime Germany had a working fission reactor capable of irradiating at least 50-60 tons of "tarnsand."

Fischer's report was promptly confiscated by the office of General Leslie Groves and never published.

DECLASSIFIED

NARA RG 77, Entry UD-22A, Box 163, Folder Australia

## The U.S. Army Discovered Some Very Special Uranium Oxide in Germany

COPY 

Subject: Additional Supply of Uranium Oxide.

To: Assistant Chief of Staff, G-2, United States Forces European Theater (Main), APO 757, US Army.

1. Reference is made to your letter from US Military Attache, London, 14 December 1945, subject: "Materials in Laboratory of Dr. KIRCHENER, Garmisch", and letter your office same subject, dated 21 February 1945.

2. Additional quantities of Uranium Oxide have been located in the amount of approximately five and one-half tons at Bad Tolz and Munich. This material was found in the custody of Dr. Fritz REHBEIN, formerly part of the investigation group of the State Investigation Council (Reichsforchungsrat). It was inspected and left in his charge by <sup>1</sup> rofessor Charles P. SYMTHE, Princeton University in June, 1945. Professor SYMTHE also inspected the materials now located in Garmisch. This is the second occurrence in which like material was located in the custody of German scientific groups inspected by Professor SYMTHE at which inspection he told the custodians to hold the material for further instructions. In view of this, request that Professor SYMTHE be contacted to determine if other such material can be located or is in the custody of any other groups.

3. 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. This is contrary to instructions for shipping material at Garmisch to the United States as given in paragraph 3 of your letter of 21 February 1940.

By reason of such danger, request that specialist personnel be provided to prepare and supervise shipment. Routine of actual movement will be handled by G-4 Section, this headquarters.

4. Request authority to ship all material now located at one time.

EDWARD M. FICKETT Colonel, GSC AC of S. G-2 EPD/sk

Manhattan Engineer District Office of the K tary Attache American Embassy, London 1 April 1946

SUBJECT: Shipment of Uranium Compounds.

TO: Colonel W. R. Shuler, Room 4181, War Department Building, Washington, D. C.

1. Reference our cable 70400 of 28 March 1946. The following are the facts behind this shipment of uranium.

2. Early in the winter, we learned of the existence of  $1\frac{1}{2}$  tons of uranium compounds at Garmisch-Partenkirchen. G-2 USFET was alerted to move the stuff. Actually, G-2 moved very slowly and we had to prod them on three successive occasions.

3. On the other hand, G-2 moved extremely quickly re the five tons of uranium oxide recently discovered at Bad Tolz. (See letter this office "Professor Smyth and Uranium Oxide in Germany", dated 15 March 1946.)

4. The two lots were consolidated into one at Bremerhaven and put aboard the Hagerstown Victory. This ship sailed on 19 March and should arrive in New York about 6 April.

> EDGAR P. DEAN Lt. Colonel, AUS

Where are the detailed reports?

DECLASSIFIED Authority NND91-101

NARA RG 77, Entry UD-22A, Box 169, Folder 32.32. Germ. Incl. TA

### 14. Submarines—Where Are the Reports???

#### "OPERATION LUSTY"

At a mediawal inn near Thumersbach near Berchtesgaden, early in May 1945, the German General Air Staff patiently awaited the outcome of surrender negotiations taking place in the They had arrived by car and plane during the past weeks, North. when the fall of Berlin was imminent, and had kept in contact by radio with Admiral Doenitz at Flensburg. Through the interception of one of these messages, their location, which had previously been unknown, was discovered. Within twenty-four hours Lt Col. O'Erien and his small party, representing the Exploitation Division of the Directorate of Intelligence, USAFE, had arrived, located the party and conducted the first of a series of discussions with General Koller, who was then in command. All documents and records that had been brought by the High Command were immediately turned over, and the first unearthing of buried records and documents, in and around Berchtesgaden, as well as the initial interrogation of the staff officers present, took place.

A casual remark made by a technical engineer, who stated that he had recently been offered a position in Japan, led to his being thoroughly interrogated for significant technical information. As an aside, and what he probably considered a relatively unimportant incident, he stated that less than a month ago, about the middle of April, ten submarines heavily loaded with the latest German equipment relative to aerial warfare, were dispatched from Kiel to Japan. When Lt Col. O Brien was thus informed he immediately advised the Directorate of Intelligence, USAFE, who in turn notified the Japanese Intelligence Section of SHAEF. A cable was then dispatched to all commands in every theater of war. All vessels in ports and at sea were notified, and one of the biggest searches ever undertaken during the war for submarines was initiated. What route they had taken, whether they had gone alone or together, no one knew. But so extensive was the search and so carefully was it executed by warshine of all Allied nations, that by the end of June, six of these ten submarines had been captured intact, some a relatively short distance away from their bases, others perilously close to Japan.

In a mountain side near the camp of the German Staff officers, an air raid shelter had been blocked up and then carefully covered and concealed with dirt. Its presence was eventually revealed by the officer who had directed this concealment, but only after he had noticed that a hole, large enough for a man to crawl through, had appeared in one of the sides. Thinking that the cache had been discovered, he explained to the USAFE party the

Operation LUSTY. Jan 1946. -1-AFHRA C5098 pdf p. 586

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NARA Boston RG 181. 1st Naval District. Office of the Assistant Chief of Staff for Operations. Formerly Security Classified General Correspondence 1944--1945. Box 26. Folder U-Boats, Surrender of.

	<u>SECRET</u> 262151 (P)	27 MAY	
•	FROM :	CNO	
	TO:	NYPORT	
	INFO:	COMONE	
	SUBJECT :	MINE TUBES, UNLOADING OF	
	INTERROG	ATION IT PEACE SECOND WATCH OFFICED H. 234	DICOLOCEC

INTERROGATION LT PFAFF SECOND WATCH OFFICER U~234 DISCLOSES HE WAS IN CHARGE OF CARGO AND PERSONALLY SUPERVISED LOADING

ALL MINE TUBES.

PFAFF PREPARED MANIFEST LIST AND KNOWS KIND DOCUMENTS AND CARGO IN EACH TUBE.

PFAFF STATES LONG CONTAINERS SHOULD BE UNPACKED IN HORIZONTAL POSITION AND SHORT CONTAINERS IN VERTICAL POSITION.

URANIUM OXIDE LOADED IN GOLD LINED CYLINDERS AND AS LONG AS CYLINDERS NOT OPENED CAN BE HANDLED LIKE CRUDE THT.

THESE CONTAINERS SHOULD NOT BE OPENED AS SUBSTANCE WILL BECOME SENSITIVE AND DANGEROUS.

PFAFF IS AVAILABLE AND WILLING TO AID UNLOADING IF RNEDT DESIRES. ADVISE.

DISTRIBUTION COMDT C/S DUTY OFF ACO (A) DIO D ORD OFF

## 14. Allied Belief in German Nuclear Weapons: PersonnelDr. Ing. Hans Kammler, the SS general in charge of almost all secret weapons by the end of the war



1. Dr. Wilhelm VOSS reported to this office 24 April 1946. Subject was the director of the Skoda Works and Bruenner Waffenwerke in Prague, Czechoslovakia from 1939--1945. Subject claims that he has valuable information on atom bomb research in Germany. [...] 2. Dr. Wilhelm VOSS was born 1 July 1896 in Rostock, Mecklenburg. [...] He was one of the founders of Reichswerke Hermann Goering and in 1938 became its commercial director. In 1939 VOSS was appointed director of Skoda and Bruenner Waffenwerke by Goering.

**3.** Subject states that the two men that were responsible for research on the most secret weapons at Skoda were SS Gruppenfuehrer Prof. KAMMLER and his deputy SS Oberfuehrer PURUCKER. On the 10 May 1945 VOSS and PURUCKER were in Schimelitz, fleeing in the direction of the American troops. PURUCKER was driving a large civilian car which contained many of the plans on the atom bomb. This car plus material fell into the hands of the Russians, and VOSS was separated from PURUCKER. VOSS at present does not know where PURUCKER is located.

### Hans Kammler in Charge of Nuclear Program

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#### Wilhelm Voss. April 1946. NARA RG 319, Entry A1-134B, Folder XE065651 Voss, Wilhelm.

In the last years [of the war], the central management of the development and production of the most secret weapons and devices was in the hands of SS General Professor Kammler and his working group. These were the most secret weapons, devices, and processes, some of which were actually used, but some of which were not used [in the war], namely in the field of atom smashing, the transformation of elements, the atomic bomb and atomic energy, and also rocket weapons, the latest propulsion systems for aircraft, remote control, etc. While in some areas the various parts of the Wehrmacht worked independently of each other until the last days of the war, Kammler succeeded in centralizing the development work in his field. He was the representative of the Ministry of Armaments, the Army Ordnance Office, the Air Force, and the SS at the same time.

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### Hans Kammler in Charge of Nuclear Program

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BIOS 142. Information Obtained from Targets of Opportunity in the Sonthofen Area. 1945. Obergruppenführer Professor Kammler, one of the directors of the S.S. Hauptamt, was said to have great influence on Himmler and more influence on Hitler than Speer himself; and he was kept informed on all questions concerning armaments. The New Weapons section of the Waffenamt was apparently directed by a man called Bree. Standartenführer Klumm worked in this section and under him Lt. Kreutzfeld, who was interrogated. One of the functions of the S.S. was to control the work of politically unreliable scientists who were kept in concentration camps. One of these camps was at Oranienburg, and research was done here on new weapons. [...] Another such camp was located at Nordhausen in the Harz, and came under the direct control of Kammler. Here the prisoners worked in an underground factory engaged on production. [...] Ernst stated that he had been imprisoned at a concentration camp for politically unreliable scientists called "Camp Mecklenburg" in the Lüneburger Heide. This place was not known to Kreutzfeld, who was however acquainted with the Oranienburg camp. The possibility of bringing Ernst over to Oranienburg was also mentioned in Ernst's personal file[....] Ernst also stated that there was a similar camp at Mauthausen, near Vienna, but this was also unknown to Kreutzfeld. [...] Ernst also stated that [...] trials on some kind of atomic bomb were made at or near the camp.

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Werner Grothmann, 2002 interview, Jonastalverein Archive, pp. 6-8, 18. In the last years of the war, which may have been in the fall of 43, close coordination was decided between Ohnesorge and Himmler. I still don't know the details, but Kammler was in on it. [...] Kammler at least had an overview of the projects that were supposed to turn our situation around in the medium term. But he was completely secretive. I still don't know whether he discussed this in detail with Himmler. I can tell you that none of us on the staff had comparable information. [...] In addition, Kammler was responsible for almost all secret developments and special projects, and he was constantly on the move. He spread optimism almost until the end of March[....] To put it bluntly, we were not in a position to force the final victory in April 45 and I still hold the view today that a decisive strike on London at the end of April would not have brought about a turnaround [...]

## **Postwar U.S. Interrogations of Hans Kammler**

Loyd K. Pepple. 30 May 1945. Memorandum: Summary of Activities, Operations Section, Exploitation Division. AFHRA folder 570.605 1944-46, Misc. Documents G-2 Miscellaneous Data.



To date the intelligence exploitation of the German Air Force and of German technical facilities has yielded a vast amount of materiel and documents. Briefly to evaluate at this time the worth of such materiel and documents is made difficult due to the fact that the emphasis has necessarily been upon the speed of collection rather than upon consise evaluation. How ever enough progress has already been made to indicate that a proximately helf of the category "one" items assigned for evacuation by Wright Field have been secured. Much of the materiel for the Tonger term research into all aspects of the German Air Force as required by "Air Staff Post Hostilities Intelligence Requirements" propered by AC/AS, Intelligence, Hq, AAF, is presently being gathered.

There follows a brief outline of recapitulation of the accomplishments to date divided into technical and non-technical exploitation.

#### GERMAN NON-TECHNICAL PERSONNEL

personnel	47. The following is a list of presently being held for interro	key German Air Force non-technical gation.
	Reichsmarschall Hermann Goering	Commander in Chief of Luftwaffe.
	Generalfeldsarschall Ehrhard Milch	Secretary of State for Air and Inspector General of the GAF-Directo General of Regipment.
	General der Flieger Koller	Chief of General Staff of Luftwaffe.
	Dr. Albert Speer	Minister for Armament and War Production.
	General Martini	Director General of GAF Signals.

General von Criegern General Quartermaster of Luftwaffe.

Generaloberst weise	specially detailed officer for defense against enemy long-range arms.
SS-Obergruppenführer Kammler	Inspector of all units of the Luftwaffe working with rocket-propelled arms.
General der Flieger Bodenscha	tz In the office of the Air Minister (also

Louis D. Caplane and William G. Magee. Undated but apparently ca. August 1949. Subject: Source of certain funds held for Sammelkonto Accounts by the Austrian National Bank at Linz, Upper Austria. NARA RG 260, DN1929, Roll 0126, pp. 26 ff.

Declassified per Executive Order 12958, Section 3.5 NND Project Number: NND 785009 By: NND Date: 1978

Ebensee and about S 2,400,000 were authorized for payment to creditors. Payment, however, was stopped and this accounts for the large balance.Had this sum been paid the balance would have been 1,100,000. On the other hand some additional 3,000,000 was forwarded to this account by the Reichsbank in München but the sum was not credited to the account because it was stopped by the Military authorities before it left München.

Shortly after the occupation, Hans Kammler appeared before the CIC in Gmünden and made a detailed statement on the operations and activities of the Baustelle Ebensee, as well as on the account, and his own authority and authority of Karl Englehardt. None of the present American Officers at the CIC, Gmünden, is familiar with his statement but it should be in the files there. Mr. Morrison of the CIC, Gmünden was requested by the team to send a copy of this statement to Mr. Loehr.

#### CONCLUSIONS :

 Sammelkonto was established by the Financial Division of the Military Government in 31 July 1945.

2. Sammelkonto received monies belonging to the German Wehrmacht and its affiliated organizations.

3. The details of the account show that some of the funds could not be classified as direct Wehrmacht funds without a more thorough investigation. There a more thorough investigation. It could be other funds which were erroneously classified as Wehrmacht funds. George C. McDonald to Ernst Englander. 2 November 1945. Subject: German Underground Installations. AFHRA folder 570.6501A 1945-46, Special Projects—Current.

1X-HEADOHARTERS UNITED STATES AIR FORCES IN EUROPE Office of Asst. Chief of Staff A-2 APO 633 AAF Station 179 2 November 194 SUBJECT: German Underground Installations. TO: Major ERNST ENGLANDER, A.C., Headquarters UGAFE, APO 633. 1. I have been instructed by the AC of S A-2. Headquarters Army Air Forces, Washington, D. C., to furnish detailed information from many aspects on enemy underground installations, technique, etc. 2. In view of recent scientific developments, it is considered of the utmost importance for future planning and of the highest priority that we obtain all the benefit of the experience of German industry regarding the use of such facilities. 3. To implement the required study, you are directed to make the necessary arrangements to personally interrogate Speer, Kammler and Sauer and report your findings to me as soon as possible. GEORGE C. McDONALD, Brigadier General, U.S.A. Asst. Chief of Staff A-2. by hand to Maji Englanden 2 nov us 2 NOV. 1945

- Where are the transcripts of Kammler's interrogations?
- Where are the German documents he brought with him or directed investigators to?
- Where are the reports on his postwar work, life, and death?

Siegfried Flügge appears to have been the top physicist of the German nuclear program. Edward Teller brought him to the U.S. to "be of marked assistance in carrying out" a "physics... program... of interest and importance to the national security." When not in the U.S., Flügge was placed on the Top Secret JIOA K "hot list" and constantly monitored/detained for at least a decade after the war, on the direct orders of CIC Lt. Col. George R. Eckman, formerly of Alsos. Where are the reports on Flügge's interrogations and on his postwar work?



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

CS GERNAND

Re: Nuclear Physics Institute

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

Karl-Friedrich Bonhoeffer Wernher von Braun **Rudolf Brill** Adolf Busemann Walter Dornberger **Rudolf Edse Krafft Ehricke Gerhard Falck Karl Fiebinger** Wolfgang Finkelnburg **Rudolf Fleischmann** Siegfried Flügge 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 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.



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

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Virtually the entire "Paperclip" file on German nuclear physicist Otto Haxel remains classified, with the documents removed or completely blanked out [NARA RG 330, Entry A1-1B, Box 66]

Photo of Otto Haxel from Wikipedia



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#### NARA RG 226, Entry A1-134, Box 219, Folder 1371: OUT AZUSA Nov. '43 Sept. '45

#### "Azusa" = OSS code word for German nuclear

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14. Allied Belief in German ►



## Some Allied Officials Whose Files May Hold Insights

Commander Herbert Agar (1897-1980), assistant to U.S. ambassador to U.K. Jack H. Alberti (??-??), U.S. Navy intelligence civilian investigator Col. Robert S. Allen (1900-1981), U.S. Army Dr. Luis Walter Alvarez (1911-1988), Manhattan Gen. Henry H. Arnold (1886-1950), U.S. Army Air Forces Col. Peter Beasley (1884-1957), U.S. Army Air Force, Strategic Bombing Survey Dr. Hans Bethe (1906-2005), Manhattan Gen. Clayton L. Bissell (1896-1972), U.S. Army Air Forces intelligence A. E. Britt (??-??), affiliation? Dr. Vannevar Bush (1890-1974), Director of OSRD/NDRC Maj. Horace K. Calvert (1915-2006), U.S. Army/Manhattan intelligence Dr. Karl P. Cohen (1913-2012), Manhattan Dr. James B. Conant (1893-1978), Assistant Director of OSRD/NDRC Captain George C. Davis (??-??), U.S. Army/Manhattan intelligence Col. Howard W. Dix (??-??), Office of Strategic Services Gen. William Donovan (1883-1959), Office of Strategic Services Director Allen Dulles (1893-1969), Office of Strategic Services, later CIA Director Col. George R. Eckman (??-1971), U.S. Army Counter Intelligence Corps, Alsos G. Verner Edlund (??-??), U.S. Army Counter Intelligence Corps Maj. Ernst Englander (??-??), U.S. Army Air Forces Dr. Richard Fischer (1910--1991), U.S. Geological Survey Dr. Victor H. Fraenckel (1908-1998), Scientific Intelligence Advisory Section (SIAS) for Supreme Headquarters Allied Expeditionary Force (SHAEF) Maj. Robert R. Furman (1915-2008), U.S. Army/Manhattan intelligence Col. Dale M. Garvey (1914-2002), U.S. Army Counter Intelligence Corps David Gattiker (??-1993), U.K. Atomic Energy Office Dr. Samuel Goudsmit (1902-1978), Alsos scientific head Gen. Leslie Groves (1896-1970), U.S. Army/Manhattan commanding officer Caperton Horsley (1903--1988), CIOS Gen. John Edwin Hull (1895-1975), U.S. Army Justice Robert H. Jackson (1892-1954), U.S. Prosecutor, Nuremberg trials Dr. Theodore von Kármán (1881-1963), chief scientific advisor for Henry Arnold Col. John A. Keck (??-??), U.S. Army Ordnance Col. Oscar Koch (1897-1970), U.S. Army intelligence Gen. Egmont F. Koenig (1892-1974), U.S. military attaché in Czechoslovakia Dr. Gerard P. Kuiper (1905-1973), Alsos

Col. John Lansdale, Jr. (1912-2003), U.S. Army/Manhattan intelligence Gen. John Magruder (1887-1958), Office of Strategic Services Deputy Director Gen. George C. McDonald (1892-1969), U.S. Army Air Forces intelligence Gen. Joseph T. McNarney (1893-1972), U.S. Army Air Forces Dr. Philip Morrison (1915-2005), Manhattan Dr. John von Neumann (1903-1957), Manhattan Dr. Todos M. Odarenko (1900-1975), AT&T Bell Laboratories Lt. Col. John A. O'Mara (19??-19??), U.S. Strategic Air Forces in Europe, **Office of the Director of Intelligence** Dr. J. Robert Oppenheimer (1904-1967), Manhattan Dr. Richard W. Porter (1913-1996), General Electric rocket programs Gen. Donald Putt (1905-1988), U.S. (Army) Air Force Gen. William L. Richardson (1901-1973), U.S. (Army) Air Force Dr. Howard P. Robertson (1903-1961), Chief of the Scientific Intelligence Advisory Section (SIAS), SHAEF; Eisenhower's highest-level science advisor Lt. Vladimir L. Rychly (1909-1992), U.S. Navy attaché in Czechoslovakia A. J. Saxon (??-??), Manhattan Whitney Shepardson (1890-1966), Office of Strategic Services Col. W. R. Shuler (??-??), U.S. Army/Manhattan intelligence Gen. Edwin L. Sibert (1897-1977), U.S. Army intell, Central Intelligence Group Col. Leslie E. Simon (1900-1983), U.S. Army Maj. Francis J. Smith (??-??), U.S. Army/Manhattan intelligence Dr. Charles P. Smyth (1895-1990), Alsos Gen. George Strong (1880-1946), U.S. Army, Military Intelligence Corps head Dr. Edward Teller (1908-2003), Manhattan Maj. Edmund Tilley (1892-1966), U.K. military intelligence Dr. Richard C. Tolman (1881-1948), Manhattan Maj. H. S. Traynor (??-??), Manhattan Dr. Maj. John E. Vance (1905-1975), U.S. Army/Manhattan Joseph Volpe, Jr. (1914-2002), U.S. Army/Manhattan Frederic A. C. Wardenburg III (1905-1997), Alsos Col. Lowell P. Weicker (1903-1978), U.S. Strategic Air Forces in Europe, **Office of the Director of Intelligence** Maj. P. M. Wilson (??-??), Dustbin interrogation center Col. George Bryant Woods (1896-1954), U.S. Air Technical Services Command (ATSC)/Air Materiel Command (AMC) intelligence

According to recently rediscovered archival documents, wartime Germany was:

• Mining uranium at at least ~11 sites all over Europe, beginning in 1938 and continuing as a high priority to the very end of the war.

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- Telling its top officials and leaders of other countries that Germany possessed/would soon possess nuclear weapons.
- Developing delivery vehicles for those weapons.

If you saw some random modern country that suddenly started doing all of those things, would you conclude that that country clearly had no significant nuclear weapons program, or would you decide that all of that evidence raises real concerns and warrants a more detailed investigation?

## **15. Further Work**

The true, detailed, complete history of the German nuclear program has not yet been publicly written by anyone (including me).

To do that, we must first:

- Search for relevant documents in archives and personal collections around the world, and lobby to have all files declassified and released.
- Conduct industrial archaeology digs (carefully!) and laboratory analyses at sites suspected to have been involved in the German nuclear program.

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



## FOR CONTINUES FLOOT TO CREAT OF CONTINUES

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



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### Over 5000 pages covering:

- Major innovators and innovations produced by the predominantly Germanspeaking scientific world ~1800–1945
- Systemic factors that promoted so much innovation in that place and time
- Technology transfer out of the German-speaking world
- What we can learn that could improve innovation in the modern world
- >1000 pages of primary sources/analysis on the WWII German nuclear program
- >400 pages of bibliography

**Reviewed by European and American historians and scientists** 

Updated as new information is found

## Short version—but click the links! Long version of nuclear program

8.8. NUCLEAR ENGINEERING IN THE THIRD REICH

#### Nuclear Engineering in the Third Reich 8.8

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 discovered in recent years, and was not publicly available when earlier historical assessments were made. The evidence presented here covers:

8.8.1. Flaws in the conventional historical view of the German program.

8.8.2. The fundamental scientific knowledge and planning of the program.

8.8.3. Sources of uranium and thorium.

8.8.4. Enrichment of uranium-235.

8.8.5. Fission reactors for breeding plutonium-239 and/or uranium-233.

8.8.6. Electronuclear systems for breeding plutonium-239 and/or uranium-233.

8.8.7. The production of other potentially nuclear-related materials.

8.8.8. Fission bomb designs.

8.8.9. Hydrogen bomb designs.

8.8.10. An October 1944 test explosion on the Baltic coast.

8.8.11. A circa November 1944 test explosion in Poland.

8.8.12. March 1945 test explosions in Thuringia.

8.8.13. Axis belief in the reality of German nuclear weapons.

8.8.14. Allied belief in the reality of German nuclear weapons.

#### 8.8.15. Further research that is needed.

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<sup>6</sup> This view is based on three categories of evidence, although each category has its own limitations as summarized below and in Section D.1

<sup>6</sup>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 2024

Available for free at: riderinstitute.org/revolutionary-innovation

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.<sup>1</sup> 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 Noddack in 1934, and discovered 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.

<sup>1</sup>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-twentiethcentury 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

Dr. Todd	H. Rider	riderinst	itute.org	Relativistic Quantum Field Theory Todd H. Rider thor@riderinstitute.org 13 November 2019
	JOLENSA OF PROFESSION AND POWER		8	Any suggestions for improvements would be greatly appreciated.
Fundamental Limitations on	Vol. 13, No. 3, May-June 1997	REPORTS	Broad-Spectrum Antiviral Therapeutics	
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Not in Thermodynamic Equilibrium	Antimatter Rocket Propulsion	Simi at the root start codes. Substitution of the 17th rootsets of rop2/Phy Ale codes would be substitution of the 22th rootsets of rop2/Phy Ale codes would average and rootset substitution of the 22th rootsets of rop2/Phy Ale codes would average and rootsets average and rootsets average and rootsets average and rootsets average and rootsets average and rootsets average and rootsets average and rootsets average average and rootsets average and rootsets average and	Abstract	-James Joyce, Finnegans Wake (1939)
Todd Harrison Rider	Todd H. Rider <sup>a</sup> Massachusetts Institute of Technology, Cambridge, Massachusetts 02139	structure, thereby preventing RNA secondary A former, ML 1242 (1999), perter by NP gene MS-0090623     structure inhibition of AT synthesis. Complicate     24 J Seignesh N Checks J, Revent M21,     and (1975), 25 March 2008, accepted 9 Jane 2008	Currently there are relatively few antivinal therapeutics, and most which do exist are highly pathogen-specific or have other disadvantages. We have developed a new broad-spectrum antivinal approach, dubbed Double-stranded BNA (didRNA) Actuated Consume (Bioanneire (DRACD) that velocitively indices accontexis in ordis containing wird dRRNA, reacidity Willing and the second se	I think I can safely say that nobody understands quantum mechanics.
S.M., Nuclear Engineering, MIT, 1994	Because antimatter could potentially be used to accelerate interstellar space probes to velocities in excess of 10% of light speed, attention is drawn to the question of whether sufficiently large quantities	that the reput codes regions can also pair with the sequence pair updature of the reput call the reput call of the reput	Infected cells without harming uninfected cells. We have created DRACOs and shown that they are nontasic in 11 mammalian cell types and effective apairot 15 different viscoss, including dengue flaviorus, Amagari and Tacarbe arenariuses, Guana buryanius, and Hillin Inferenza. We have also demonstrated that DRACOs can rescue mice challenged	–Richard Feynman, The Character of Physical Law (1965)
S.M., Electrical Engineering and Computer Science, MIT, 1991 S.B., Electrical Engineering, MIT, 1991	of antimative could be produced in a frashlik fashion. A number of different proposed methods for large- scale antimative production are analysed, and fluctamental, brough applicable limitations on all of these schemes are presented. The implications for antimather rocket propabilion are discussed.	Identification of Pathogens  Todd H, Rider, <sup>1+</sup> Martha S, Petrovick, <sup>1</sup> Frances E, Nargi, <sup>1</sup>	with HINI influenza. DRACDi have the potential to be effective threspectics or prophylactics for numerous clinical and priority visues, due to the bimad-spectrum is unstitivity of the doRNA detection domain, the potentia activity of the apoptosis induction domain, and the novel direct linkage between the two which visues have never encountered.	Overview
Submitted to the Department of Electrical Engineering and Computer Science	Nomenclature $\gamma$ = relativistic factor, (1 - $v^2(c^2)^{-10}$	tional suming of uncharged (RNA <sup>1/9</sup> are used by it. addits to regulate ap oproce capres- tion. <i>Ecoleristica</i> coll and assess succhargid to the second seco	Classine Rider Nr, Zook OJ, Bertheler TL, Mick ST, Pancoust JL, et al. (2011) Broad-Spectrum: Antiviral Therapeutics. PLoS ONE 9079 e22572. doi:10.1017/ journal.journ.8022572	Relativistic quantum field theory (or field theory, for short) combines special relativity, which
Doctor of Philosophy	A = ratio of ion mass to proton mass $\Delta E$ = energy fluctuation of particle-antiparticle pair B = magnetic field strength $\Delta r$ = lifetime of virtual particle-particle pair c = speed of light e = electric field strength	dBAA <sup>(**)</sup> translationally in regulating np operon expression, however, the mechanism of action is very different (?). He use of genetically engineered cells in a pathogen identification sensor. This sensor uses B lymphocytes that have been engineered to entil light	Edites: Supprisals Senthan, Center for Dissan Control and Prevention, United States of America Received Nay 20, 2011; Amerginal June 24, 2011; Addiabade July 27, 2011 Cappright or 2011 Role et al. This is an operational activation don't the terms of the Center Conneces Attribution States, which permits	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 second s
. at the	E         a beam energy         η         e efficiency of antronom protocolo           E <sub>taw</sub> laser energy         η <sub>mon</sub> e efficiency of laser light absorption           e         charge of proton         η <sub>mon</sub> e atfrainanter rocket engine           e         charge of proton         η <sub>mon</sub> e atfrainanter rocket engine	References and Notes 1. D. Inore, C. Youdity, in function subtits and Other at very low levels. Recause of its speed, sensitivity, and specificity, this pathlogen at very low levels. Recause of its speed, sensitivity, and specificity, this pathlogen	simetricad aux, desbatas, and reproduction in any medium, provided the original author and source are coded. Funding: This work is Andret by parter ABST103 http://www.maidstn.gov/fundu.apu/hom the Material institute of Allerge and infections.Discours and the New Engineer Reprod Engineer Centre of Engineeries Indexidence and Engineeries profession.Discours with previous. Andreof Report.Ch on the New Engineeries of Engineeries Technicana and Engineeries profession.Discours, with previous. Andreof Report.Ch and the New Engineeries of Engineeries Technicana and Engineeries profession.Discours with previous. Andreof Report.Ch and the New Engineeries of Engineeries Technicana and the Internet State and t	high specis (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 map particles moles calculations mean complicated. Field theory will thus be applied in
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	$e^{-}$ = electron have $L_e^{-}$ = Compton wavelength $f^{-}$ = pointeen $L_e^{-}$ = Compton wavelength $f^{-}$ = fraction of synchrotron radiation that escapes $\mu_{0}$ = magnetic permeability $e^{-}$ = atternets methads for zeros section	dentification technology could prove useful for medical diagnostics, bioverfare defense, food- and water-quality monitoring, and other applications. watering on Print particular	Project, Aprice, Defense These Reductor Aprice, and Devices of Defense Research & Engineering. The funders had no only in study design, data collection and engine, decision to additive, anothesis of the measure). Opinions, interpretations, conclusions, and economendations are those of the authors and are not reconsulty endorsed by the United States government.	spin or real particles makes calculations make comparison. From theory will there 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 reheave a compared such as Compton scattering and
June 1995	f <sub>h</sub> = antimate propriate fraction         τ         = confinement time of laser target pellet           h         = Planck's constant         τ         = confinement time of laser target pellet           h         = Planck's constant         τ         = int-int Collects collision time           f         = Planck's constant         τ         = int-int Collects collision time           f         = base bases interaction         τ         = attirection production time	2. F. Correst, P. Matchan, C. Yunothy, B. The diagnosis of infections diseases such as parental cell line with stable expression of cyto- ficial A. I. Januardan, J. A. Istok, R. Linda, University and directions of potential busicerrorisin against. ML22JR (JgM+) B cell line (N), and the chore that and advection of potential busicerrorisin against. ML22JR (JgM+) B cell line (N), and the chore is a stable service acceler experiment of potential busicerrorisin against.	Computing Indexents I'm it for investor on patients and parent application covering ORXCO. Nam I'm issued costee (2), 2009. A head-pathogen treatments, U.S. Parent 73,2020; Risk PS Mound My 22, 2020. A neg pathogen treatments, Si Parent 74,804. Risk PS Mile Mark PS Testiments, U.S. Parent Registration 2700008888, Risk PM filled Hotsway 7, 2020. Anti-Pathogen Testiments, Sangana Parent Registration 27109811, Risk PS Mile I Indraway 2, 2023. And-Pathogen Testiments, Castade Internet, Sala Cost, Sala Mile Villed Internet, Sala Sala Sala Sala Sala Sala Sala Sal	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
© Todd Harrison Rider 1995	$M_{+} = a train the propertiant mass K_{+} = e \text{lectric permittivity}M_{+} = a train atter propertiant mass f \approx \Lambda = \text{Coulomb logarithm}M_{-} = a \text{final property mass}$	<ul> <li>Barran, S. Yon, S. Yu, Yu, Yu, Yu, Yu, Yu, Yu, Yu, Yu, Yu,</li></ul>	Cooperation Trans Section No. (2021):2019; Baller TH Filler February 7, 2021. Anti-Pathogen Teatments, Japanese Pater Application. 2020503429; Baller The Balle Neuroster 14, 2020. Hord-Pathogen Teatments, Japanese Paters Application 2020023426. This does not after the authorit' adheesing to all the Russ OHE policies on dwaining data and metanish.	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
The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic copies	Mr, * total (antimatter + matter) peopellant mass. m, * mass of detection or position m, * mass of energy of a stateway for the state of the state	<ol> <li>A. A must at , other MR 107 (1999)</li> <li>B. A. Amme at A. (Ammer 4R) 157991</li> <li>B. A. Ammer 4R, 157991</li> <li>F. Bataska, C. Yanzitag, Prov. Natl. Anal. Sci. U.L.A. and polymerase: chain reaction (PCR) (2)</li> <li>Trajion games, into which variable regions spe- region games, into which variable regions spe- ter and polymerase. Chain reaction (PCR) (2)</li> </ol>	- Law Read The File	theory to gravitation, although there remain obstacles to developing a complete quantum theory of gravity.
of this thesis document in whole or in part.	n,         e electron density         star systems with a travel time of less than the businan inferpan.           n,         e ion density         H has been preposal <sup>3</sup> be accomplished as a complished as a complished as a second plant and a second pl	B. (Donga, P. Gansa, Pe., Nati Asad. Sui U.A. 90     Their report describes a perforger serior that     City. For a particular gathagin were unmethed     Si U.S. 48 (2014)     Si U.S. 49 (2014)     Their report describes a perforger serior that     City. For a particular gathagin were unmethed     statistics 0. Gate, C. Yaudda, Porc. Nat. Asad     and sensitivity through the use of B Sympho-     disc optimal response to that parbogon (1/9)	Introduction is effective against a very broad spectrum of visues, nonstaic is sits and is riss, and powenially similable for either puephylactic or therapeutic administration. Our approach, which we call a	Biochemistry
	$n_{c1}$ = density of second ion type vehicle. In determining the feasibility of automatter roket pro- P = plasma pressure pulsion the most important issue is whether sufficiently large $P_n$ = son-electron energy transfer rate quantities of antimatter can be created in an affordable and	<ol> <li>Ito is Brownin, M. L. Kurste, C. Sanstlag, D. J. Imassa, J. Backwini Wei, M. 2019</li> <li>M. Kang, A. &amp; Kana, P. Galink, J. Backwini Wei, 487 (1988).</li> <li>M. Balane, A. K. Lunk, P. Galink, J. Warty efficiently. B cell lines were engineered.</li> </ol>	visues (HIV, hepatitis visues, etc.), matural emerging visues (polar and wine influenan strain, SARS, etc.), and visues polarity of the strained gives (DRACO), is designed to infectively and trapidly life visue-infected effects to research historyconing. Excl., unaltance, etc.). Uniform	Todd H Rider ther@riderinetitute.org 13 November 2019
	Pp         = power converted into antiprotos         practical tashien. This paper will any end evaluate a norm.           Pp         = synchrotron tallation power         ber of different antimative been posposal           P         = proton         for creating antimative rocket propellar; this paper will also           P         = proton         for creating antimative rocket propellar; this paper will also	<ol> <li>Ji Ko, K. Tuguy, K. Banana, J. Banania 199, 2004</li> <li>Shi Ko, K. Tuguy, K. Banana, J. Banania 199, 2004</li> <li>Shi Ko, K. Fagaran, J. Banania 199, Banania 199,</li></ol>	natardy, there are relatively itsy prophylactics or therapeutics for these strates, and mont which do cost can be divided into three band customing 11.9 (c) Knowledge induktion or a strategierous the strategierous doubles or sinderstrated BNA	Any suggestions for improvements would be greatly appreciated.
Signature of Author	μ = astground possai prova international possai product and and a set out of the possai product and a set many possai product and and a set out of the possai product and a set out of the possai	(ang) (1996) 15 nt Tomineg, Januardi 193, 1932 (1934) 15 nt Tomineg, Januardi 193, 1933 (1934) 16 nt A. (1985), J. Januardi 1934, Marcine 1934, 1834 (1996), J. Januardi 1934, Marcine 1934, antibodies by even lew levels of the appro- sents (1996) for 20 CU in antibodies by even lew levels of the appro- sents (1996).	unget (e.g., HIV protease inhibiters, RNA) generally must be deschaped for each view or viral strain, are pours to resistance if a copion and reglication, the remainder of views have DNA generates	Near the further end a low arched passage branched away from it and led to the chemical laboratory.
Department of Electrical Engineering and Computer Science May 10, 1005	T = this unread over and have have a set of the se	<ol> <li>J. Strems, S. Morin, C. Twadig, Jins, Nat. Last, And S. M. 2005. Constructions of the sequence function of the sequence function of the sequence function. Second Sci U, S. M. Neisen, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Meine, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Meine, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Meine, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Meine, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Meine, Car. Open Mexanical. A 149 (2006).</li> <li>M. Markin, Car. Open Mexanical. A 149 (2006).</li> <li>M. M. Markin, Car. Open Mexanical. A 149 (2006).</li> <li>M. Markin, Car. Ope</li></ol>	vious instances not uring longit, are not instances or assume too emerging or eighterent visit diversa, and can have indiverses to adverse effects. (2) Varcines also require a new varcine to be produce long dBNA (greater than ~21-25 hase pairs) [4-5].	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
May 13, 1393	b = patient votante V <sub>ρ</sub> = reaction volume producing antiprotons V <sub>a</sub> = volume emitting synchrotron radiation v = baan velocity	B: Glanss to be seamed for all look uses groups. The seame CANARY (collular analysis and old excess F: inference block for expression book for expression block for expression	developed for each view or viral strain, must be administered before ar in some cases soon after exposure to be effective, are next immediately available for emerging or engineered viral directs, protini lianar R (FKR) contain an Neurmini domain with most	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.
Lawrence M. Lidsky	r <sub>int</sub> = reclect engine exhaust velocity compact storage of the antimative propellast in a reckert, asti- Z = ratio of loans protein charge is protein charge protein have the further advantage that their analolitation with d = retain of planma pressure to magnetic field	simple tables and piered in a bulkgrowth table tables and the particular set of the set	can have unformers before effects, and are difficult to produce for certain pathegens (e.g., HIV) (3) Interferous and other prev or aminimfammatrics are less vieu-specific, but oil are only world begin of at loat 30–50 base pais (3) actions to the PKR via trans-	"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."
Professor of Nuclear Engineering Thesis Supervisor	pressure yet to thrust it a rocket engine than the gamma rays produced by electron-positive annihilation. This paper vill analyse various methods that have been pro-	surgence was interconferenced in an 10%-10% pilly and pilly and pi	against certain viruses, and they can have serious adverse effects through their interactions with the instance and endocrine supersystem of the instance and endocrine supersystem of the instance of the ins	Had he discovered a gold mine, greater delight could not have shone upon his features. "Dr. Watson, Mr. Sherlock Holmes," said Stamford, introducing us.
Accepted by	Encurrent Out, E. (1998), revisions menuing Pub. 10, 1997), acceptud for publication Public 1999, pp. 10, 100, 1997, H. (2004), period for producing antiprevision. Each of the methods will be Publicated by the American Institute of Aeronautics and Astronautics.	b/h Dataché à Data in () invanduliarigi na enteres to the 47 praties band arbhidy and mailter arb houraid arbhidy and arbhidy and mailter arb houraid arbhidy and arbhidy and mailter arb houraid arbhidy and mailter arb houraid arbhidy and for Excerning and the QEM arbitrary arbitrar arb houraid bit arbhidy and for Excerning and the QEM arbitrary for Excerning and description of the QEM arbitrary arbitrar arbitrary arbitrar	To correspect the description of the state o	-Arthur Conan Doyle, A Study in Scarlet (1887)
Frederic R. Morgenthaler Chairdhan, Department Committee on Graduate Students	<sup>10</sup> Department of Elevirol Engineering and Compare Ecience car- ensity at 501 West A Street, North Linke Rock, AR 72116. Measher AlAA.	www.sciencemag.org 3CENCE VOL301 11 JULY 2003 2	PLIS ONE   www.pissone.org         1         July 2011   Volume 6   Issue 7   e22572	"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
	United States Patent [19] [11] Patent Number: 4,723,736	United States Patent [19] [11] Patent Number: 6,087,114	(12) United States Patent (10) Patent No.: US 7,566,694 B2	infinitoria, with a notice of ejectiment or sometrang For a moment he gaped. Then he gave a sort of inarticulate cry, dropped candle and writ together, and went blundering down the dark passane to the stairs. I shall near fermet that dawn, and the strange here of gaving that my
Fundamental limitations on plasma fusion systems not in thermodynamic equilibrium	Rider [45] Date of Patent: Feb. 9, 1988	Rider [45] Date of Patent: Jul. 11, 2000	Rider (45) Date of Patent: *Jul. 28, 2009	passage to the scans I shan never longer that adward, and the strange notion of seeing that my hands had become as clouded glass, and watching them grow clearer and thinner as the day went be until at text I could use the sidely disented of the scene threads them, then the local me
Todd H. Bider <sup>40</sup> Massachusetts Iduations of Technology, Department of Electrical Engineering and Computer Science, Conductors, Messachusetts 2010.	[54] ROCKET STAGING SYSTEM like wherein a carriage borne rocket engine assembly is sequentially employed within separate, generally	[54] OPTOELECTRONIC SENSOR Paddle, "Biosensors for Chemical and Biological Agents of Defence Interest", Biosensors & Bioelectronics	(54) ANTI-PATHOGEN TREATMENTS Finlay et al., "Exploitation of Marenalian host cell functions by baserial pathogens," Science, vol. 276 No. 5313, pp. 718-725 (May 1007).	transparent eyelids. My limbs became glassy, the bones and arteries faded, vanished, and the little white nerves went last. I critted my teeth and staved there to the end. At last only the dead time
(Received 5 June 1996; accepted 6 January 1997)	[76] Inventori Liette Rock, Ark. 72116 [71] Anol No. 866 000 [71] Anol No. 866 000	<ul> <li>[75] Inventor: Todd H. Rider, Acton, Mass.</li> <li>[73] Assignce: Massachusetts Institute of neerad Molecular Recognition—Part II: Enzyme Amplifi- neerad Molecular Recognition—Part II: Enzyme Amplifi-</li> </ul>	<ul> <li>(75) Inventor: Todd H. Kider, Liftleton, MA (05) Allgood, Victoria E. and Eastman, Eric M, "Chimeric Receptors as</li> <li>(73) Assignce: Massachusetts Institute of Technology, Gene Switches," Corr. Opts. in Bowerh, 8(4):474-479 (1997).</li> </ul>	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
Analytical Fokker–Planck calculations are used to accurately determine the minimum power that must be recycled in order to maintain a plasma out of thermodynamic equilibrium despite collisions. For virtually all mostlib trons of finein reactors in which the maine markle species are similaterative and the species of t	alted carrage. A central her tank surrounded by sev- eral separate, cooperating superally ring-shaped oxi- dizer tanks generally coaxially disposed about he	Technology, Cambridge, Mass. (31) And No. 40/007 410 Discussional at al. 747-646, 1997. Discussional at al. 747-646, 2007.	Cambridge, MA (US) Applia. Raw et al., "Intendation - Jack A Novel Priority of Human Chemics". Proteins for Targeted Therapy," <i>IEBS Leners</i> , (*) Notice: Subject to any disclaimer, the term of this 457:271-276 (1999).	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
non-Maxwellian or are at radically different mean energies, this minimum recirculating power is substantially larger than the fusion power. Barring the discovery of methods for recycling the power	<ul> <li>[31] Int. Ci.*</li></ul>	<ul> <li>[21] Appr. No. 98(99) (40)</li> <li>[22] Filed: Dec. 9, 1997</li> <li>Biosensers &amp; Bioelectronics 12:287-299, 1997.</li> </ul>	patent is extended or adjusted under 35 U.S.C. 154(b) by 47 days.	the apparatus and completed the process." -Griffin, in H. G. Wells' The Invisible Man (1897)
at exceedingly high efficiencies, grossly nonequilibrium reactors will not be able to produce net power. © 1997 American Institute of Physics. [S1070-664X(97)01404-3]	244/135 R; 244/135 R [58] Field of Search	<ul> <li>[51] Int. Cl.<sup>2</sup></li></ul>	This patent is subject to a terminal dis- claimer. Bocke, lef D. and Hahn, Beatrice, "Destroying Retroviruses from	Outpution:
LINTRODUCTION systems, fasion products, or other sources. This as-	60/252, 257, 258, 259, 39-40 tank in response to thrust. When the carriage is firmly seated inside the next higher oxidizer tank and all of the	422.82.07, 422.82.06, 422.82.09, 422.82.11; 435.721; 435.287.1; 435.287.2; 435.287.1; and Semi-Symbetic Acqueries and Recombinant Flaores- trant Semi-Symbetic Acqueries and Recombinant Flaores- Semi-Symbetic Acqueries and Recombinant Flaores- Semi-Symbetic Acqueries and Recombinant Flaores- trant Flaores- Semi-Symbetic Acqueries and Recombinant Flaores- Semi-Symbet Acqueries and Recombinant Flaores- Semi-Symbet Ac	(21) Appl. No.: 11/503,416 Within," Jonation of Maximulan Host Cold Costart, Pacade, 9(1):421–425 (1996). Host and Costart, Pacade, "Subscription of Maximulan Host Cell Functions by Bacterial Pathegens," Science, 256:718–725	Biochemistry covers the chemical molecules and reactions that are important in biology. Most
One of the most important challenges in modern physics is to identify the best arenaech to clean and efficient fusion	U.S. PATENT DOCUMENTS U.S. PATENT DOCUMENTS 2114 214 4/031 Duplace 102/218 Thus when a stage is jettisoned, its oxidizer lised discon-	435806; 436/104; 436/172; 436/518; 436/527; 436/536; 436/805; 436/519 [58] Field of Search	(22) Filed: Aug. 11, 2006 (1007). Bedrinoly, Michael L and Haffar, Omar K., "HIV-1 Nackone Import: In Search of a Lenden," Frontiers in Bioscience, 4 #72-781 (1999).	biological molecules fall into five categories: (1) nucleic acids such as decoxyribonucleic acid (DNA), ribonucleic acid (RNA), and their component nucleotides; (2) proteins and their component amino
power generation. Advanced aneutronic fuels such as 'He-'He, p-'1'B, and p-'Li would produce considerably less (iii) Liewise, it is cortinitically assumed that the entire formance of the fusion systems.	2,753,017 7/195 Camering	422:58, 82.05, 82.06, 82.07, 82.08, 82.09, 82.11; 4557.7, 721, 2871, 2872, 2887, while a statistic stat	US 2007/0031965 A1 Feb. 8, 2007 US 2007/0031965 A1 Feb. 8, 2007 Feb. 8, 2007 Chen, Qi et al., "Brachne-Based Discovery of Ligandre Taggeted to the RNA Double Hilm," <i>Biochemistry</i> 30(11402-11407 (1997), Feb. Ligandre at al., "Brachnessved Artificial Databased Switchen Based on	acids: (a) inputs such as naty acids, triggyceriaes, and choesteror: (4) caroonydrates such as simple sugars and various polymers composed of them; and (5) iron- or magnesium-containing porphyrins is been acid, a such as the such as t
neutron radiation and radioactive by-products than more con- ventional fusion faels like deuterium-tritium (D-T) and douterium-douterium (D), and furthermore they might	3.006.21 //1942 dwater	Wilson et al., "The B Lymphocyte Calcium Response to Arti-Ig is Dimisided by Merithenic Immunoglobulin Count-Induces " The Journal of Immunology	Related U.S. Application Data Capasee and FADD," <i>Human Gene Therapy</i> 10:2273-2285 (1999). (62) Division of application No. 10766,208, filed on Feb. Nuclear Localization Strate International Of Human International Controls	in memognoom, concorption, etc. Anost onconcentrical reactions nave many steps, each of which is cat- alyzed by different enzymes, proteins that act as specialized molecular machines to greatly speed up and control reactions. Some moins trans of biochemical reactions include the surpthesis (produc-
permit high-efficiency direct electric conversion of the fusion energy instead of low-efficiency thermal conversion. Unfor- tion comparing collisional scattering effects, fusion, and	Primary Examiner-Galen Barefoot most stage and closed in all other stages to allow oxi- Atterney, Agent. or Firm-Stephen D. Carver dizer to be drawn only from the lowermost taak.	[56] References Cited 138:1712-1718, 1087. U.S. PATENT DOCUMENTS Primary Examiner-Christopher L. Chin	<ol> <li>ZOD, BDF PR, NO. 7122,809.</li> <li>Provisional application No. 60355,359, filed on Feb.</li> <li>Nondriving Cellin, "Biochemismy 377-3616-5622 (1998).</li> <li>Songradian Cellin, "Biochemismy 377-3616-5622 (1998).</li> </ol>	up and control percents, some major spices or not-mean an encoder means include the spinness (produc- tion) or catabolism (degradation) of proteins, nucleic acids, lipids, carbolydrates, and porphyrins. Other immortant biochemical reactions include resultation, in which energy is produced by com-
namic equilibrium cannot break even against radiation losses with these unestroric fuels, <sup>1</sup> for this reason. It has been sag-	[57] ABSTRACT An improved rocket staging system for missiles and the 15 Claims, 9 Drawing Figures	5,126,276         6:1992         Fish et al.         456:51         Attorney, Agent, or Firm-Fish & Richardson P.C.           5,139,037         8:1990         8:0592         Issue et al.         455:051         [57]         ABSTRACT           5,300,278         11:1990         Product         457:199         [57]         ABSTRACT	on Fyb. 7, 2002, provisional application No. 66/432, 386, filed on Dec. 10, 2002. Buthways by Bacterial Pathogens," Microbes and Infection, 2:1705- 1719 (2000). Gao, Lius Young and Kunik Young Ahn. "The Modulation of Hort	bining hydrogen from biomolecules with exygen from the air to form water; fermentation, in which smaller amounts of energy are extracted from biomolecules without oxygen; and photosynthesis.
gested that plasma fusion systems which are substantially out of thermodynamic equilibrium should be considered? As a further insertion for the surface function function function for the surface function of the surface function of the surface function of the surface function funct		5541,309 71996 Proder	(51) Int. CL. Cell Apoptosis by Intracellular Bacterial Pathogens," Denks in MolK 38:09 (2005.01) Generalized Science 1 et al. "Spectrace Development Developme	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.
institute interface we used to instrugementation pairs mass, the somewhat more convertinned in Ref $D$ . He could be made cleaner and more attractive if it were possible to sup- as a function of position.		OTHER PUBLICATIONS Control of the event and a respective of the antipolities results in an increase in calcium concentration in the cytosel results in an increase in calcium concentration in the cytosel	A61K 38/45         (2006.01)         Cytokine/Receptor Genes in HTLV-1 Associated Diseases: Candidate TRS for Chimeris Gene Therapy." Lewlewis, 11(Steps. 3):79-81           C07K 1400         (2006.01)         date TRS for Chimeris Gene Therapy." Lewlewis, 11(Steps. 3):79-81	
press indistrible D–D side reactions more than can be done in an equilibrium D– <sup>1</sup> He plasma. <sup>1</sup> This space will resolve the question of whether highly This space will resolve the question of whether highly	1 the second sec	Used to Report Ca <sup>2+</sup> Mobilization <sup>+</sup> , Cell Calcium 14:663–671, 1993. Cell Calcium	C07K 1/107 (2005.01) Knoller, Leigh A. et al., "Pathogenic Trickery: Deception of Host C12P 21/00 (2005.01) Coll Processes," Stature Review Molecular Cell Biology, 2(0):578- (52) E.S. CL 514/2: 550/500- 530/550- 588 (2001)	Fluid Mechanics and Aerodynamics
nonequilibrium plasma systems would be useful for fusion purposes, especially with regard to advanced-fuel fasion billies.		Chaine, "Geere Protoneern Protein", "Protochemistry and Photobiology 62:651–656, 1975. Mosier, "Primary In Viro Antibody Responses by Purified from the cell.	530(402; 424/94.1; 435(6).1; 435(6).7 (58) Field of Classification Search	Todd H. Rider thor@riderinstitute.org 13 November 2019 Any suggestions for improvements would be greatly appreciated
Retter that timit the analysis to a particular type of honequi- librium fusion reactor design, it would be wise to make this study as generally applicable as possible. Accordingly, a they will be optimistically ignered here.		Murine B Lymphocytes in Serum–Free Defined Medium", The Journal of Immunology 127:1490–1493, 1981. 10 Claims, 2 Drawing Sheets	See application file for complete search history. Primary Examiner—Zacharah Lucas (56) References Cited Reynolds, PC.	On aircraft:
minimum of assumptions will be made with regard to the (vii) Spatial variations of particle energies may be ne- pliant geometry, reactor confinement system, type of fuel, gleeted in regions of significant $\int d^2 \mathbf{x} [\mathbf{v}(\mathbf{x})]^2$ .	4 <sup>200</sup> 20 20 <sup>-11,1</sup> a. 9		U.S. PATENT DOCUMENTS (57) ABSTRACT 5,561,222 A 10/1996 Keene et al.	"There is as much pressure exerted by a substance against the air as by the air arainst the substance
made are as follows: (i) Losses other than bremostrablune radiation and the (ii) Losses and the functional for the functional			5,905,131 A * 101999 Griffiths et al 424133.1 5,976,800 A 1121999 East et al. Chimeric molecules that contain at least one pathogen-detec- tion domain and at least one effector domain, and their meth-	"Observe how the beating of its wings against the air suffices to bear up the weight
power required to keep the plasma out of thermody- namic equilibrium are ignored, so this analysis sets an of the ion velocity distributions' shares if the distributions' shares if the distributions' shares in the distribution of the ion velocity of the ion velocity of the distributions' shares if the distribution of the ion velocity of the distribution of the di	12 200 20 22 and 20 30 30	· /	5.990.388 A 11/1999 Roh et al. odi of use in preventing or treeting a phogen infection in a 6.037.461 A 3/2090 Alsennei cell or organism are described. The pathogen-detection 6.074.656 A 6/2090 Nichola desnain and effector denain of the chimeric molecules are	or the eagle in the mighty rateneed air which borders on the nervy element: Observe also how the air moving over the sea, beaten back by the bellying sails, causes the heavily holds this to a disclosurement
optimistic bound on the performance of nonequilib- nium fusion reactors.			6.221.355 Bi 4 2001 Dowdy 6.319.500 Bi 112001 Goldenberg 6.326.466 Bi 122001 Bonare et al. and the set one provided the set one provide	"So that by adducing and expounding the reasons of these things you may be able
the only energy source available to the electrons; the electrons cannot acquire energy from external heating automation power on the mean electron velocity (x) is a superscript of the electron velocity automation in the electron velocity of the electron velocity.	10 (23) (5 22) (		6.416.785 B1 * 122002 Linfe, II	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
"Power mailing address: 501 West A St., North Little Rock, Adamoss Trata. Ass. demonstrated in Ref. 5, systems, which violate the			2003/0054000 AI 3/2003 Dowdy vettion and treatment described herein are effective for a broad spectrum of puthogens and exhibit little or no toxic side-effects. Assays for the detection of a puthogen, puthogen	himself upon it." On nemchates:
Phys. Plasmas 4 (4), April 1997 1070-664X97/4(4)1039/0510.00 © 1997 American Institute of Physics 1039	27 29 20 20 40 - 10 - 10 - 10 - 10 - 10 - 10 - 10		Lasher et al., "The Adapter Protein Apoptotic Pronous-activating Pactor-1 (Apat-1) Is Protechtally Processed during Apoptosis,"	"If a man have a tent made of linen of which the apertures have all been stopped
		PROCESSOR ROCKION	Jeenal of Biological Chemistry, vol. 276 No. 32, pp. 29772-29781 (Aug. 2001)* 6 Claims, 86 Drawing Sheets	up, and it be twelve braccia across and twerve in depth, ne win be able to throw numsen down from any great height without sustaining any injury."
	and the bear of the second	Conce		On holicopters: "I find that if this instrument made with a screw be well made that is to say, made
A CALL AND				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:
	NUKE AS			"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."
A AND A A A A A A A A A A A A A A A A A				-Leonardo da Vinci, The Notebooks (ca. 1500)
	And A HAR A MARKEN			Overview
			A SALAN A SALAN	runn mechanics and servelynamics 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 mostly the data is a server of the server
				a much is whether the much is compression, 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 source to take to another and null on each other. Therefore, it is most commined
			A MAR A A A A A A A A A A A A A A A A A	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