Forgotten Creators of the German Nuclear Triad

Dr. Todd H. Rider thor@riderinstitute.org

riderinstitute.org/revolutionary-innovation

Für den Ring nimm nun auch
mein Roß !
Ging sein Lauf mit mir
einst kühn durch die Lüfte,
mit mir
verlor es die mächt'ge Art;
über Wolken hin
auf blitzenden Wettern
nicht mehr
schwingt es sich mutig des Wegs.

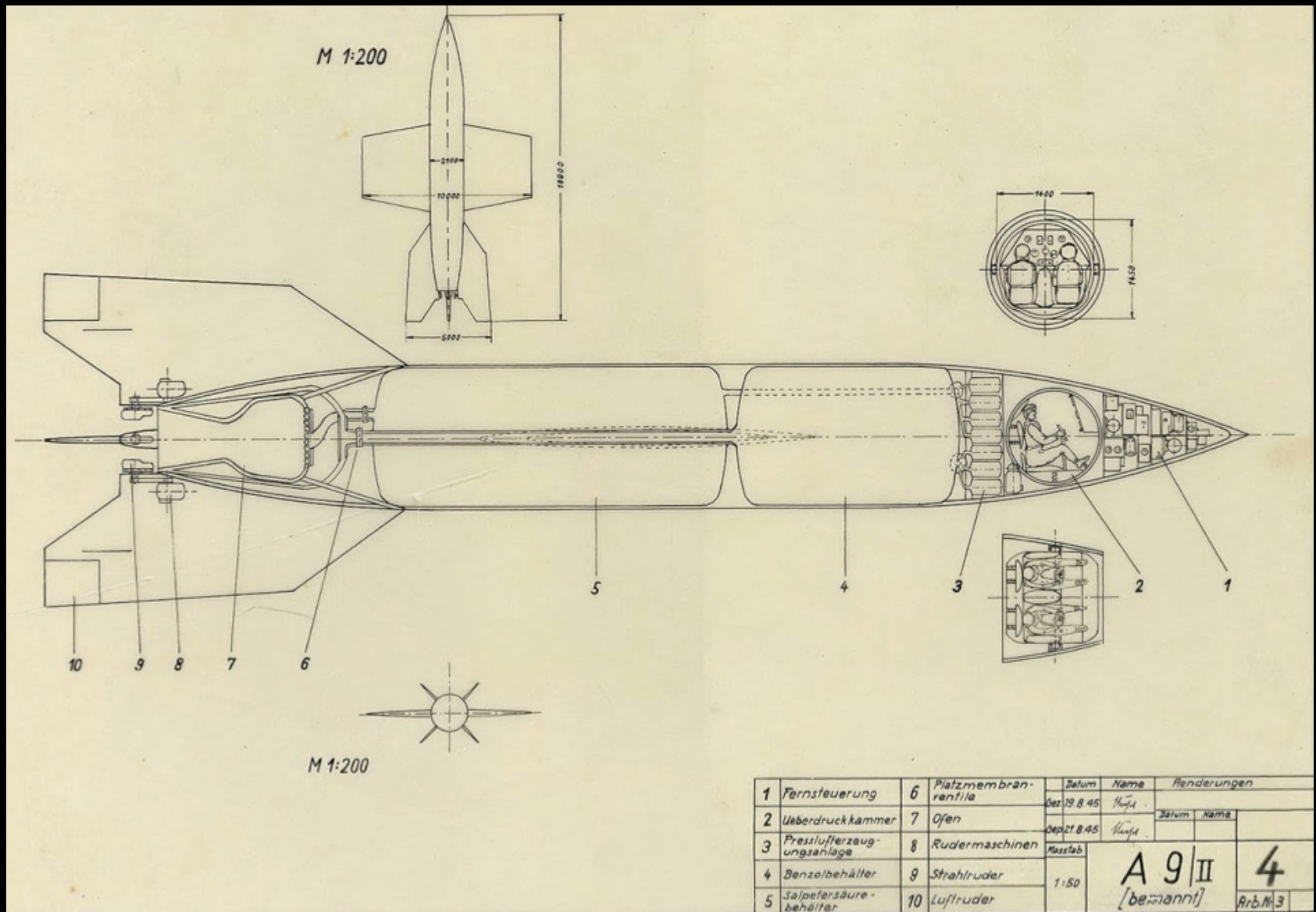
For the Ring take now
my horse!
Though he once carried me
boldly through the air---
with me
he lost all his magic powers;
above the clouds
through lightning and thunder
no more
will he brave the way.

Richard Wagner *Götterdämmerung*, Prologue, Brünnhilde (1874)

Forgotten Creators of the German Nuclear Triad

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

riderinstitute.org/revolutionary-innovation



Acknowledgments

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)

Guido Abate
Joseph E. Backofen, Jr.
Umberto Bartocci
Christian Bergner
David Bleecker
Stefan Brauburger
Gordon James Brown
David Cassidy
Casey Clarke
George Cully
Frank Döbert
Andrzej Ditrich
Gernot Eilers
Silke Fengler
Friedrich Georg
Charlie Hall
István Hargittai
Rudolf Haunschmied
Michael Haupt
Gunther Hebestreit
Philip Henshall
Marko Herceg
Manfred Höfert
Dieter Hoffmann
Karl-Heinz Huhn
Carter Hydrick
Guy Inchbald
Rainer Karlsch
Adam Kretschmer
Wolf Krotzky
Tom Kunkle
Norberto Lahuerta
Benjamin Levin
Kathy Lowney
Manuel Lukas
Jaroslav Mareš
Diane McWhorter
Thomas Mehner
Marek Michalski
Günter Nagel
Yorck Neudenberger
Michael Neufeld
Douglas M. O'Reagan
William Pellas
Philip Pesavento
Heiko Petermann
Fritz Pfeiffer
Jaroslav Pilar
Lee Pondrom
Johannes Preuss
Bruce Cameron Reed
Georg Ribienski
Luca Russo
Rolf-Harald Ruthke
William Schneck
Wolfgang Schwanitz
Brian R. Scott
Rick Sheridan
D. Ray Smith
Henry Stevens
Family of Heinz Stoelzel
David Strozzi
Andreas Sulzer
Matthias Uhl
Mark Wade
Mark Walker
Stephen Walton
Alex Wellerstein
Ed West
Kevin, Cathy,
and Peter Wilson
Clive R. Woodley
Benjamin Zusman
My family for their
patience and support

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

Atzeni, Stefano, and Jürgen Meyer-Ter-Vehn. 2004. *The Physics of Inertial Fusion: Beam Plasma Interaction, Hydrodynamics, Hot Dense Matter.* Oxford, U.K.: Oxford University Press.

Benedict, Manson, Thomas H. Pigford, and Hans Wolfgang Levi. 1981. *Nuclear Chemical Engineering.* 2nd ed. New York: McGraw-Hill.

Coster-Mullen, John. 2012. *Atom Bombs: The Top Secret Inside Story of Little Boy and Fat Man.* Self-published.

Ford, Kenneth W. 2015. *Building the H Bomb: A Personal History.* World Scientific Publishing.

Fortov, Vladimir E. 2016. *Extreme States of Matter: High Energy Density Physics.* 2nd ed. Berlin: Springer.

Glasstone, Samuel, and Philip J. Dolan. 1977. *The Effects of Nuclear Weapons.* 3rd ed. Washington, D.C.: U.S. Government Printing Office.

Goncharov, G. A. 1996a. American and Soviet H-Bomb Development Programmes: Historical Background. *Physics--Uspekhi* 39:10:1033-1044. www.globalsecurity.org/wmd/library/report/1996/goncharov-h-bomb.pdf

Goncharov, G. A. 1996b. Thermonuclear Milestones. *Physics Today* 49:11:44--61.

Goncharov, G. A., and Lev D. Riabev. 2001. The Development of the First Soviet Atomic Bomb. *Physics-Uspekhi* 44:1:71--93.

Gsponer, André, and Jean-Pierre Hurni. 2009. *The Physical Principles of Thermonuclear Explosives, Inertial Confinement Fusion, and the Quest for Fourth Generation Nuclear Weapons.* Geneva: Independent Scientific Research Institute. http://isri.ch/wiki/_media/publications:ag-09-01.pdf

Hansen, Chuck. 1988. *U.S. Nuclear Weapons.* New York: Orion.

Hansen, Chuck. 2007. *Swords of Armageddon.* 2nd ed. www.uscoldwar.com.

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

Lindl, J. D. 1998. *Inertial Confinement Fusion.* Berlin: Springer.

Morland, Howard. 1981. *The Secret That Exploded.* New York: Random House.

Pondrom, Lee G. 2018. *The Soviet Atomic Project: How the Soviet Union Obtained the Atomic Bomb.* Singapore: World Scientific.

Reed, Bruce Cameron. 2015. *The Physics of the Manhattan Project.* 3rd ed. Berlin: Springer.

Reed, Bruce Cameron. 2019. *The History and Science of the Manhattan Project.* 2nd ed. Berlin: Springer.

Rhodes, Richard. 1986. *The Making of the Atomic Bomb.* New York: Simon and Schuster.

Rhodes, Richard. 1995. *Dark Sun: The Making of the Hydrogen Bomb.* New York: Simon and Schuster.

Serber, Robert. 1992. *The Los Alamos Primer: The First Lectures on How to Build an Atomic Bomb.* Berkeley: University of California Press.

Smyth, Henry DeWolf. 1945. *Atomic Energy for Military Purposes.* Princeton: Princeton University Press.

Sublette, Carey. 2019. *The Nuclear Weapon Archive: A Guide to Nuclear Weapons.* nuclearweaponarchive.org

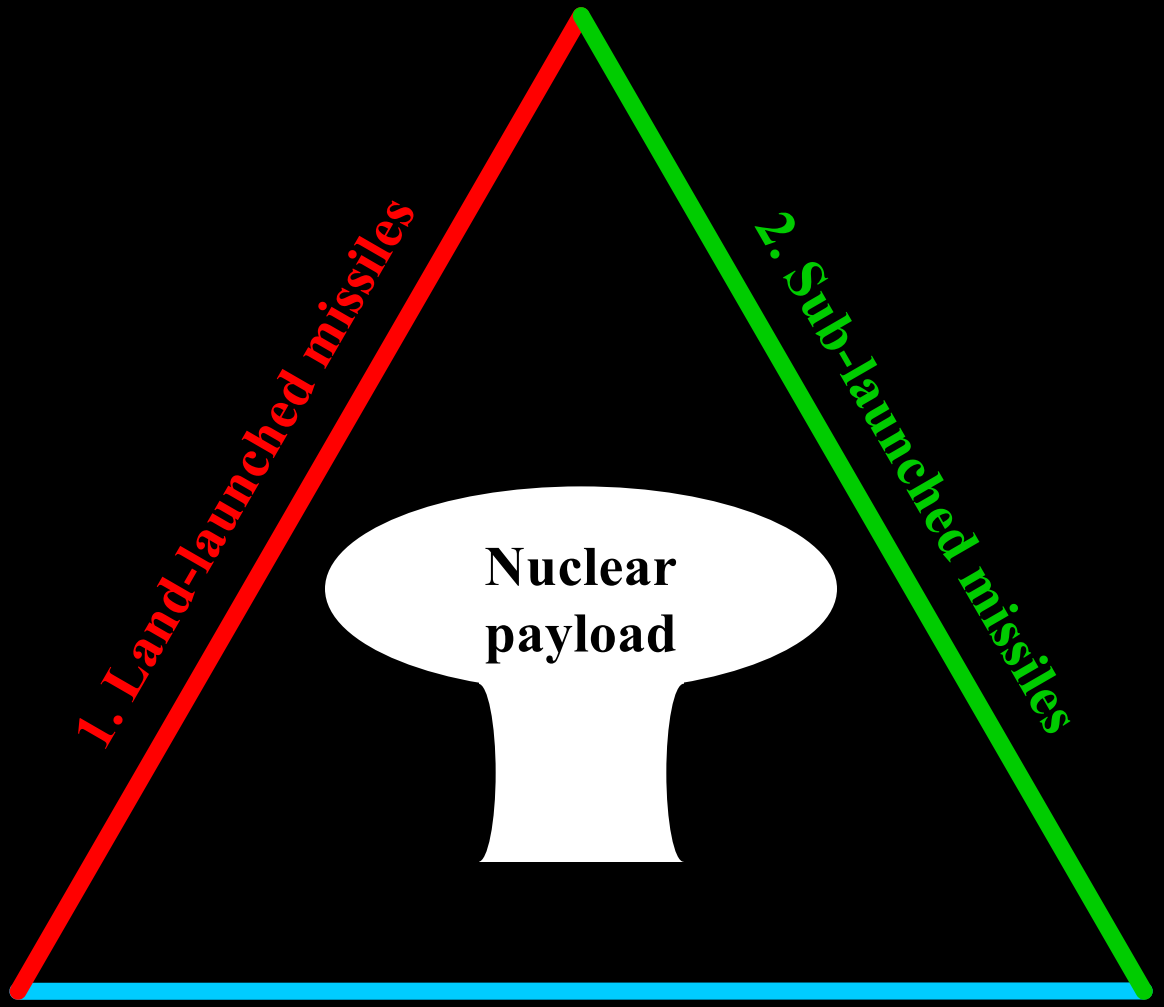
Wellerstein, Alex, and Edward Geist. 2017. The Secret of the Soviet Hydrogen Bomb. *Physics Today* 70:4:40.

Winterberg, Friedwardt. 1981. *The Physical Principles of Thermonuclear Explosive Devices.* New York: Fusion Energy Foundation.

Winterberg, Friedwardt. 2010. *The Release of Thermonuclear Energy by Inertial Confinement: Ways Towards Ignition.* Singapore: World Scientific.

NARA RG 374, Microfilm A1218. Manhattan District History. https://ia802303.us.archive.org/26/items/ManhattanDistrictHistory/

Nuclear Triad



- 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.

Outline

Nuclear payloads

1. Land-launched intercontinental missiles

    A. Liquid propellant missiles

    B. Liquid propellant space planes

    C. Solid propellant missiles

2. Submarine-launched missiles

    A. Sub-launched cruise missiles

    B. Sub-launched ballistic missiles

3. Intercontinental jet bombers

Outline

Nuclear payloads

1. **Land-launched intercontinental missiles**

   A. Liquid propellant missiles

   B. Liquid propellant space planes

   C. Solid propellant missiles

2. **Submarine-launched missiles**

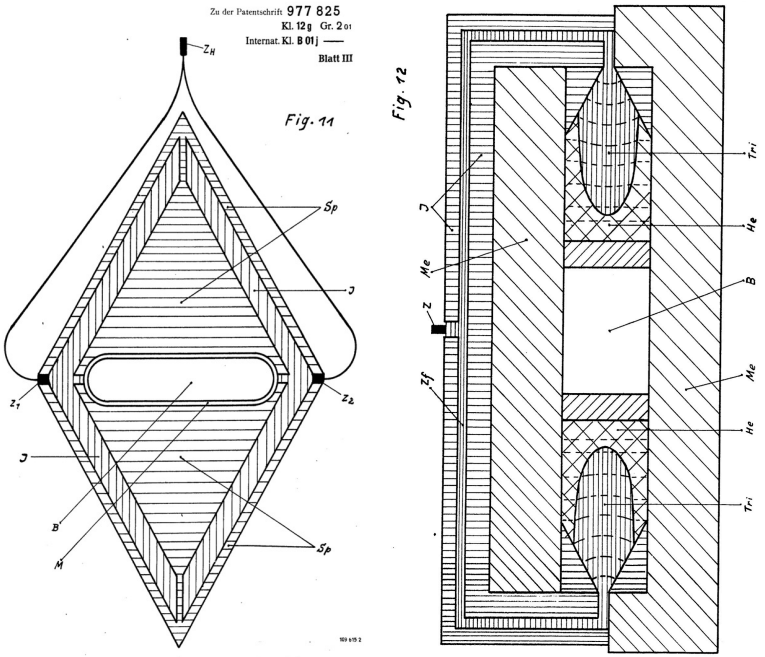
   A. Sub-launched cruise missiles

   B. Sub-launched ballistic missiles

3. **Intercontinental jet bombers**

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

Erich Schumann and Walter Trinks. DE977825.



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

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

Werner Grothmann, 2002, pp. 9, 18.

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

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

SECRET

WAR DEPARTMENT
Military Intelligence Service
Washington

26 March 1945

BW INFORMATION

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

EXTRACT

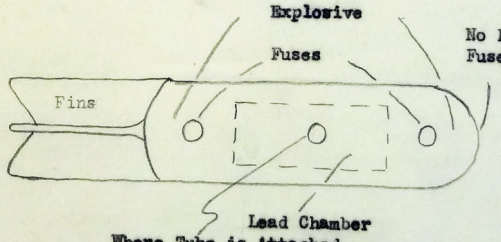
* * * * * * * * *

16. Microbe Bombs

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

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

PW thinks the germs are of cholera type.



* * * * * * * * *

G-2 COMMENT:

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

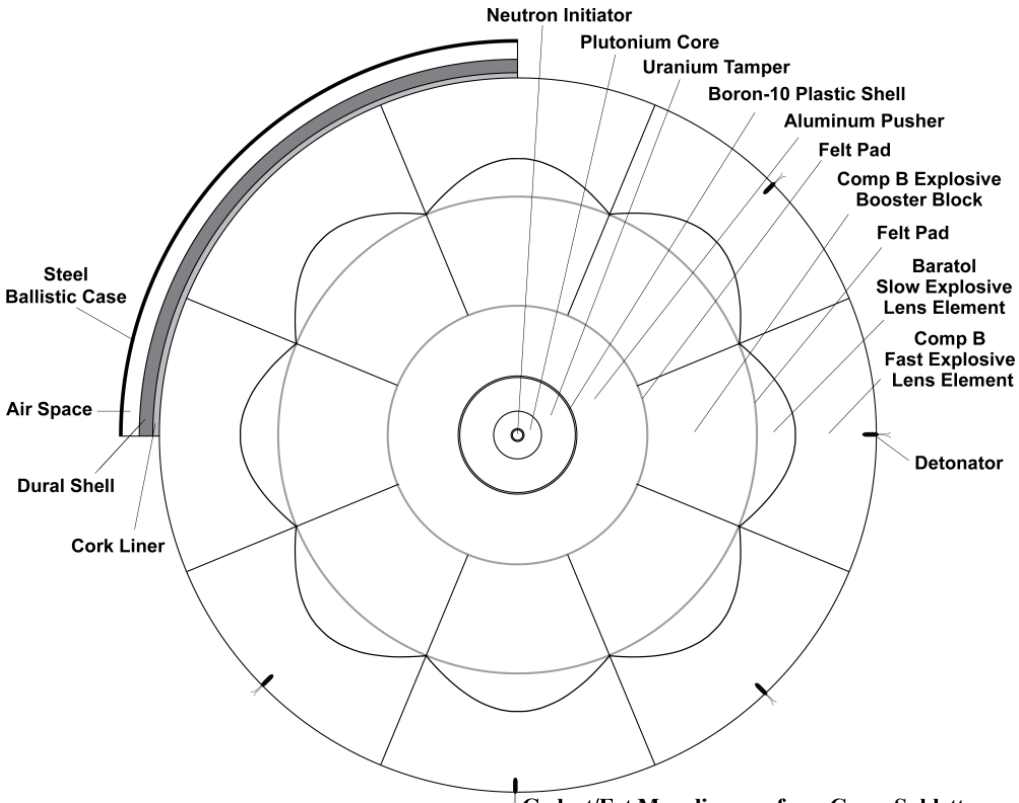
NARA RG 165, Entry NM84-187, Box 137, Folder BW 55

DECLASSIFIED
Authority NND 750122

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

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

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



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

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

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

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

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

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

Sources:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Outline

Nuclear payloads

1. Land-launched intercontinental missiles

    A. Liquid propellant missiles

    B. Liquid propellant space planes

    C. Solid propellant missiles

2. Submarine-launched missiles

    A. Sub-launched cruise missiles

    B. Sub-launched ballistic missiles

3. Intercontinental jet bombers

Outline

Nuclear payloads

1. Land-launched intercontinental missiles

   A. Liquid propellant missiles

   B. Liquid propellant space planes

   C. Solid propellant missiles

2. Submarine-launched missiles

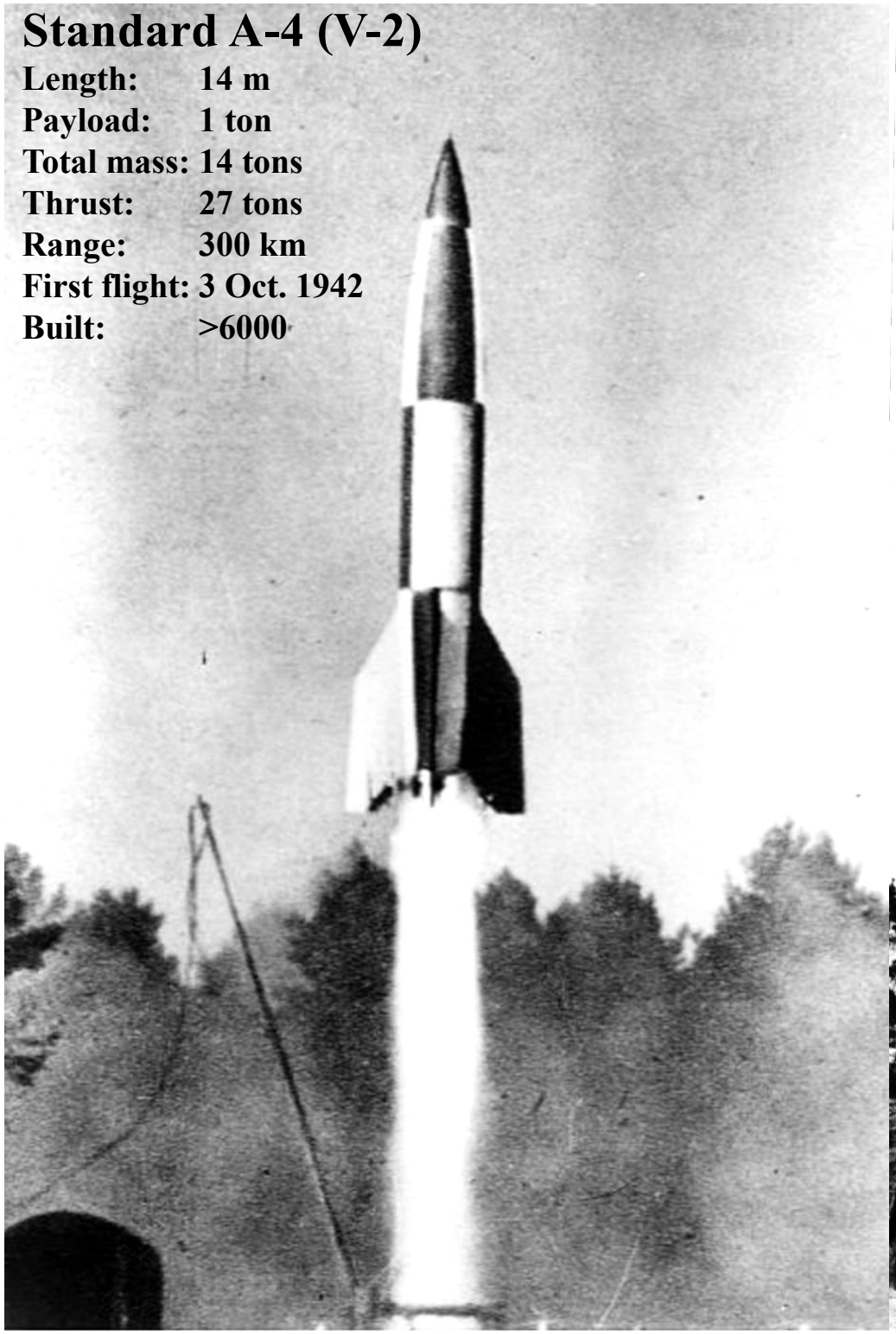
   A. Sub-launched cruise missiles

   B. Sub-launched ballistic missiles

3. Intercontinental jet bombers

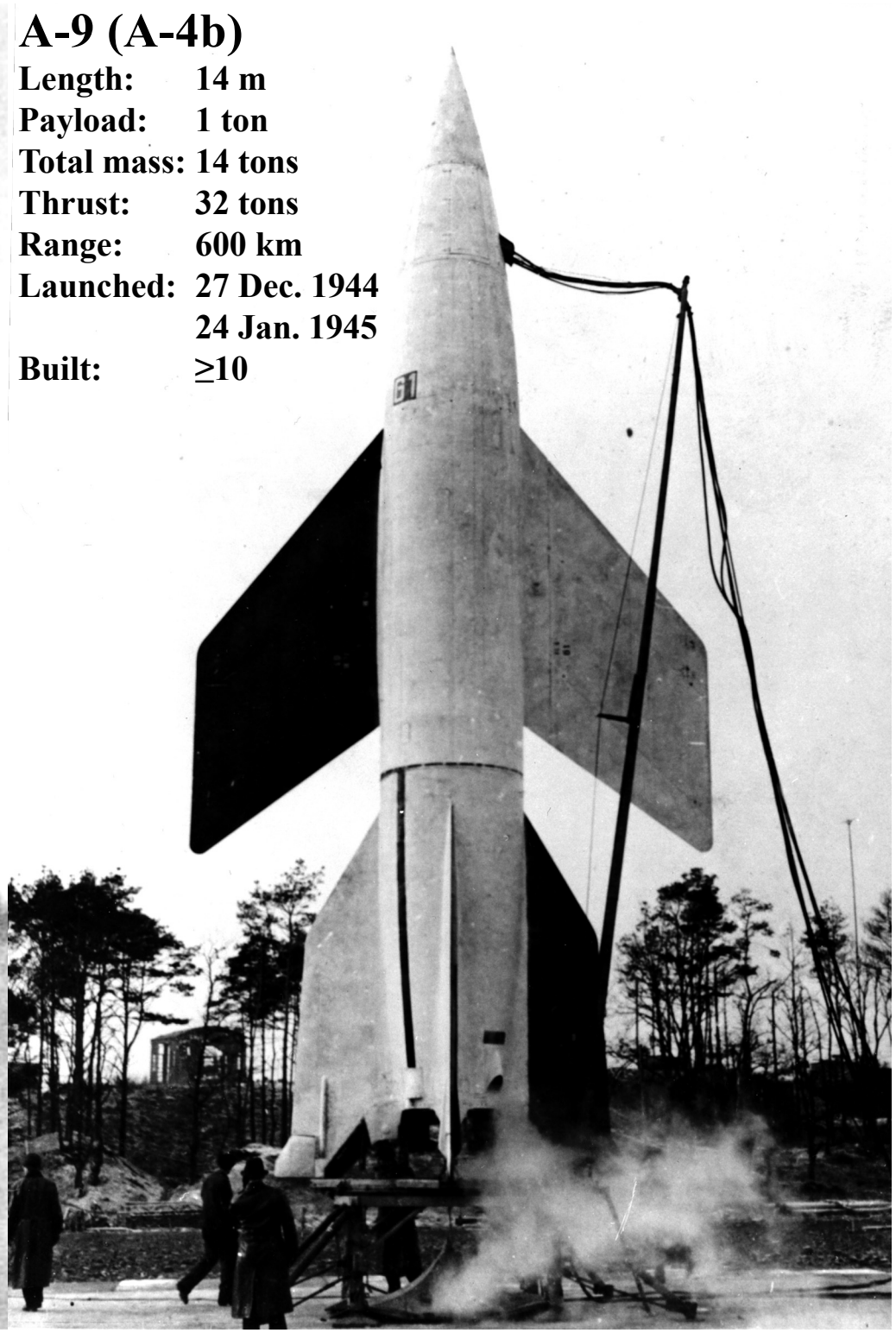
Standard A-4 (V-2)

Length: 14 m
Payload: 1 ton
Total mass: 14 tons
Thrust: 27 tons
Range: 300 km
First flight: 3 Oct. 1942
Built: >6000



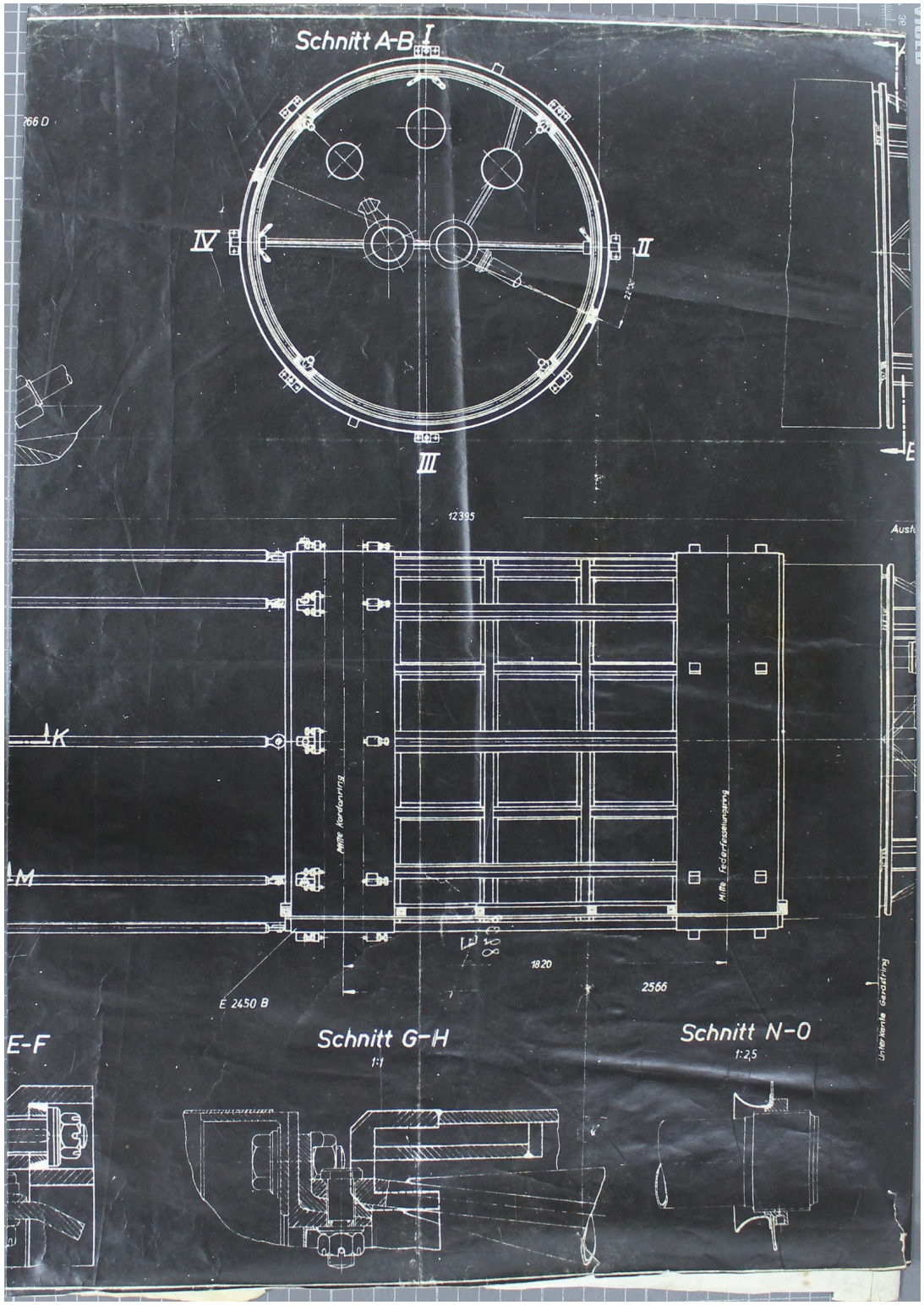
A-9 (A-4b)

Length: 14 m
Payload: 1 ton
Total mass: 14 tons
Thrust: 32 tons
Range: 600 km
Launched: 27 Dec. 1944
24 Jan. 1945
Built: ≥10

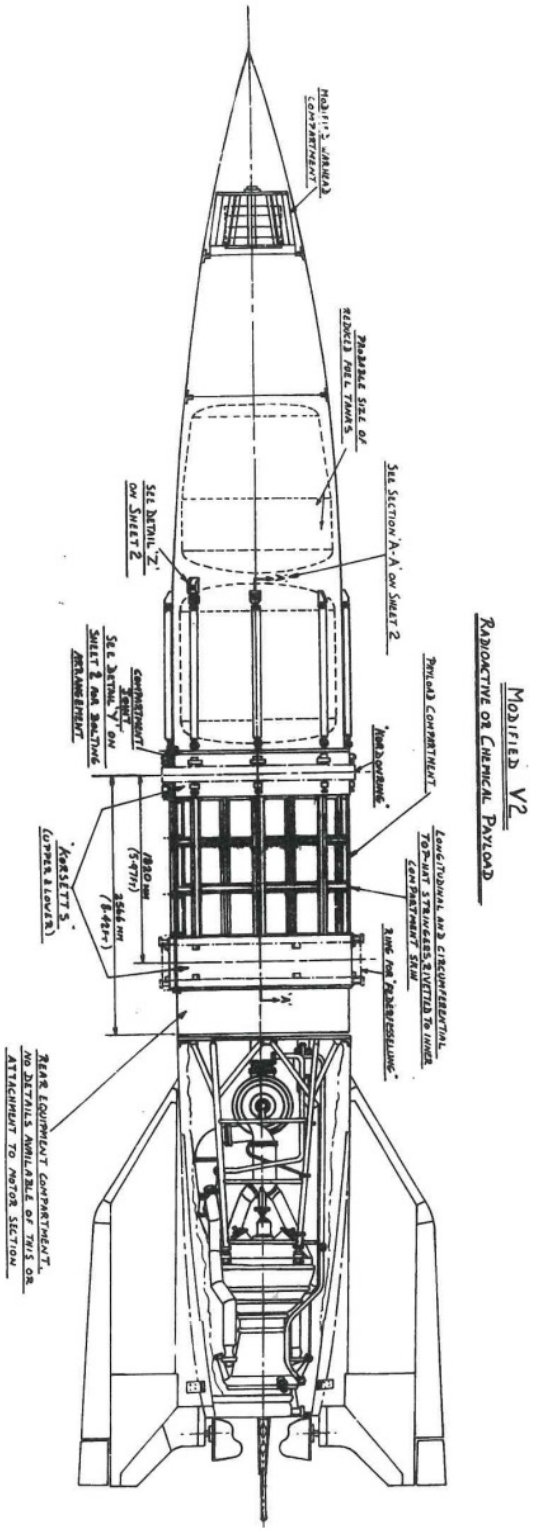


Modified A-4 with Central Payload?

(A 2-Ton Fission Bomb?)



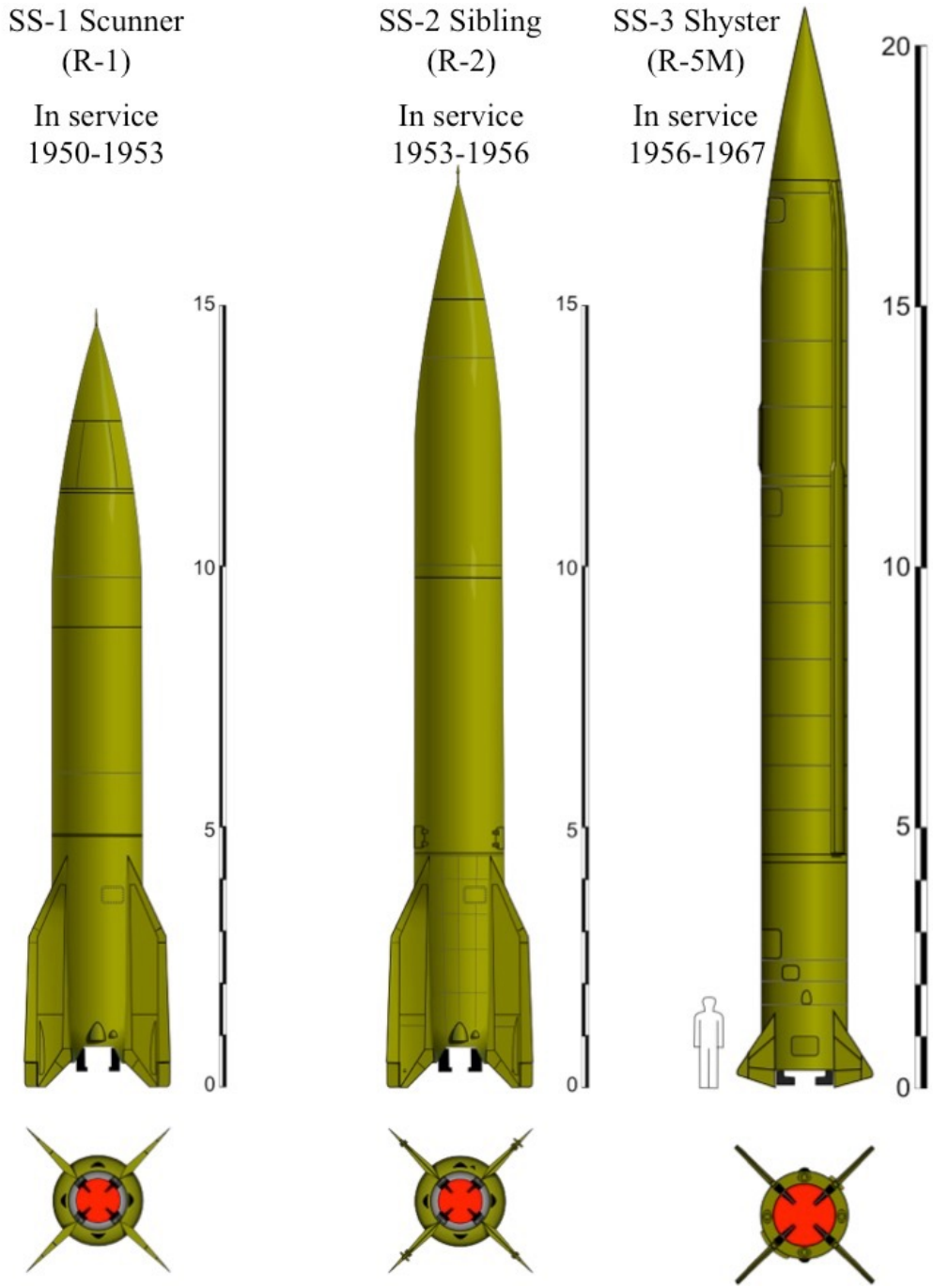
TNA (Kew)
AVIA 40/717.
March 1943.

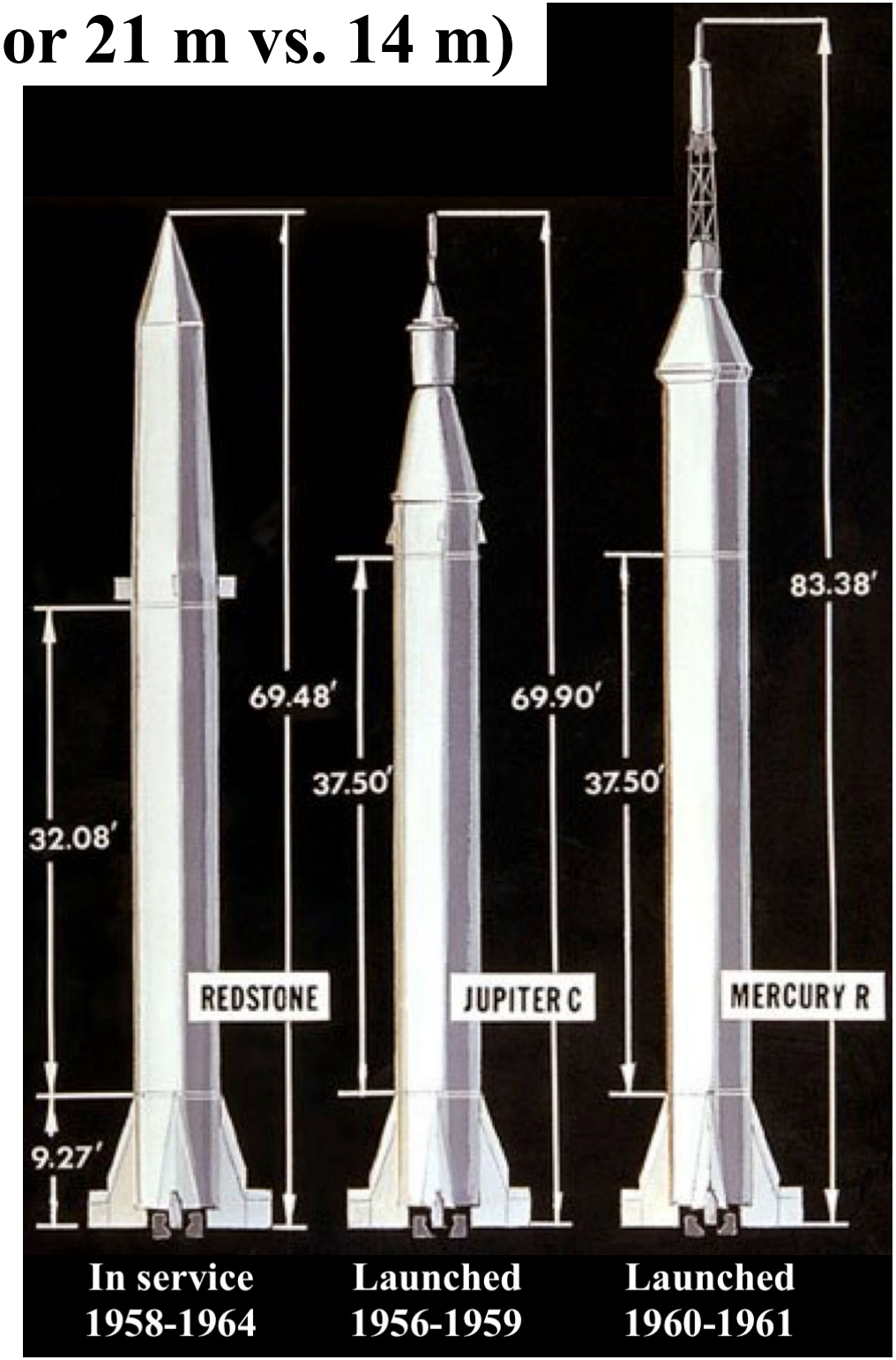


Redrawn by Philip Henshall. 2000. *The Nuclear Axis: Germany, Japan and the Atom Bomb Race 1939-1945.* Phoenix Mill, UK: Sutton. p. 123.

Extended A-4 (18 or 21 m vs. 14 m)

Were extended A-4s built during the war?





Calculated range for 14-meter A-4 (V-2), postwar rockets, and 18- and 21-meter A-4 versions that may have been developed during the war

Characteristic	A-4	18 m A-4	21 m A-4	SS-1	SS-2	SS-3	Super V-2	Redstone
Country	Germany	Germany	Germany	USSR	USSR	USSR	France	US
Operational	1942–45	1945?	1945?	1950–53	1953–56	1956–67	1946 design	1958–64
Diameter (m)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.77
Length (m)	14	18	21	14	18	21	14.5	21
Body (kg)	4000	4000	4000	4000	5000	4000	3000	4000
Propellant (kg)	9000	16,000	24,000	9000	16,000	24,000	16,000	24,000
Payload (kg)	1000–2000	1000–2000	1000–2000	1000	1000	2000	1000	4000
Total mass (kg)	14,000–15,000	21,000–22,000	29,000–30,000	14,000	22,000	30,000	20,000	32,000
Fuel	Ethanol	Ethanol	Ethanol	Ethanol	Ethanol	Ethanol	Kerosene	Ethanol
Oxidizer	LOX	LOX	LOX	LOX	LOX	LOX	Nitric acid	LOX
v_{exh} **(m/s)**	2000	2000	2000	2000	2000	2300	2630	2300
Thrust (kN)	270	380	400	280	380	490	392	460
Burn time (s)	68	85	120	63	85	112	108	120
Range (km)	300	600	900	300	600	1200	1500	400
Est. velocity Δv **(m/s)**	1850–1650	2600–2300	3200–2900	1850	2300	3300	3800	2900
Est. flight time Δt **(min)**	4.5–4.0	6.2–5.6	7.6–7.0	4.5	5.6	8.0	9.2	6.9
Est. altitude ΔH **(km)**	88–70	170–140	250–210	88	140	280	370	210
Est. range Δx **(km)**	350–280	680–560	1000–860	350	560	1100	1500	840

Table E.4: Approximate values from known German (14-meter regular A-4), German-based Soviet (SS-1, SS-2, and SS-3), German-based French (Super V-2), and German-based U.S. (Redstone) rockets used to extrapolate characteristics of possible German extended A-4 rockets (18-meter and 21-meter versions) [data adapted from Jürgen Michels 1997; Uhl 2001; http://www.astronautix.com]. Extended German rockets may have also used kerosene (or other hydrocarbon fuel) and nitric acid oxidizer like the proposed Super V-2.

See Forgotten Creators E.7 for details

Meet the A-8 (Multiple Versions)

Jürgen Michels. 1997. *Peenemünde und seine Erben in Ost und West: Entwicklung und Weg deutscher Geheimwaffen.* Bonn: Bernard & Graefe, p. 71.

A whole series of designs, some of which differed greatly from one another, ran under the name Aggregat 8. The first study corresponded in size to Aggregat 5, but was to be powered by Salbei [nitric acid] and Visol (also known as fuel oil). At the end of 1941, a so-called high-pressure rocket was developed, which was to correspond in size to Aggregat 4. With 8330 kg of nitric acid and 1670 kg of fuel oil, a thrust of approximately 50 tons was to be achieved. This rocket was to carry a warhead of 2000 kg over 300 km. Even larger was another design, which envisaged 14,295 kg of nitric acid and 2860 kg of fuel oil. Although a lower thrust of 35 tons was planned, it was hoped that a maximum speed of 7380 km/hr could be achieved due to a long burn time of approximately 100 seconds and a payload of 2500 kg could be fired over a distance of around 450 km. The launch weight was intended to be 22,370 kg.

None of these studies ultimately got beyond wind tunnel tests.

Gerhard Reisig. 1997. *Raketenforschung in Deutschland: Wie die Menschen das all eroberten.* Münster: Edition Lenser. pp. 707-708.

In his memorandum "Development Principles" of November 1941, W. Dornberger postulated that the "A-4" rocket should only be a temporary interim solution. The actual military requirement was for a long-range missile with a range of 450 km (Dornberger, 1941). The corresponding rocket type was given the designation "A-8."

The "A-8" project thus required a fundamentally new system configuration, which was analyzed in detail (Hellebrand, 1942). Meissner (1941) discussed 16 different configurations of an "A-8" rocket in order to determine an optimal balance of the various parameters of the rocket. In these designs, the aerodynamic shape of the "A-4" rocket was to be retained as far as possible.

The basis of the "A-8" configuration was a new engine with a thrust of 30 tons (294 kN). Werner Thiel had already begun the development of such an engine in 1941 (Thiel, 1941). The propellant for the 30-ton engine is a combination of fuel oil and Salbei [nitric acid]. The fuel oil can be replaced with a 50 percent mixture of benzene and gasoline. This engine is a high-pressure type with a combustion chamber pressure of 40 atmospheres (41 bars). With the 30-ton engine, an engine cutoff velocity of over 2,000 m/sec, Mach number of 6.8, is achieved. At these high Mach numbers, the rocket becomes aerodynamically unstable, i.e. the center of pressure of all aerodynamic forces on the rocket moves in front of its center of gravity. A certain improvement in stability is achieved by lengthening the airframe to L = 13.5 diameters.[7] [...]

The "A-8" missile would have been an advanced, pioneering project. It remained only a "paper project."

Table XI.2 Dimensions of the "A-8" model

Length:	13.5 diameters [22 m]
Diameter:	1.651 m
Weight without payload:	22.8 tons/224 kN
Engine cutoff Mach number:	6.8 [~2100 m/s]

[7] "A-4" rocket: L=8.5 diameters [14 m]

1943-44 Production of Large Rockets at Friedrichshafen

S E C R E T page 2, Target Notes A/5, 4 November/44.

a triple train wreck by throwing a switch on the double track R.R. near Ktobuck. Two freight trains collided, and later a passenger train ~~likewise~~ piled into the wreckage.

5. Under-ground Factory in FRIEDRICHSHAFEN: In Jan/43 P/W visited the site of a large new under-ground factory being built by Dornier at FRIEDRICHSHAFEN. Factory lies between the lake and the road to IMMENSTAAD, on the NW edge of FRIEDRICHSHAFEN. It is covered by a storage yard for wood and other bulk materials, and there is a R.R. spur leading into the underground part. P/W could give no information as to the size of the underground unit, other than to say that it was about the same size as the large Mercedes Factory in STUTTGART. He heard from friends that V-2 was being made there, and that three R.R. cars were necessary to haul away a single V-2 bomb. P/W considered himself an Italian, having been born in BOLZANO, and was obviously trying to give reliable information.

6. A/C Components Factory - BERLIN: The Heinrich H. Zins Kluesendorf Factory, on Sittnik Citadellan Weg, Spandau, BERLIN, employed 600 in Feb/43 making A/C parts for Junkers. The parts were for A/C motors, but P/W did not know to which factory they were later sent for assembly. P/W did not visit Spandau at the time of his last leave, and had not heard whether the factory is still running to-day. This factory is not listed in Bomber's Baedeker.

R. R. Thun,
1st Lt. AC.
Air Targets.

Distribution:

MAAF Int	1
CSDIC (Air) CMF	1
5th Army Cage	1
File	1

SECRET. A.D.I.(K) Report No. 113A/1945.

THE FOLLOWING INFORMATION HAS BEEN OBTAINED FROM P/W. AS THE STATEMENTS MADE HAVE NOT AS YET BEEN VERIFIED, NO MENTION OF THEM SHOULD BE MADE IN INTELLIGENCE SUMMARIES OF COMMANDS OR LOWER FORMATIONS, NOR SHOULD THEY BE ACCEPTED AS FACTS UNTIL COMMENTED ON IN AIR MINISTRY INTELLIGENCE SUMMARIES OR SPECIAL COMMUNICATIONS.

DECLASSIFIED Authority NND 969111

SUSPECTED 'V' WEAPON FACTORIES - GERMANY AND POLAND.

A number of P/W and Allied nationals recently interrogated in this country and on the Continent have passed on stories about suspected 'V' weapon factories. These are not all very convincing but they may be found to tie up with rumours from other sources or be capable of proof by photographic interpretation.

UNDERGROUND WORKS OBER RADERACH.
(September 1944).

2. A co-operative German P/W, who lived in the Friedrichshafen area until September 1944, said there was an underground factory between two hills to the North West of Ober Raderach village rather less than four miles North North West of Freidrichshafen at 47° 42' 18" N., 9° 26' 25" E. This pinpoint is very near that of a site described in a report from Italy dated 24th November 1944 reference MFIU/HQ/CSDIC/12.

3. It was locally rumoured that the Ober Raderach works was closely connected with the Zeppelin works at Friedrichshafen and that "25 ton objects" presumed to be 'V' weapons, were being produced. During the winter of 1943/1944 loud noises similar to those made by a power unit under test emanated from the plant but in about March 1944 there was a loud explosion; thereafter things quietened down more than somewhat.

4. P/W had no idea of how many workers might be employed but said they were all either P/W or German troops undergoing detention and they were never allowed outside the factory precincts.

5. These precincts were, however, extensive, as the 6 ft. wooden fence round the site enclosed both the above mentioned hills and a fairly considerable area of ground. A number of small brick office buildings and barrack huts were visible from the outside but the presence of guards operating under Gestapo supervision discouraged the curious from looking too closely.

6. With reference to the Zeppelin factory itself a French report on the interrogation of an employee of Bugatti, Molsheim, mentions that some of the Zeppelin shops at Friedrichshafen were being tooled up in 1944 for the manufacture of aircraft torpedoes and that these would be tested on Lake Constance.

AFHRA folder 512.619C-15A 1943-1945

THIS PAGE DECLASSIFIED IAW EO 13526

NARA RG 77, Entry UD-22A, Box 165, Folder ALSOS MATERIAL

CIOS XXVIII-56. Rockets and Guided Missiles. p. 9.

"The capacity of the fuel tank was 4,460 litres. Some larger tanks were made for A.4 towards the end of the war, but were never used. (ENG. FINZEL)"

CIOS ER 38. AFHRA
A1007 frames 0983-0984

KO-13483

SECRET

ENCLOSURE

Evaluation Report 38.
25 May 1945

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

(LUFTSCHIFFBAU ZEPPELIN - DIR. ECKENER)

1. TARGET NO: 4/111.

2. TITLE OF TARGET: Luftschiffbau Zeppelin - Dir. Eckener.

3. LOCATION: FRIEDRICHSHAFEN L48 C29.

4. CONDITION OF TARGET: Severely damaged by bombing, but foundry still working.

5. DESCRIPTION OF CONTENTS: DIR. KURT ECKENER was interviewed and gave information:- Luftschiffbau Zeppelin made only the A and B tanks for the A-4, castings thereto and part of the outer case. The threefold tube casting caused trouble owing to leaks developing.

The tanks were developed by L.Z. who also helped other firms to go into production. One of the main of these firms was Schindler of Kennelbach, Austria, Nr. Bregenz where tanks can probably be found now. DR. VON BRAUN was the Peenemunde representative with whom this firm carried out the development; he gave them an order for tanks of the same diameter but about 20 cm. longer than normal, and about ten of these were made. Some of these should also be available at Kennelbach. In full production 200 pro: of tanks were produced, and 350 bodies. At first they were despatched assembled (but later not) to Mittleberg (werk?) in Harz.

Leichtmetall - Regensburg, moldewerke- Slesian, Marcus- Berlin also made tanks. The only special tool involved was a welder used on the tanks which is available at the works. All the documents were removed by the French, Herr Zalewski- Neuenborn could give more detail on the tanks and construction. Venturis, Eckener said, were made by Linke-Hoffmann.

The only development of A4 of which Eckener had heard was one of the same size with lateral wings which was to have a range of 10,000 Km. and a ht. of 60 Km. One of these had been constructed at Peenemunde. It is possible that this might have been flown by a pilot. One of Eckeners test pilots was exceedingly keen to fly an A4 and had asked him to approach Von Braun to suggest this. One of his test pilots had been killed previously flying a V-1. This firm also produced wooden wings for aircraft in conjunction with HUTER who had designed a specially strong and light type of wooden wing. This could either be assembled to the aircraft Hs 211 of which Eckener has an outline drawing and specifications or to standard aircraft. They also had under development in conjunction with a French firm a six-engine ninety-six ton aircraft for transport purposes. They produced reflectors for short wave reflection and detectors mainly.

SECRET
CIC 75/31

- 1 -

Enclosure (2)

SECRET

KO-13483

ZALEWSKI, when interviewed, gave information:-

L.Z. produced only the middle part of the rocket i.e. the tanks and surrounding body. Components to the rear (mainly of Ferrous composition) were produced by Linke-Hoffmann of Breslau. Turbines were produced by Walther-Kiel who also with Siemens produced electrical apparatus. L.Z. were originally approached to construct and assemble the whole A4 but owing to their inability to cope with the heavy metal components did not do so. As far as he knew, MITTELWERKE of HALLE/SAALE were the only firm who assembled the complete round. He had no knowledge of the graphite blades or who produced them. He had seen a round fired into the sea at Peenemunde about a year ago.

He had heard of an A4 project with wings in the middle. He thought it had the same performance, the wings being only to stop it from rolling.

The tanks were welded light alloy the pressings being slightly flanged and the joint formed from the flange. Every tank was tested, the A (forward) tank at 2½ atm., the B (rear) tank at 1½ at. with soapy water over the seams, being re-welded where bubbles appeared.

He named ten firms engaged on production of tanks. They were:-

(1) L.Z. - Friedrichshafen.
(2) Austria - Vienna.
(3) Bertram Müller - Wilhelmsruh.
(4) Wegel - Ehingen, Nr. Stuttgart.
(5) Marcus - Berlin.
(6) Holder - Preistadt i/o S.
(7) Metallwerk - Halberstadt.
(8) Gebrüder Hoffmann - Berlin.
(9) Mittelwerke - Halle.
(10) Schindler - Kennelbach, an associated firm.

It took about six weeks to get a firm into production on the tanks.

6. ITEMS SEARCHED: None.

7. PRIORITY ASSESSMENT: Third (3).

8. OTHER REMARKS: None.

9. DATE OF ASSESSMENT: 6 May 1945.

10. ASSESSING TEAM: S/Ldr B.J.M. ROBINSON, RAF, CRAD
Capt. T. CHAPELL, U.S. Ord.

ARMY GROUP 6
ZONE GROUP 2

11. DOCUMENTS AND EQUIPMENT REMOVED: None.

SECRET

Enclosure (3)

UNCL

THIS PAGE IS DECLASSIFIED IAW EO 13526

1943-44 Test Launches of Extended A-4 Rockets

Report T.I. 3339 (SD-2621pt/947), Flying Bombs and Rockets. December 1944. NARA RG 77, Entry UD-22A, Box 165, Folder ALSOS MATERIAL

Telegram No1 Dated: December 11, 1943.

D'ETAT

SECSTATE

WASHINGTON

WATCH. Repeated London and Algiers.

Following obtained by Austrian contact who has proved reliable but his source untested by us.

Germans already manufactured 12,000 rocket projectiles 10 to 12 tons total weight containing 3 plus tons explosive charge consisting of propane in some types and propylene in other types. Projectiles are 12 to 15 meters long. Twenty meter model abandoned because always exploded in air. Transport is by special RR cars with 10 axles. Range 230 to 330 km. Hits ground at angle of 48 degrees. Launched by apparatus powered with steam. Explosive charge in nose is followed by chamber capable receiving radio stimulus then cell containing rocket fuel composed of butane acetaldehyde and source understands also nitric or perhaps nitrous acid. Next chamber is for combustion where fuel burns in presence of nitric or perhaps nitrous acid. Part of escape gases operates turbine which another source says is to compress air required for combustion of fuel. Outer case is double with carbonic acid between for cooling. Firing locations are near Calais, St. Omer (these two towns have 17 batteries) and in Holland Belgium Denmark. (From 110. View range last location not comprehensible). Date for beginning their use postponed ~~fxr~~ from Xmas to beginning Feb. 1944. Suggests consulting Fritz von Opel who we understand is in USA. Manufacturers in Austria and vicinity include Raxwerke at Vinzendorf am Schneeberg also at Ebensee and Alt-Oetting. Also in region Berchtesgaden and parts are made in Heinkel works Schwekat and another Schwekat factory.

The rocket is apparently launched by an additional explosion within a cavity or chamber which is closed by mounting the rocket on it before firing. The explosion is set off in the same manner as the propulsion ~~xxpxixxx~~ explosions. No figures are known as to the initial velocity, it is not very great as it has been repeatedly observed that at the moment of launching the rocket does not follow a straight line but seeks its course in a wavering manner.

V-2, V-26, V-32.

The information at hand differs as to the explosive (charge) in the rockets. This is evidently due to the fact that two types of rockets are now being used. For a considerable time the V-2 was known in Germany as the V-26, the only type then used. This projectile is 13 m. long (some say 16 m.), its diameter is 1.70m. (some say 2m.), it carries 900 kg. of explosives, its total weight is 6000 kg., its speed is 4800 km. per hour, its radius is 300 km. It can go 100 km. high.

It is reported that since a short time ago a new rocket is being used, the V-32, said to be 18 m. long (some say 25m.), with a diameter of 5m. (?), and to carry 1200 kg. of explosives (some say 1600 kg.). Nothing is as yet known as to its speed, radius of action, and the altitude it can reach.

According to an unconfirmed report the total weight of the V-32 is supposed to be considerably greater than that of the V-26. This report states that 1600 kg. of explosives are required to send such a rocket across the North Sea, besides the necessary nitrogen, 5 tons of liquid oxygen, and 3 tons of spirits distilled from potatoes for which 30 tons of potatoes have to be used up. This explains why the Germans seized so many barge-loads of potatoes which were destined for the civilian population. The propulsion of the V-32 is said to be very bad, a large number of them having come to grief soon after being launched. The largest plants producing rocket equipment are located in Halle on the Saale.

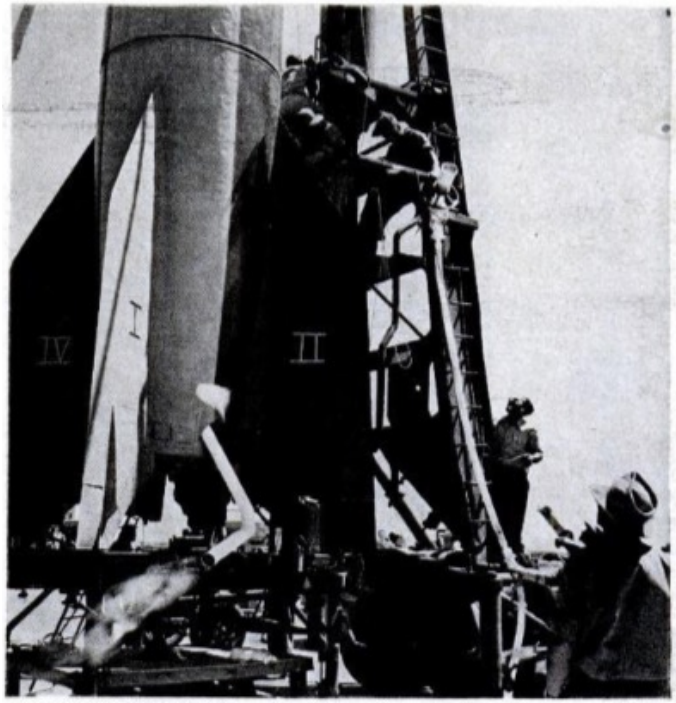
Launching:

The ground from where the rocket is to be launched must be hard and firm, and able to withstand great shocks. At first a concrete base was built, its wide surface reducing the ground shock per square foot so that the ground did not sink in. The trouble with this was the considerable time it took to build it, and the being confined to a certain spot. Now freezing mixtures (probably liquid oxygen) brought in special trucks, are used to freeze the ground (to what extent and depth is not known) thereby obtaining practically the same results as if concrete were used, except for a short duration only. Many reports indicate that, taking into account the time necessary for the setting up and pointing (about 2 hours) only four rockets can be launched each time per site thus obtained. The trucks and equipment are camouflaged; as th are spread out and as all transfers take place at night, they cannot easily be attacked from the air; after allied reconnaissance flights the are set up on another site. It follows that rocket launching sites cannot be destroyed for the simple reason that there aren't any to destr

Boris Chertok. 2005-2012. *Rockets and People.* Vol. 2, pp. 188-189.

The Germans who developed the guidance system for the A4, and after them our specialists who developed the R-1 and R-2 guidance systems, viewed them as controllable objects possessing the properties of a "solid body," meaning that when exposed to loads, the missile hull would not deform at all. Such an assumption proved inapplicable for the R-5 missile, which was more than 20 meters long with hull diameter of 1.65 meters, like the R-1. The missile hull bent under the effect of loads from the control fins. The flexural elastic modes of the hull were transferred to the gyroscope bases. The gyroscopes responded naturally to these modes and sent commands to the guidance system, causing the control fins to shift. The loop closed and entered an unexpected self-oscillation mode.

Charles J. V. Murphy. The State of the Armed Forces.
Life. 2 Sept. 1946, pp. 96-108.



GERMAN SCIENTISTS work with Americans fueling V-2 rocket at White Sands, N.M. U.S. imported Germans who were far ahead in rocket research.

pable, at the present stage of design, of lifting, unaided, enough fuel to raise it to the thin air of the high altitudes where supersonic speeds are possible. Therefore they will have to be lifted five or six miles into the air by a B-29 before being turned loose for a few minutes of epochal flight. It will be some time—probably a decade—before the supersonic airplane is developed to a point where its manufacture can be undertaken with confidence. But a decade is not a long time. On the subsonic side of flight U.S. airpower has been supreme. Can we be sure of our place on the supersonic side?

As a matter of fact, though the airplane has not yet physically crossed the sonic wall, the supersonic flak rocket for shooting it down is already waiting on the far side, lacking only a refinement of its electronics guiding systems. The old law stands: the attack inevitably brings forth its counter. The radar systems of World War II, limited to a 200-mile range and fairly easily jammed, will manifestly be unable to cope with the supersonic airplane. But the behavior pattern of lift-frequency microwaves in the upper atmosphere suggests that the waves may be bent and made to travel around the world. If this is actually the case it should be possible for radar observers in this country to follow air movements in any part of the world and vice versa.

Yet, as matters stand now, the most important question mark in the U.S. military equation is not the conflicting rate of development of the supersonic airplane and its counter. It is whether the big, long-range supersonic rocket, such as the German V-2, will develop to a point where it will supplant the strategic bomber.

The V-2 now being tested in the New Mexico desert is, by bombsight standards, an inaccurate and unreliable weapon. On a 200-mile range it is seldom accurate within six miles. It consumes about nine tons of alcohol and oxygen to deliver a ton of explosives. But it would be a dull man indeed who considered these shortcomings decisive. As a mechanical proposition, the rocket offers the most effective way to deliver the atomic bomb. Its plunging descent at ultrasonic speed (maximum: 4,400 feet per second) makes the problem of radar tracking and interception as agonizingly difficult as coping with the atomic explosion itself. In fact, even now the 1945 model of the German V-2 with a non-atomic warhead and a 350-mile range (unfortunately none of the samples fell into our hands) has been conceded by the British Imperial Staff as rendering the British Isles indefensible.

While the Germans had a transatlantic rocket on the drafting board when the war ended, their research into heat-resistant materials and electronic control had not been carried far enough to assure success. The current American tests are chiefly to fill out knowledge of the upper atmosphere and the behavior of materials under intense heat and pressure. And on the basis of what they have already found, American scientists say it should be possible to construct a fairly dependable rocket of transatlantic range within 10 years. The principal unresolved problem is control—but preliminary research in several scientific fields promises a solution.

Not insignificantly the common language in the assembly sheds at White Sands is German. The fact of our dependence upon German scientists in this epochal development in the art of war explains in large measure the unprecedented preoccupation of our military planners with pure research. For in many fields of research—guided missiles (of which they invented 138 types), supersonic flight and submarine warfare—the Germans were far ahead of us. The real reparations prize of the war was not German machinery but German brains and research records.

Under the Potsdam partitioning of Germany, the Russians ended up with all the guided-missile proving grounds and most of the factories, the principal supersonic research centers (with wind tunnels far in advance of our own) as well as the underground mass-production and V-2 plant at Nordhausen. Equally precious were masses of official records, of which the some 400 tons plucked out by a handful of American intelligence officers represent but an inadequate sampling. Chance delivered into our hands the two leading V-2 research men, but the rank and file of German technicians in nearly all branches of the war sciences—nuclear physics, jet propulsion, supersonics and so on—were left in the Russian zone. The Russians have not only put them to work, but they have begun to coax across the Elbe scientists and other technicians from the American and British zone. Top-flight men are being offered the equivalent of $35,000 a year, with assurance of freedom of research and of person.

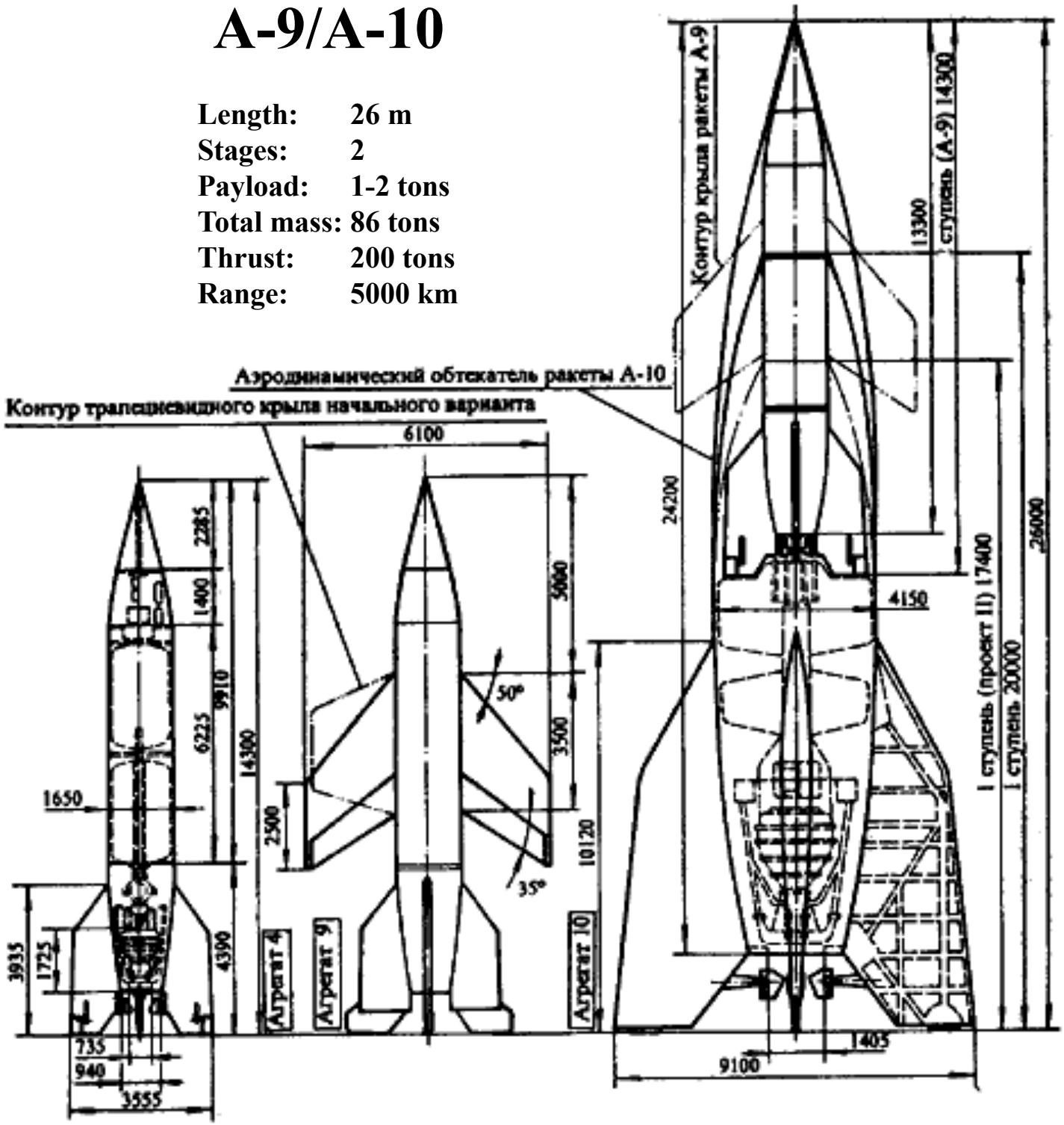
The possibility that these wandering talents, embodying billions of dollars worth of research knowledge, may drift into Russia worries U.S. strategists far more than the stripping of German machinery. An American general observes, "These German scientists are the new mercenaries."

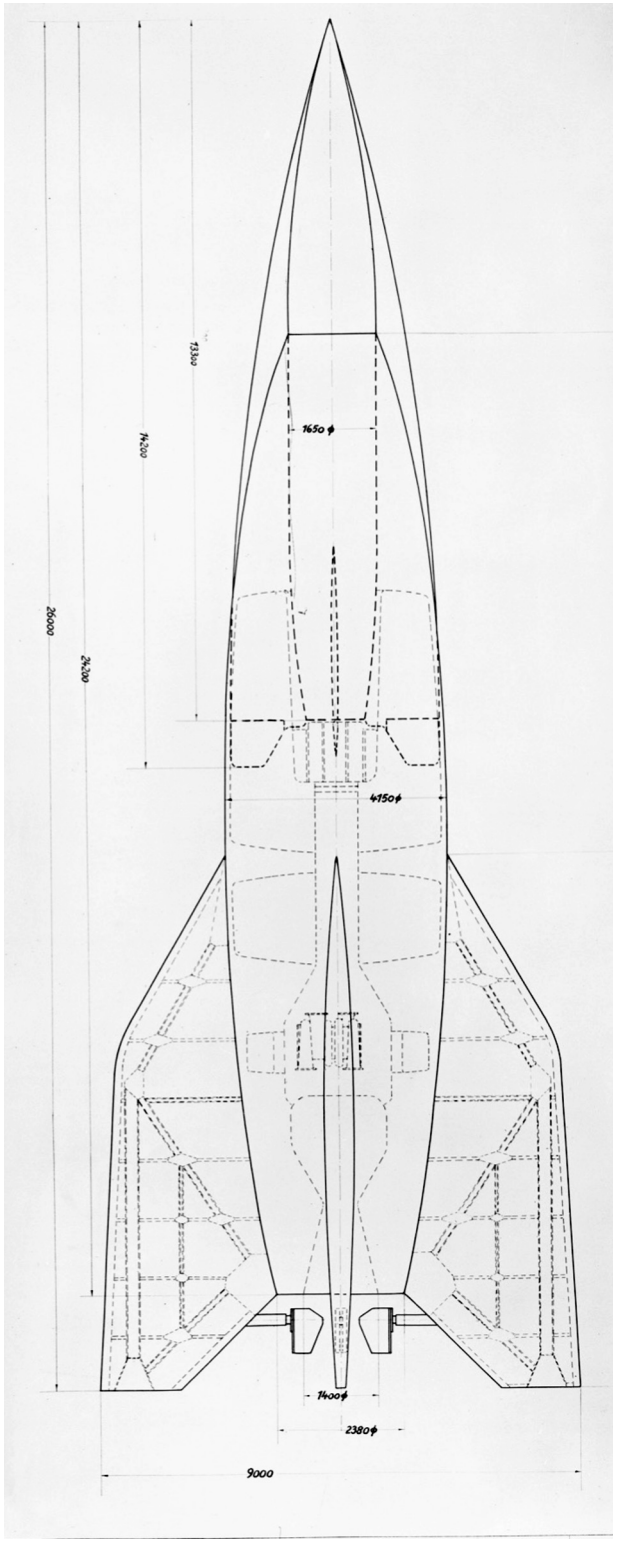
Bidding for German brains

A deadly game is now being played for possession of these displaced brains. Being civilians, the German scientists could not be put to work like ordinary prisoners of war; and for obvious reasons the State Department was not of a mind, at the outset, to encourage a general immigration of our former enemies. The few hundred brought in at the Army's insistence were gingerly classed as State Department special employes and are paid $10 a day plus

A-9/A-10

Length: 26 m
Stages: 2
Payload: 1-2 tons
Total mass: 86 tons
Thrust: 200 tons
Range: 5000 km





Says New V-Bomb Now Ready to Cross Atlantic. *Ottawa Citizen* 26 Jan 1945 p 17

STOCKHOLM, Jan. 25---(Reuters)---V-4---new super flying bomb which the Germans claim can hit New York and other points on the eastern North American coast---now is in production and ready for launching across the Atlantic, a German engineer who was one of the principal inventors of V-weapons told correspondents today.

Until a few days ago he was head of an experimental station for V-bombs in Jutland but escaped to Sweden. He first posed as a Danish refugee but after questioning by Swedish authorities disclosed his real identity. The German was then interned but as his knowledge was useful to the Swedish general staff, they are granting him special conditions and are keeping his name secret.

The V-4 is faster and more accurate than the V-2---and V-3 which is only an improved version of V-2---the engineer said. It weighs about 15 tons, travels at 1.8 miles a second and attains an altitude of more than 120 miles. It reaches this height in just over two minutes after being fired at an angle of 75 degrees.

Its great altitude and speed give it increased accuracy and range. At 360 kilometers altitude, the atmosphere is thinnest, so there is practically no friction to impede flight and thus reduce range. Further, an object of this weight and travelling with this speed cannot easily be diverted from its course by forces such as wind pressure, when climbing or falling.

The great disadvantage of V-4, the engineer said, is that it is difficult to produce in quantity. The Germans could therefore only send a limited number of bombs against Halifax, New York or such cities. The Germans will probably reserve it for European targets until their final defeat, when sheer spite may cause them to attack North American cities, he said.

Theodore von Kármán. Where We Stand. 22 August 1945.

In addition to the German view that the final guided missile would be completely automatic in operation, the possibilities of long-range strategic bombing were fully understood. There is no question but that the diversion of the efforts of the Peenemünde scientists in 1943 to the development of an antiaircraft guided rocket delayed the introduction of the winged V-2 rocket (A-9) and its successor, the transoceanic rocket (A-9 plus A-10). Drawings and computations had been completed for the A-10, a rocket weighing 85 T with a thrust of 200 T to be used as a launching rocket for the A-9, accelerating it to a speed of 3,600 ft/sec. The motor of the A-9 would accelerate it further to a speed of 8,600 ft./sec, giving it a range of about 3,000 miles. Some consideration was given to the design of one version of the A-9 carrying a pilot. The Scientific Advisory Group agrees that the German results of wind-tunnel tests, ballistic computation, and experience with the V-2 justify the conclusion that a transoceanic rocket can be developed.

Can Super-Rockets Hit America? *American Magazine.* March 1945. pp. 25-108.

I have talked to the leading V-2 authority for the United States Strategic Air Forces in Europe, an officer of high rank and solid reputation who knows all the Allies know about V-2. And we know a surprising amount. Because of his secret work I am not permitted to reveal his name [Donald Putt?]. But he has given me new and exclusive information which points to only one conclusion: This great rocket is unquestionably the most revolutionary weapon of our time. [...]

This authority, from facts at his command, has calculated for me approximately what kind of rocket might hit New York. Leaving Germany, it would weigh 63 tons, mostly fuel. Its war head would be 7 tons of high explosive. The journey from Germany to New York---about 4,000 miles---would only take 25 minutes. The "motor" would run but 8 minutes of this time. The rocket would climb almost vertically as high as 300 miles above the earth before leveling off sharply, and its maximum speed would be over 9,000 miles per hour, with an added time saving from the earth's rotation. "I am using New York merely as an example," he said. "The Germans could just as easily fire at Detroit or Chicago or San Francisco, although the error will naturally be greater if they aim farther west."

It still sounded a little Buck Rogers to me and I must have shown it, for he smiled and said, "I know. Only a few months ago a lot of people in Britain were joking about the 'fantastic' rumors of V-1 and V-2. I've helped dig some of those same people out of the rubble. . . . No, I'm afraid such a rocket is really practical. In fact, it's even more practical than the one they're using now against Britain. The curious thing about rockets is that the bigger you build them, the more efficient and satisfactory and inexpensive they become." I asked him why the Germans hadn't yet used such a rocket, if it was so simple. In answer he pulled out a newspaper clipping, reporting a speech on December 1 by the Nazi Labor Chief, Speer. In an address to the German War Production Board, Speer promised that "V-3" would be ready for firing at America very soon.

U.S. astronaut Gordon Cooper. 2000. Leap of Faith. pp. 148-155.

Wernher [von Braun] was brilliant, as one would expect, but I also found him to be a marvelous conversationalist, raconteur, and genial host. [...] On many occasions, I sat at the bar in his home all night long talking space until the sun came shining in the windows. [...] He regaled me with tales of his life in Germany, before and during the war. [...] Then there was Joachim "Jack" Kuettner, with whom I worked in the early days of Mercury on the Redstone rocket program. Jack had some hair-raising flying stories to tell.

At war's end, a manned V-2 was sitting on the pad at Peenemünde, all tested out, fueled up, and ready to go. It would have been launched on a low-energy easterly orbit, Jack explained. The plan: to drop a warhead on New York City. That 1945 manned rocket flight—sixteen years before the first U.S. manned rocket flight—came within a week or so of being launched.

Walter Dornberger. 1958. V-2: The Nazi Rocket Weapon. pp. 138-140.

It was only a step from the pilotless A9, with fully automatic guidance, to the piloted A9. This extremely fast aircraft, with a wing area of only about 145 square feet, had no military significance. Special landing flaps enabled it to land, after traveling about 400 miles in 17 minutes, at a speed of only 100 m.p.h. […]

Catapulting was an alternative method of imparting a high starting speed to the A9. On the basis of calculations and experience with V1 launching sites, a long, inclined catapult had been designed capable of giving the A9 a launching speed of 800 m.p.h. This would have been sufficient for the fully fueled rocket to fly on smoothly, after leaving its launching ramp.

A better plan, however, and one which greatly improved range, was to construct the A10, weighing 87 tons and with a total propellant capacity of 62 tons, as the first stage of the combined A9/A10. The A9 was placed on top of the A10. The latter had a thrust of 200 tons for 50 to 60 seconds and gave the rocket a speed of 2,700 m.p.h. After exhaustion of the first stage the A9 would be ignited and lift out of the A10. The A9 was to tilt fairly sharply soon afterwards and reach a peak altitude of 35 miles. Then the long supersonic glide was to begin. Meanwhile the A10, equipped with brake-flaps and parachute, could be recovered for further use after drifting down on to water.

The A9, beginning to operate at a great height, would acquire an additional velocity of about 3,600 m.p.h., resulting in a maximal velocity of about 6,300 m.p.h. at the moment its motor cut off. A distance of 2,500 miles could therefore be covered in about 35 minutes. Like the single-stage A4 this two-stage rocket was to take off vertically and obviate the need for elaborate launching installations. […]

Once we reached this stage the horses fairly bolted with us. With our big rocket motors and stage-rockets we could build space-ships which would circle the earth like artificial moons at a height of 300 miles and a speed of 18,000 m.p.h. Space stations and glass spheres containing the embalmed bodies of pioneers of rocket development and space travel could be sent round the Earth on endless journeys. Even an expedition to the moon was a popular topic.

We dreamed, too, of atomic energy, which would at last give us the necessary drive for flight into the infinity of pace, to the very stars.

Charles R. Christensen. 2002. A History of the Development of Technical Intelligence in the Air Force, 1917-1945: Operation Lusty. p. 189. [See also: https://www.annualreviews.org/doi/pdf/10.1146/annurev.fl.16.010184.000245]

Dr. [Karl] A. Pohlhausen from the Peenemunde Group assisted Northrop Aircraft Company with guidance system for their missile development program. Pohlhausen had worked out the mathematical formula for the motion of a gyroscope under high G-forces. His work was being used to develop a guidance system for the transoceanic A-10 surface-to-surface missile when the war ended.

PW interrogation report for Peenemünde chemist. MU 500, CSDIC (West), Seventh Army APO 758 US Army, Reference No. 579, Peenemunde Experimental Center (Karlshagen). 14 December 1944.

The V-2 flying bombs are assembled in the EAST Works […] which has about 3,000 engineers and workers. Two types of V-2 have been built: Type A 1[0], which is about 23 m long and 4.5 m in diameter, and Type A 4, which is about 18 m long and 2.5-3 m in diameter. Only the latter is in mass production. The experimental launching of V-2 used to take place every Saturday afternoon from Mar 43 to Mar 44. At the latter time it was rumored that HITLER had visited the center and had demonstrated his anger at the slow progress of the experiments. From this time on the frequency of the bomb launchings was increased to every other day. When PW left the center in July 44 there were still some launchings which were not successful due to the fact that the bombs were not able to be radio-guided, although they were launched successfully. [...] PW heard that German technicians intended to launch them to an altitude of 120 km, which would have permitted them to reach NEW YORK. At the height of 15 km the bombs have a range of 500 km. When the bomb drops through the stratosphere to a lower level, it becomes red through friction.

V-2 Plant Survivors Publicize Their Story. Huntsville Times. 28 February 2000.

"People have now started to realize what happened there," said Alex Baum, who was a member of the French resistance and was captured and sent to the underground V-2 plant. He now lives in California. "We want to make the public more aware," Baum said. [...]

Baum said he remembers von Braun both from Peenemünde and Dora, although he had no contact with him or the other German engineers at the time by orders of the SS. He remembers one day when the top German brass, including Heinrich Himmler, the head of the dreaded SS and the second-ranking official in the Third Reich, visited Peenemünde. Von Braun praised the V-2 to them, Baum said.

"I understand German, too, because I was raised in Alsace-Lorraine (a region of France on the German border)," Baum said. "I could hear von Braun talking about the ultimate weapon that's going to destroy the United States and everything else. We (the prisoners) were not very close, but we could see them." Later, he would see von Braun visit the Mittelwerk, usually in the company of top military officials. "He was very desperate to get this thing going, and he knew exactly what was going on," Baum said.

Benjamin Jacobs. 1995. The Dentist of Auschwitz. Chapter 16: Dora-Mittelbau.

"What work are you doing here?" I asked an inmate. [...] "Have you heard of the German V-rockets? After the Allied bombing destroyed Peenemünde, where they were first built, now we assembled them here, in the Harz mountain caves. At first we worked on the V1, then on the V2, and now," and here he began almost to whisper, "we are beginning to work on the V3."

Nazi Secrets Given Japan to Use on U.S. *Washington Post.* 29 August 1945 p. 3.

The Germans were within six months of mass production of new weapons of great destruction when VE-Day closed their laboratories and shut off their production lines, Naval Secretary Forrestal disclosed yesterday. […] In the development stage at least two or three rockets better than the V2, which were to be mass-produced in large underground factories.

U.S. Army Ordnance Department. 1946. History of Ordnance Technical Intelligence in World War II, Part 1: History, Orders & Circulars, Publicity.

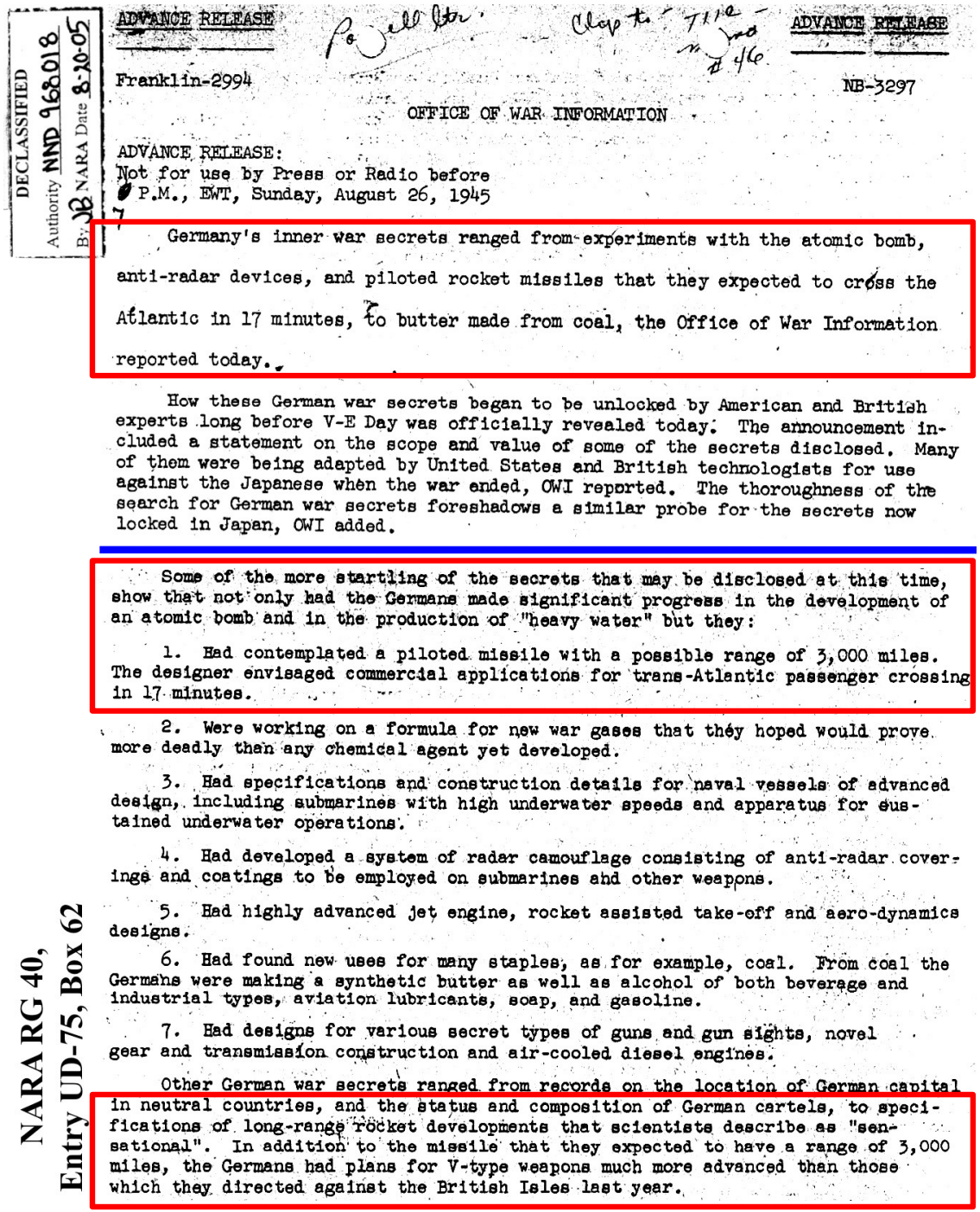
Quite a number of types of the well-known V-2 rocket had been worked on by the Germans and the research progress was laid out in such a manner that it would appear that very long range rockets might have been used some time in the near future had the war continued and nothing else interfered with their efforts. It is frightful to consider the possibility of a guided missile with an atomic bomb as a warhead, but there is little doubt that the Germans were actively considering the possibilities of such a weapon.

Albert Ducrocq. 1947. *Les Armes Secrètes Allemandes.* Paris: Berger-Levrault. pp. 160-161.

There had long been doubts about the military effectiveness of the A-9: spending 100 tons of fuel and wasting complicated machinery to throw just one ton of explosive on American territory seemed like a high price to pay for the pleasure of annoying your adversary! First of all, it is worth noting that the actual cost is not much higher than in the case of a V-2 attack, since the A-10 first stage is recoverable, and second, what is expensive (at least in terms of man-hours) is not so much the alcohol or liquid oxygen as the V-2 or A-9 machinery; in both cases, the cost was decided in advance. [...]

And there is worse: in Hitler's mind, the A-9 was also intended, if need be, to transport atomic bombs onto American territory. [...] Do you realize the material and moral repercussions of dropping a single atomic bomb on New York, for example? It is virtually impossible to measure them.

What is more, in addition to A-9 bombing, the Germans wanted to undertake direct bombing of the American coastline using submarine-launched V-2s. This was their second new weapon against America. It was to come into action at the same time as the A-9, i.e. in early summer 1945...



DECLASSIFIED Authority NND 968018 By NARA Date 8-30-05

ADVANCE RELEASE — ADVANCE RELEASE

Franklin-2994 — NB-3297

OFFICE OF WAR INFORMATION

ADVANCE RELEASE:
Not for use by Press or Radio before
P.M., EWT, Sunday, August 26, 1945

Germany's inner war secrets ranged from experiments with the atomic bomb, 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.

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 sustained 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.

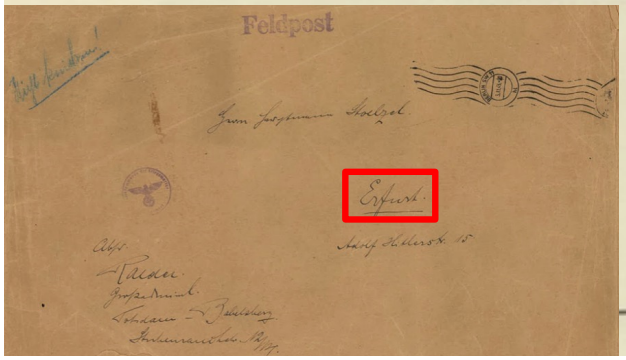
7. Had designs for various secret types of guns and gun sights, novel gear and transmission construction and air-cooled diesel engines.

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 rocket 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.

NARA RG 40, Entry UD-75, Box 62

Piloted A-9 "2-Man Rocket"

Heinz Stölzel



				Datum	Name	Renderungen
1	Fernsteuerung	6	Platzmembran-rentile	Gez. 19.8.45		
2	Ueberdruckkammer	7	Ofen	Dep. 21.8.45		Datum / Name
3	Pressluferzaug-ungsanlage	8	Rudermaschinen	Masstab 1:50	A 9/II [bemannt]	4
4	Benzolbehälter	9	Strahlruder			Arb.Nr. 3
5	Salpetersäure-behälter	10	Luftruder			

Estate of Heinz Stölzel

GERMANS ARE STILL STRIVING TO PERFECT NEW V WEAPONS

Rocket, Atom, Freezing and Plague Bombs And an 'America Bomber' on Their List

New York Times, 22 October 1944, p. E5

By HARRY VOSSER

By Wireless to The New York Times

LONDON, Oct. 21—The Germans' parting shots at Britain with their flying bombs are growing fewer. The attacks are small and scattered and are of the hit-and-run variety.

Robots reaching this country are launched from carrier planes—the almost obsolete Heinkel III—while the planes are over the North Sea. The Heinkels generally take off before moonrise or just after the moon has gone down and they seldom attack with their robots in daylight or when weather conditions favor the air defenses of Britain.

Some Heinkels operate from the few bases left to the Germans in northern Holland while others, it is thought, come from airdromes either in southern Norway or northwest Germany.

More Horrible Weapons

The fact that the Germans continue to use flying bombs in their attacks on southern England and the London area tends to confirm neutral reports reaching this country that all is not well on the Nazi V-weapon front.

However, it is equally clear from these reports that although difficulties are being met with in the construction of other V weapons Hitler, who has always put his hopes of victory in them, has ordered a great speed-up on all work and experiments in this direction. German scientists and technicians are working day and night to discover and develop more horrible weapons of terror and destruction.

If Hitler can get the necessary breathing space by holding the invading Allied armies on the borders of the Reich for from three to six months more, he may enable the scientists to complete their work.

V-2—a rocket projectile—was reported by the Germans to be ready some time ago. This was confirmed by neutral sources which said that rockets had landed in Sweden and Poland from the firing point at Peenemunde. It was also reported that some rockets fired from bases in northern Holland had crashed in the North Sea.

Hitler is said to have stopped the production of that type of rocket and to have ordered scientists to concentrate on the production of bigger and more powerful ones. At least four of these latest experimental rockets are reported to have landed in Sweden and many more have crashed into the Baltic Sea off Sweden's southeast coast.

Torpedo With Fins

The rocket differs from the flying bomb in four ways. It carries a much heavier load of explosives. As it is a rocket, it is not jet-propelled. Its range is much greater and, finally, it is not so accurate. V-2 in its new form looks more like a big torpedo with fins attached. It is of varying sizes—ranging from 18 to 50 feet long—with a maximum load for the largest size of about ten tons of high explosives. It is said to reach a height of nearly twenty miles. As it begins its downward glide the fins give it stability to enable the radio-controlled steering apparatus to operate. It is this radio steering that is giving the German experts their biggest headache.

Once that problem has been solved there seems to be no known reason which will prevent the Germans from launching an offensive from deep inside Germany against Britain and the Low Countries.

Other V weapons have been spoken of in recent weeks, and V-3 is reported to be the atom bomb. Dr. Goebbels has until now kept quiet regarding this one, but it is said that German scientists credit the weapon with having enormous possibilities.

Neutral sources describe the atom bomb as resembling an airplane in shape, with complicated machinery for steering and propelling the bomb to its target. The rest of the space is filled with explosives and fuel, the amount of explosives being governed by the amount of fuel necessary to carry the bomb to its selected target.

Atomic Power

An electric shock from a small instrument set to operate at a given time detonates explosive and atom simultaneously. The expansion caused by a normal explosive substance, such as dynamite when it becomes a gas, is increased by the force of the disintegrating atoms. This atomic power is said to double and quadruple the expansive force of any ordinary explosive.

These neutral reports may exaggerate the possibilities of the atom bomb, but it is significant that two or three sources have reported the existence of the weapon. It is interesting too to note that a report from the Berlin correspondent of a Swedish newspaper describes V-3 as "the America Bomber and the biggest and best of all Hitler's secret weapons." The correspondent said that successful experiments had been completed in Austria and that the weapon would carry two members of Himmler's recently founded SS air force. He finished his article with the words "America will soon know what war is."

Reports regarding the efficacy of the atom, freezing and plague bombs may be treated with some reserve, since they may easily prove too dangerous to be practical, but the rocket shell cannot be dismissed so lightly. There is no possible doubt that the Germans are straining every nerve to complete it and put it to use before the forthcoming onslaught by the Allied armies.

Mass Production of 2-Man Rocket

G-2 MSG FILE

Tp)
: Rpt
Verbal)

To:

Fr:

info -
TOP- report Location of installation making V-4
R-6-sheet - ~~869544~~ 869451 in hillside
and elevation of hill 315 - entrance S side of hill
Between 20 and 30,000 DP's - Gadget holds
2 men - used finished product to
Names for complete assembly -

G-2 MESSAGE SUMMARY

MESSAGES

8 April 45

From 353:

Displaced persons report underground factory in hill 315 at J869451. Entrance on south side of hill. Factory employs some twenty to thirty thousand Russians, Poles, French, etc. They are making the V-4 which is a two man rocket of some sort. Partial assembly at this factory and weapon then is sent to WEIMAR J5271. During the time the source of this information worked at this factory, approx one week ago, there had been no bombing.

More information later after a complete interrogation.

Tuxedo 2
0900

17

Corps
C G
Asst C G
C/S
G-1
G-3
G-4
Div Arty
353d Inf
354th Inf
355th Inf
Recon Tr
Engrs
Med
C H
Ord
Hq Co
A G
CC Cp Trs
Msgr
Journal File
LNSEC
AGLO

DECLASSIFIED
Authority NND 735017

NARA RG 407, Entry NM3-427, Box 11005, Folder 389-2.2 G-2 Jrnl File—89th Inf Div. 8–9 Apr 45

Selon un poste clandestin allemand

Paris-presse

Rédaction, Administration, Publicité : 100, rue de Richelieu, Paris (2e). Tél. : Rich. 81-55 à 58

Mercredi 18 Avril 1945 — 6e édition — 1 fr. 50

PATTON ET KONIEV auraient fait leur jonction au sud de Dresde

Un poste clandestin allemand annonce que les avant-gardes américaines et russes sont entrées en contact dans la vallée de l'Elbe, quelque part entre Pirna et Tetschen, au sud-est de Dresde. Cette information n'a reçu aucune confirmation officielle. On la considère même comme étant prématurée.

Les aviations anglaise et soviétique attaquent ensemble Berlin

LONDRES, 17 avril. — L'agence Transocéan a annoncé aujourd'hui que les bombardiers russes ont attaqué Berlin la nuit dernière.

Reuter, de son côté, annonce que la R.A.F. a également effectué deux raids la nuit dernière sur la capitale allemande.

Joukov a déclenché son offensive vers Berlin à partir de l'Oder

LONDRES, 17 avril. — L'offensive soviétique de l'Oder est déclenchée.

L'Armée Rouge attaque sur un front de plus de 300 kilomètres entre Schwedt, où des brèches profondes ont été réalisées dans les positions allemandes, et le nord de Guben, où la Neisse a été franchie en plusieurs endroits par les armées de Koniev.

Selon la radio allemande, les opérations se développeraient sur trois points à la fois :

Sur l'Oder central entre le sud de Francfort et le nord de Kustrin; dans la région de Forst, sur la Neisse, à 110 km. au sud de Berlin ; dans le secteur de Schwedt, à 45 km. au sud-ouest de Stettin, où une tête de pont a été établie.

D'après le D. N. B., les forces de Joukov ont pénétré profondément dans les défenses allemandes à l'est de Berlin dont ils ne seraient plus qu'à 45 km. dans la région de Seelow, sur la route de Kustrin à la capitale allemande.

Les troupes soviétiques tiennent une tête de pont relativement large de 32 km. de largeur à l'ouest de l'Oder et s'efforcent d'en faire de Berlin.

Un million d'hommes

Plus de dix armées soviétiques, sont massées sur ces fronts. Koniev disposerait de plus d'un million d'hommes. Une concentration d'artillerie encore jamais atteinte, appuie l'attaque et la progression des unités de choc. On estime dans les milieux militaires alliés que les maréchaux soviétiques disposent de trois canons de gros calibre et de cinq pièces de campagne par dix mètres de front.

Dans les autres secteurs, les Russes poursuivent leur progression. Au nord de Vienne, Malinovsky marche sur Brno et Prague à

Invasion de la Saxe

La volonté des Allemands de se défendre jusqu'au bout et de former des « hérissons » est confirmée par la décentralisation du commandement encore à Model dans la Ruhr, Busch dans le nord, Wettinghof en Italie. Ce qui reste de l'armée allemande compte encore 160 divisions.

MONTGOMERY — En Hollande, [illegible] de la 1re armée parachutée a été terminé par l'avance des Canadiens sur la digue qui borne le Zuiderzee. Sur le front du général Dempsey, on se bat toujours dans Brême et Oldenburg est menacé. La marche sur Hambourg a amené l'aile droite de la 2e armée sur la ligne Zetten-Velzen.

GEROW — Le Ruhr est à peu près bouclé par la 15e armée. Des nombreux généraux et 200.000 hommes ont été faits prisonniers et on s'attend à la capture de Model lui-même ; 30.000 Allemands résistent encore à Duisbourg.

SIMPSON — La 9e armée tient maintenant l'Elbe sur 150 kilomètres.

Exclusivité Paris-presse

Libérés plus tôt que les Allemands ne pouvaient s'y attendre par l'avance américaine, des déportés français affectés à la fabrication des armes secrètes

nous font des révélations SUR LE V-4

dernier rêve de Hitler

Ces déportés qui n'avaient pas vu le jour depuis des mois, travaillaient au secret dans une usine souterraine s'étendant sur 24 km²

HITLER avait fait un rêve : le dernier. Il rêvait de gagner la guerre, grâce à une nouvelle arme secrète, le V-4. Ce rêve ne se réalisa pas. Les nazis n'en emporteront même pas le secret dans leur tombe. Car ils avaient eu l'imprudence d'affecter par représailles, aux usines où l'on expérimentait et fabriquait le V-4, des déportés français qui permettent aujourd'hui aux Alliés de percer le mystère de l'ultime arme secrète sur laquelle le IIIe Reich fondait ses ultimes espoirs.

Ces Français, qui ont travaillé pendant plusieurs mois sous terre, sans revoir la lumière du jour, ont pu fournir sur le V-4, ses perspectives et son emploi, des précisions que « Paris-presse » est le premier à publier.

Nous connaissions les V-1 et les V-2. Nous connaissions même, par ouï-dire, les V-3, qui devaient être une édition améliorée et agrandie des V-2.

Nous savions aussi que les Allemands se proposaient d'expédier une véritable pluie de ces projectiles sur Londres. Mais nul n'avait encore entendu parler des V-4, l'arme qui devait [illegible]

FILE --- PH/Int/Adm
No. XXXI-3

V-2 Factory at Possneck (J-73)

1. Intel Exec. 19 June 45
Ops

1. Following information phoned by Col. T. Ames, Asst. A-2, Air Staff Shaef:

a. The CIO (Group Capt. Humphrey) of 2nd TAF, has advised that the V-2 factory at Possneck (J-73) has not been examined. Since this is in the Russian area, it is suggested by Group Capt. Humphrey that any action taken must be immediate.

b. Col. Hall, G-2 of the 30th Division, is reported to be familiar with this installation.

c. The above information furnished to 2nd TAF by a Major Darling.

d. It has been requested that Group Capt. Humphrey be advised of any action taken on the above.

A. W. DETWEILER
Lt. Col., Air Corps
Executive

Where are the reports?

AFHRA folder 519.650-1 Oct 1944 – Dec 1945
Exploitation—Enemy Equipment

>450-Page Report from Naval Technical Mission to Europe

NavTechMisEu 237-45. Survey of German Activities in the Field of Guided Missiles. August 1945. NARA RG 38, Entry P5, Box 38.

It must be borne in mind that the magnitude of the Germans' basic research program was tremendous and that it was equally thorough for all types of controlled missiles. Once they realized the defensive potentialities of various types of this new weapon, a program was inaugurated, which if given six more months uninterrupted time, might well have resulted in the achievement of what had become a basic policy: to drive bombers from the sky at altitudes below fifty thousand feet.

To increase range, the A-4b was made by the simple addition of wings to the A-4. This approximately doubled the A-4's range. With the ultimate operational range in sight for the A-4b, design work was immediately started on more radical weapons. There is little of humorous nature in the statements so often heard that the Germans intended to bombard New York from launching sites in Europe, as two missiles, the A-9 and A-10, were under development for use against the U.S. in the early months of 1946. This contemplated use was scientifically possible and undoubtedly would have been realized has time permitted.

Work on the science of controlled missiles was being carried out in every area visited in Allied occupied territory, from the border of Denmark to Switzerland and from the coast of France to the Russian zone of occupation. It is a known fact that some work was being done in Denmark, Norway and Poland, and it is estimated that 50% of the total German effort in this field was in what is now Russian-occupied territory, to which investigators have not had access. The results of the enemy's guided missile work are evident on the targets in England, Belgium and Holland.

It is estimated that one-third of the energy directed to aerodynamic research in Germany was devoted to the problems of guided missiles. The research laboratories at Braunschweig, Goettingen, Darmstadt, Ainring, etc., were involved in major projects and the above establishments have capacities exceeding anything previously dreamed of in America. There exists in Germany numerous wind tunnels with a Mach number of 4, i.e., four times the speed of sound. One tunnel with a Mach number of 10 was under construction. Some degree of guided missiles research was being carried out in all of the above tunnels.

It has been gratifying to find a few isolated items relating to the field of guided missiles in which the German product was inferior to similar accomplished in America. However, this is subject to being misconstrued if used to magnify our virtues or exonerate our failures by so-called experts who have "surveyed the field" in a few weeks, returned to America and announced they are disappointed to find the Germans have nothing to offer. Such a statement is evidence of the individual's refusal to accept the obvious fact, inexcusable if made in innocent though stupid sincerity, and criminal if made for ulterior motives.

From observation of the enemy's work, it is concluded that:

(a) If given a relatively short period of time, Germany would have succeeded in bringing into the war an effective counter measure against aerial bombers. She would have produced infinitely superior assault weapons through intensive exploitation of the science of guided missiles;

(b) From the standpoint of future warfare, the work of the Peenemunde and associated groups without question ranked among the most important being done in Germany on any subject. Although the apparent results of this organization have been extensively covered by investigators, determination of the groups' ultimate goal remains an assumption based on the trend of their developments. Undoubtedly they expected to produce weapons from the A series with which they could accurately hit any area on the face of the earth. It is equally obvious that with the V-2 they were not only working out in advance the aerodynamic and control problems of such weapons, but that in the present weapon they had a proven vehicle ready to receive whatever radically new explosive and propulsive substance they expected to become available. It is inconveivable that the V-2 was considered by the German scientists to be an end in itself, nor that with all its complexities, it was developed at the cost of billions of dollars and manufactured in great quantity with highest priority merely to deposit 750 kilograms of ordinary explosive on British territory.

With the relaxation to a practival degree of the impenetrable screen that has surrounded the investigation of German atomic disintegration research, some of the hitherto inexplicables of their guided missile program are now subject to an analysis from which reasonable answers can be derived. It is now obvious that the Germans realized and have accepted for years the fact that a controlled missile is the natural vehicle with which to transport atomic explosive. At last, the reasoning behind the design specifications which provided for very small warheads and the invariable orders to terminate missile projects upon completion of development are no longer mysteries or absurdities.

PW Intelligence Bulletin No 1/47.
13 March 1945. NARA RG 165,
Entry NM84-79, Box 1915.

SECRET

PW Intelligence Bulletin No 1/47

17. Uranium Explosive

O/Lt GOTT, a chemist, OC coy in PW's bn (959 Gren Regt) had been granted indefinite leave to resume his former position as director of a chemical laboratory in S Germany. This laboratory was experimenting with uranium. It produced 1/10 milligram of an explosive which, when accidentally set off, destroyed the plant and killed the scientists engaged in the experiments. O/Lt GOTT maintained that if subsequent experiments and production have proceeded without accident, enough of the explosive should now (Feb 45) be available to "destroy England in one blow".

(Source: Lt Helmut SCHWOTZER 959 Gren Regt captured 25 Feb vic WELLDORF)

18. V-Weapon against USA

An acquaintance told PW (28 Jan) that the laboratory in SWINEMUNDE where he worked, experimented with a new rocket missile, resembling V-2, 30 m long 4-5 m in diameter. Experiments conducted with 1/25 of the explosive charge produced devastating results. It was intended to use the projectiles in nuisance bombings of the USA.

19. Atom Smasher

PW heard from friends that atom-smashing experiments (conducted somewhere NW of BERLIN) were successful and would result in the perfecting of an atom-disintegrating weapon by May 45.

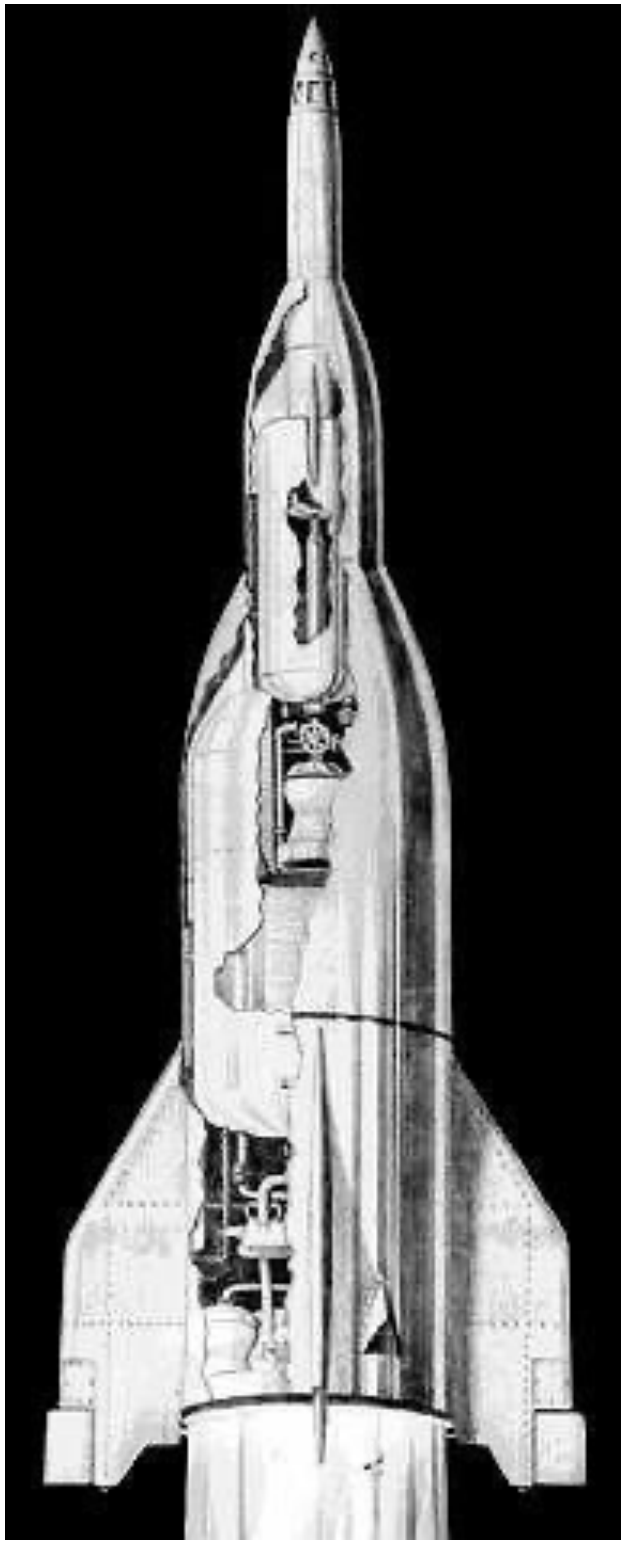
(Source: San Uffz Theodor GÖRGES 4 San Bereitschaft Hermann GÖRING Fallsch Corps captured 1 Mar)

Boris Chertok. 2005-2012. *Rockets and People.* Vol. 1, p. 245.

From 1937 through 1940, the Germans invested more than 550 million Reichsmarks into the construction of the Peenemünde center, an enormous sum for that time. […] All of this was conceived prior to the war, then refined and implemented during the hostilities under the conditions of Hitler's totalitarian regime, which spared no expense to develop the proposed secret weapon of mass destruction. […]

On 22 June 1941, Germany attacked the Soviet Union. While certain of a rapid victory on the eastern front, Hitler was troubled by Britain's tenacity. On 20 August 1941, at his "Wolf's Den" headquarters in East Prussia, he received Colonel Doctor Dornberger, Doctor von Braun, and the lead specialist for the development of missile guidance systems, Doctor Steinhoff. There was no need for the new missile weaponry for the Blitzkrieg against the East, since the Germans would be in Leningrad within a month and Moscow no later than October. Why then such attention to missile specialists? Dornberger and von Braun familiarized Hitler with the current status of their work on the A-4 missile, which had a range of up to 300 kilometers. They also discussed the potential for new missiles that would have intercontinental ranges. As a result of this meeting, Hitler gave the programs at Peenemünde the highest priority.

In autumn 1941, roused by this support from the highest level, the work force at Peenemünde began to speed up the design process for two-stage and perhaps even three-stage A-9, A-10, and A-11 systems. But the basis was to have been the A-4 design.



A-10/A-11 (or Similar Rocket) with 6-Ton Payload (H-Bomb)

New York Times.
4 December 1946, p. 35.

Nazis Planned Rocket to Hit U. S.

FORT BLISS, Tex., Nov. 19 (U.P.) (Delayed)—Wernher von Braun, 34-year-old German scientist who invented the deadly V-2 supersonic rocket, revealed today that before the war ended the Nazis were building a 100-ton rocket to strike at the United States.

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

Where are the reports???

The complete A-series of weapons had 16 models designated A-0 through A-15. They are all associated with developments up to the V-2 or developments of improvements of the V-2 as it is known to have been used.

The first six A-series models resulted in the V-2 weapon :-

Ao - Was the first attempt to develop a rocket motor whose thrust was sufficient to propel a 13.75 ton projectile. The Ao was never capable of sufficient thrust, however, through the study of the Ao, A1, A2, the small version of the V-2 was developed and became the A5.

A1, A2 & A3 - Were additional attempts to develop the thrust units and fuel for a V-2.

A4 - Development completed after the A5 had been successful. The V-2 was the production model of the A4.

A5 - Was a small version of the V2. It was the first successful attempt at large scale, long range rocket propelled projectiles by Germany. Through the experience gained from the A5 and its predecessors Ao, A1, A2 and A3, the A4 (V-2) was finally perfected.

A6, A7 & A8. - Were experimental developments of the A4 (V-2) with the addition of wings so that the range could be incresed.

A9 - Was the result of work on the A6, A7 and A8, and was a V-2 with wings so that instead of following a normal Hyperbolic trajectory, it would glide to earth after reaching a maximum height from the rocket propellent. Its range was increased to about 600-km or about 375 miles. Thus, the projectile could be launched well inside Germany, itself, and still reach England.

A10 - Was an experimental model of an additional thrust unit which was to be fastened to either the A4 (V-2) or the A-9 to give an additional range. It was to carry its own fuel, and

- when the fuel was completely burned the unit was released, at the same time starting the normal thrust unit in the A4 (V-2) or A9.

A-11, A12, A13 & A14 -- Were development models of the A9 - A10 series attempt- to produce a long range rocket projectile for attacks on the North American continent. The range strived for in these and the A15 model was 3500 miles.

A15

- Was to have been a 3500 mile range projectile using the A9 and A10 developments. This project probably never progressed beyond the drawing board stage.

A Weapons

A0 First Model of V-2.	**A8** A-9 Development Model.
A1 V-2 Development// Failure.	**A9** V-2 or A-4 with wings for range of 600 Meters.
A2 V-2 Development// Failure.	**A10** Development of additional take-off unit for A-9 or V-2.
A3 V-2 Development// Failure.	**A11** Development model of A-9 & A-10 for long-range (3500 Mi).
A4 Later known as V-2. V-2 Development.	**A12** Development model of A-9 & A-10 for long-range (3500 Mi).
A5 Small V-2 Model// First success.	**A13** Development model of A-9 and A-10 for long-range (3500 Mi).
A6 A-9 Development Model.	**A14** Development model of A-9 and A-10 for long-range (3500 Mi).
A7 A-9 Development Model.	**A15** 3500 Mile range V-2 with glide wings (Never constructed).

Bohemian V-3/V-4

Where are the reports???

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

In time the first secret of the Weser became apparent. Its parent plant was producing V-weapons. But it also manufactured cyclotrons for atomic experimentation. As the Allies bombed German laboratories, the Weser shipped new cyclotrons to secret destinations in the Reich where Hitler's scientists were running a losing race with history. At least three cyclotrons were shipped in the last year and a half of war.

The retreating Germans left the Weser grounds littered with the fuselages, fins and working parts of V-bombs. In iron safes were plans for Vergeltungswaffe-4, said to be a giant, radio-controlled rocket capable of being fired from Prague to the Americas. The Germans also left parts of cyclotrons and other equipment for research in nuclear physics.

S.D. 4840/MIS-926047. Headquarters European Command, Office of the Deputy Director of Intelligence. Possible use of Czechoslovak made arms in the Soviet Army and the present status in the Czechoslovak armament industry. Annex A. June 1946 NARA RG 319, Entry NM3-85M, Box 44, Folder 926047.

It is known that the following plants are producers of scientific warfare weapons: A.E.G. Plant---located at BEDRICHOV; Poldina Hut---VITKOVICE; Siemens Plant---CESKE BUDEJEVIC; and the Askania Works. The A.E.G. Plant produces weapons of a military and secret nature, under the guidance of German scientists. Access is barred to all persons of allied nationality. V-3 and V-4 models presumed to be still there, including all data. Poldina Hut is now producing semi-finished steel and iron products; Siemens---proximity fuses, homing torpedoes, and similar delicate equipment; Askania---fine instruments and laboratory equipment.

V. L. Rychly. Report No. 2655: Report on Visit to Czechoslovakia. 11 February 1946. NARA RG 38, Entry 98C, Box 9, Folder TSC # 2601—2700.

A. Between 3 January and 22 January, arrangements were made with the Czech General Staff to visit a number of plants that had been working for the German Navy during the war. Contact was made with this Staff through the British and U.S. Military Attachés who introduced me to Gen. BOCEK. The Czech authorities granted the permission but informed me that I would have to be escorted throughout by the Czech Secret Police (O.B.Z.). The plants visited were the following: […]

8. A.E.G. at BEDRICHOV (Bohemia). Manufactured F.B. Zielsuchgeraet. Pfau. Amsel. Ida 105 mine, accoustic, induction and reacting to change in water pressure. V-1 and V-2 fuses. The completed V-4. Lichtspiegelanlage.

The German scientists Pfister and Bakes, with whom I had the opportunity to speak, and some 22 other German scientists are still working on the development of the above under Czech supervision for the Russians. The program on which this firm is still engaged is much more extensive than that listed above. Pfister tried to pass me a copy of the complete program of work, but this was seized from my hand by one of the O.B.Z. officials present.

Egmont F. Koenig. Dispatch No. A-161-46. Office of the Military Attaché, American Embassy Prague. 20 November 1946. Subject: German V-Weapons in Czechoslovakia. NARA RG 319, Entry NM3-85A, Box 2144, Folder 326851 THRU 326860.

1. It has been determined with a fair degree of reliability (B-2) that the "V-4" weapon removed by the Russians from Bedrichov was the nose of a surface to surface guided missile, referred to as the "Pfau-2".

2. This nose had a new and more powerful charge, and missile itself was reported to have considerably increased range over the A-4. (B-3)

Where Are the Files?

[redacted]

HEADQUARTERS
SUB-REGION KASSEL
COUNTER INTELLIGENCE CORPS REGION III

APO 757

9 January 19 47

COPY # 1 OF 6 COPIES.

III-K-266.43

MEMORANDUM FOR THE OFFICER IN CHARGE

SUBJECT: Plans regarding Construction of Long Range, manned Rocket Bombs

Re: Operation 'MESA'

1. This information has been obtained in compliance with CIC mission referenced above.

2. Exhibit 'A', attached hereto, has been obtained from O-64-III-K who, in turn, received it from a V-2 specialist who escaped from ZENTRAL WERKE in BLEICHERODE (M53/3 91) to avoid being sent to Russia proper. The exhibit embraces the first outline for the manufacture of manned rocket bombs and was obtained from the files of the research bureau of ZENTRAL WERKE, BLEICHERODE, where it had been sent from PEENEMÜNDE (N55/P83).

3. Because of the technical nature of Exhibit 'A', an accurate translation by this office is impossible. Evaluation: A-2.

Approved:

MAX ETKIN
Special Agent, CIC
Commanding

ROBERT CLAUSEN
Special Agent, CIC

ALEXANDER N DUKAS
Special Agent, CIC

Exhibits:

'A' - Outline for long-range, manned rocket bomb in German.

SECRET
by [redacted] th of:
AC of S, G-2
Hqs, USFET
Init. RS
Date 15 JAN 1947

EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION SCHEDULE

REGRADED CONFIDENTIAL BY AUTHORITY OF COL D. G. ERSKINE, BY [redacted] 1ST LT, HQ 66TH CIC DET, 14 JULY 1950

CONFIDENTIAL

C/17892

DECLASSIFIED
Authority NND 007010

NARA RG 319, Entry A1-134A, Box 29, Folder ZA 019293 Soviet Guided Missiles, Rockets and V-Weapons Research, Development and Production Vol. 1, Fldr. 2 of 3

CONFIDENTIAL

HEADQUARTERS
COUNTER INTELLIGENCE CORPS REGION VIII
ZEHLENDORF FIELD OFFICE

VIII-5499

APO 755

13 January 1947

25 vs. 50 tons of "fuel" should be 25 vs. 50 tons of "thrust" [translation error]

MEMORANDUM TO THE OFFICER IN CHARGE

SUBJECT: SCHOEN, Edward

1. Upon request of the SAC, Zehlendorf Field Office this agent had informant Heinrich FEISE bring SCHOEN to this office for questioning this date.

2. SCHOEN gave the following information:

a. He resides with his wife at Berlin-Prenzlauer-Berg, Scherenbergstr 24. He was born 8 January 1907 at Berlin.

b. He was approached in August 1946 by a Soviet official who offered him a job at SOMMERDA (Leipzig sheet J39) constructing V-2 weapons. He was told that he would receive a bonus of 50,000 marks upon completion of the job and was warned that if he did not accept the job he would be taken anyway. He took the job.

c. After the machinery was installed and set up in the factory three rockets were built over a period of eight weeks. These rockets had fifty tons of fuel instead of the twenty five tons of the old V-2. The three rockets were crated 24 December 1946 and a week later they were loaded on a train to be sent to a proving ground or factory 13 km from MOSCOW.

d. There are four hundred mechanics working on electrical parts for rocket weapons at a factory in SONDERSHAUSEN (Leipzig sheet D11). This factory is also a collecting point for engineers and mechanics from which many are sent to RUSSIA. There are no mass shipments but individuals are sent, some of them against their will. SCHOEN knows many engineers who are willing to come work for the Americans.

3. AGENT'S NOTES COMMENTS AND RECCOMENDATIONS: SCHOEN has been turned over to Captain BIERMANN of FIAT.

EVALUATION: F-6

APPROVED:

HENRY S JONES JR
SAC

ALBERT HOLMAN
Special Agent CIC

CONFIDENTIAL

TOP SECRET

ISSUED BY THE INTELLIGENCE DIVISION
OFFICE OF CHIEF OF NAVAL OPERATIONS
NAVY DEPARTMENT

Copy No. 1 of 5.

TOP SECRET

INTELLIGENCE REPORT

JTR:cj/128

TOP SECRET CONTROL NO. 2925

Serial 0009-46 (Start new series each year, i. e. 1-43, 2-43)

Monograph Index Guide No. (To correspond with SUBJECT given below. See O. N. I. Index Guide. Make separate report for each main title.)

From COMNAVFORGER VIA COMNAVEU (Ship, fleet, unit, district, office, station, or person) at FPO., NY., NY. Date 1 May 1946

Reference None. (Directive, correspondence, previous related report, etc., if applicable)

Source S.S.U. Report. (As official, personal observation, publication, press, conversation with—identify when practicable, etc.)

Evaluation C-3 A-1 to E-O etc. A3/EN 3-10; SER. 4312416—11-18-42

Subject GERMANY - WEAPONS RESEARCH (Notice reported on) (Main title as per index guide) (Subtitles) (Make separate report for each title)

DECLASSIFIED Authority NND 963159

BRIEF.—(Here enter careful summary of report, containing substance succinctly stated; include important facts, names, places, dates, etc.)

SUMMARY: The following S.S.U. report, L-1262, dated 19 February 1946, concerns Weapons Research at Kreisel-Siemens-Gema, along with a list of leading personnel, their title and function.

GERMANY/BERLIN : MILITARY

Weapons Research at Kreisel-Siemens- Gema.

The information below comes from a well-placed and fairly reliable source:

1. The Russian technical office in the Gema-Haus in Köpenick is now known as KSG (Kreisel-Siemens-Gema). It is under Navy control and directed by Lt. Col. Sherlok and Lt. Col. Grudnitzki (?).

2. Apparatus not yet tested by the German Navy is being further developed. These are: depth steering (Tiefensteuerung) for submarines, floating steering (Schwebesteuerung) for submarines, automatic fire control devices (Geschützsteuerung), gyroscopic devices, steering for V-3 and V-4 weapons, aiming devices and gauges. The development is carried to the point of final tests; at the same time plans are made for mass production in Russia.

3. At present about 400 people are employed.

4. About 60 machine-tools are now operating; more are on the way from Morsleben, where an underground factory with about 2000 machines is being dismantled.

5. The Russians succeeded in retaining the most important specialists, many of them former party members. Below (paragraph 9) is a list of the more important employees in each group.

6. The Kreisel group, with the former employees of Kreisel-Geräte G.m.b.H., is carrying on the development of gyroscopic devices and hydraulic steering apparatus. The Siemens group, with the former employees of Siemens-Apparatebau is working on electrical steering apparatus, particularly remote-control steering and aiming devices. The Gema group is working with remote-control steering, bearing and aiming devices.

7. Wages paid by KSG range from 1 to 7.5 marks per hour. These are 20 percent or 30 percent above the established rates for such work in the Soviet Zone.

8. V-3 and V-4 are about 15 m long and 3 m thick, larger than V-1 and V-2. Propulsion units go into action by groups. After one group has been emptied, it is ejected from the rocket. Steering and ignition are performed by remote control. Hulls for these weapons are said to be built in the Harz Mountains and in a factory near Berlin; exact addresses are not available.

NARA RG 38, Entry 98C, Box 10, Folder TSC # 2801-2900

Subject: Guided Missiles---USSR. Reference No. 478-13. SD-5820. 7 August 1947. NARA RG 319, Entry NM3-85M, Box 170, Folder 929657.

When further questioned, this subject said that he believed Guided Missiles were being produced in the U.S.S.R. He spoke of a huge underground factory at ARNSWALDE in the Polish Zone, which, he said, is intact, and production is in full swing. He spoke of the very heavy guards on the place, that the only railway line in the vicinity terminates at the factory, and that he has seen large railway flat wagons leaving covered with tarpaulins. [...]

As Director General GROETTRUP controlled all the details of production. Among the special projects under his control were the reconstruction of the A-4, G-2 and A-9, the possibility of using steel rockets for stratosphere flight, developments for the calculation of course (both electrical and optical), and airframe developments. He registered the formula for KRAFTSTOFF GRUEN with the Russians and took an active interest in all aspects of the work connected with modifications to the G-2.

Subject: Construction of Radio-guided Rockets at NOVOSIBIRSK. D-152490, CW138175. 12 October 1947. A.I.B. NARA RG 319, Entry A1-134A, Box 29, Folder ZA 019293 Soviet Guided Missiles, Rockets and V-Weapons Research, Development and Production Vol. 1, Fldr. 1 of 3.

Special Report (translated from Russian)

Subject: Construction of Radio-guided Rockets at NOVOSIBIRSK

1. New radio-guided rockets are being constructed in factory "BOLSHEVIK" at NOVOSIBIRSK. These rockets are similar to the German "V" type but larger in size. This rocket in the shape of a cigar is 16 m long and 2.5 to 3 m in diameter. [...]

2. It is not known how many rockets are being constructed but according to unconfirmed reports only 5 or 6 rockets are constructed for tests and experiments.

3. In charge of the construction is ANSHUKOV an engineer sent from MOSCOW. He is obviously a military officer and he often wears military uniform though without rank insignia. Approx. 10 German specialists arrived from MOSCOW with ANSHUKOV.

CLASSIFICATION SECRET ~~SECRET~~

CENTRAL INTELLIGENCE AGENCY REPORT 50X1-HUM

INFORMATION FROM FOREIGN DOCUMENTS OR RADIO BROADCASTS CD NO.

COUNTRY USSR

SUBJECT Scientific - Miscellaneous, military weapons

HOW PUBLISHED Weekly newspaper

WHERE PUBLISHED Munich

DATE PUBLISHED Not available

LANGUAGE German

DATE OF INFORMATION 1948

DATE DIST. 10 Nov 1950

NO. OF PAGES 6

SUPPLEMENT TO REPORT 50X1-HUM

THIS IS UNEVALUATED INFORMATION

SOURCE Die Neue Muenchner Illustrierte,

50X1-HUM

NEW SOVIET WEAPONS

The following is a report of the experiences of a German scientist, Dr H. Tellman, who was taken prisoner by the Russians in 1943 and who worked for them as a scientist until he escaped by airplane. Dr Tellman now lives in Argentina.

My friend, Professor D. took me along on an inspection trip to Tomsk where the Russians had built an experimental station for V-2 rockets. I met an old acquaintance from Germany, Engineer P., who was in charge of the technical work of the entire installation. At first, the only experiments performed were the same kind which I knew from my work in Germany, but later, during my stay, new designs with much higher power were developed. Work was also carried out in the field of radio guidance of rockets. I saw the launching of several giant rockets whose dimensions considerably exceeded those of the V-2. The measuring devices recorded ceiling altitudes of 210 kilometers in these flights. A new rocket is still in the development stage. It weighs 40 tons and is expected to reach an altitude of more than 400 kilometers. I was also interested in the design of a multistage rocket, whose first stage was to be powered by nuclear energy.

To study the effect of the high accelerations on the living organism, the Russians placed into the warhead a parrot in an insulated cage. The warhead otherwise housed the recording instruments. The parrot was found to have suffered no ill effects.

The experimental rockets in the development stage today are nearly powerful enough to fly from the earth to the moon and to leave the earth's gravitational field.

A second trip took me to Kalinin. A large rocket-aircraft-testing station has been built there. The rocket aircraft developed there are based on the design of the German V-1. Essentially, they are nothing but manned rockets. The wings are small and sweptback. The cockpit is hermetically sealed and holds a two-man crew. The Soviets have also succeeded in obtaining the services of most of the important German rocket experts, who have attained very high speeds with their rocket aircraft; in one case, an aircraft equipped with three rocket engines reached a speed of nearly 2,000 kilometers per hour.

During one test flight which I witnessed, the material did not withstand the terrific strain, and the aircraft crashed, killing the German pilot. These aircraft are started from catapults. Fuel consists of a hydrocarbon compound and nitric acid. One of the German test pilots succeeded in reaching an altitude of 25,000 meters with one of these aircraft. The immense power of the engines was demonstrated to me when a rocket aircraft turned over during take-off and exploded. The explosion made a crater of 15 meters in diameter and 3 meters in depth, and the aircraft was torn into tiny fragments. These rocket aircraft are still in the experimental stage. However, the USSR has many types of jet aircraft which are already in service. They were designed and built in a plant near Voronezh by former members of the Messerschmitt firm.

A few days after my return to Moscow, I was taken to Peenemuende. The installation is operating full blast, and the region between Usedom and Greifswald is one single armed camp. There is no trace left of the demolitions carried out in 1945. Over 150 German scientists are working around the clock developing rocket projectiles and rocket-propelled fighter aircraft. I was able to determine that the Russians had obtained all German data for all the versions of the V-2 rocket. Special attention was given to the A-8 version of this rocket, which can fire 6,000 kilometer across the Atlantic with a flight time of 42 minutes.

The tests with guided rockets at Peenemuende made a great impression on me. Rockets were launched from sites in the Leningrad-Kronshtadt area. They landed with almost dead accuracy on the island of Pol. The rockets are launched to an altitude of 12,000 meters, and the propulsion unit of the rocket is cut in at that altitude by radio signal. The rockets then fly in a straight line, controlled by radio and radar signals from picket boats in the Baltic, until a measuring station stops them over the island of Pol and breaks off the flight there. The rockets come down nearly vertically and land near the target. The tests were repeated several times, and the results, in regard to accuracy, were always equally good. I am convinced now that the sensational reports once heard in Germany about rockets over the Baltic were not just imagination, but that rockets from Leningrad sometimes flew as far as Swinemuende, and that some of them supposedly got lost and flew to Sweden.

My work at Peenemuende consisted mostly in trying to persude the German scientists there to go to work for the War Academy in Moscow. In 1945, the Russians shanghaied the scientists, but stopped this practice in 1948, since they found out that they could not obtain good work from scientists who were in the USSR under duress. During my conversations with my colleagues there I found that the research results obtained at Peenemuende should be a matter of great concern to other countries. The accuracy attained with rockets over the comparatively short range of 1,100 kilometers between Leningrad and Usedom was also attained over a 2,500-kilometer range. These tests were conducted between the Kronshtadt-Leningrad area and the great rocket-testing site at Omsk in Siberia. On the basis of these tests, it could easily be possible for the Russian using rockets launched from the interior of the USSR, to reach any target in Europe or in the US with great accuracy.

DECLASSIFIED
Authority NND 07045
By NARA Date 8/7/09

TOP SECRET

TOP SECRET

254

HEADQUARTERS
THIRD UNITED STATES ARMY
Office of the Assistant Chief of Staff, G-2
APO 403

REGRADED: By authority of ACSI letter dated 24 March 1959
by _____ on _____

4 December 1946

SUBJECT: Report No. 45

TO : Assistant Chief of Staff, G-2, Headquarters, United States Forces European Theater, APO 757, US Army.

[redacted]

1. GENERAL.

Russian-trained Czechoslovakian officers and even General BOCEK himself appear to believe that the Soviet leaders would have no reluctance to enter into a major conflict if they felt that the USSR would profit. Although the statements of this common belief appear to have been based only on inferences drawn from technical military considerations, there is evidence presented here which could support that view - particularly notable is their continued intensive program for the development of atomic age weapons. Speculation by uninformed sources continues on both the time necessary for the Soviets to develop atomic weapons and her capabilities and future intentions. General BOCEK's dissertation as presented in this report gives food for thought. Additional information has been obtained on the mass movement of skilled German workers to the USSR. Not yet has any confirmation been received here of the recent press reports of extensive troop movements out of Germany.

Charles P. Bixel. 9 December 1946.
Subject: Report No. 45. NARA RG 319,
Entry NM3-85M, Box 40, Folder 925907.

(1) BURG (Y-21)

The "Tack" Shoe and "Mundlos" Machine factories were both dismantled in April 1946. (USCon C-3)

(2) ARNSTADT (J-25)

The "Polte Works" which at one time employed 22,000 people in the production of munitions was dismantled beginning in October 1945. The work was completed in May 1946. (USCon F-6) Source probably referred to "Meta Metallwerk" factory as the Polte Werke of ARNSTADT (J-25) because the Meta Werk, which is reported to have made anti-tank shells during the war, was believed to be associated with the larger Polte arms work of MAGDEBURG. (Y-60).

(3) GREPPIN (E-14)

Dismantling operations on the munitions plant, which once employed 30,000 people, have been proceeding since May 1946. Shipping stickers on crates indicate the machinery is being sent to KIEV. (USCon C-3)

"Work on a rocket which these officers described as twice the size of a German V-2 is being conducted with assistance of German scientists. One assembled rocket was seen at CHELYABINSK. The rocket is approximately 4 meters in diameter and approximately 40-45 meters in length. The war-head of the rocket is conically shaped. It differs from the German V-2 in that its tail fins have a much larger surface and are movable. The weapon is of all metal construction and is motivated by a rocket propellant… The officers were told at the school that by May 1947 the USSR will have radio or radar controlled rockets capable of extended flights up to 4000 miles."

6. SOVIET RESEARCH IN ROCKET AND ATOMIC WEAPONS

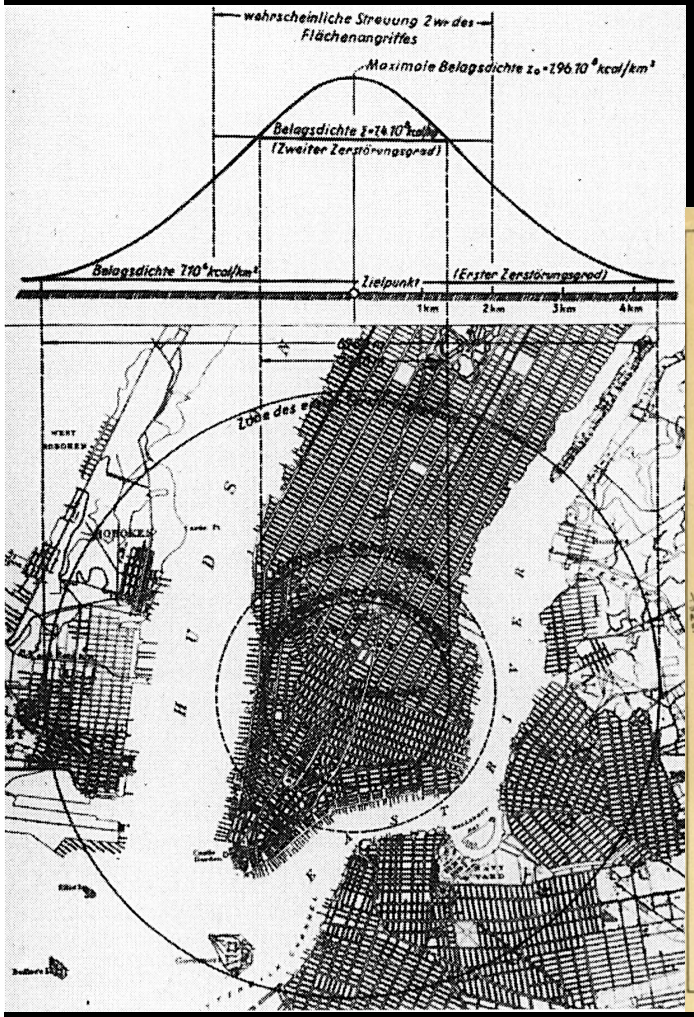
a. Two CZECH Army officers recently returned from a special aeronautical course were enthusiastic about what they saw while attending the school. The officers stated that the USSR is presently engaged in the construction of what they described as the largest rockets in the world. (Evidently the USSR's propaganda has taken effect). The plants engaged in the construction of these rockets are located in the URALS and are sufficiently dispersed to safeguard them in the event of concentrated bombing attacks. To insure the secrecy of the rocket project, each plant is engaged in the manufacture of only one part. Work on a rocket which these officers described as twice the size of a German V-2 is being conducted with assistance of German scientists. One assembled rocket was seen at CHELYABINSK. The rocket is approximately 4 meters in diameter and approximately 40-45 meters in length. The war-head of the rocket is conically shaped. It differs from the German V-2 in that its tail fins have a much larger surface and are movable. The weapon is of all metal construction and is motivated by a rocket propellent. Since no visible attachment was apparent on the rocket the officers surmised that the engine was built into the fuselage and the rocket vapors, flames, and gases created by the motor were evacuated through the tail section of the rocket. The officers were told at the school that by May 1947 the USSR will have radio or radar controlled rockets capable of extended flights up to 4000 miles.

b. The following dissertation on the intentions and capabilities of the USSR was obtained from a Czechoslovakian official holding a high position in the Czech Government. The source had recently returned from a trip to the USSR. Evaluation is B-3.

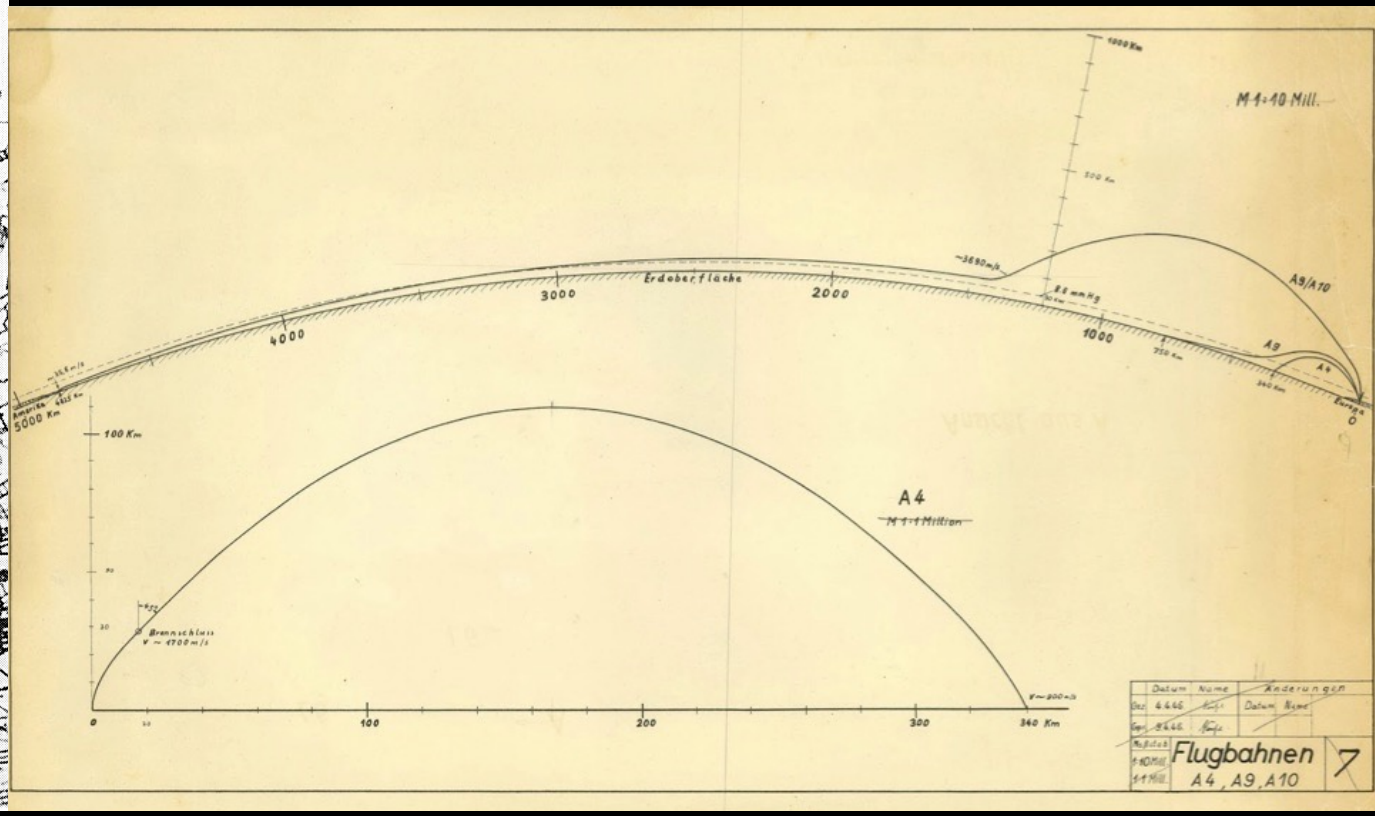
The USSR's industrial strength, along with the industrial capabilities of her Satellites, is at present being concentrated in a gigantic armament effort centered around the development of long range rockets with atomic war-heads. This is the major reason why the rebuilding of the devastated areas of the USSR has advanced so slowly and also the reason why the major Ukranian and Polish armament industries are being put into operation again. The Czechoslovakian official has heard many comments to the effect that the USSR will have the atomic bomb developed not later than June 1947. He knew of no industries or scientific laboratories engaged in atomic research, but claimed high hopes are attached to this new weapon. The Soviets believe that in the event of war between the Western Powers and the so-called Eastern Bloc they will be capable of firing their rockets from Eastern-most Siberia against all of Southern Asia, Australia, and even the Western part of the United States. Alaska would be within easy range of weapons employed at present. The British Islands and the eastern half of the United States will be reached by rockets launched from Central Europe.

Large Rockets Were Specifically Designed to Reach the United States

Deutsches Museum Archive, photo CD56143



Estate of Heinz Stölzel



For more information, see *Forgotten Creators* E.2

German Officials: Large Rockets Were Built

Henry Picker. 2009. *Hitlers Tischgespräche*. 2nd ed. Berlin: Propyläen. pp. 42, 683.

And how much more death, war damage, refugees, and destruction would have been the result if Hitler's opponents had not won--as Churchill said--"five minutes before midnight" and thus thwarted Hitler's new end-run defense in the spring of 1945. For with the A-9 "interglobal rockets" developed in Peenemünde, which also reached their targets in the USA, and with 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, if Hitler had been able to make these weapons actually deployed, the suffering, the cruelty, the harshness, the extension, and the duration of World War II would certainly have been multiplied. […]

Hitler had over 2000 scientists and engineers exempted from military service for the development of […] the liquid fuel rockets V-2 (= A-4) and A-9. Up to early 1945, he also wanted the A-9 long-range rocket, intended against the USA, to be ready for series production and completely operational. He hoped that this intercontinental rocket would make the USA "amenable to peace," especially if he could have equipped the rocket warhead with several small uranium bombs.

Otto Skorzeny. 1995. *My Commando Operations*. Atglen, PA: Schiffer. pp. 161, 169.

In October 1944, after the Budapest operation, I flew once again to Führer Headquarters in East Prussia. Preparations were just being made for the Ardennes offensive and Hitler wanted to give me his instructions for Operation Greif. [...]

He assured me that the German Army would triumph in the end in spite of treason and mistakes. This offensive would be successful. Apart from that, "new, truly revolutionary weapons would take the enemy completely by surprise." […]

However most talk was about another, terrible weapon that was supposed to be based on artificially produced radioactivity. [...]

Included in the V-weapons program was the construction of a rocket capable of bombarding New York or Moscow. This rocket was practically finished at the end of March 1945 and could have gone into series production beginning in July. [...]

I could go on and list a whole series of other new weapons which were designed and built by us during the war.

Werner Grothmann. 2002. Jonastalverein Archive, Arnstadt. pp. 9-11, 33.

I found it amusing, however, that our best piece, the giant rocket, which was to fly to America, had just been built in a plant that was not big at all. Well, those were the prototypes for the flight tests. The mass production would then be closer to the military training base. […] So the rocket would have been built in a very large plant, which was also supposed to produce one [kind] of the nuclear bombs. […]

This was the real long-range rocket for America. From Thuringia it would have reached only the east coast, but there lay the cities that were important to us. V4 had been chosen because it was basically a further development of the V2, albeit with two stages and more than double the height, but not with a higher payload. The first attack with full cargo was actually scheduled for October 45. After the detonation of the test bomb in March 45 […], hotheads from the political side had demanded an attack with the prototype [V4] and a hastily assembled uranium bomb. […]

Gerlach did not go to Bormann until we got the first successful launch of our big rocket or the big rocket for the distance from Thuringia to London, which was also a new development. That was on 16 March. […]

The Russians found more [in Thuringia] than we had hoped. For example, the prototype of a new rocket for which, however, the Americans had previously captured the design documents.

Allied Wartime Intelligence: Large Rockets Were Built

HEADQUARTERS
UNITED STATES STRATEGIC AIR FORCES IN EUROPE
Office of the Director of Intelligence

DECLASSIFIED
EO 11652

AAF 586
APO 633
[illegible] 1944

SMG

19.6522-4

AFHRA folder 519.6522-4

TO : COL. L. P. WEICKER

In the face of continued reverses and diminishing manpower and materials during the Spring of 1943, it became very apparent that very drastic steps had to be taken if the German Government even hoped to stave off defeat. We are just now beginning to appreciate what some of those drastic steps were. One such step is the attempt to develop a substitute for planes and pilots and this was the story behind their much publicised (so-called) secret weapons.

In January 1943 General Galland, at that time in charge of GAF technical development acknowledged the declining strength of the Luftwaffe before a large audience of Military and high Party officials. He said the plans had been made for a new air force and promised greatly increased performance for new planes which would be ready for the Spring campaign. Production was increased slightly on improved models, but the performance of these new planes didn't begin to live up to the promises. Just when this became self evident high officials of the Wehrmacht and the GAF started talking of "Secret Weapons".

Investigation quickly disclosed that there was a group of party technicians in the Wehrmacht experimenting with a very large conventional type of rocket with a total weight in the neighborhood of 68 tons. Another group of scientists in the GAF technical development section were working on a jet-propelled pilotless aircraft and both organizations were testing some of these weapons at Peenemunde, on the shores of the Baltic.

THIS PAGE DECLASSIFIED IAW EO 13526

S E C R E T page 2, Target Notes A/5, 4 November/44.

AFHRA folder 512.619C-15A 1943-1945

a triple train wreck by throwing a switch on the double track R.R. near Ktobuck. Two freight trains collided, and later a passenger train ~~likewise~~ piled into the wreckage.

5. Under-ground Factory in FRIEDRICHSHAFEN: In Jan/43 P/W visited the site of a large new under-ground factory being built by Dornier at FRIEDRICHSHAFEN. Factory lies between the lake and the road to IMMENSTAAD, on the NW edge of FRIEDRICHSHAFEN. It is covered by a storage yard for wood and other bulk materials, and there is a R.R. spur leading into the underground part. P/W could give no information as to the size of the underground unit, other than to say that it was about the same size as the large Mercedes Factory in STUTTGART. He heard from friends that V-2 was being made there, and that three R.R. cars were necessary to haul away a single V-2 bomb. P/W considered himself an Italian, having been born in BOLZANO, and was obviously trying to give reliable information.

AFHRA folder 519.635 1945
Intelligence Digest

THIS PAGE DECLASSIFIED IAW EO 13526

TOP SECRET

PART SIX - OTHER WEAPONS

1. In the following paragrpahs are listed the actual or potential weapons which the Germans may use against USSTAF operations in 1945. For the most part they include the so-called V weapons. No consideration is given to those for which there is lacking evidence of possible use for some time to come. Both V-1 and V-2 are considered in this analysis because, even though they are, in effect, long-range artillery, they do possess the ability to affect our operations by hitting airfields, and supplies enroute and in concentrations.

2. V-2:

a. Present status. The V-2, or rocket projectile, with a warhead of approximately one ton, and a current range of 225 miles; is being fired at London at the rate of 180/250 per month, and against Continental ports at the rate of approximately 300 per month.

Against London its accuracy is currently rated at 3.2/1,000 per square mile at the main point of impact. Against Continental ports it is estimated at the least 6.1/1,000 per square mile at the main point of impact. The best record was 75 in a twenty-four hour period within a four square mile area of the Antwerp Docks.

b. 1945 Potential: The German plan calls for an increase in monthly production from 600 to 1200. It is known, however, that any increase would be at the expense of the aircraft industry in radio equipment and certain essential components. An increase in accuracy would depend upon increased firings and increased use of already proved radio equipment, without which the majority of firings are conducted today. It is thought unlikely that range will be materially increased. Accuracy begins to fall off somewhere between 165 and 190 miles, and becomes increasingly inaccurate to the maximum of 225 miles. Whether or not V-2 becomes an increased menace in 1945 must depend upon the position of the aircraft industry and its requirements. Its potential lies in stabilization of the expanding aircraft program.

Larger rockets (68 feet in length as against 45 feet) are known to exist, and may appear in small quantities during the year. They would have a considerably larger warhead.

Allied Political Leaders: Large Rockets Were Built

Winston Churchill. BBC London. 13 May 1945.

But it was only when our Armies cleaned up the coast and overran all the points of discharge, and when the Americans captured vast stores of rockets of all kinds near Leipzig, which only the other day added to the information we had, and when all the preparations being made on the coasts of France and Holland could be examined in detail, in scientific detail, that we knew how grave had been the peril, not only from rockets and flying-bombs but from multiple long range artillery which was being prepared against London. Only just in time did the Allied armies blast the viper in his nest. Otherwise the autumn of 1944, to say nothing of 1945, might well have seen London as shattered as Berlin.

For the same period the Germans had prepared a new U-boat fleet and novel tactics which, though we should have eventually destroyed them, might well have carried anti-U-boat warfare back to the high peak days of 1942. Therefore we must rejoice and give thanks, not only for our preservation when we were all alone, but for our timely deliverance from new suffering, new perils not easily to be measured.

Senator Elbert Thomas. *The American Magazine*. April 1946.

About a dozen new V-weapons were on drawing boards, in laboratories, and nearing production. One would carry troops in a pressurized cabin. Another would be launched from a submarine 300 feet below the surface. A third would cross the Atlantic in 14 minutes, arching to 500 miles' altitude and flying at 16,000 m.p.h. It was intended for morale-shattering mass (*Continued on page* 121) raids on New York. It wasn't impractical. The Germans' prediction that they would do it in a year or so was no idle boast.

Had our invasion been delayed six months, the Germans could have regained air superiority, not only in Europe, but over the Channel and southern England. We could have continued night raids, but our daylight raids would have been suicidal. They could have raided England both night and day. Our planes couldn't have stopped them. Striking at airfields, troop-concentration areas, ports, and shipping—decimating our armies and destroying their equipment—they could have made an invasion of Europe almost impossible. Their better planes could have destroyed ours on the ground, as ours did theirs when muscle outweighed mind.

Between raids by their planes there would have been thunderous barrages of V-weapons. They planned to launch 1,000 V-1's a day. Rockets more deadly than the V-2 would have reached north to all important cities in England. We couldn't have prevented it.

England would have been pounded to rubble. Even if the Germans didn't invade, and they might have, a stalemate and negotiated peace would have been our best prospect, and total defeat not at all unlikely. We had a narrow escape, as it was. After our ground forces conquered the Continental coast just before V-E Day, I visited a V-weapon factory. I could not help but utter to myself, and I've repeated it often, "We are just in time." That was no flight of poetic oratory; it was the stark and awful truth. And the threatened defeat which it so clearly implied *would have been due directly to our backwardness in the science of aviation.*

Senator Harry F. Byrd. *The American Magazine*. March 1948.

astounding new air weapons into combat before the war ended. Their jet and rocket fighters slashed through our bomber formations almost unmolested by our slower propeller-driven fighters. Their guided missiles, almost invisibly fast, were conceived to track down planes in flight and explode automatically when near them. Their jet V-1 and rocket V-2 did great damage in England and Europe; we had developed little defense against either the former or the latter. Almost ready was a V-2 of much greater range, for more widespread destruction. As the war ended, I personally saw the progress they had made on the super V-2 type, rocket-powered, which they thought might blast New York across 3,000 miles of Atlantic Ocean.

They started research in supersonics (speeds faster than that of sound) years before we did. Air Force officers concede that they were so far ahead along that uncharted road that findings we captured made radical changes necessary in our supersonic plans, as applied to both planes and guided missiles.

"It will probably cost $100,000,000 to achieve practical supersonic flight" (with a piloted plane), wrote Lt. Gen. Nathan F. Twining, former Wright Field commander, in THE AMERICAN MAGAZINE for August, 1946. There is no estimate on what it would have cost without benefit of the earlier German research.

General Putt states: "Our Washington people say that in guided-missile development alone the Germans we've brought to America will save us 10 years and $750,000,000, and that seems reasonable to me. I'm sure that the total saving will amount to billions of dollars, but the actual figure must be anyone's guess today."

Allied Military Leaders: Large Rockets Were Built

General Carl A. Spaatz. Air Power in the Atomic Age. *Collier's*. 8 Dec. 1945.

have greater offensive potentialities now than defensive, and as long as science continues to run in its present broken field, the big edge probably will stay with attack. For instance, it is foreseeable that we can make a rocket like the German V-2 devastatingly accurate, but how we could "defend" ourselves against it is not so clear.

At the top of its arc the V-2 traveled at an altitude of 60 or 70 miles and reached a maximum speed of about 3,500 miles an hour —approximately a mile a second. It was a bifuel rocket utilizing liquid oxygen and a hydrocarbon like alcohol or hydrogen peroxide.

Three improvements would make a similar rocket almost a perfect weapon: more range, increased explosive power, greater accuracy. The Germans were readying a transatlantic model when the war ended. Our atomic development supplies the explosive. There is no barrier visible to solution of the accuracy problem.

Examination of other primarily offensive weapons reveals the same story.

DECLASSIFIED
Authority NND 760250

NARA RG 331, Entry 83D, Box 33, Folder S.H.A.E.F. Releases/1 June 20 June 45

General Henry H. Arnold. 1949. *Global Mission.* New York: Harper. p. 497.

On the other hand, it had to remain conceivable that if certain of these very plausible gadgets were completed, if enough of them could be used in the right way at the right time—especially before the Allies landed in Northwest Europe—they might have very disagreeable results. The whole main platform, not only for our combined bomber offensive but for the invasion—England itself—might be blasted.

Fortunately, judging from the mere 1100 that finally fell on England, chiefly London, the long-range V-2 rockets did not get into production until January, 1944. The planned output of 900 a month was not achieved, 50 to 300 being the number produced monthly until August. Between September, 1944, and March, 1945, the production rate was 700 a month. The first of these fourteen-ton missiles, which traveled at four or five times the speed of sound, were not launched against England from their bases in Holland and western Germany until September, 1944, at which time technical difficulties were still encountered. A large bombproof launching site was under construction in France as early as May, 1943, however, and another in August, at about the same time the V-1 launching sites were begun. The V-10 (A-10), a very large rocket intended especially for New York, was being built.

HAH/Gris

HEADQUARTERS
COMMUNICATIONS ZONE
EUROPEAN THEATER OF OPERATIONS
UNITED STATES ARMY

RELEASE ON RECEIPT
Number 2327

13 June 1945
(Censored)

LARGE-SCALE PRODUCTION OF V-2 BOMBS NEAR WHEN GERMANY SURRENDERED

HEADQUARTERS, COM Z - Mass production of the V-2 rocket bombs, capable of pin-point bombing at a range of 3000 miles, was within reach of German scientists at the close of the war, U.S. Army Ordnance intelligence experts revealed today. Within six months after VE-Day, they said, Germany would have been able to produce the bomb on a mass scale, and the Germans believed they would have turned them out in large enough numbers to "neutralize any advantage our airplane superiority had given us".

The intelligence experts based their findings on a month-long survey of the huge rocket assembly plant and in conversations with captured scientists. The plant was built 800 feet deep in the heart of the Kohnstein mountains near Nordhausen, Germany. It was captured by units of the U.S. First Army in the closing days of the war.

Major William J. Bromley, of Grants Pass, Oregon, who directed the job of assembling 100 of the projectiles for delivery to the United States for analysis, disclosed that numerous gadgets and improvements, designed to give the rocket greater range and accuracy, were much in evidence at the factory.

"That raid on the experimental plant at Peenemunde on the Baltic by British planes set the scientists back just about six months in their experiments," Major Bromley said. "They admitted that it caused great damage to installations, and killed 800 of their best authorities. That raid was a life-saver for us."

Colonel Donald L. Putt. 1946. *SAE Journal* 54:8:404-411.

The science and development of guided missiles and their propulsive units were exploited to the greatest extent by German scientists prior to V-E Day.

Rockets as defensive weapons caused very little excitement in Germany until 1943, although a tremendous amount of experimentation had been accomplished by pure rocket enthusiasts since 1925. As the war progressed it became evident that Germany would eventually be on the defensive, and rocket weapons came into prominence to a greater and greater extent. These were the so-called "secret weapons" Hitler had promised his people. They were to have reversed the course of the war and given Germany a new and startling shortcut to victory. After watching the V-1 and V-2 firing trials at Blizna and Cracow, Poland, in April, 1944, Hitler is reported to have stated that German secret weapons were not the product of dreamers and that England and the whole world would soon feel their effect.

It wasn't until allied technicians examined German developments in this field that we fully realized the tremendous achievements of German scientists, and how near they were to achieving the boasts of their leader.

The Germans were preparing rocket surprises for the whole world in general and England in particular, which would have, it is believed, changed the course of the war if the invasion had been postponed for so short a time as six months. Many of Germany's research laboratories and several large commercial firms concentrated on this field of endeavor. This tremendous effort resulted in 138 guided missiles and assorted devices, including their modifications. These were of types wholly unknown to laymen in the United States. At the outbreak of the war some of these were strictly "out of this world" – to use a current phrase. In addition, German scientists had developed other equipment of a type we had considered impracticable, such as the ram jet.

The stupendous effort in basic research expended by the Germans in the guided missile field was designed to cover the complete field of potentialities for such weapons. The losses incurred in Germany by heavy bomber raids can in no way be charged to lack of preliminary research on missiles. Weapons of this category were divided into the following classifications:

A. Ground to air.
B. Air to air.
C. Air to ground.
D. Ground to ground.
E. Underwater to underwater.
F. Underwater to ground.
G. Underwater to air.

Moreover, every known type of remote control and fusing means was being exploited. These included radio control, wire control, radar, continuous wave, acoustics, infrared, light beams, and magnetics.

USAAF General Henry Arnold

AFHRA 43811 pdf pp. 962–963

[redacted]

WAR DEPARTMENT
CLASSIFIED MESSAGE CENTER

OUTGOING MESSAGE

[redacted]

OCG/AAF
2766

22 July 1944

Commanding General
US Strategic Air Forces in Europe
London, England

Number WAR 69061

FDR Library, Map Room Files, Box 49, Folder Rocket Bombs 1944

For Spaatz from Arnold

I agree with you that everything possible must be done in order to determine ways and means of preventing the large German rockets from ever reaching their destination or causing damage to US. This in reply to your 65292. Doctor Bowles and his assistants are working on this problem and have been working on it for some time, particularly from the radio countermeasures viewpoint. Doctor Fraenckel has brought back from England information of great value in our countermeasure work and has already met with McClelland and others to formulate a specific program including proper search facilities and jamming equipment. We will keep you posted on techniques and on schedules of equipment which we propose to supply. As soon as suitable jamming materials are developed they will be sent to you posthaste. Doctor Fraenckel will return to England within a very short time and be prepared to give you such aid and advice as he can. He should be able to leave here not later than July 30th. If you have any other ideas as to how we can help you let us know.

A.F. 2759

End

ORIGINATOR: Gen Arnold

INFORMATION: OPD
Gen Bissell
Gen Henry
Col Park
JEIA
C of S

DECLASSIFIED
OSD Letter, 5-3-72
MAY 15 1974

CM-OUT-69061 (22 Jul 44) 1931Z bem

[redacted]

[redacted] COPY No. 13

THE MAKING OF AN EXACT COPY OF THIS MESSAGE IS FORBIDDEN

RECORD ZZ L/C Box 54 7-87

Arnold Deeply Concerned with the German Developments of Robots, Rocket Torpedoes, and Jets - July 1944

Letter, Arnold to BG Eubank, AAF Evaluation Board in Orlando, Fla. Arnold mentioned the pending visit of Dr. Fraenckel (a scientist who had been in the UK) to Orlando. Arnold wanted to be able to determine whether there was any military usefulness for robots during the European campaign or in the Pacific. He said they could have been used effectively against POE's for the OVERLORD operation, if they had been concentrated in a number like 10,000 a day against London. If we were to use robots against the enemy, we would probably want to use them against bridges, or more precision targets than the Germans had. Arnold wanted to know whether robots would be of sufficient value to the US to be more than a nuisance.

He also wanted the Evaluation Board to study the use of robots in the changing European war, which Arnold expected to become a war of movement. He also wanted the board to study the possible use in the Pacific against island bases to make a recommendation as to the urgency of such construction by the AAF. He also wanted the board to study countermeasures against the robot, including the possibility that large numbers of belly tanks filled with gasoline could be dropped on the launch installations. Arnold was most concerned. "If this rocket procedure is allowed to be developed uninterrupted, there may come a time when these large 75 ton rockets land in England, in occupied France, or possibly if they are radio-controlled, in the United States. We must use everything in our power to prevent any such occurrences."

And finally, but not least, Arnold expressed great concern that Germany was about to use jet propelled against us in the very near future. Moreover, "it is quite obvious that we cannot get production of our jet propelled airplanes in time to meet this situation." He called it essential to develop some kind of technique to protect US bomber formations and our own air forces against the jet. He mentioned that Spaatz was sending some of his experts back to the US to try out the P-59, the P-80 and the P-80A. The purpose was to work out a technique of defense against the German jets.

Arnold wanted to be kept immediately informed of any new developments in this area. In his letter to Gardner on the same date, Arnold indicated that Dr. Fraenckel had returned to the US with a practically complete German V-1. He told Gardner he had asked Fraenckel to visit the AAF Tactical School at Orlando, to sit in with the planning staff, so as to work out tactics and techniques.

Arnold also asked Gardner to get all the information he could from Dr. Fraenckel and then go ahead to build experimental articles. He didn't care whether there was a duplication of the German model or a combination

L.A. Times 30 Sept. 1944 p. 3

Big Projectile Reported New Hitler Weapon

SOMEWHERE IN FRANCE, Sept. 23 (Delayed.) (AP)—American 3rd 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.

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 man-hours 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 sabotage 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???

Allied Military Leaders: Large Rockets Were Built

General Thomas J. Betts and Sir Reginald Patrick Linstead. 15 September 1945. *The Intelligence Exploitation of Germany. Report of Combined Intelligence Objectives Subcommittee.* G-2 Division, SHAEF. Ch. 4, AFHRA A5186 frames 920–1044.

United States and British specialists have obtained complete information covering all German directed missiles from the pioneer model "A sub-o", which employed oxygen and alcohol fuel in attaining a range of 18 miles, to the latest model of the A-9 which was capable of a 3400 mile per hour speed and a range of 2400 miles. The A-9 was an improved development of the V-2 or A-4, and was equipped with wings thereby enabling it to level off at a height of 70,000 feet. One model of this missile was equipped with a Lorin tube which provided propulsion at the peak of the trajectory, the missile was expected to result in a maximum range of 2400 miles. Other variations of this model were capable of attaining altitudes 60 miles above the earth's surface and speeds in excess of 7300 feet per second. Improved radio controls were developed to supercede the "integrating accelerometer" used in early V-weapons. Some measure of the accuracy which could be achieved with these controls is evidenced by the fact that the radio controlled models were capable of an accuracy of plus-or-minus 150 feet in contrast to a plus-or-minus 50 mile error inherent in the V-2.

German scientists engaged in directed missiles envisaged important commercial applications of the long range missile. Experiments had already been conducted on piloted models. Missiles capable of trans-Atlantic crossings in approximately 40 minutes were found on design boards and scale models were undergoing wind tunnel tests. Amazing performances were considered practical because of the lessened atmospheric resistance and gravitational pull in stratospheric regions.

The Germans particularly concentrated on controlled rockets and missiles for anti-aircraft defense. One of the most promising of the AA missiles under development was the "Wasserfall". This was a ground-to-air guided

missile capable of a 2200 mile per hour speed. The "Wasserfall" was equipped with a homing device which would enable it to pick up and track a target airplane at a range of one mile. The acoustic fuse provided was designed to detonate the explosive charge within a radius of 20 meters from the target.

The "Enzian" was another type of controlled missile designed for ground-to-air or air-to-air anti-aircraft defense. This weapon was equipped with a homing device and was capable of a 900 mile per hour speed. Other German anti-aircraft missiles included the Taifun and the X-4. The Taifun was a comparatively simple and inexpensive aimed rocket capable of high speed and a 60,000 foot altitude. The X-4 was designed for air-to-air operations and wire control in order to prevent jamming or effective counter-measures.

One of the most important results of Allied investigations of German directed missile development was the vast amount of data obtained concerning aero-dynamic research in the range of supersonic speeds. This information is expected to provide invaluable assistance to research in the United States and United Kingdom.

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 smaller war-heads. Quite possibly this trend was in anticipation of the successful development of a German atomic explosive.

Where are the reports???

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

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

By Science Service

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.

The Germans, he said, developed several rockets known as the "A" series. The V-2, used against London, was one of these. Although it 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 sufficient time to complete developments.

Acid Used in Fuel

Each of the "A" series was developed primarily for research, with the exception of A-4, later known as the V-2. The A-10 was the end result toward which this whole program was directed. This is the weapon which the Germans expected to use in bombing New York.

The A-10 was described by him as a booster rocket placed behind the A-9, giving it two-step co-operation to secure ranges of 3000 miles. The A-9 was much like the A-4, more familiarly called the V-2, with wings added to give increased range and using acid as an oxidizer in its fuel.

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

Speed Put at 6000 M. P. H.

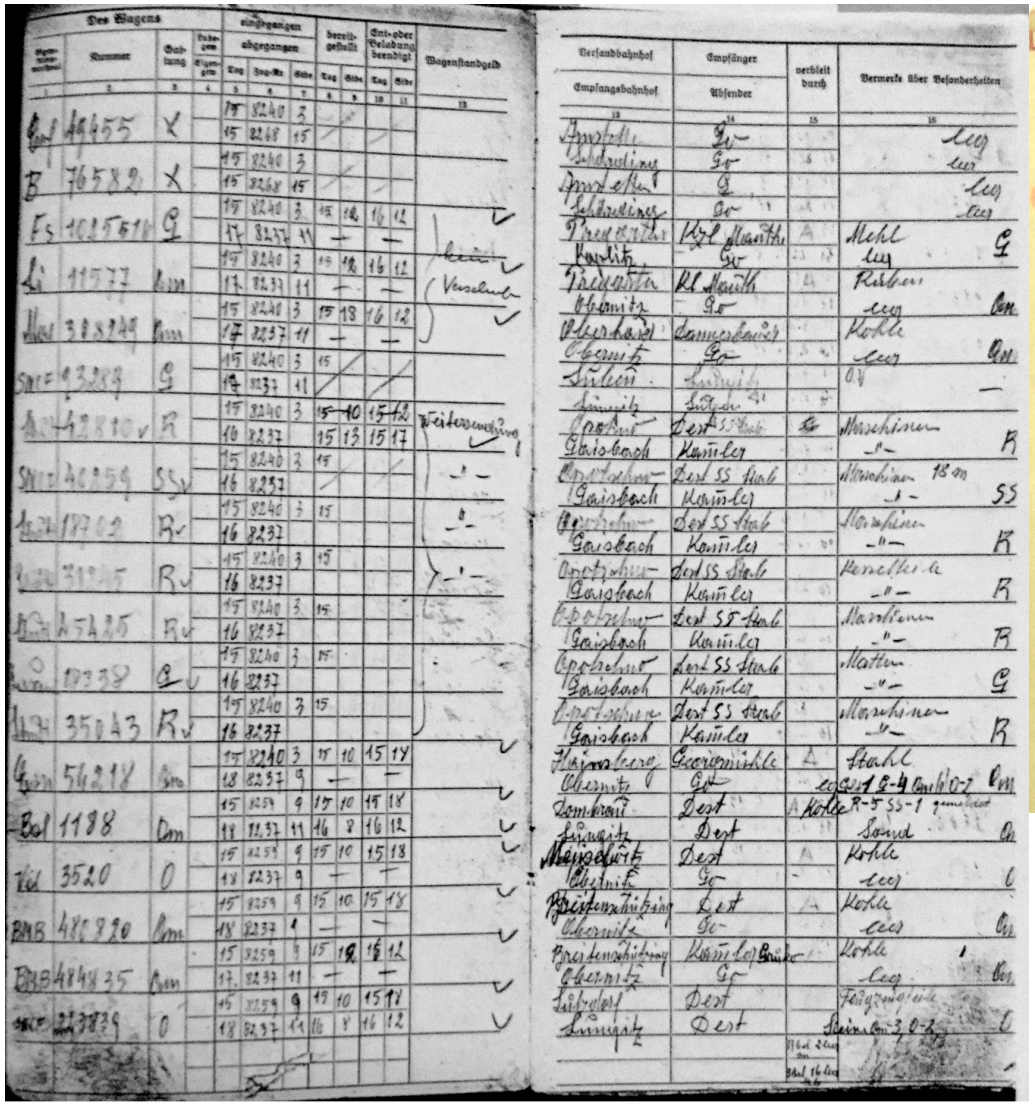
The total weight of the A-10 was to have been 190,000 pounds. The weapon was nearly 12 feet in diameter and 25 feet long. The 29,000-pound A-9 was to have been accelerated to a speed of 2500 miles per hour by the use of the A-10 as a launching rocket, which detached itself and would drop free after serving its purpose.

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 about 6000 miles an hour. It would have carried a warhead of about 2000 pounds. This is a payload of only 1 per cent of the starting weight of the weapon, but there is evidence to believe, he stated, that the Germans intended to utilize an atomic warhead which would have made this weapon extremely deadly.

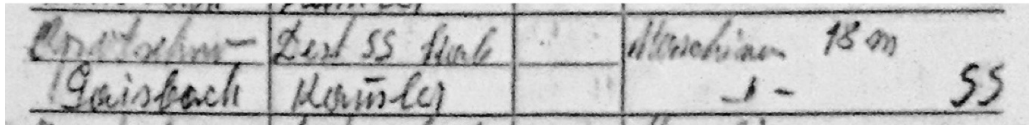
Indianapolis Times,
2 Aug. 1947, p. 4

Where are the reports???

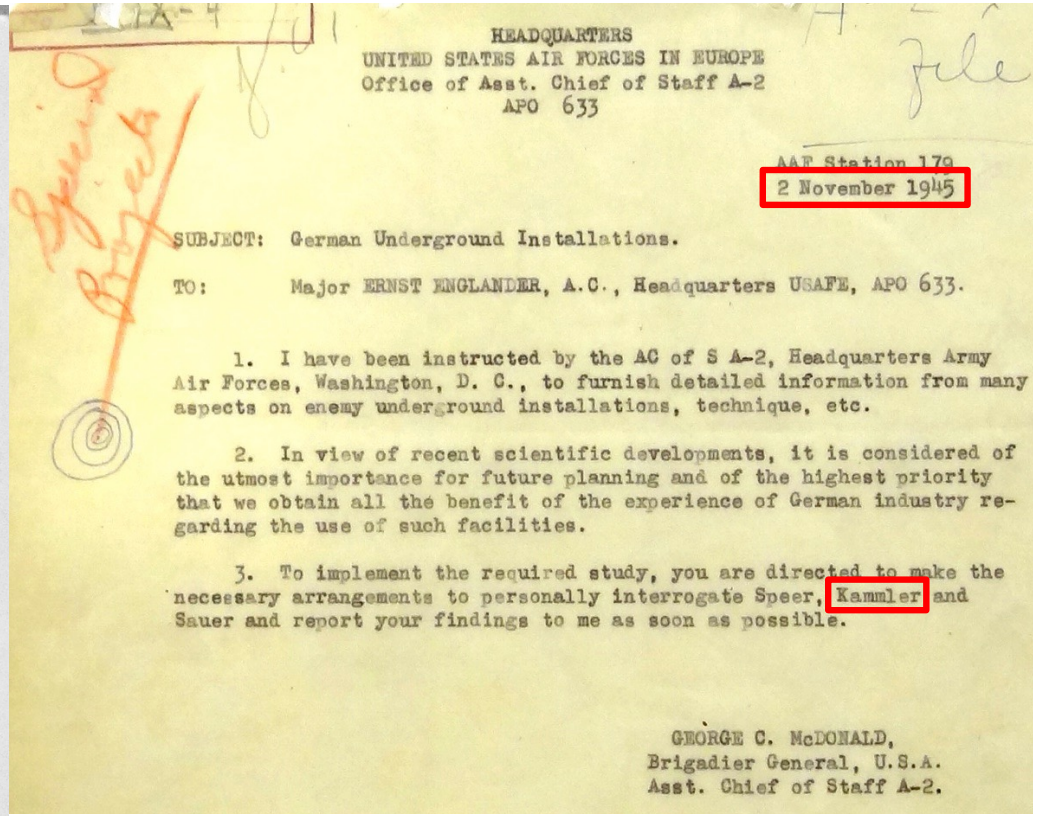
The U.S. May Have Learned Everything from Hans Kammler



A train shipment of "18 m machines" and accessories was apparently personally forwarded by Hans Kammler in St. Georgen an der Gusen, Austria on 15–16 March 1945



Rudolf A. Haunschmied, Gusen Memorial Committee



HEADQUARTERS
UNITED STATES AIR FORCES IN EUROPE
Office of Asst. Chief of Staff A-2
APO 633

AAF Station 179
2 November 1945

SUBJECT: German Underground Installations.

TO: Major ERNST ENGLANDER, A.C., Headquarters USAFE, 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.

AFHRA 570.6501A 1945–46, Special Projects—Current and Reel C5098, frame 0886

Hans Kammler
Top SS general
of the German
nuclear program

Where are the reports???

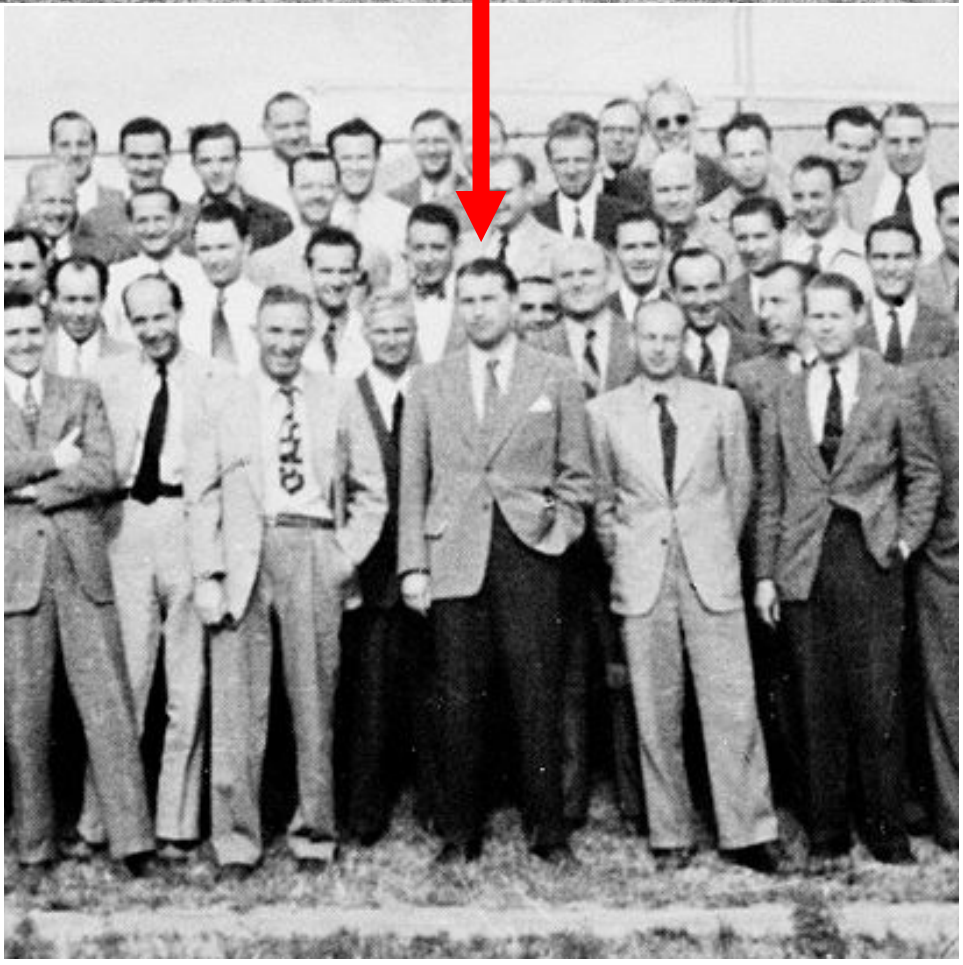
NARA RG 330, Entry A1-1B, Boxes 1-186.

Foreign Scientist Case Files 1945-1958 - 230/86/46/05 186 boxes

Last name	First name	Middle name	NARA box#
BOECKLING	HANS		016
BOEHM	WALTER	F.	016
BOEHM	OTTO		016
BOEHM	JOSEPH		016
BOEHME	THEODOR		016
BOERSCH	HANS		016
BOETTNER	ALEXANDER		016
BOLLENRATH	FRANZ	M.J.	016
BOMELBURG	HERBERT		016
BOMKE	HANS	A.J.	017
BONEFF	STOYAN		017
BONHOEFFER	KARL	F.O.A.	017
BOPP	FRITZ		017
BORGES	HERMANN		017
BORN	PAUL		017
BOSCH	CARL		017
BOSCH	LORENZ	F.	017
BOSNJAKOVIC	FRAN		018
BOST	HEINRICH		018
BOTH	EBERHARD		018
BOTHE	WALTER		018
BOTT	HANS	A.	018
BOTTENHORN	HERMANN		018
BRABENDER	CARL		019
BRAEUNINGER	KARL		019
BRAND	JOHANNES-KO		019
BRANDNER	FRIEDRICH		019
BRANDSTAETTER	FRIEDRICH		019
BRANDT	KLAUSE	ERICH	019
BRAUCH	WOLFGANG		019
BRAUN	GERHARD	WINIFRIED	019
BRAUN	RICHARD		020
BRAUN	WOLFGANG		020
BRAUN	KLAUS	ARN0	020
BRAUN, von	MAGNUS		020
BRECHLIN	ALFRED		020
BREDTSCHNEIDER	KURT		020
BREITENBACH	JOHANN	WOLFGANG	020
BREY	WILHELM		020
BRIEGLIEB	GUNTHER		020
BRILL	RUDOLF		020
BRINGEWALD	AUGUST		021

Where are all the interrogation transcripts and reports on wartime work?

Why is Wernher von Braun's entire Paperclip file missing?



Where Are the Reports???

THIS PAGE DECLASSIFIED IAW EO 13526

AFHRA folder 570.650 May-Aug 1946

A-2 File

HEADQUARTERS
UNITED STATES AIR FORCES IN EUROPE
Assistant Chief of Staff, A-2

A.P.O. 633 U.S. Army
10 June 1946

BA 452.03

SUBJECT: Report on Large Sized Rockets

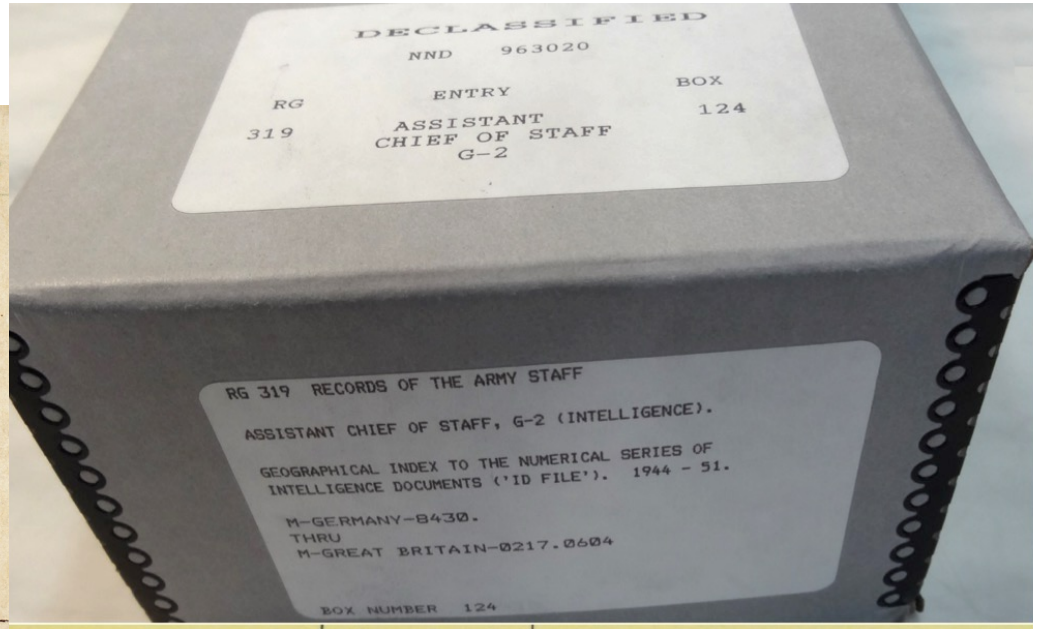
TO: Assistant Chief of Staff, T-2, Air Material Command, Wright Field, Dayton, Ohio.

The inclosed report on "Large Sized Rockets and Applications" prepared by Hugo Kalimourski and Max Corissen, German engineers, is forwarded for your evaluation.

1 Incl:
Report on Rockets.

Approved by ...
Prepared by ... Operations Br.

21-22-23-24-1-2-3
20 ADMIN DIV 4
19 5
18 10 JUIN 1946 6
17 DIRECTION CENTRALE RENSEIGNEMENT 7
16 EMG USSTAF 8
15-14-13-12-11-10-9



M-GERMANY (COUNTRY OR AREA)	8600.0715 (BID NUMBER)	Nuclear Physics - Uses - Other

NEW BID-NEW NUMBER

DATE	SOURCE	COMMENTS	M.I.S. NO.
8 June 46	50-46 C- EA 2	Alleged new German Missile	275059

M-GERMANY (COUNTRY OR AREA)	8600.0711 (BID NUMBER)	Nuclear Physics(Atomic Energy) - Uses - Rockets (2

1947 NEW BID-NEW NUMBER

DATE	SOURCE	COMMENTS	M.I.S. NO.
4 Mar.47	CIG	(T) History of German Trans-Atlantic Rocket A-10	S.D.4622

DECLASSIFIED
Authority NND 963020

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

INTELLIGENCE LIBRARY

For more information, see *Forgotten Creators* E.2

Why Are 1946 Documents on German-Derived Missiles in US and USSR Still Classified?

WITHDRAWAL NOTICE

RG: 319
Tab #: 00001
Entry: 0001041
Copies: 1
Pages: 0004

Box: 00047

ACCESS RESTRICTED

The item identified below has been withdrawn from this file:

Folder Title: 926087
Document Date: 08/14/1946
Document Ser#:

Description: MEMO FROM: R.F. ENNIS TO: HALLINGER

In the review of this file this item was removed because access to it is restricted. Restrictions on records in the National Archives are stated in general and specific record group restriction statements which are available for examination.

NND: 20017045
Withdrawn: 09/14/2001 by: B. COOPER

FOIA RETRIEVAL #: 20017045 00047 00001

DECLASSIFIED
Authority NND 017045
By NARA Date 8/18/09

NARA RG 319, Entry NM3-85M,
Box 47, Folder 926087 (former SD-3676)

RESTRICTED CONFIDENTIAL SECRET TOP SECRET

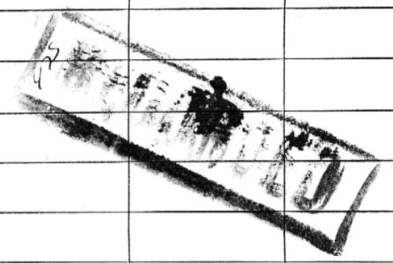
INTRA-BRANCH ROUTING

BID SHEET

This sheet must be forwarded with the document to the Intelligence Library, where it will be permanently filed with the "Library File Copy" of the document

M. I. S. No. S.D. 3 6 7 6

LTR.	BASIC AREA	SUB-AREA	NEW BID No.	COMMENT	PAGE OR PAR.	INTL.
N	U. S. S. R.	(1)	8430.0000 re	Comparison of US & USSR Guided Missiles		
V	U. S.	(2)	8430.0000 re	Comparison of US & USSR Guided Missiles		
		(2 documents)				
		(T)14 Aug 46 MIS				
		(T)31 Jul 46 AAF				



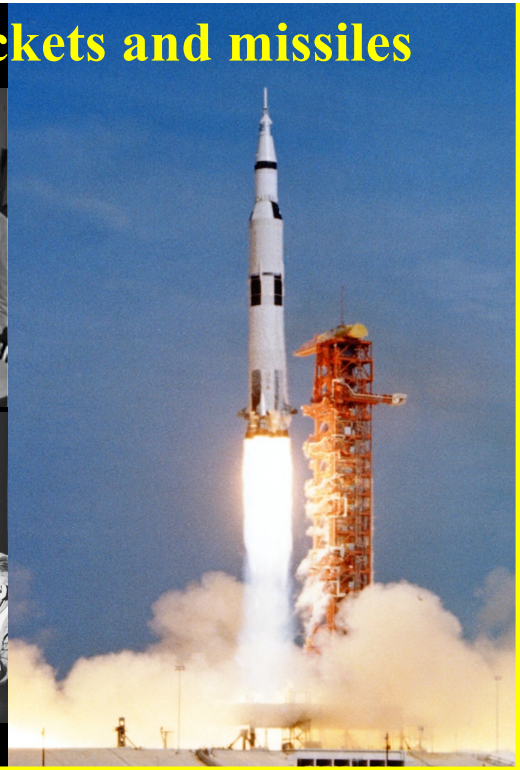
RESTRICTED CONFIDENTIAL SECRET TOP SECRET

GPO 16—45888-1

MILITARY INTELLIGENCE SERVICE

Postwar U.S. rockets and missiles

+ many others

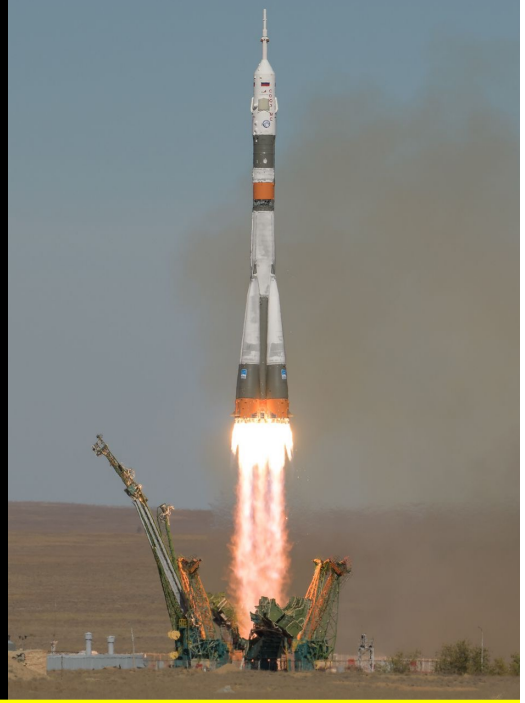


Postwar Russian rockets and missiles

Helmut Gröttrup

Werner Baum

+ many others



Postwar U.K. rockets and missiles

Dieter Huzel

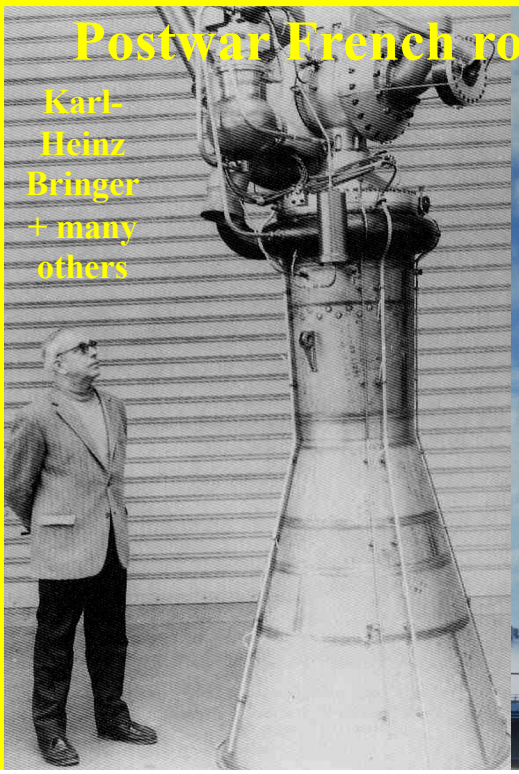
Walter Dornberger

+ many others

Postwar French rockets and missiles

Karl-Heinz Bringer

+ many others



Outline

Nuclear payloads

1. Land-launched intercontinental missiles

    A. Liquid propellant missiles

    B. Liquid propellant space planes

    C. Solid propellant missiles

2. Submarine-launched missiles

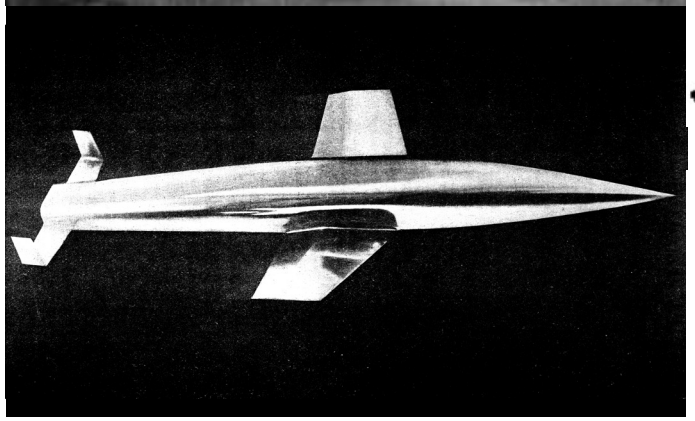
    A. Sub-launched cruise missiles

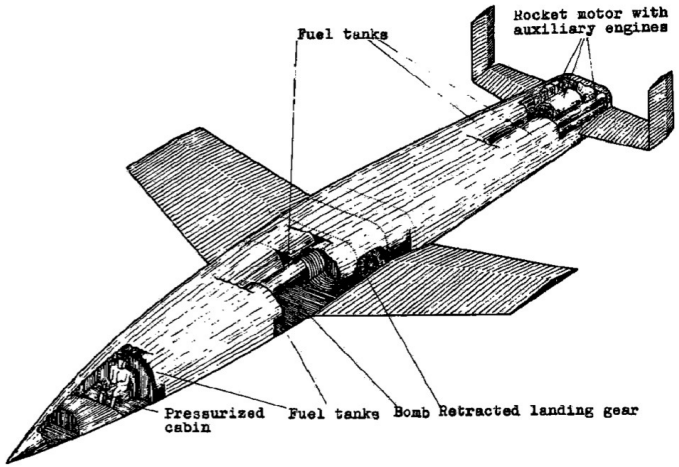
    B. Sub-launched ballistic missiles

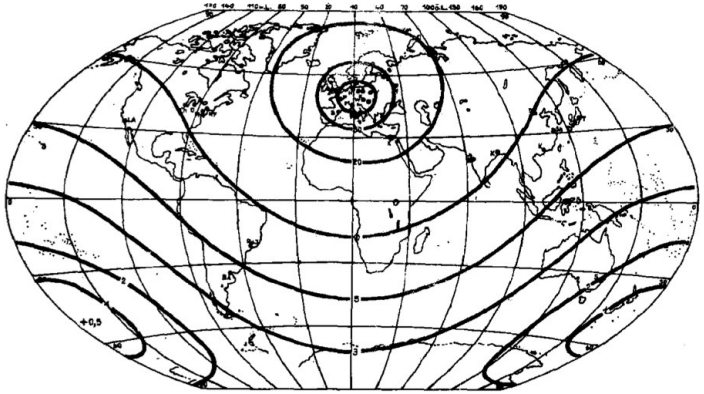
3. Intercontinental jet bombers

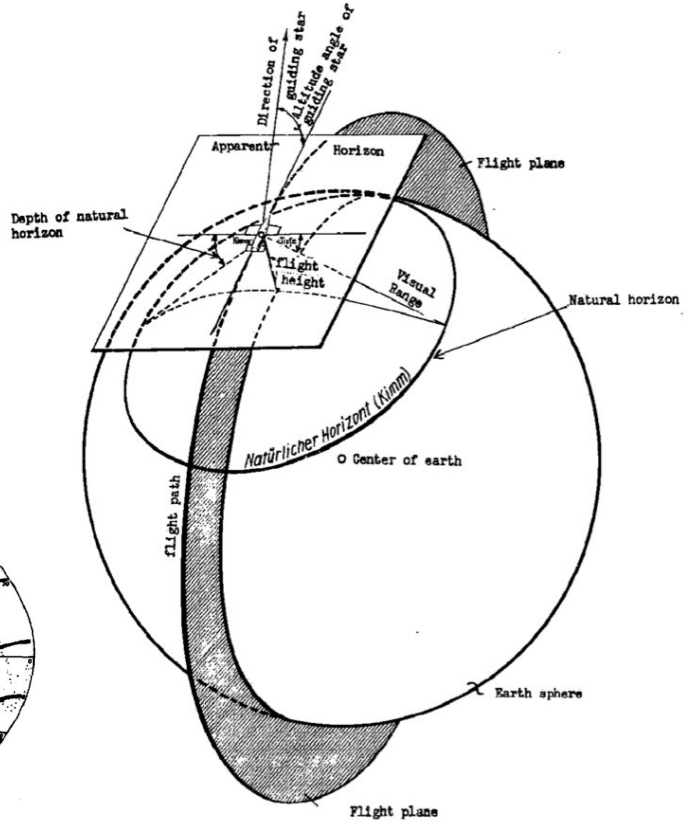
Silbervogel Suborbital Bomber (1933-1945)

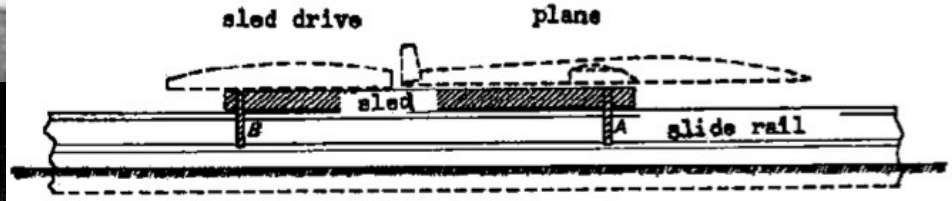
Eugen Sänger (1905–1964)
Irene Bredt (1911–1983)

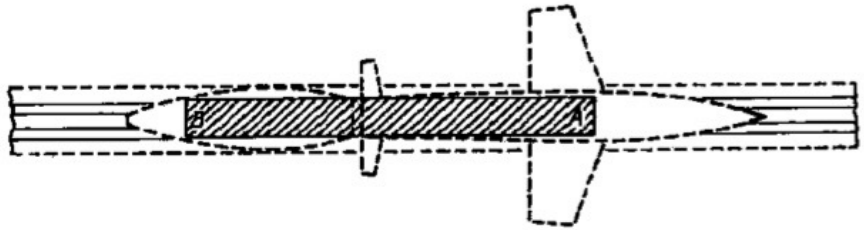










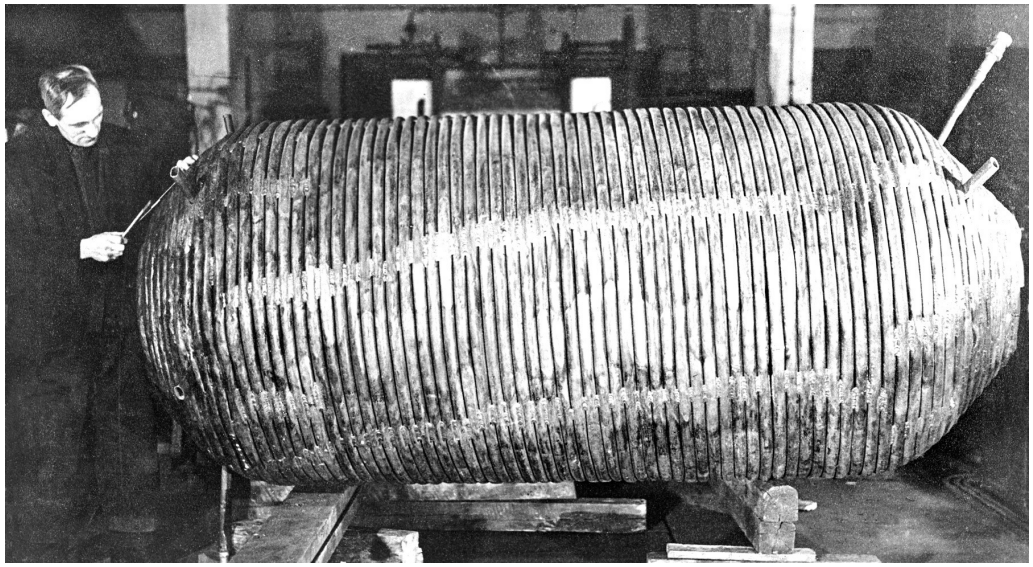


Eugen Sänger and Irene Bredt. 1944. Über einen Raketenantrieb für Fernbomber. UM 3538. Ainring: Deutsche Luftfahrtforschung. English translation 1952.

Evidence That Silbervogel Was Actually Built

Germans Had Jet 'Planes 5 Times Faster Than Sound.' *Ottawa Journal.* 18 January 1946 p. 9.

A jet aircraft designed to travel at five times the speed of sound and a rocket motor 10 times larger than those used on V-2s at the end of the war were just two of many German developments in aeronautics viewed by Canadian-scientists during a recent tour of the battered Reich. The experts, five members of the National Research Council Staff, spent four months poking around former German research stations, airfields and underground factories. […] Mr. Samaras reported the Germans had made "considerable headway" in trans-Atlantic rockets and actually were making preparations for space travel. […] In rockets and jet propulsion, the Nazis had "10 times our technical facilities" and in rocket research were "miles ahead of us."



Construction of 100-ton-thrust Silbervogel rocket engine in 1941. Deutsches Museum, photo 30391.

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

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

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

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

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

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

Where are the reports?

Charles Lester Walker. October 1946. Secrets by the Thousands. Harper's Magazine 193:329-336.

"The V2 rocket, which bombed London," an Army Air Forces publication reports, "was just a toy compared to what the Germans had up their sleeve." […]

Another German rocket which was coming along was the A-9. This was bigger still---29,000 pounds---and had wings which gave it a flying range of 3,000 miles. It was manufactured at the famous Peenemünde army experiment station and achieved the unbelievable speed of 5,870 miles an hour.

A long range rocket-motored bomber which, the war documents indicate, was never completed merely because of the war's quick ending, would have been capable of flight from Germany to New York in forty minutes. Pilot-guided from a pressurized cabin, it would have flown at an altitude of 154 miles. Launching was to be by catapult at 500 miles an hour, and the ship would rise to its maximum altitude in as short a time as four minutes. There, fuel exhausted, it would glide through the outer atmosphere, bearing down on its target. With one hundred bombers of this type the Germans hoped to destroy any city on earth in a few days operations.

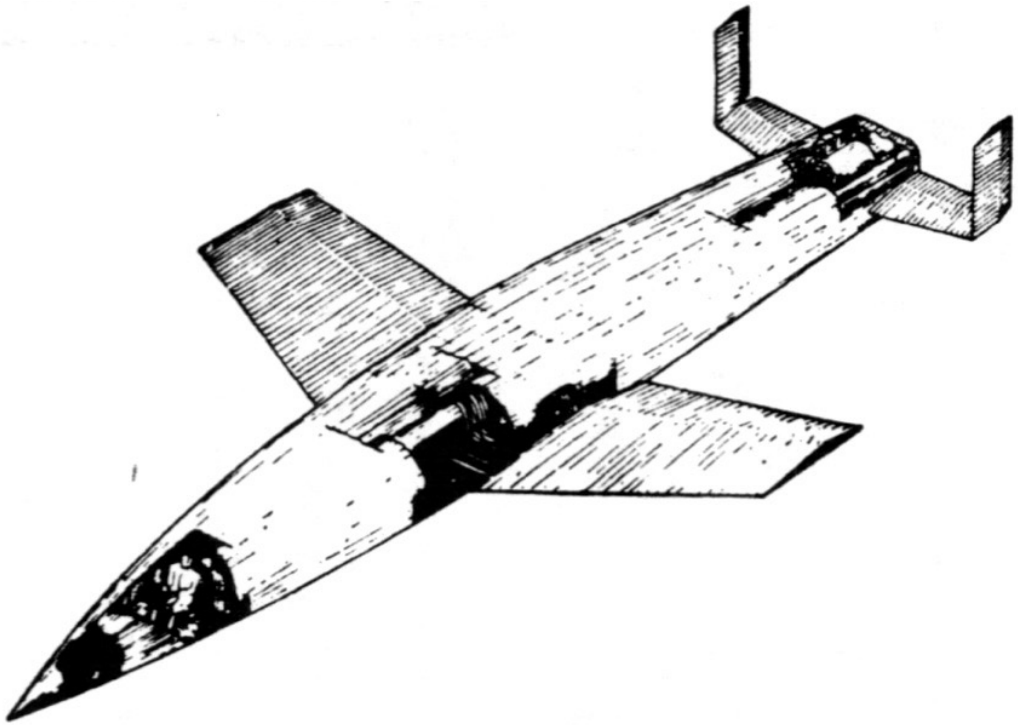
Little wonder, then, that today Army Air Forces experts declare publicly that in rocket power and guided missiles the Nazis were ahead of us by at least ten years. […]

All such revelations naturally raise the question: was Germany so far advanced in air, rocket, and missile research that, given a little more time, she might have won the war? Her war secrets, as now disclosed, would seem to indicate that possibility. And the Deputy Commanding General of Army Air Forces Intelligence, Air Technical Service Command [Donald L. Putt], has told the Society of Aeronautical Engineers within the past few months:

The Germans were preparing rocket surprises for the whole world in general and England in particular which would have, it is believed, changed the course of the war if the invasion had been postponed for so short a time as half a year.

Evidence That Silbervogel Was Actually Built

Col. Donald L. Putt. 1946. German Developments in the Field of Guided Missiles. *SAE Journal* 54:8:404-411.



■ Fig. 14 – Rocket bomber designed to fly from Berlin to New York in 40 min at an altitude of 154 miles – engine burned liquid oxygen and alcohol – rocket nozzle was cooled by water, condenser being used to form water from products of combustion – other side of condenser could be used to vaporize the alcohol. Test model was made that carried one man and had landing gear, although it is not known if this model ever flew; it is known, however, that test runs were made on its engine

Robert Godwin. 2003. *Dyna-Soar: Hypersonic Strategic Weapons System.* Apogee. pp. 38-51.

R&D PROJECT CARD	TYPE OF REPORT: Proposed Weapon System	REPORT CONTROL SYMBOL: DD-R&D/A/119
1. PROJECT TITLE: (Conf) Hypersonic Glide Rocket Weapon System (Uncl) Hypersonic Strategic Weapon System	2. SECURITY OF PROJECT: Secret 4. INDEX NUMBER: N/A	3. PROJECT NO.: System 464L 5. REPORT DATE: 23 August 57
6. BASIC FIELD OR SUBJECT: Supporting Systems	7. SUB FIELD OR SUBJECT SUB GROUP: SS	7A. TECH. OBJ.: SS-1
8. COGNIZANT AGENCY: Hq ARDC 9. DIRECTING AGENCY: Hq ARDC, RDZP 10. REQUESTING AGENCY: Hq USAF	12. CONTRACTOR AND/OR LABORATORY: To be determined	CONTRACT/W. O. NO.
11. PARTICIPATION AND/OR COORDINATION: NACA (P) AMC (P) SAC (I) U. S. NAVY (I) U. S. ARMY (I)	13. RELATED PROJECTS: Project 7990 Task 89774 14. DATE APPROVED 15. PRIORITY: 1A 16. MAJOR CATEGORY: A	17. EST. COMPLETION DATES RES. "Cont." DEV. "Cont." TEST "Cont." OP. EVAL. 18. FY / FISCAL ESTIMATES 58 3,000 59 5,000 60 8,000

19. REPLACED PROJECT CARD AND PROJECT STATUS: This report supercedes DD Form 613 dated 31 Dec 56, System 459L (Brass Bell); DD Form 613 dated 28 Dec 56 System 610A (HYWARDS): and Task No. 89774 (ROBO) of DD Form 613 dated 8 Jan 57, Project 7990.

20. Requirement and/or Justification

This system is proposed to satisfy System Requirement 131, dated 14 November 1956, title:(U) Hypersonic Weapons Research and Development Supporting Systems; GOR No, 92 (TA-4e-1-59), dated 12 May 1955, title:(U) GOR For A Piloted Very High Altitude Reconnaissance Weapon System; and SR No. 126, dated 12 June 1956, title classified, Unclassified short titles ROBO.

The logical development of weapon systems utilizing the boost-glide concept encompasses the above requirements in the order mentioned. In keeping with the philosophy of "more Air Force per dollar" and the desirability of obtaining operational weapon systems of this type as early as practicable, it is essential that. weapon systems using the boost-glide concept be developed under a completely integrated program. This program consolidates the DD Form 613's previously submitted on projects. HYWARDS and Brass Bell (see Item 21e); the ARDC Form 111's dated 29 March 1957 and 10 May 1957 on Project 7990, Task 89774 (ROBO); and the Evaluation Report of the Ad Hoc Committee for ARDC System Requirement No. 126 ROBO dated 1 August 1957. This program is identified as Weapon System: 464L and given the nickname Dyna Soar, which stands for Dynamic Soarer. (Confidential)

22. OASD (R&D) | SN. | CN. | C. | X. | L. | C.

DD FORM 1 APR 58 613 REPLACES DD FORM 613, 1 JAN 55, WHICH MAY BE USED.

SECRET

C7-115361

PAGE 1 OF 10 PAGES

c. Background History

The boost-glide concept is not new. In the early Forties, Dr. Sanger, German rocket scientist, proposed a skip-glide vehicle to bomb New York from a launch site in Germany. Serious consideration was given this proposal by the Germans. A program known to the Germans as the A9/A10 development was designed to use a winged V-2 rocket as the second stage of a two-stage system. This vehicle was under development and test by the Germans when the war ended. At the close of the war Dr. Walter Dornberger, ex-German general and head of the Peenemunde Rocket Research Institute in Germany went to work for Bell Aircraft Corporation in this country. It is not surprising then that Bell approached the USAF in 1952 with an unsolicited proposal for a Manned, Hypersonic Boost-Glide Bomber/Reconnaissance Weapon System. Rand conducted investigations of this concept in 1948 and the NACA published work on the subject in 1954. Since 1954, the ARDC has sponsored a considerable amount of work in the boost-glide field. The following table summarizes this effort.

German Measurements of Reentry Heating

W. G. A. Perring. 1946. A Critical Review of German Long-Range Rocket Development. *Journal of the American Rocket Society.* 65:1-17.

The highest velocity reached is at all burnt, the rocket is then traveling at 5000 ft. per sec. and it is interesting to note that at this velocity the rocket motor is developing well over 600,000 horsepower. The stagnation temperature corresponding to a velocity of 5000 ft. per sec. is about 1400°K, and in view of this it might be expected that the skin temperatures of the rocket during flight would tend to be high and approach the stagnation value.

To check this point a careful examination of the rocket skin was undertaken, and both from an examination of the condition of the paint, and a metallurgical examination of the skin material, it was concluded that the skin temperatures had not exceeded about 900°K. This figure agrees very closely with measurements that the Germans were able to make on an actual rocket in flight. In their tests the Germans inserted small discs of various metals of known melting point into the skin of the rocket and connected these into electrical circuits. As each disc melted, a signal was transmitted by telemetering to a ground station. It was found that the skin temperatures nowhere exceed 920°K, conduction and radiation losses therefore must have kept the skin temperature down well below the stagnation temperature.

Reentry Heating for a Winged Vehicle

Maximum reentry heating is proportional to (velocity)^3

Situation	Reentry velocity	Maximum heating
Sunlight at sea level		1.0 kW/m^2
Sunlight in space		1.4 kW/m^2
U.S. Space Shuttle	8000 m/sec	25 kW/m^2
A-9 launched by itself	1750 m/sec	0.26 kW/m^2
A-9 launched on A-10	3870 m/sec	2.8 kW/m^2
Silbervogel	6170 m/sec	11 kW/m^2

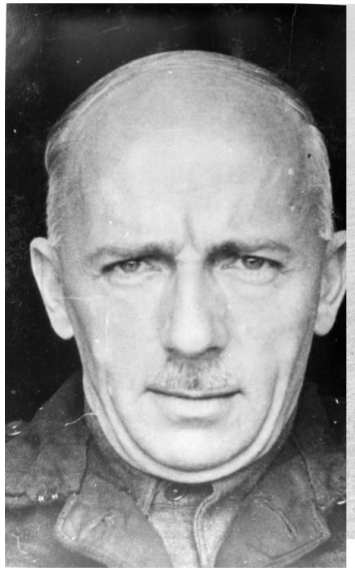
Reentry heating was much less of a problem for A-9 and Silbervogel than it was for the U.S. Space Shuttle.

Silbervogel was also intended to use a skip reentry, dissipating the velocity and heating in a series of brief dips into the atmosphere, rather than all at once.

See *Forgotten Creators* E.3 and E.7 for more details.

Postwar Space Planes Based on Silbervogel

Walter Dornberger (1895–1980)

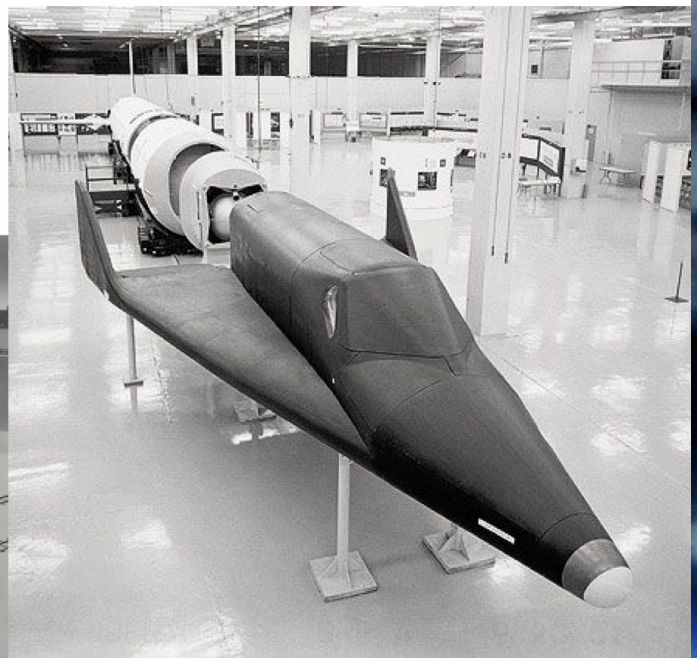


X-15 rocket plane (first flight 1959)

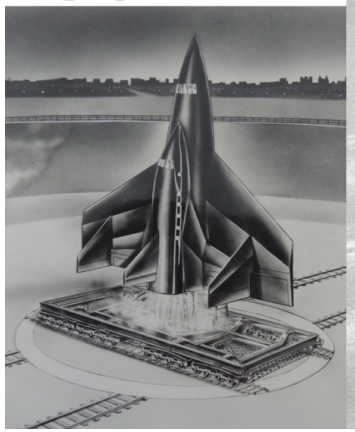
Hans Multhopp (1913–1972)

X-24 lifting body (1969)

X-20 Dyna-Soar space plane prototype (cancelled 1963)



Bell Aerospace Bomi (Bomber Missile, proposed 1952)



For more information, see *Forgotten Creators* E.3

U.S. Space Shuttle

Wernher von Braun had publicly lobbied for a U.S. space plane since 1952.

In 1965, Walter Dornberger named the newest U.S. space plane program the “Space Shuttle.”

The Space Shuttle incorporated design features, experience, and personnel from the earlier A-9, Silbervogel, Bomi, Dyna-Soar, and X-24 space plane programs.

Adolf Busemann proposed ceramic tiles to insulate the Shuttle and contributed his detailed knowledge of hypersonic aerodynamics and heating for the design and reentry.

Krafft Ehricke was deeply involved in space plane projects from Bomi to the Space Shuttle.

The Space Shuttle Main Engines were directly derived from engine designs with especially high combustion chamber pressures that were developed during and after the war (such as the MBB P111 engine and the Rocketdyne HG-3 engine) by Klaus von Riedel, Karl Stöckel, Hans Georg Paul, Dieter Huzel, and others.

The Space Shuttle Solid Rocket Boosters (SRBs) used solid rocket propellants and technology developed by Uwe Bödewadt, Rolf Engel, Hermann Teichmann, Karl Klager, and others.

See *Forgotten Creators* E.3.

Outline

Nuclear payloads

1. Land-launched intercontinental missiles

   A. Liquid propellant missiles

   B. Liquid propellant space planes

   C. Solid propellant missiles

2. Submarine-launched missiles

   A. Sub-launched cruise missiles

   B. Sub-launched ballistic missiles

3. Intercontinental jet bombers

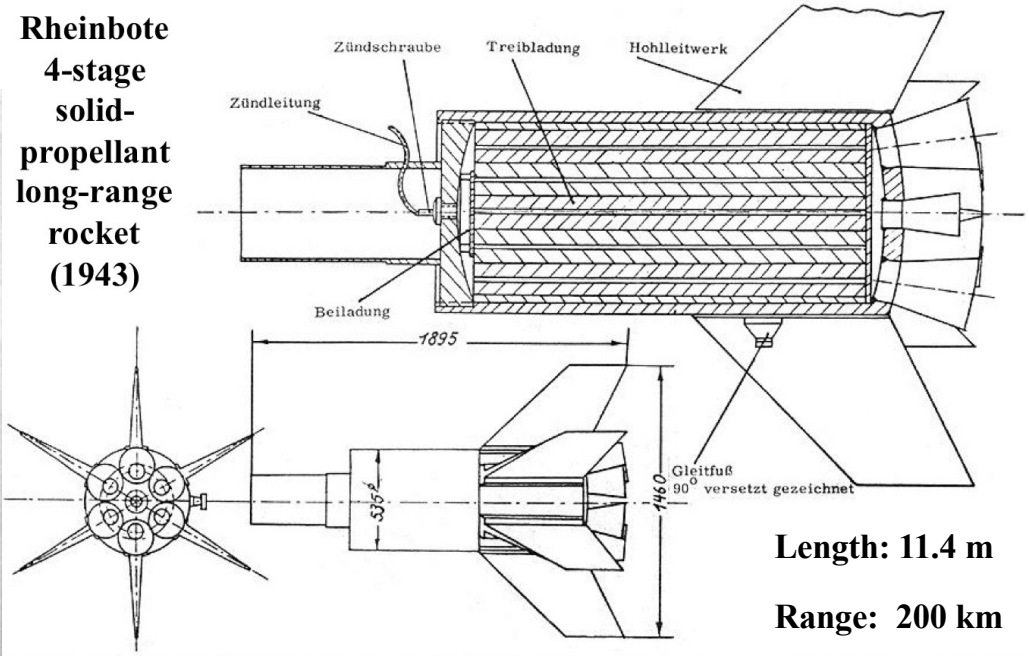
By 1943, German Rockets Had Pushed Conventional Solid Propellants (e.g., Diglycol-Dinitrate) to Their Limits

Rheintochter R1 surface-to-air missile, first demonstrated in 1943

Length: 6.3 m

Altitude: 8 km

Rheinbote 4-stage solid-propellant long-range rocket (1943)

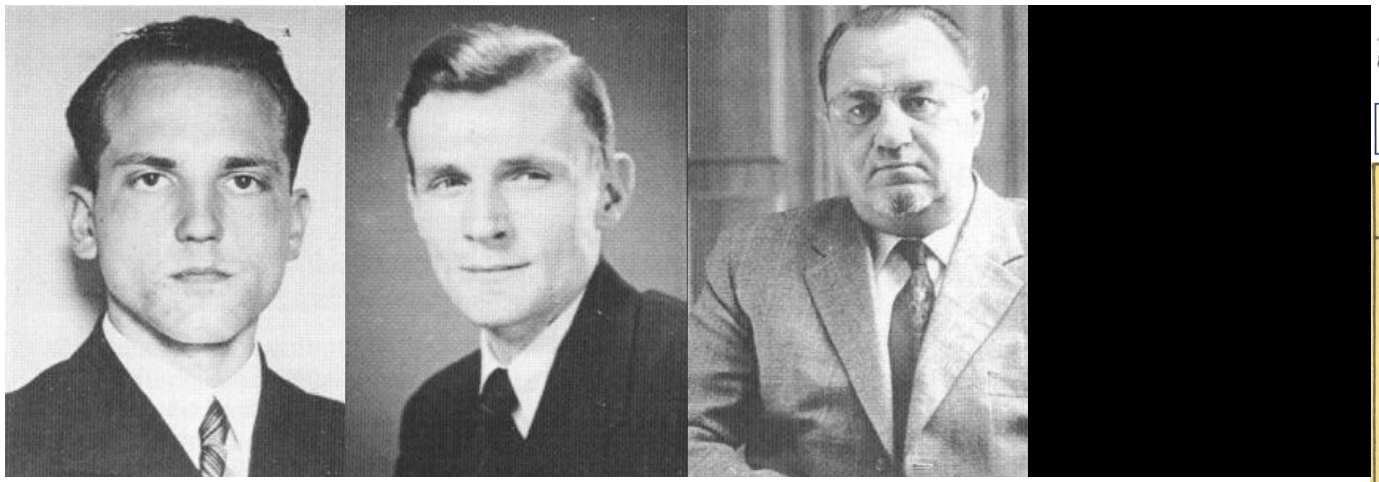


Length: 11.4 m

Range: 200 km

German Scientists Invented and Used Modern Solid Propellants and Methods (1943): Ammonium Perchlorate, Polybutadiene, Aluminum, Plasticizer, Grain Patterns, Etc. ("Ammonium Perchlorate Composite Propellant")

Uwe Bödewadt (1911–2003) | **Rolf Engel (1912–1993)** | **Hermann Teichmann (1913–1976)** | **Hermann Vüllers (19??–19??)**



H. Vüllers, Design and Development of the Solid-Fuel Rocket

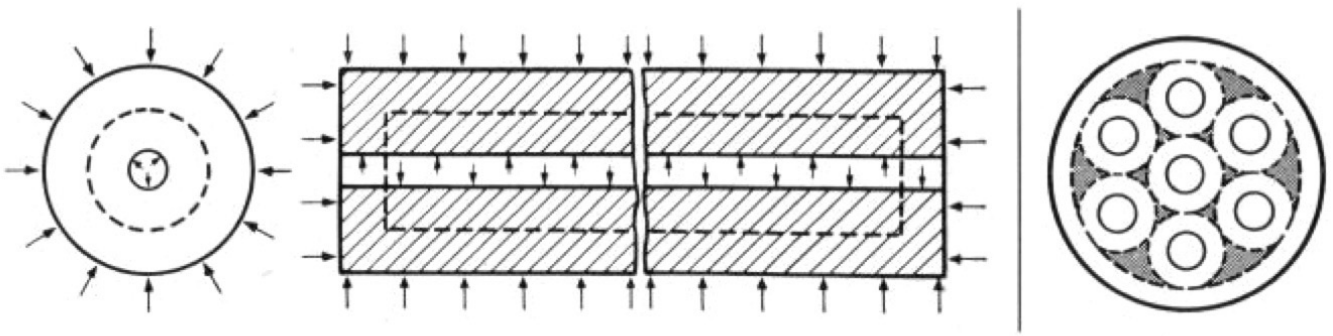


Fig. 1. Behaviour of powder surface during burning
Single-tube charge. Surface area decreases (regressive)
Multi-tube powder. Surface increases (progressive)
——— *Surface when burning starts*
– – – *Surface when burning finishes*

Theodore Benecke & A. W. Quick. 1957. *History of German Guided Missiles Development.* NATO.

BIOS 571

Per-pulver

Mr. Larsson worked with the applications of this propellant to various rocket weapons, at the Skoda Works Rocket Research Station at Pibrans, Czechoslovakia, for about 6 months. Here he met the inventor of Per-pulver, Dr. Teichmann, and his two collaborators, Dr. Knust and Dr. Nord.

Per-pulver is also called Nider-druck-pulver, Super-pulver and Dauerbrand.

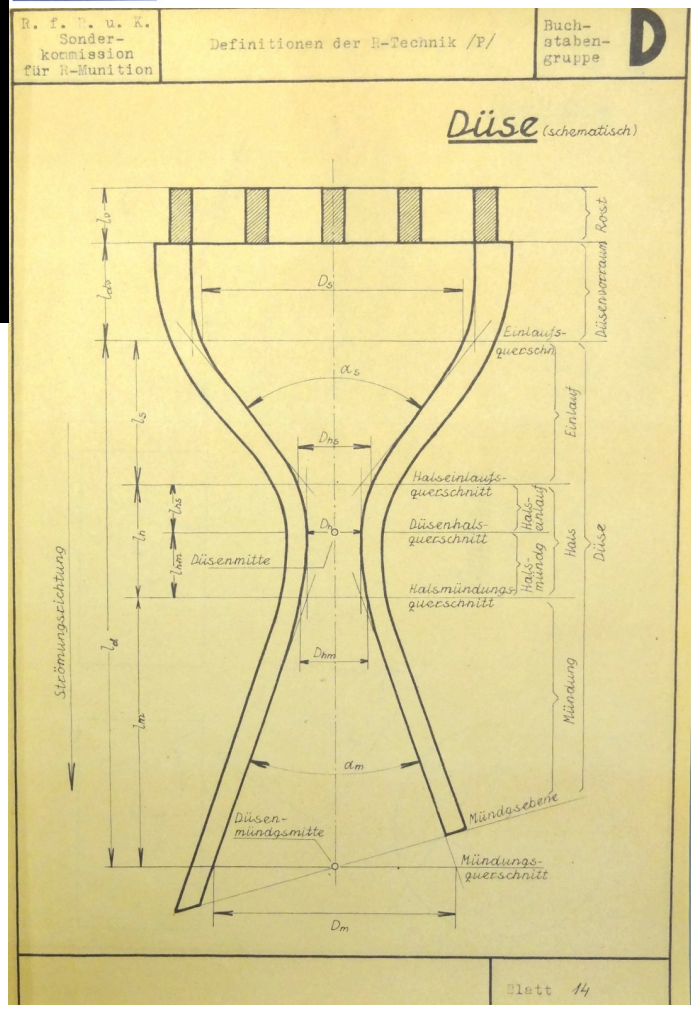
Composition:

Ammonium perchlorate	25 - 40%
Buna S3	25%
Vinapas	50 - 35%
Stabiliser	3 - 5%

Later interrogations of Dr. Teichmann however, show that these figures are not exact. The composition contains about 80% of ammonium perchlotate.

DECLASSIFIED Authority NND 755001

NARA RG 319, Entry NM3-82A, Box 14, Folder OB-3



V-101 Rocket: Ammonium Perchlorate Composite Propellant, 140,000 kg Total Mass, 30 m Tall, 3 Stages (?), 1800 km Range

Seventh Army Interrogation Center. 3 June 1945. Notes on German Weapons Developments. SAIC/38. http://hydrastg.library.cornell.edu /fedora/objects/nur:01298/datastreams/pdf/content

NARA RG 38, Entry P5, Box 38, NavTechMisEu 237-45, August 1945

Ref No SAIC/38
3 Jun 45

Where are the detailed reports?

a) NATTER ("Adder")

The NATTER's dimensions are:
Length: 2 m.
Largest Diameter: 1 m.
Starting Weight: 200 kg.
Flight Efficiency: 10 km in 1 minute.

The NATTER is armed with the 55 mm ORKAN B rocket projector. The device was ready for flight testing in May 45.

b) KAUPER - is another rocket-propelled one-man "aircraft".

7. Long Range Rocket Missiles

The V-series weapons are the representatives of this class. Also, future developments for communication purposes can be expected in rockets of this category.

a) V-1.

b) A-4, which was the prototype of V-2.

c) V-2.

d) TL (TURBOLADER) - for jet-propelled planes.

e) V-101.

This weapon, in the planning stages only, was being developed in the PIBRANS Experimental Center by Dr BOEDENWADT, Dr TEICHMANN, Dr KALSCHEUER, and Ing THOMAS. It is a giant rocket of a total weight of 140 tons, of which 100 tons were to be taken up by the fuel. It was to have a length of 30 m and a diameter of 2.8 m. It was to attain a velocity of 2,000 km per hour at an altitude of 200 km. Its maximum range was calculated to be 1,800 km. It was to be fired by a catapult mechanism, also rocket-operated. Source LARSSON claims that he would be able to prepare a complete report, with drawings, of this weapon.

8. "Detonation Rocket Weapons"

Contrary to the normal rockets, where the projectile is propelled forward by the rearward push of the gases during the explosions, the "detonation rockets" move through the utilization of the rearward impulses caused by the detonations themselves. For practical purposes this principle is applicable only at extremely high velocities. The DERA is the only rocket in which this principle was used. Ing LARSSON (source) was the specialist in charge of research on this rocket at the GROSSENDORF Experimental Station, under Ing THOMAS. Source explains that the successive detonation impulses are properly directed by means of a parabolic surface. Normal rocket mechanisms are used to attain a certain minimum velocity, at which time the "detonation" mechanism begins to function.

CONFIDENTIAL

V-101 LONG RANGE ROCKET

A. General

1. Introduction.

(a) The V-101 is a long range rocket missile which was in the planning stages at the Pibrans Rocket Experimental Station, a subsidiary of the SKODA Munitions Work at Pibrans, Czechoslovakia. The only information presently available is from a brief interrogation of Dr. Edgar Ruppelt, Dr. Alfred Nordt, Dr. Ernst Knust and Nils Larsson, in the 7th Army Interrogation Center. (Report Ref. No. SAIC/38 of June 1945).

(b) No drawings or illustrations are available.

(c) As in the case of the Rochen, reference to the V-101 has been made simply as an illustration of the extent of the German effort being utilized in the development of long range rockets and missiles.

B. Details

2. Description.

(a) It is believed that the projected purpose of the weapon was for use in long range area bombing. The type of explosive, fuel, and exact utilization had not been fully determined. The missile was to operate in the stratosphere.

(b) The rocket was to be about 30 meters long; the diameter was estimated to be 2.8 meters. The total weight was to be approximately 140 tons, with the fuel weight of approximately 100 tons.

(c) The speed of the rocket was estimated to be in the vicinity of 2000 km/hr when operating at an altitude of 200 kilometers. The proposed range was to be 1800 kilometers.

(d) The rocket was to be launched from a catapult mechanism.

German Solid Propellant Rocket Technologies Were Transferred to the United States

NARA RG 319, Entry NM3-47B, Box 991, Folder 400. 112 Research/009. 14 May 1945.

009

16 July 1946

MEMORANDUM FOR DIRECTOR OF INTELLIGENCE, WDGS:
(Attn: Special Exploitation Branch)

SUBJECT: Assembling Certain German Scientific Personnel for Interrogation

1. This Headquarters has been advised by Dr. F. Zwicky, Director of Research, Aerojet Engineering Corporation, and Colonel R. L. Wassell, Power Plant Laboratory, Engineering Division, through Air Materiel Command, of the necessity of obtaining information and reliable data in the fields of thermochemistry and kinetics of chemical reactions to round out information obtained by them in Germany in 1945. Basic knowledge in these fields is considered of prime importance for future progress in jet propulsion. It is felt that much of this data may be obtained from interrogating German scientific personnel now in Germany. Since Dr. Zwicky was going to Paris to attend the conference on applied mechanics in September, and Col. Wassell is scheduled to go to Germany about the same time, it was suggested by Wright Field that they plan on going over in August to accomplish the mission of obtaining this information for T-2. Dr. Zwicky assented to this proposition and has furnished the names of the scientists he thinks should be contacted. This list is enclosed herewith.

2. It is requested that the necessary action be taken to locate the scientists listed and that arrangements be made to assemble them in two or three locations so that they may be conveniently interrogated. The actual date of assembly will be furnished by this Headquarters as soon as the proposed date of departure of Dr. Zwicky and Col. Wassell is known. It will be necessary, however, that this matter be given expeditious handling in order that this may be accomplished the first part of August.

FOR THE COMMANDING GENERAL:

1 Incl:
List as above

ROBERT TAYLOR 3RD
Colonel, Air Corps
Chief, Collection Branch
Air Information Division
AC/AS-2

PARTIAL LIST OF GERMAN CHEMISTS IN THE FIELD OF KINETICS OF CHEMICAL REACTIONS

NAME	INSTITUTE ASSOCIATED WITH AT TIME OF PUBLICATION	LAST KNOWN ADDRESS
Jost, Wilhelm, Prof.	Dir. of Inst. for Physical Chemistry, Marburg. Formerly Leipzig & Strassburg, Elsass, Inst. for Lubrication and Fuels	Mozartstrasse 2, Leipzig-Markkleeberg
Juza, Prof.	University at Heidelberg (Specialist in catalysis, inorganic Chemistry)	Possibly at Dustbin
Teichmann, Dr.	He and staff were associated with Prof. Jost. Group has very good ideas about chemical reaction problems important for jet propulsion. Teichmann joined Waffen Union, Skoda, Pibrans in 1944. He and staff was at Camp Föhrenwald, Wolfratshausen, Bavaria in 1945. It is important to find Dr. Teichmann.	Hindenburgstrasse 96A, Berlin-Wilmersdorf
Grube, G., Prof. Dr.	Dir. of Inst. for Physikalische Chemie u. Elektrochemie der technischen Hochschule, Stuttgart	Hangleiterstrasse 2, or Wiederholdstrasse 15, Stuttgart N.

Fritz Zwicky (1898-1974). Swiss, moved to U.S. in 1925. Worked for CalTech, War Dept., and Aerojet (Research Director).

Postwar transfer of German and Austrian experts (such as Karl Klager to Aerojet) was also extremely important.

German Solid Propellant Rocket Technologies Were Transferred to the United States

AFHRA folder 201-56 Vol. 1 Pt. 2 May 1945--Mar 1947 THIS PAGE DECLASSIFIED IAW EO 13526

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSDIN

AIR TECHNICAL SERVICE COMMAND

TSDIN/DLP/deg

WRIGHT FIELD, DAYTON, OHIO
23 January 1946

SUBJECT: Research and Development of Solid Fuel Rockets

TO: Commanding General
Army Air Forces
Washington 25, D.C.

Attn: Major General Curtis E. LeMay
Deputy Chief of Air Staff for
Research and Development

1. It is understood that your office has recently received a communication setting forth the need for reviving research on solid fuel rockets.

2. For such use as can be made of the information, it is desired to present the following:

a. German aeronautical research establishments and industry have spent years working on subject development. It is believed that the Germans were considerably advanced beyond our own efforts in this field. Most of the documentary information covering this past research is available in the Air Document Division, Wright Field.

b. Every effort should be made to take advantage of this work which has already been done so as to profit from the mistakes made by the Germans and to prevent costly duplication of effort in repeating the work already done.

c. There are presently stationed at Wright Field several German scientists who have worked in the rocket field. One scientist in particular has done research work on solid rocket fuels and motors for the past ten years. Another was instrumental in the development of the motor and liquid fuels for the ME-163. Both have plans and ideas for further research which would lead to improved fuels and increased efficiencies of rocket motors. Every effort should be made to provide means and facilities to acquire the projected thinking and plans of these scientists to assist and expedite our own research and development to the greatest possible extent.

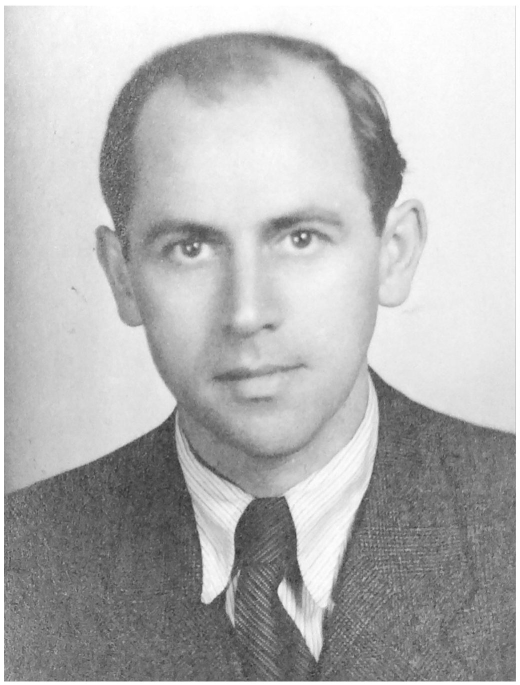
D. L. PUTT
Colonel, Air Corps
Deputy Commanding General
Intelligence (T-2)

Gerhard Braun (?)

Wolfgang Noeggerath (helped U.S. create Polaris missiles)

Postwar U.S. Sub-Launched Missiles

Karl Klager (1908–2002)



United States Patent [19]

Klager

[11] **Patent Number:** 5,811,725

[45] **Date of Patent:** Sep. 22, 1998

[54] **HYBRID ROCKET PROPELLANTS CONTAINING AZO COMPOUNDS**

[75] Inventor: **Karl Klager**, Sacramento, Calif.

[73] Assignee: **Aerojet-General Corporation**, Rancho Cordova, Calif.

[21] Appl. No.: **748,738**

[22] Filed: **Nov. 18, 1996**

[51] **Int. Cl.**[6] **C06B 45/10**

[52] **U.S. Cl.** **149/19.4**; 149/19.1; 149/19.5; 149/36; 149/109.4; 60/219

[58] **Field of Search** 60/219; 149/19.1, 149/19.4, 36, 19.5, 109.4

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,728,760	12/1955	Kenney .	
3,096,312	7/1963	Henry .	
3,140,582	7/1964	Tyson, Jr. .	
3,171,249	3/1965	Bell .	
3,219,499	11/1965	Graham .	
3,244,702	4/1966	Marcus	149/19.1
3,336,837	8/1967	Anger .	
3,350,374	10/1967	Fetscher et al. .	
3,640,070	2/1972	Kaufman et al.	60/219
3,697,339	10/1972	Satten et al.	149/19.1
3,727,407	4/1973	Rains et al.	149/36
3,734,789	5/1973	Moy et al. .	
3,940,298	2/1976	Beckert et al. .	
3,967,989	7/1976	Hawthorne .	
4,013,596	3/1977	Ernberg	149/19.1
4,023,352	5/1977	Sayles	149/36
4,065,332	12/1977	Lorson et al.	149/19.9
4,206,006	6/1980	Ratz	149/19.9
4,288,262	9/1981	Flanagan et al. .	
4,432,817	2/1984	Frankel et al. .	
4,482,404	11/1984	Witucki et al. .	
4,581,082	4/1986	Hagel et al. .	
4,925,909	5/1990	Kubota et al.	149/19.4
4,938,814	7/1990	Schoyer et al. .	
4,950,341	8/1990	Schoyer et al. .	
5,188,682	2/1993	Lochner et al.	149/1
5,198,046	3/1993	Bucerius et al. .	
5,339,624	8/1994	Calsson et al.	60/219
5,388,519	2/1995	Guindon et al. .	
5,466,315	11/1995	Erickson et al. .	
5,509,981	4/1996	Dean	149/19.4

FOREIGN PATENT DOCUMENTS

55-136195	4/1979	Japan .
57-117307	1/1981	Japan .
578081	3/1943	United Kingdom .

OTHER PUBLICATIONS

VASO Product Literature, DuPont Company (E–93156) 10 pages.

D. Altman, "Hybrid Rocket Development History," AIAA 91–2515, AIAA/SAE/ASME/ASEE 27th Joint Propulsion Conference (Jun. 24–26, 1991).

C.B. Luchini, et al., "Investigation of GAT as a High Regression Rate Hybrid Rocket Fuel," AIAA 96–2592, AIAA/ASME/SAE/ASEE 32nd Joint Propulsion Conference (Jul. 1–3, 1996).

Primary Examiner—Edward A. Miller

Attorney, Agent, or Firm—Townsend and Townsend and Crew LLP

[57] **ABSTRACT**

Hybrid rocket propellants are disclosed that contain azo compounds, i.e., compounds containing the group R—N═N—R' as part of their structure, where R and R' represent a variety of groups including aliphatic, alicyclic and heterocyclic groups. The azo compounds are mixed with the other solid components of the propellant grain and serve either as plasticizers, binders, fuels, or fillers. The effect of including the azo compounds is an increase in the regression rate of the grain as the propellant burns.

26 Claims, 2 Drawing Sheets

United States Patent Office — 3,214,474 — Patented Oct. 26, 1965

1

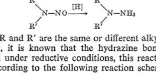
3,214,474
PREPARATION OF UNSYMMETRICAL HYDRAZINES
Karl Klager, Monrovia, Calif., assignor to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
No Drawing. Filed Sept. 28, 1953, Ser. No. 382,828
6 Claims. (Cl. 260—583)

This invention relates to an improved process for preparing unsymmetrical alkyl hydrazines.

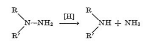
Unsymmetrical alkyl hydrazines have been known for many years and their properties as fuels have been well recognized in the art. However all of the known processes for their production produce poor yields of low purity. Accordingly, the use of alkyl hydrazines as fuels, in particular as propellant fuels, has been somewhat restricted for economic as well as for safety reasons, since a high degree of purity is required for this use in order to lessen the possibility of explosive reactions.

It is an object of this invention to provide an improved method for the preparation of unsymmetrical alkyl hydrazines which will provide increased yields of greater purity.

Classically unsymmetrical alkyl hydrazines are prepared by the reduction of nitroso dialkylamines. This reaction proceeds in accordance with the reaction scheme set forth below:



wherein R and R' are the same or different alkyl radicals. However, it is known that the hydrazine bond may be dissolved under reductive conditions, this reaction taking place according to the following reaction scheme:



where R and R' are the same as above.

Hence it becomes apparent that a catalyst or set of reaction conditions which favors the former reaction and disfavors the latter will result in a successful method for the preparation of such substituted hydrazines.

Alkyl hydrazines have been prepared by reducing the nitroso group in the classical manner with zinc and acetic acid, however these conditions usually result in a complicated work up, a yield of approximately 65%, and in a product of relatively low purity.

In recent years it has been found that lithium aluminum hydride may also be employed to effect this reaction. However the lithium aluminum hydride method is very expensive, ordinarily yields a product of low purity and generally provides a theoretical yield of only about 75%.

We have discovered that by using palladium catalysts to effect the reduction, a yield of approximately 85% of the theoretical may be obtained and that the product thus obtained possesses a high degree of purity. Suitable palladium catalysts are: palladium charcoal, palladium-calcium carbonate and palladium-barium sulfate. Colloidal palladium may also be used as well as finely divided palladium on carriers such as silica gel, infusorial earth, alumina and other commonly used catalyst carriers. Because of these improved results, this method is applicable to large scale production with considerable decrease in the overall cost of production. Moreover my reaction catalyst has been found to be useful for the preparation of any of the unsymmetrical alkyl hydrazines. The following examples are provided to more clearly illustrate the invention:

2

Example I.—Preparation of palladium charcoal catalyst

1 part of 10% palladium charcoal and 10 parts of water was stirred in a hydrogen atmosphere until the catalyst was activated, that is, until no additional hydrogen was absolved.

Example II.—Preparation of dimethyl hydrazine

5 parts of nitroso dimethyl amine in 90 parts of water were added to the catalyst as prepared above and subjected to hydrogen atmosphere with rapid stirring. After a quantity equivalent to 2 moles of hydrogen had been absorbed the reaction was stopped, the catalyst filtered, and the water solution neutralized with hydrochloric acid. After evaporation of the water a yield equivalent to 81% of the theoretical of dimethyl hydrazine hydrochloride was isolated.

Example III.—Preparation of ethyl methyl hydrazine

5 parts of nitroso ethyl methyl amine in 90 parts of water were added to the catalyst as prepared in Example I and subjected to hydrogen atmosphere with rapid stirring. After an amount of hydrogen gas equivalent to 2 moles of hydrogen had been absorbed the reaction was stopped. The catalyst was filtered off and the water solution neutralized with hydrochloric acid. The water was distilled off and a theoretical yield of 79.2% ethyl methyl hydrazine hydrochloride was isolated.

In the same fashion simply by selecting the appropriate alkyl substituted nitroso amine and reducing it in accordance with the examples set forth above, any of the alkyl substituted hydrazines may be prepared.

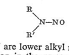
The concentration of the catalyst has not been found to be critical, however, we have found that optimum results are obtained when the palladium-charcoal catalyst is present in an amount below 2.0% by weight. No appreciable differences where observed when amounts in excess of 2.0% were used, however, when amounts below 0.2% were used, a slight decrease in the rate of reaction was observed.

Any of the aforementioned catalysts may be used successfully in the performance of my invention. The palladium metal, itself, being the catalytic substance, is substantially unaffected by the particular carrier or means of introduction employed.

My process, as is evident, lends itself equally well to continuous or batch processes, hence is well adapted to commercial production of unsymmetrical hydrazine compounds.

I claim:

1. The method of preparing unsymmetrical lower alkyl hydrazines which comprises reducing a nitroso amine having the general formula:



wherein R and R' are lower alkyl radicals, with hydrogen in aqueous solution in the presence of a hydrogen activated palladium metal catalyst.

2. The method of claim 1 wherein the hydrogen activated palladium catalyst used is a catalyst selected from the group consisting of palladium on charcoal, palladium on calcium carbonate, palladium on barium sulfate, colloidal palladium metal, and finely divided palladium metal a catalyst carrier.

3. The method of claim 1 wherein the catalyst used is hydrogen activated palladium on charcoal.

4. The method of claim 1 wherein the hydrogen activated palladium catalyst is present in an amount of from about 0.2% to 2.0% by weight.

5. The method of preparing unsymmetrical dimethyl

United States Patent Office — 3,000,968 — Patented Sept. 19, 1961

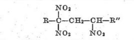
1

3,000,968
METHOD OF PREPARING NITRO COMPOUNDS
Karl Klager, Monrovia, Calif., assignor to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
No Drawing. Filed Mar. 5, 1956, Ser. No. 570,204
13 Claims. (Cl. 260—644)

This invention relates to new high explosive compositions of matter and to a method of preparing them. This invention also relates to a new process for introducing nitroalkyl groups into organic compounds.

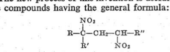
This application is a continuation-in-part of my copending application Serial No. 337,212, filed February 16, 1952, now abandoned.

The new compositions of matter of this invention are trinitroalkane compositions, having the general formula:



wherein R and R'' are hydrogen or lower alkyl radicals.

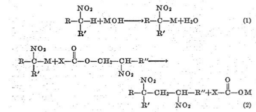
The new process of this invention is useful in preparing the compounds having the general formula:



wherein R is a nitro, halogen, hydrogen or lower alkyl radical and R' and R'' are hydrogen or lower alkyl radicals.

This process can be used to prepare the new compounds of this invention, as well as a variety of other known compounds having different utilities and properties. The conventional method for introducing nitroalkyl groups into organic compounds has been to react the compound with a nitro-olefin. This process generally leads to relatively poor yields due to the tendency of nitro-olefins to polymerize, thereby preventing the occurrence of the reaction and at the same time rendering separation of the desired product, if any, difficult.

The new process of this invention permits the introduction of nitroalkyl groups into organic compounds without employing any nitro-olefin. The reaction proceeds smoothly and produces the desired product in high yield. The new process of this invention proceeds according to the general reaction scheme set forth below:



wherein R is a nitro, halogen, hydrogen or lower alkyl radical, R' is a hydrogen or lower alkyl radical, R'' is a hydrogen or lower alkyl radical, X is a lower alkyl, phenyl or lower arylalkyl radical, such as benzyl, and M is a monovalent radical of an alkali or alkaline earth metal. The reaction is preferably conducted at a temperature of about 40° C., however, the reaction temperature can be varied over an extremely wide range of temperatures if desired. Methanol is the preferred solvent, however, any inert organic solvent can be used if desired. While any of the alkali or alkaline earth metal hydroxides can be used in the preparation of the aci-salt, it is preferred to use sodium hydroxide for reasons of economy, and because

2

the sodium aci-salts are generally more soluble than other alkali and alkaline earth metal salts. The lithium salts are about as soluble as the sodium salts, however, the relatively high cost of lithium hydroxide makes it more economical to use sodium hydroxide in the practice of this invention.

X, the acid portion of the ester reactant in the general reaction scheme set forth above, can be any organic radical including phenyl, alkyl, benzyl, etc., since the acid portion of the ester does not enter into the reaction. For reasons of economy, X is preferably a methyl radical.

The alkali or alkaline earth metal aci-salt can be prepared in situ in the presence of the ester reactant or can be prepared separately in advance.

The following examples are presented to more clearly define my invention. It should be understood, however, that the examples are presented purely for purposes of illustration and that the invention is to be limited only by the scope of the appended claims.

EXAMPLE I

Preparation of 1,3,3-trinitrobutane

A solution of 120 g. of 2,2-dinitroethane was placed in 1000 ml. of 4% aqueous sodium hydroxide and the mixture heated to 40° C. With constant stirring, 133 g. of nitroethyl acetate in 150 ml. of methanol was added slowly over a period of 30 minutes. After additional stirring for two hours at 40–45° C., two phases were observed to form. The mixture was then diluted with 2000 ml. methylene chloride and twice washed with water. The solvent was then removed by evaporation and the residue distilled at a pressure of 10 microns. The product boiled between 102 and 102.5° C. The yield of 1,3,3-trinitrobutane was 87 g.

The calculated composition for the empirical formula is: $C_4H_3N_3O_6$: Percent C, 24.88; percent H, 3.65; percent N, 21.76.

The ultimate analysis of the above compound showed: percent C, 25.27; percent H, 3.74; percent N, 21.65.

The index of refraction at 25° was 1.4760.

EXAMPLE II

Preparation of 1,3-dinitro-3-chlorobutane

This compound was prepared by placing in a three-necked flask, having a stirrer, dropping funnel and a reflux condenser, 750 ml. of water containing 44 g. of sodium hydroxide and cooling the solution to between 10 and 15° C. 110 g. of 1-chloro-1-nitroethane was added slowly to form the sodium salt thereof. The mixture was heated to between 30–35° C. and to the solution was added slowly 133 g. of nitroethyl acetate. The temperature was raised to 40–45° C. and was maintained at that point for one hour. At this stage, two phases were seen to form.

2500 ml. of methylene chloride was added to the mixture and the mixture washed twice with water. After drying the methylene chloride solution over sodium sulfate, the solvent was evaporated and the residue distilled at one micron at a temperature of between 80 and 90° C. in an air bath. 60 g. of 1,3-dinitro-3-chlorobutane was produced. The index of refraction for this compound n_D^{25} was 1.4723.

EXAMPLE III

Preparation of 1,3-dinitro-3-methylbutane

44 g. of sodium hydroxide was dissolved in 750 ml. of water. To this solution, 89 g. of 2-nitropropane was added after cooling the solution to 10 to 15° C. When the aci-sodium salt formation was complete, a solution of 13.3 of nitroethyl acetate and 250 ml. of methanol was added slowly at a temperature between 40–45° C.

United States Patent Office — 3,132,976 — Patented May 12, 1964

1

3,132,976
SOLID PROPELLANT COMPOSITIONS CONTAINING POLYURETHANE RESINS
Karl Klager, Richard D. Geckler, and Richard L. Parrette, Sacramento, Calif., assignors to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
No Drawing. Filed July 20, 1959, Ser. No. 829,182
17 Claims. (Cl. 149—19)

This invention relates to novel solid propellant compositions and in particular to novel propellant compositions comprising a polyurethane binder with a finely divided oxidizing agent dispersed therein.

Solid propellant compositions are ordinarily composed of a resin fuel and an oxidizing material, the oxidizing material being intimately dispersed in the fuel. The ignition and burning properties of such propellant compositions, as well as their physical properties, are dependent to a large extent upon the particular resins employed as fuels.

In the novel propellant compositions of this invention polyurethanes are used as the resin fuel component to produce propellants of unexpectedly superior physical properties and performance characteristics. Our novel polyurethane propellants have substantially no internal strains due to the fact that there is little shrinkage and low heat of reaction during polymerization of the polyurethane fuel component. This lack of internal strain is important in that it assures substantial freedom of the propellant grain from cracking during burning. As those skilled in the art realize, propellant cracking is highly undesirable and dangerous and can result in erratic burning or even explosion of the propellant grain.

In addition to their freedom from cracking, the polyurethane propellants of this invention are superior in other ways. For example, they are possessed of sufficiently tenacious adhesive properties to enable them to be bonded directly to the rocket chamber lining, thus permitting optimum utilization of the available space in the rocket motor and simplifying manufacturing techniques. The novel polyurethane propellants of our invention are also possessed of many other desirable physical properties for example: rubbery mechanical qualities, low brittle point, excellent resilience and superior aging properties.

Our novel solid propellants can be used as the primary propulsion source in rocket-propelled vehicles or as a propellant for artillery missiles. When used as the primary propulsion source for rocket vehicles, they can be conveniently ignited by a conventional igniter, as for example, the igniter disclosed in assignee's copending application Serial No. 306,030, filed August 23, 1952 now, Patent No. 3,000,312. The propellant is preferably cast directly in the rocket chamber in which it is to be fired and restricted on one or both ends in the conventional manner with a relatively slow burning inert resin, such as a polyurethane or a polyester resin. The restriction is preferably accomplished by applying a relatively thin coating of the inert resin to the inner surfaces of the rocket chamber lining prior to casting the propellant therein. Rocket chambers such as those in which our novel solid propellants are employed are ordinarily of the conventional type having one end open and leading into a venturi rocket nozzle. Upon ignition, large quantities of gases are produced and exhausted through the nozzle creating propulsive force.

The polyurethane binders of our invention are prepared by reacting a compound having two active hydrogen groups capable of reacting with an isocyanate with an organic compound having as the sole reacting groups, two isocyanate or isothiocyanate groups. The compound having the active hydrogen groups is preferably an or-

2

ganic compound having as the sole reacting groups, hydroxyl or thiol groups.

It will be appreciated that in any given batch of propellant the individual polyurethane molecules may vary in length from several to tens of thousands of repeating units, hence molecular weight figures on polyurethanes represent statistical averages. The exact nature of the terminal groupings is not known and will vary depending upon whether plasticizers, polymerization catalysts, etc., are present. Moreover a given molecule may even form a ring and thus leave no dangling radicals.

It is evident from the above that a wide variety of polyurethane binders for the propellants of this invention can be prepared simply by varying the particular isocyanate and hydroxy starting materials.

The isocyanate starting materials for our polyurethane binders are diisocyanate compounds which can be saturated or unsaturated; aliphatic or aromatic; open or closed chain; and, if the latter, monocyclic or polycyclic; and substituted or not by groups substantially unreactive with isocyanate or hydroxyl groups, such as, for example, ketone, halogen, ester, sulfide or ether groups. The following diisocyanate compounds are particularly suitable as reactant for the preparation of binders for our novel polyurethane propellants.

(*a*) Alkane diisocyanates such as:
Ethylene diisocyanate;
Trimethylene diisocyanate;
Propylene-1,2-diisocyanate;
Tetramethylene diisocyanate;
Butylene-1,3-diisocyanate;
Decamethylene diisocyanate;
Octadecamethylene diisocyanate;
etc.

(*b*) Alkene diisocyanates such as:
1-propylene-1,2-diisocyanate;
2-propylene-1,2-diisocyanate;
1-butylene-1,2-diisocyanate;
3-butylene-1,2-diisocyanate;
1-butylene-1,3-diisocyanate;
1-butylene-2,3-diisocyanate;
etc.

(*c*) Alkylidene diisocyanates such as:
Ethylidene diisocyanate;
Propylidene-1,1-diisocyanate;
Propylidene-2,2-diisocyanate;
etc.

(*d*) Cycloalkylene diisocyanates such as:
Cyclopentylene-1,3-diisocyanate;
Cyclohexylene-1,2-diisocyanate;
Cyclohexylene-1,3-diisocyanate;
Cyclohexylene-1,4-diisocyanate;
etc.

(*e*) Cycloalkylidene diisocyanates such as:
Cyclopentylidene diisocyanates;
Cyclohexylidene diisocyanate;
etc.

(*f*) Aromatic diisocyanates such as:
m-Phenylene diisocyanate;
o-Phenylene diisocyanate;
p-Phenylene diisocyanate;
1-methyl-2,4-phenylene diisocyanate;
Naphthylene-1,4-diisocyanate;
Diphenylene-4,4'-diisocyanate;
2,4-tolylene diisocyanate;
2,6-tolylene diisocyanate;
4,4'-diphenylmethane diisocyanate;
1,5-naphthalene diisocyanate;
Methylene-bis-(4-phenylisocyanate);
2,2-propylene-bis-(4-phenylisocyanate);
Xylene-1,4-diisocyanate;

United States Patent Office — 3,245,849 — Patented Apr. 12, 1966

1

3,245,849
SOLID PROPELLANT COMPOSITIONS CONTAINING POLYURETHANE RESINS OF LOW CURE TEMPERATURE
Karl Klager, Richard D. Geckler, and Richard L. Parrette, Sacramento, Calif., assignors to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
No Drawing. Filed July 20, 1959, Ser. No. 829,180
32 Claims. (Cl. 149—19)

This invention relates to novel solid propellant compositions and in particular to novel propellant compositions comprising a cross-linked polyurethane binder with a finely divided oxidizing agent dispersed therein.

Solid propellant compositions are ordinarily composed of a resin fuel and an oxidizing material, the oxidizing material being intimately dispersed in the fuel. The ignition and burning properties of such propellant compositions, as well as their physical properties, are dependent to a large extent upon the particular resins employed as fuels.

In the novel propellant compositions of this invention, cross-linked polyurethanes are used as the resin fuel component to produce propellants of unexpectedly superior physical properties and performance characteristics.

The novel polyurethane propellants of our invention can be cured at low cure temperatures and in addition exhibit no measurable heat of reaction. As a result of these unique properties they are not subject to shrinkage and have no internal strains. Composite propellant systems heretofore used have all been severely restricted in their use because of high heats of reaction and the need for high cure temperatures which produce shrinkage and internal stresses. These faults have heretofore imposed severe restrictions upon the size of solid propellant motors because of their tendency toward cracking as a result of internal strains. We have produced a propellant which constitutes a major breakthrough in rocket technology in that solid propellant motors are no longer subject to size limitations and can be manufactured in sizes as large as desired using the novel propellant compositions of our invention.

In addition to their freedom from cracking, the polyurethane propellants of this invention are superior in other ways. For example, they are possessed of sufficiently tenacious adhesive properties to enable them to be bonded directly to the rocket chamber lining, thus permitting optimum utilization of the available space in the rocket motor and simplifying manufacturing techniques. The novel polyurethane propellants of our invention are also possessed of many other desirable physical properties, for example: rubbery mechanical qualities, low brittle point, excellent resilience, and superior aging properties.

Our novel solid propellants can be used as the primary propulsion source in rocket-propelled vehicles or as a propellant for artillery missiles. When used as the primary propulsion source for rocket vehicles, they can be conveniently ignited by a conventional igniter, as for example, the igniter disclosed in assignee's copending patent application Serial No. 306,030, filed August 23, 1952. The propellant is preferably cast directly in the rocket chamber in which it is to be fired and restricted on one or both ends in the conventional manner with a relatively slow burning inert resin, such as a polyurethane or a polyester resin. The restriction is preferably accomplished by applying a relatively thin coating of the inert resin to the inner surfaces of the rocket chamber lining prior to casting the propellant therein. Rocket chambers such as those in which our novel solid propellants are employed are ordinarily of the conventional type having one end open and leading into a venturi rocket nozzle. Upon ignition, large quantities of gases are produced

2

and exhausted through the nozzle creating propulsive force.

The polyurethane binders of our invention are prepared by reacting a compound having two or more active hydrogen groups capable of polymerized with an isocyanate, with an organic compound having as the sole reacting groups, two or more isocyanate or isothiocyanate groups. The compound having the active hydrogen groups is preferably an organic compound having as its sole reacting groups, hydroxyl or thiol groups.

It will be apparent that, where there are more than two active hydrogen, isocyanate, or isothiocyanate groups present on any of the polyurethane reactions, the resulting molecular structure of the polyurethane binder will be at least to a certain extent of a cross-linked rather than a linear nature. The cross-linking is accomplished when all three functional groups of a sufficient number of the trifunctional molecules undergo the urethane reaction with other groups present in the mixture, thus resulting in a product having a "three-dimensional" molecular structure rather than mere aggregates of linear chains as is the case when bifunctional reactants are employed.

Where bifunctional reactants, such as dihydroxy compounds and diisocyanates, are employed to produce the polyurethane binders for our novel propellants, it is necessary to also employ a "cross-linking" agent to assure a product having the cross-linked structure essential to this invention. Cross-linking agents can also be used with polyurethane reactants having more than two functional groups, such as triols and/or triisocyanates, within the scope of this invention. Compounds suitable as cross-linking agents for our polyurethane binders are those organic compounds having as the sole reacting groups three or more groups polymerizable with hydroxy or isocyanate groups.

It will be appreciated that in any given batch of propellant the individual polyurethane molecules may vary in number of repeating units from several to tens of thousands of these units, hence molecular weight figures on polyurethanes represent statistical averages. The exact nature of terminal groupings is not known and will vary depending upon whether plasticizers, polymerization catalysts, etc., are present. Moreover, a given molecule may even form a ring and thus leave no dangling radicals.

It is evident from the above that a wide variety of polyurethane binders for the propellants of this invention can be prepared by varying the particular isocyanate and hydroxy starting materials.

The isocyanate starting materials for our polyurethane binders are preferably diisocyanates but not necessarily so since, as explained above, other polyisocyanates (such as triisocyanates) or polyisothiocyanates may be employed within the scope of the invention if desired.

Our preferred diisocyanate compounds can be saturated or unsaturated; aliphatic or aromatic; open or closed chain, and, if the latter, monocyclic or polycyclic; and substituted or not by groups substantially unreactive with isocyanate or hydroxyl groups such as, for example, ketone, halogen, ester, sulfide, or ether groups. The following diisocyanate compounds are particularly suitable as reactants for the preparation of binders for our novel polyurethane propellants:

(a) Alkane diisocyanates, such as:

Ethylene diisocyanate;
Trimethylene diisocyanate;
Propylene-1,2-diisocyanate;
Tetramethylene diisocyanate;
Butylene-1,3-diisocyanate;
Decamethylene diisocyanate;
Octodecamethylene diisocyanate;
etc.

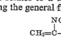
United States Patent Office — 3,187,053 — Patented June 1, 1965

1

3,187,053
4-NITRO-4-PENTENAL
Karl Klager, Sacramento, Calif., assignor to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
No Drawing. Filed Dec. 21, 1959, Ser. No. 861,138
1 Claim. (Cl. 260—601)

This application is a continuation-in-part of my copending application Serial No. 387,023, filed October 19, 1953 and now abandoned, which was a continuation-in-part of application Serial No. 235,569, filed July 6, 1951, and now abandoned.

This invention relates to a novel method of preparing nitroolefins having the general formula

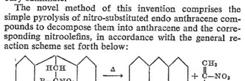


wherein R is an alkyl, halogen, ω-carboxyalkyl, ω-acyloxyalkyl, ω-carboalkoxyalkyl, cyanoalkyl, or ω-formylalkyl radical, and to nitroolefins prepared thereby.

The nitroolefins prepared by the method of this invention in which R is an ω-acyloxyalkyl radical, such as nitroallyl acetate, readily condense with nitro compounds having a labile hydrogen function, such as methyl 4,4-dinitrobutyrate, to form highly nitrated compounds, such as dimethyl 4,4,6,8,8-pentanitro-1,11-undecanedioate, useful as high explosives. A more complete description of this process can be found in my copending application Serial No. 636,839, filed January 28, 1957 and now Patent No. 3,000,932. In addition, all of the nitroolefins prepared by the method of this invention undergo an addition reaction with polynitro compounds having a labile hydrogen function, such as 2,2,4,4-tetranitrobutyl acetate, to form highly nitrated compounds useful as high explosives. 2,2,4,4-tetranitrobutyl acetate is disclosed in assignee's copending application Serial No. 617,667, filed October 22, 1956 and now Patent No. 2,978,455. The addition reaction is conducted according to the method set forth in copending application Serial No. 636,839.

The highly nitrated compounds obtained by the above-described methods are useful as high explosives and can be used in any conventional explosive missile, projectile, rocket, or the like, as the main explosive charge. An example of such a missile is disclosed in United States Patent 2,470,162, issued May 17, 1949. One way of using the high explosives of this invention in a device such as that disclosed in United States Patent 2,470,162 is to pack the crystalline explosive in powder form into the warhead of the missile. Alternatively, the crystals can be first pelletized and then packed. A charge thus prepared is sufficiently insensitive to withstand the shock entailed on the ejection of a shell from a gun barrel or from a rocket launching tube under the pressure developed from ignition of a propellant charge, and can be caused to explode on operation of an impactor time-fuse mechanism firing a detonating explosive such as lead azide or mercury fulminate.

The novel method of this invention comprises the simple pyrolysis of nitro-substituted endo anthracene compounds to decompose them into anthracene and the corresponding nitroolefins, in accordance with the general reaction scheme set forth below:



wherein R is as defined above.

The pyrolysis is preferably conducted under a vacuum so as to avoid the possibility of undesirable oxidation. The heat, as may be seen above, breaks the nitroolefin-

2

anthracene bonds to yield anthracene and the desired nitroolefins.

The following examples are provided to more clearly illustrate my invention. It should be understood, however, that these examples are provided purely for purposes of illustration and are not intended to limit the scope of the invention in any way.

EXAMPLE I

Preparation of methyl-4-nitro-4-pentenoate

One part of 11-(2-carbomethoxyethyl)-11-nitro-9,10-ethanoanthracene was heated in vacuum at 21 mm. to 185–200° C. A slightly yellow colored liquid was distilled and condensed in a receiver. The weight was 0.28 part of the starting material. At 230–240° C., at the same pressure, 0.62 gm. solid material distilled which was identified as anthracene (M.P. 215° C., mixed melting point 215° C.). The first fraction was redistilled at 96° C. and 4 mm. The analysis indicated that methyl-4-nitro-4-pentenoate was formed, n_D^{24}=1.4612.

EXAMPLE II

Preparation of nitroallyl acetate

A bulb tube charged with 1 gm. 11-acetoxymethyl-11-nitro-9,10-ethanoanthracene, prepared by acetylation of 11-methylol-11-nitro-9,10-ethanoanthracene with acetic anhydride, M.P. 103–105° C., was heated to 200–220° C. at 29 mm. in an airbath. Decomposition was observed and a greenish-yellow liquid distilled, accompanied by crystals. After redistillation at 90–120° C. airbath temperature and 5 mm. the light-yellow liquid (0.1 gm.) gave the following analysis for nitroallyl acetate:

Analysis.—Calc'd for $C_5H_7O_4N$: percent C, 41.38; percent H, 4.86; percent N, 9.65. Found: percent C, 41.53; percent H, 5.45; percent N, 8.83.

The anthracene fraction was purified by crystallization from tetrahydrofuran and methanol. The melting point and mixed melting point with pure anthracene were 214–216° C.

EXAMPLE III

Preparation of 4-nitro-4-pentenonitrile

A bulb tube was filled with 0.8 gm. 11-(2-cyanoethyl)-11-nitro-9,10-ethanoanthracene and heated to 195–200° C. at 28 mm. A yellow liquid and crystals distilled. The distillate was dissolved in ether and filtered from the insoluble anthracene. The extract was evaporated and distilled at 120° C. airbath temperature and 5 mm. producing a greenish-yellow liquid with a refractive index, n_D^{22} 1.4735.

Analysis.—Calc'd for $C_5H_6O_2N_2$: percent C, 47.61; percent H, 4.80; percent N, 22.22. Found: percent C, 47.97; percent H, 4.94; percent N, 22.62.

The ether insoluble portion was crude anthracene. It was dissolved in tetrahydrofuran and methanol was added. After two recrystallizations the melting point was 213–214° C. and the mixed melting point with anthracene (M.P. 214–216° C.) was 214–216° C.

It will be apparent that any nitroolefin within the scope of the general formula given above can be prepared by heating the corresponding nitro-substituted 9,10-ethanoanthracene in the manner described in the above examples. For example, 2-nitro-1-butene; 2-nitro-1-hexene; 2-nitropropylene; 1-chloro-1-nitroethylene; 1-bromo-1-nitroethylene; 1-fluoro-1-nitroethylene; ethyl-4-nitro-4-pentenoate; methyl-2-methyl-3-nitro-3-butenoate; 4-nitro-pentenoic acid; and 4-nitro-4-pentenal can be prepared by heating 11-ethyl-11-nitro-9,10-ethanoanthracene; 11-butyl-11-nitro-9,10 - ethanoanthracene; 11-methyl-11-nitro-9,10-ethanoanthracene; 11-chloro-11-nitro-9,10 - ethanoanthracene; 11-bromo-11-nitro-9,10-ethanoanthracene; 11-fluoro-

PATENT SPECIFICATION

NO DRAWINGS

974,805

974,805

Inventor: KARL KLAGER

Date of Application and filing Complete Specification: April 5, 1961.

No. 12241/61.

Complete Specification Published: Nov. 11, 1964.

Index at acceptance:—C2 C (1F3C3, 1F3D1, 2B29)

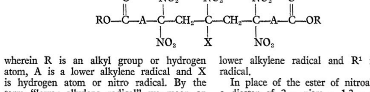
International Classification:—C 07 c

COMPLETE SPECIFICATION

Polynitro-Substituted Dibasic Acids and Esters

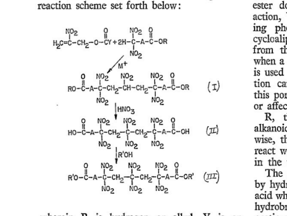
We, AEROJET-GENERAL CORPORATION, a corporation duly organized and existing under the laws of the State of Ohio, United States of America, of 6352 North Irwindale Avenue, Azusa, State of California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to new compounds, and in particular, to polynitro-substituted dibasic acids and esters thereof having the general formula:



wherein R is an alkyl group or hydrogen atom, A is a lower alkylene radical and X is hydrogen atom or nitro radical. By the term "lower alkylene radical" we mean an alkylene radical having from 1 to 4 carbon atoms.

The new compounds of this invention are prepared by condensing esters of nitroallyl alcohol with ω,ω-dinitroalkanoic acids or esters thereof, and in accordance with the general reaction scheme set forth below:



wherein R is hydrogen or alkyl, Y is an organic radical, preferably alkyl, M is an ion of an alkali or alkaline earth metal, A is a lower alkylene radical and R¹ is an alkyl radical.

[Price 4s. 6d.]

In place of the ester of nitroallyl alcohol, a diester of 2 - nitro - 1,3 - propanediol can be used, as for example, 2 - nitro - 1,3-diacetoxypropane. It is believed that the diester generates the nitroallyl alcohol ester *in situ* and then reacts in the manner illustrated above.

Since the acid portion of the nitroallyl ester does not enter into or affect the reaction, Y can be any organic radical including phenyl, benzyl, heterocyclic, aliphatic, cycloaliphatic, or the like, without departing from the scope of the invention. Similarly, when a diester of 2 - nitro - 1,3 - propanediol is used as the starting material, the acid portion can be any organic acid inasmuch as this portion of the diester does not enter into or affect the reaction in any way.

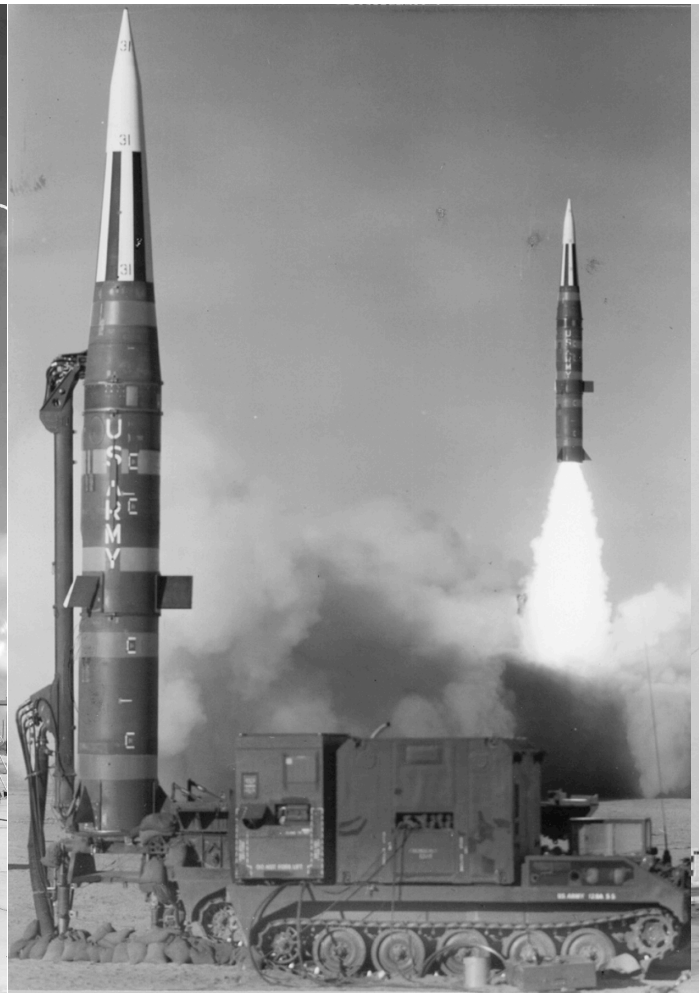
R, the alcohol portion of the dinitroalkanoic acid ester is an alkyl radical. Likewise, the dibasic acids of this invention will react with any organic alcohol to form esters in the usual manner.

The corresponding dibasic acid is prepared by hydrolysis of the alkyl ester with a strong acid which is sulphuric acid, hydrochloric acid, hydrobromic acid, phosphoric acid, trifluoroacetic acid or mixtures thereof in the conventional manner. The reaction of compound (I) with nitric acid produces the hexanitro deriva-

German Solid Propellant Rocket Technologies Were Used by the United States

U.S. Navy Polaris A-1
solid propellant rocket engines
developed at Aerojet
(first flight 1958)

U.S. Army Pershing 1
solid propellant rocket engines
developed at Redstone & Thiokol
(first flight 1960)



U.S. Air Force Minuteman I
solid propellant rocket engines
developed at Aerojet & Thiokol
(first flight 1961)

For more information, see *Forgotten Creators* 9.8 and E.4