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Germany's Sources of Fuels Before and During World War II plus German use of War Horses

Presentation to WW II veterans and widows

Jewish Community Center with guests

Beachwood, OH January 5, 2015

Re-presented at Cornell University March 6, 2015

Hosts: Captain James E. Horten, Commander NROTC

Prof Andrew Hunter, Industrial Practitioner, Chem Eng

Blitzkrieg concurrent with War Horses

- Wehrmacht armored and motorized infantry - 16% land forces
- WW I precedent - Mobilization six weeks, mostly horses
- Horses used in Operation Barbarossa to invade Russia - 700,000
- Horses planned for Operation Seal Lion to invade UK - 57,000

Horses drawing German Artillery -1

A leFH18 10.5cm Howitzer being pulled by a horse limber
from http://www.flamesofwar.com/hobby.aspx?art_id=2486

Horses Drawing German Artillery-2

A leFH18 10.5cm Howitzer, limber and horse team cross a pontoon bridge from http://www.flamesofwar.com/hobby.aspx?art_id=2486

German Horse Numbers

- *For Operation Barbarossa (to Moscow)*
- *the Germans amassed*
- *3 million men, 600,000 vehicles, 3350 tanks and 2000 aircraft*
- *and 750,000 horses.*
- *At 6 kg/day feed, 4500 tonnes feed per day; slowed advance*
- *As the German Army drove deeper into Russia many vehicles broke down it became steadily less motorized.*

Rasputitsa - Sea of Mud

- In 1812 Napoleon found the Sea of Mud to be great hindrance
- German interleaved-wheel system innovative, but no match for the deep mud of Rasputitsa
- Horses better in mud, but overmatched by heavy loads

Rasputitsa - Sea of Mud

Bundesarchiv, Bild 146-1981-149-34A
Foto: o.Ang. | November 1941

Rasputitsa– Sea of Mud

Horses in Russia -3

German horses stuck in Rasputitsa from http://en.wikipedia.org/wiki/Horses_in_World_War_II

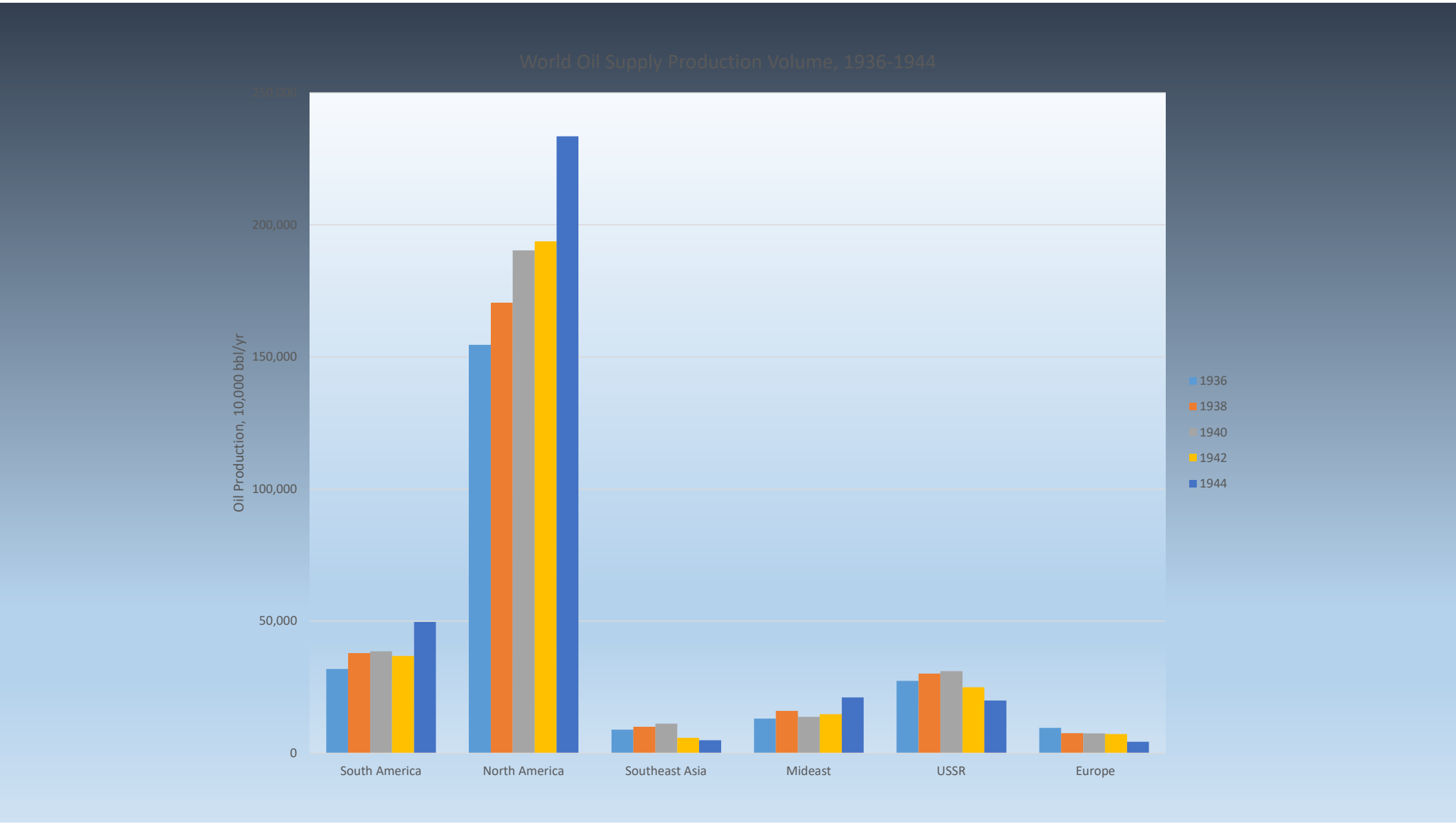
Battle of Stalingrad

- *In Demyansk Pocket couth of Leningrad Feb-April 1942*
- *20,000 horses trapped with 95,000 men*
- *"axe rebounds as a stone from a frozen horse corpse“*

- *In Battle of Stalingrad August 1942-Febraury 1943*
- *In urban battle, horses sent to rear*
- *German 6th army is encircled, no horse transport to move artillery*
- Artillery loss key to Soviet encirclement and loss of 6th Army

World Oil Supply by Region - 1

- South America:
  - Argentina, Bolivia, Colombia, Ecuador, Peru, Trinidad &Tobago, Venezuela
- North America:
  - Canada, Mexico, United States
- Southeast Asia:
  - Burma, Brunei, China, Japan, India, Indonesia, Sarawak
- Mideast:
  - Bahrein, Egypt, Iran, Iraq, Kuwait, Saudi Arabia
- Union of Soviet Socialist Republics
  - Russia, Belarus, Ukraine, Kazahkstan, Azerbaijan, others
- Europe:
  - Germany, Hungary, Poland, Romania


World Oil Supply Production Volume, 1936-1944
Oil Production, 10,000 bbl/yr
250,000
200,000
150,000
100,000
50,000
0
South America
North America
Southeast Asia
Mideast
USSR
Europe
1936
1938
1940
1942
1944

Wood-Fueled Vehicles World War II

- Producer gas from wood + limited air at > 1100 F
- 'Producer Gas' Vehicles used in Northern Europe
- Trucks, buses, tractors and few ships and trains
- Sweden Denmark France had 150,000 woodmobiles in 1943
- Finland had 30,000 buses and trucks, 7,000 cars, 4,000 tractors & 600 boats in 1944 – all wood powered

Title: German wood-fueled Vehicles

Bundesarchiv, Bild 183-V00670A
Foto: o.Ang. | 1946

Bundesarchiv, Bild 183-V00670
Foto: o.Ang. | 1946

http://dev.energybulletin.net/node/51237

The Fight for Baku Oil -1

- Baku Azerbaijan was cradle of Soviet oil industry
- 22.2 million tonnes in 1940 was 70% of Soviet oil production
- Maikop (further west) was 7% of total oil production
- Distances: Moscow to Baku - 1190 miles
- Berlin to Baku - 1890 miles
- Rostov-on-Don to Baku - 694 miles
- The German Army captures Rostov late July 1942

Hitler wanted Baku Oil

- Hitler determined to capture Caucasus oil fields
- Grozny, Russia, Maikop, Chechyna, and Baku, Azerbaijan
- Operation Edelweiss to cross Caucasus mountain range
- Countering Allied plan to bomb Baku oilfields using French warplanes based in Syria
- Strategy "Basic Strategies of the War" January 23, 1940
- demolishing Baku's oil fields would be "a knock-out" for the Soviets

Hitler Military push toward Baku

- The Germans capture Rostov-on-Don late July 1942
- The German capture Maikop oil center August 1942
- Plan to capture Stalingrad, unite with Caucasus, sweep into Iran/Iraq
- Two fronts; Stalingrad and Caucasus, spread forces too thin
- The German Sixth Army is captured at Stalingrad
- Stalingrad is first major defeat for German Wehrmacht
- Sign to senior German Commanders that war could not be won

Hitler's Failure to Damage Soviet Oil Production in August 1942

- Joel Hayward in Journal Military History July 2009

- Dual attack on Stalingrad and Caucasus Oil split German forces
- Hitler ordered saturation bombing of Stalingrad
- Bombing of Maikop and Grozny in October 1942
  - Combine these two sources were 10% Soviet oil production
- Baku Azerbaijan was unrealistic target for land attack
  - Baku was 90% of Soviet oil production
- German vs. Russian balance of air power in August 1942 would have allowed Germany to severely damage Baku oil

Implied lessons from Hitler's failure

- Hitler over-confident from the blitzkrieg conquest of France
- Hermann Goering was inept head of German economic planning
- Hitler consistently over-ruled competent field and air marshals
- Soviet Counter-attack started Dec 5, 1941 at Moscow
- German Sixth Army loss at Stalingrad started German defeat
- Hitler's command doomed German men and war material;
- In effect his own worst enemy

Inside the Third Reich by Albert Speer

- 1939 Treaty with USSR had fuel as objective
  - Germany received 4 million gallons in 1940 and 1941 from USSR
- Comments on aerial bombing by US. 8th Air Force
  - May 19, 1944 The enemy has struck at our weakest point; If they persist we will not have any fuel worth mentioning
  - June 24, 1944 The allies staged a new series of attacks which put many fuel plants out of action. In June 22 raid, nine-tenths of production of airplane fuel was knocked out
  - July 28, 1944 I implored Hitler to reserve a significantly larger part of fighter planes to protecting the home hydrogenation plants
  - November 10, 1944. The army had become virtually immobile because of the fuel shortage.
  - Result: Dec 16, 1944 German offensive main objective is Allied fuel depots; known to Americans as the "Battle of the Bulge"

German Synthetic Fuels Efforts

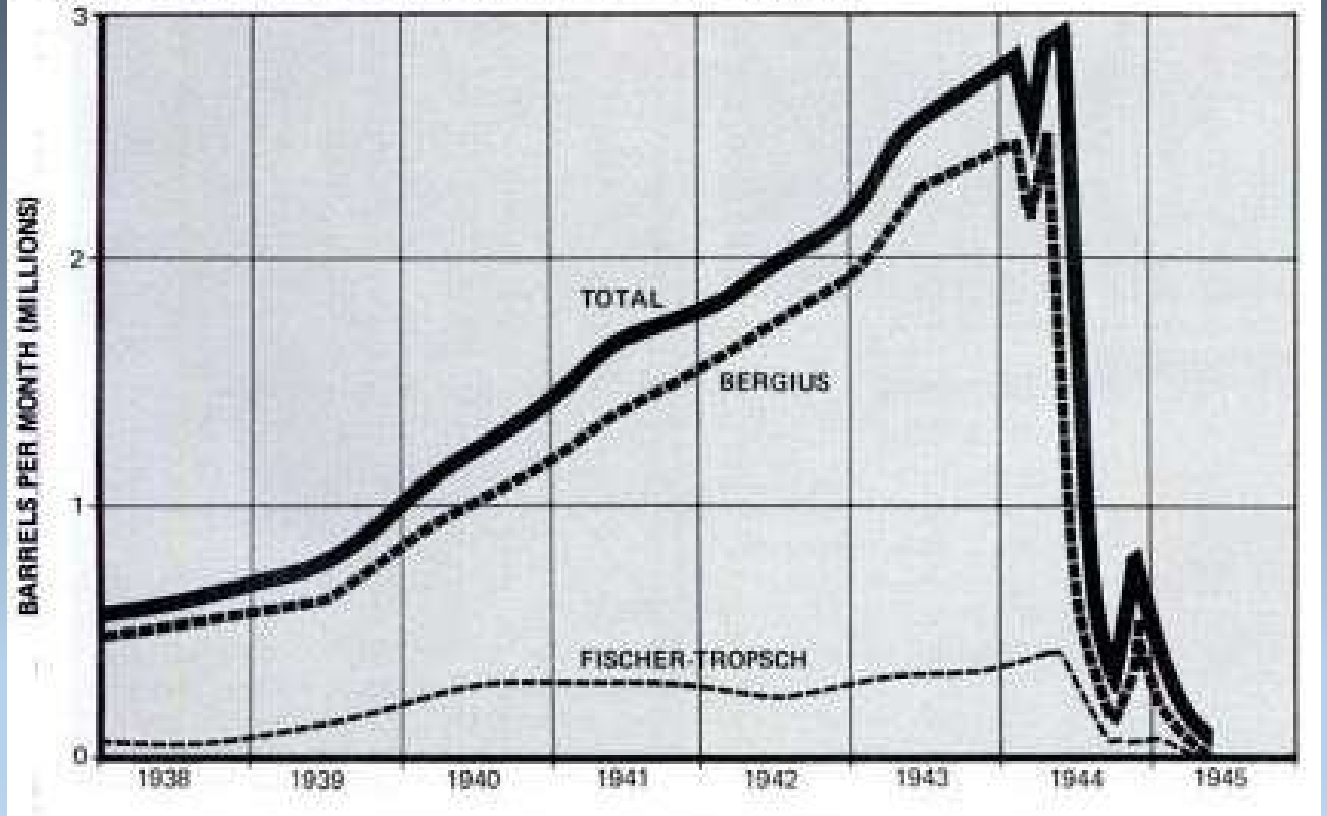
- German scientists and engineers invented and developed two processes that enabled them to synthesize petroleum from their country's abundant coal supplies and to establish the world's first technologically successful synthetic liquid fuel industry.
- Friedrich Bergius (1884-1949) in Rheinau-Mannheim began the German drive for energy independence with his invention and early development of high-pressure coal hydrogenation or liquefaction in the years 1910-25.
- A decade after Bergius began his work Franz Fischer (1877-1947) and Hans Tropsch (1889-1935) at the Kaiser-Wilhelm Institute for Coal Research (KWI) in Mülheim, Ruhr, in 1923 invented a second process for the synthesis of liquid fuel from coal.
  (Now known as the Fischer-Tropsch process.)

Comparison of Bergius and F-T Processes

- Coal Liquefaction (Bergius process) was more advanced and produced the bulk of the synthetic fuel used by Germany.
  - Also known as coal hydrogenation
  - 12 plants constructed
  - Produced aviation and motor gasoline (high octane with high aromatics content)
- Fischer-Tropsch Synthesis produced about 10% of the volume produced by the Bergius process
  - Coal Gasification to CO/H2 followed by hydrocarbon synthesis
  - Produced predominantly diesel fuel
  - Also waxes and lubricating oils (much like PAO)
  - Low octant gasoline produced, but could be blended with coal hydrogenation stocks
  - Some F-T wax oxidized into fatty acids and used as margarine substitute

Fischer-Tropsch Plants						
Plant	Location	Raw Material	Production, 1944	Products	Pressure, atm.	Started Operation
Ruhrbenzin AG	Oberhausen-Holten, Ruhr	Bituminous	62,200	motor fuel, Lube oil	Normal, Medium	1937
Steinkohen-Bergwerk Reinpreussen	Moers-Meerbeck, Homberg, Heiderrhein	bituminous	19700	gasoline, diesel, wax, oils for fatty acids	Normal, Medium	1936
Gewerkschaft Viktor, Klocknerwerke-wintershall AG	Castrop-Rauxel, Ruhr	bituminous	40380	primarly oils	Normal, Medium	1936
Braunkkohle-Benzin AG Brabag	Ruhland-Schwartzheide (North of Dresden)	Lignite	158500	Primarly oils	normal	1937
Mitteldeutsche Treibstoff und Ol Werke	Lutzkendorf-Muchein	Lignite	29320	primarly oils	normal	1938
Krupp Treibstoffwerk	Wanne-Eickel, Ruhr		39802	primarly oils	Normal, Medium	1938 (late)
Chemische Werke Essener Steinkohle AG	Kamen-Dortmund, Ruhr	Bituminous	86580	primarly oils	normal	1939
Hoesch-Benzin GmbH	Dortmund, Ruhr	Bituminous	51000	primarly oils	medium	March, 1939
Schaffgotsch Benzin GmbH	Deschowitz-Beuthen Odertal (Upper Silesia)	Lignite	39200	primarily oils	medium	1941
Total Production			526,682			

Production of synthetic fuel increased slowly in the '30s, but then showed a marked rise at the start of WW II. A peak production of nearly 3 million barrels per month was reached in 1944 before plants were captured or destroyed by Allies.



GERMAN SYNTHETIC FUEL PRODUCTION DURING WW II

Synthetic Fuels Plants Targets of Aerial Bombing

- Major part of aerial bombing campaigns was to destroy fuel production capabilities of Germany

*Aerial photography showing damage to the **Fischer-Tropsch** synthetic oil **plant***

Ground level photograph of damage to synthetic fuels plant

German Synthetic Fuel Plant
Synthetic fuel plant in Germany after being bombed during WWII. (source: Fischer-Tropsch Archive)

German Fuel Situation - Pre-World War II

German Fuel Source	Million Barrels (Annually	Barrels/day
Domestic Oil Production	3.8	10,411
Synthetic Fuel Production	9	24,658
Import from Overseas	28	76,712
Import Overland--Europe	3.8	10,411
Total	44.6	122,192

German Fuel stockpile pre-WWII was only 15 mm bbls, a 4 month supply.

Observations on Germany's Synthetic Fuels Efforts and Fuel Supply

- Germany was critically short of fuel resources before and during WWII
- Allies bombed fuel production facilities, but with little effect and less dedication
  - British Strategy (Sir Arthur Harris):
    - The ultimate aim of an attack on a town area is to break the morale of the population which occupies it. To ensure this, we must achieve two things: first, we must make the town physically uninhabitable and, secondly, we must make the people conscious of constant personal danger. The immediate aim, is therefore, twofold, namely, to produce (i) destruction and (ii) fear of death.
  - Other targets were deemed more important than fuel
    - Aircraft production and ball bearing plants
    - Transportation infrastructure
    - Hydroelectric power production
    - U-Boat Production and Naval Yards
    - Housing

Question re Bombing of Romanian Oil Refineries

Air Raid on Ploesti Oil Refineries 1

- Romania major oil producer and refinery since 1900
- In 1943 Ploesti supplied 35% of Axis Fuel
- Halverson Project June 1942 18 B-24s attacked Ploesti
- caused small damage but large response in air defense
- About 400 88 mm guns and FlaK 38 anti-aircraft guns
- Luftwaffe 3 fighter groups; 52 Bf 109 fighters, Bf 110 night fighters
- and Romanian IAR-80 fighters

Operation Tidal Wave August 1, 1943

- Multiple air groups launched from Benghazi, Libya
- Heavy fuel/bomb load in climb over Pindus Mountains
- Total 177 B24 bombers in five air groups
- Last group knocked out Steaua Română refinery
- Other refineries quickly repaired, increasing fuels by September
- Only 88 B24s returned, 310 airmen killed
- Strategic failure against strong defense; not repeated
- Five Congressional Medals of Honor awarded, 3 posthumously

The Bomber Will Always Get Through

- In speech "A Fear for the Future" to British Parliament in 1932
- Stanley Baldwin said "The bomber will always get through"
- Hugh Dowding led RAF Fighter Command during the Battle of Britain;
- Coastal watch + Radar + Merlin-powered Hurricane and Spitfires cancelled daytime flights in the Blitz of London, night bombing inaccurate
- Ploesti were complete refutation of unaccompanied bombers; 8th air force bombers with P51B escorts successful in late 1943 over Germany
- Supercharged Merlin engine with 100 octane gasoline was performance match for Messerschmitt bf109 using fuel-injected distillate fuels
- P51B 1943 Mustang 1650 HP at Western Reserve Historical Society

P-51 B over Germany

Flown by Lt. Donald McDowell,
*missing in action **over** North Sea*