

GERMANY'S SYNTHETIC FUEL INDUSTRIES

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Abstract

Germany's Synthetic Fuel Industry 1930-1945 Abstract

Petroleum was clearly the fuel of the future, and to insure that Germany would never lack a plentiful supply, German scientists and engineers synthesized petroleum from their country's abundant coal supplies and thereby established the world's first technologically successful synthetic fuels industry. Of the several conversion processes the Germans developed, high-pressure coal hydrogenation or liquefaction and the Fischer-Tropsch synthesis (F-T) were the most advanced. Friedrich Bergius (1884-1949) launched the German program for energy independence with the invention of high-pressure coal hydrogenation in the years 1910-25. Franz Fischer (1877-1947) and Hans Tropsch broadened it with the gaseous synthesis of liquid fuels in the mid-1920s. IG Farben, Ruhrchemie, and others industrialized the German energy program with their development of the Bergius process and Fischer-Tropsch synthesis from the 1920s to the end of World War II. This paper examines Germany's industrialization of the two synthetic fuel processes, analyzing their growth over several decades of social, political, and economic unrest.

Overview

SYNTHETIC FUELS IN GERMANY OVERVIEW 1911-1945

For the Fischer-Tropsch process the research and development falls into two divisions

<i>PERIOD</i>	<i>ACTIVITY</i>
1922-1935	Laboratory research and pilot plant development
1936-1945	Industrial-size development, with most of the development occurring prior to World War II

For high-pressure coal hydrogenation the research and development falls into four divisions

<i>PERIOD</i>	<i>ACTIVITY</i>
1911-1920	Friedrich Bergius, laboratory research and pilot plant development BASF-IG FARBEN laboratory research and pilot plant development
1920-1933	BASF-IG FARBEN research and development at Ludwigshafen and Leuna, most important breakthroughs occur such as introduction of two-phase conversion and sulfur resistant catalysts
1933-1939	IG FARBEN use of 700 atm pressure (1936) first hydrogenation of bituminous coal (1936) new hydrogenation companies established seven plants constructed
1933-1939	New steel alloys introduced Both research and development continue
1939-1945	Five plants constructed, mainly a period of development not much research other than on catalysts

German Outline

GERMANY'S SYNTHETIC FUEL INDUSTRY

- I. Introduction
- II. Franz Fischer Biographical
- III. Origin of F-T Process
- IV. World War I
- V. Organization of the Fuel Industry Between the Wars
 1. Germany's Energy Plan 1930s to 1940s
 - Tariffs 1930-31 December 1936
 - Regulatory Boards 1931-39
 - Fuel Agreement, 14 December 1933
 - WIFO, 24 August 1934
 - Brabag, 26 October 1934
 - Four year plan, 9 September 1936
 2. Construction of F-T plants (8 plants completed, 1 more in operation in 1941)
- VI. World War II Development on Converters
- VII. Economics of Synthetic Fuel Production
- VII. Conclusion

Franz Fischer (1877-1947)



Franz Fischer (1877-1947)



**Professor Dr. Franz Fischer, Geh. Reg.-Rat
(Direktor des Instituts von der Gründung bis heute)**

Hans Tropsch (1889-1935)



**Dr.-Ing. Hans Tropsch,
Abteilungsleiter von 1921—1928
(am Institut tätig von 1916—1917 und 1921—1928)**

Helmut Pichler

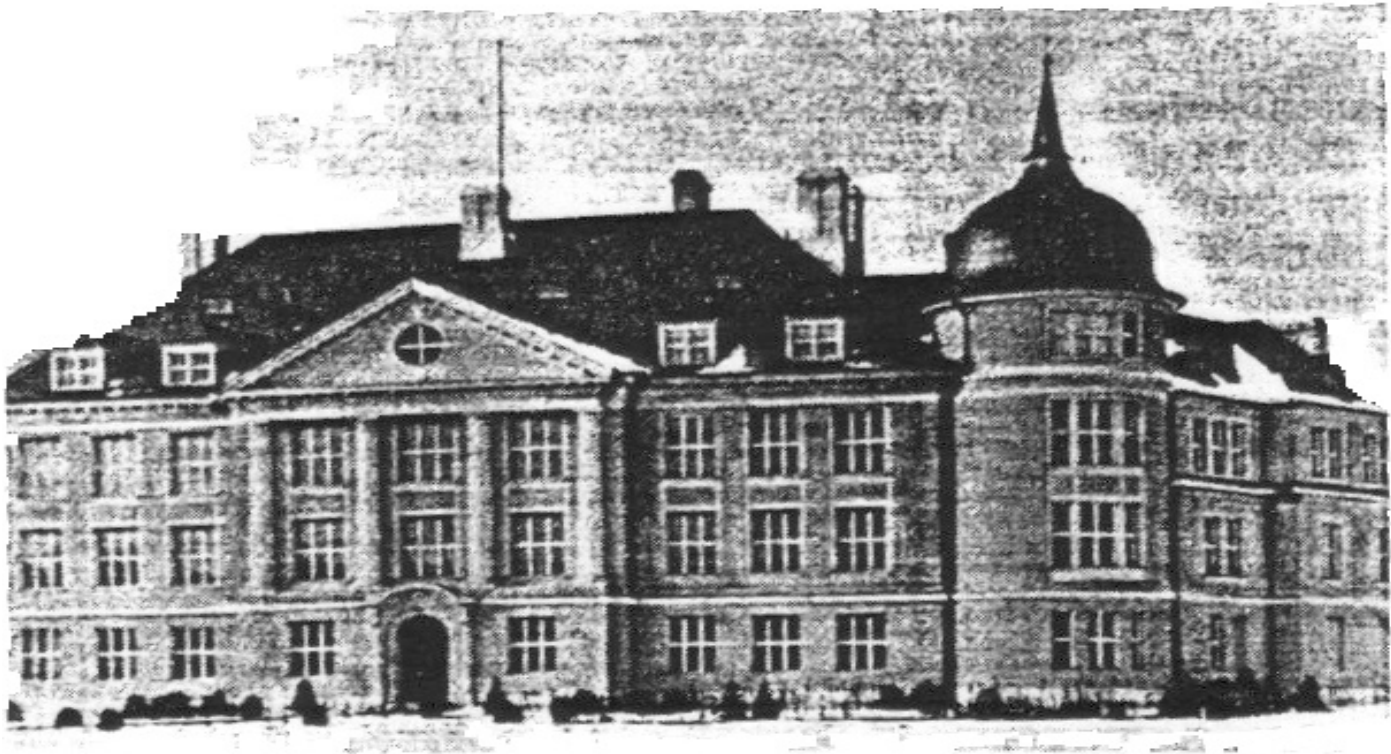


Dr. phil. Helmut Pichler, Abteilungsleiter seit 1936
(am Institut tätig seit 1927)

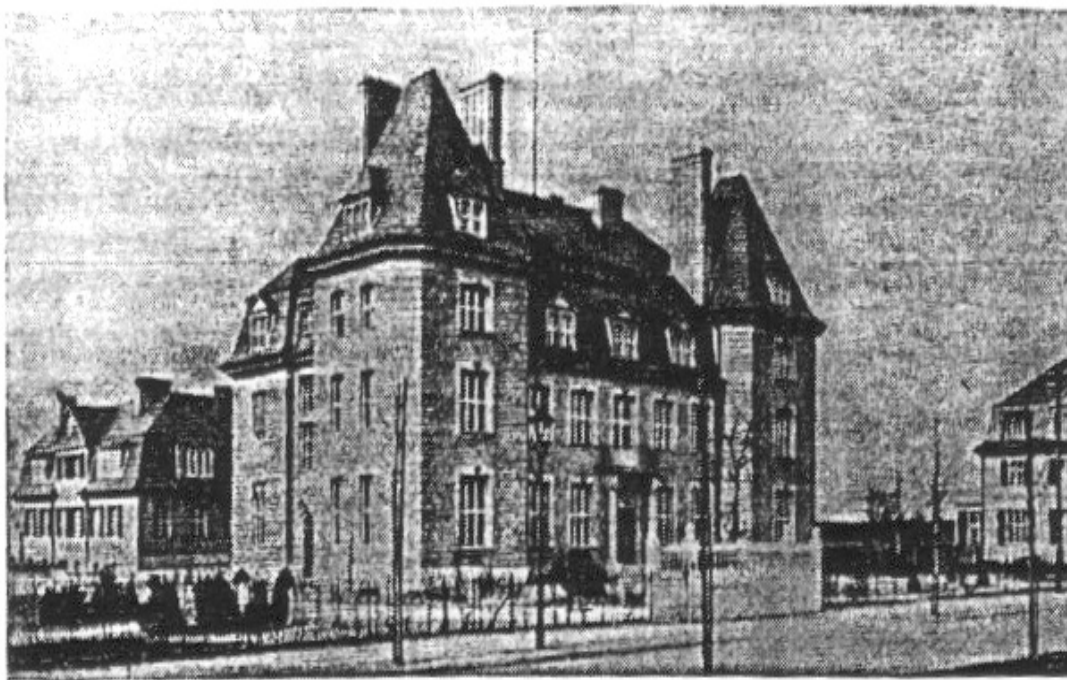
Dedication of Kaiser Wilhelm Institute October 28, 1913



Kaiser Wilhelm Institute for Chemistry 1913

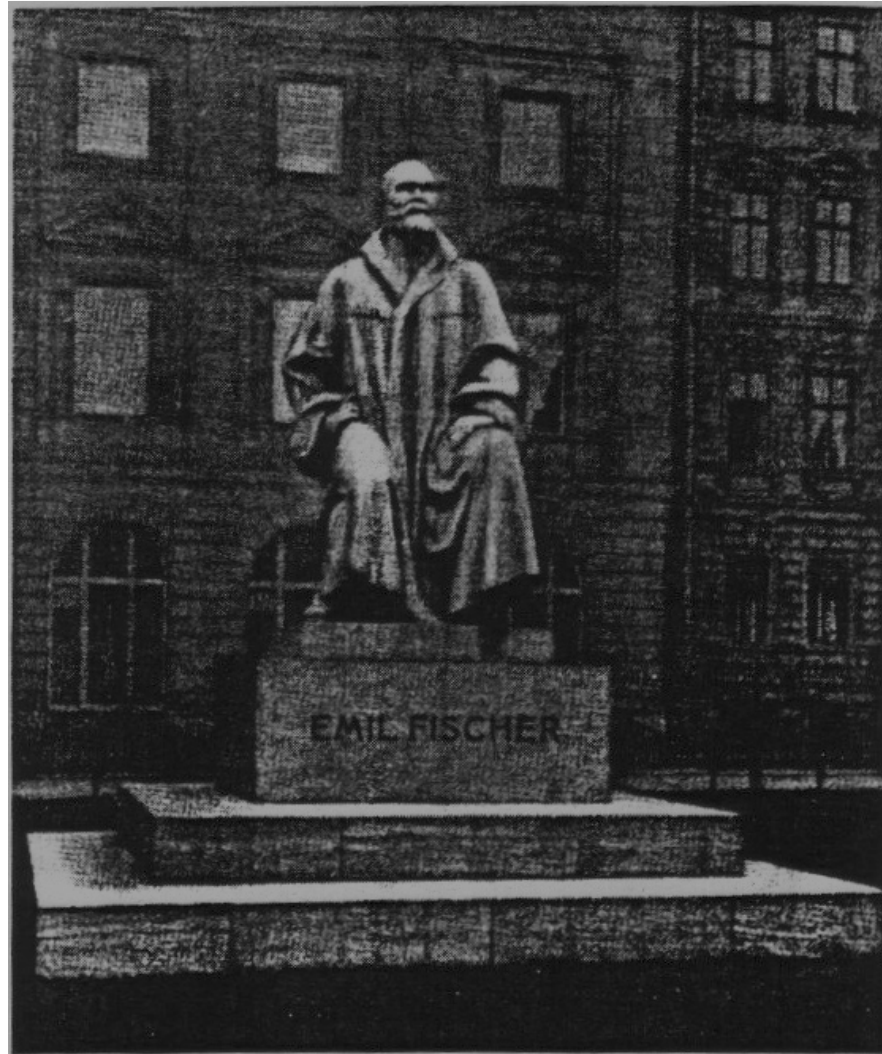


Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry 1912

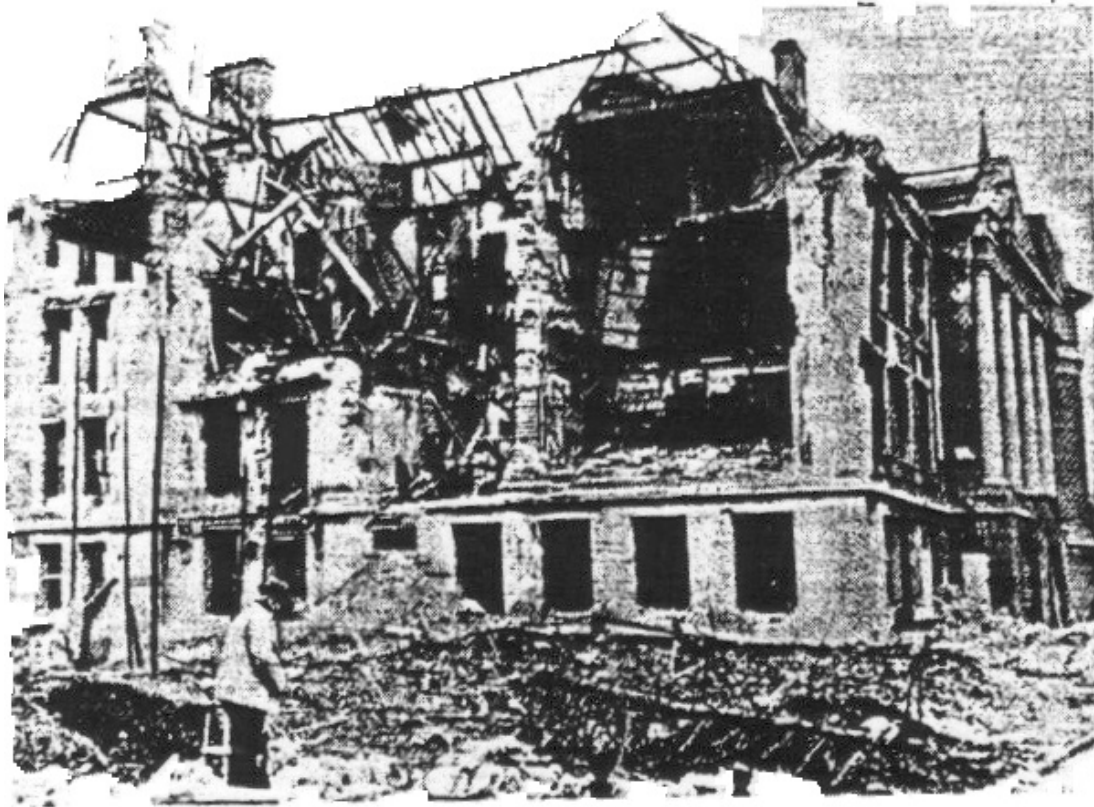


Photograph of the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry, 1912.

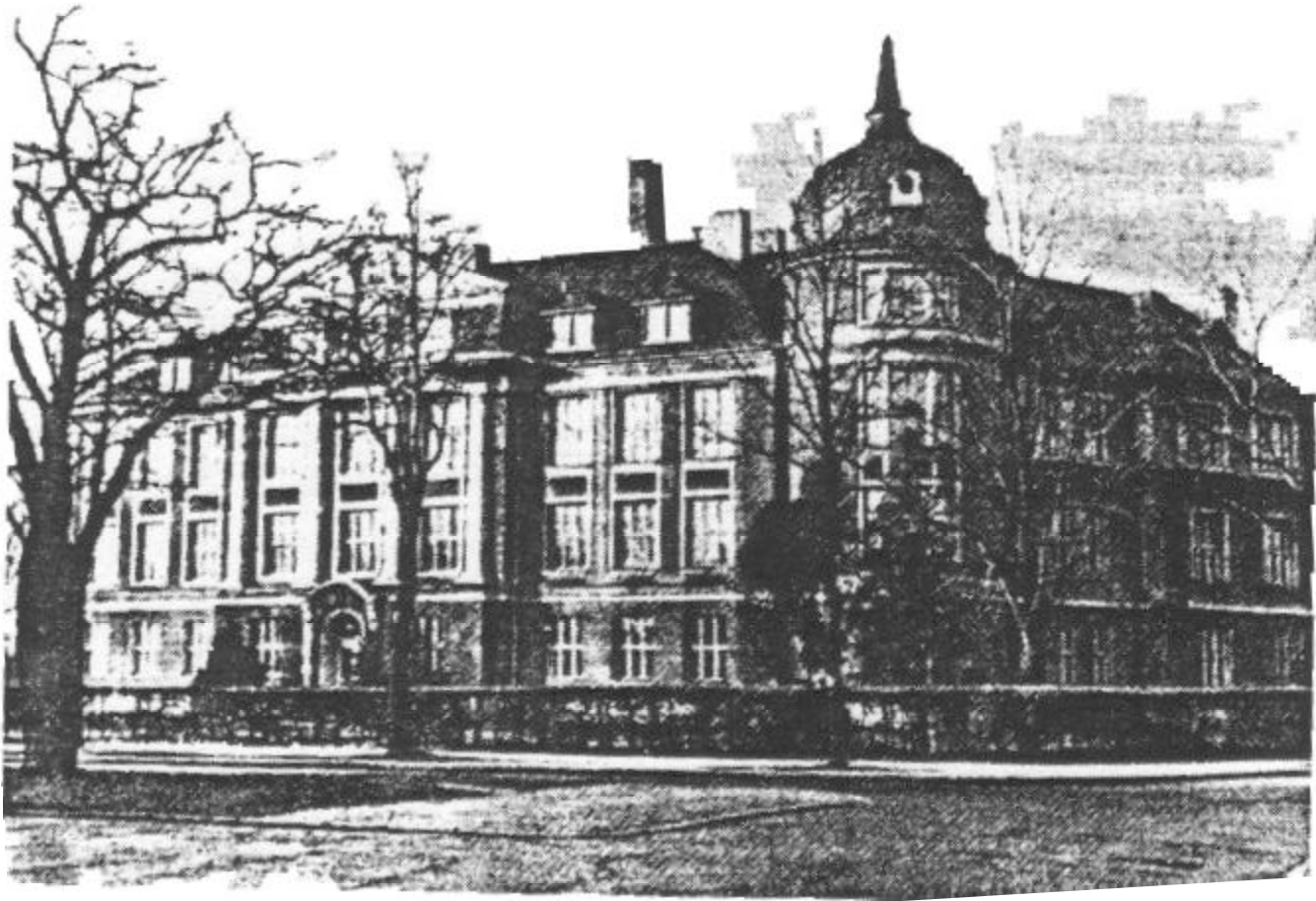
Emil Fischer Monument



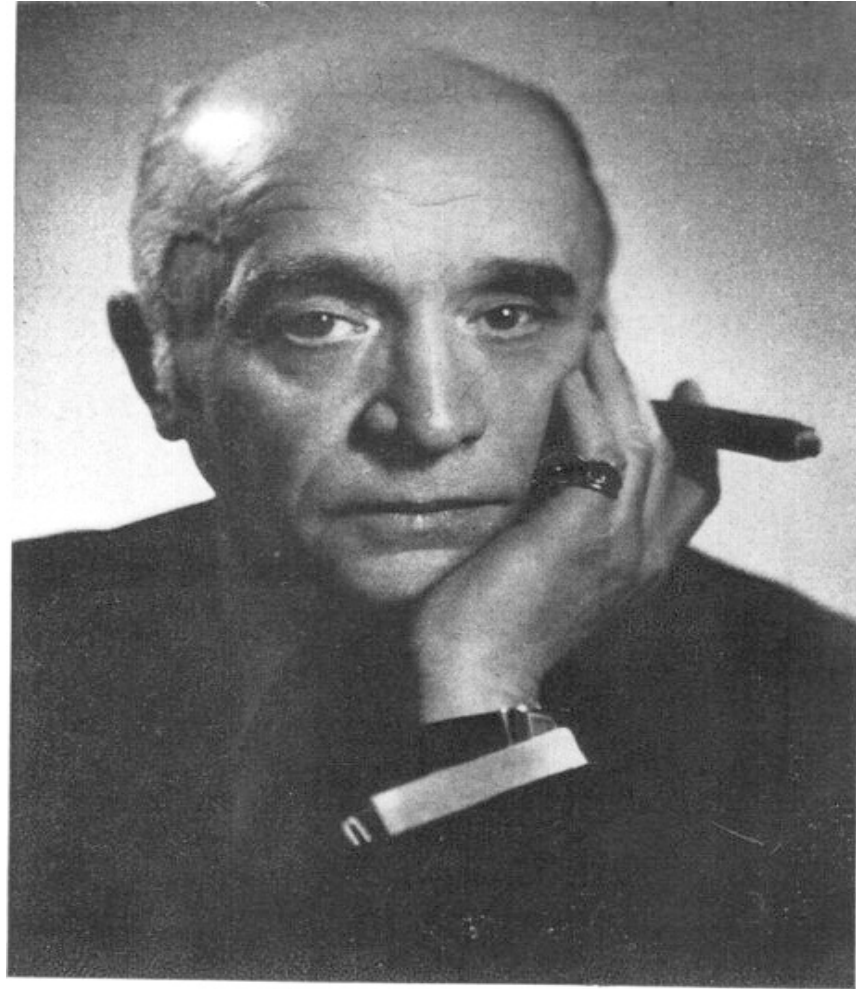
Bombed Kaiser Wilhelm Institute March 15, 1944



Kaiser Wilhelm Institute after Reconstruction 1953



Friedrich Bergius (1884-1949)

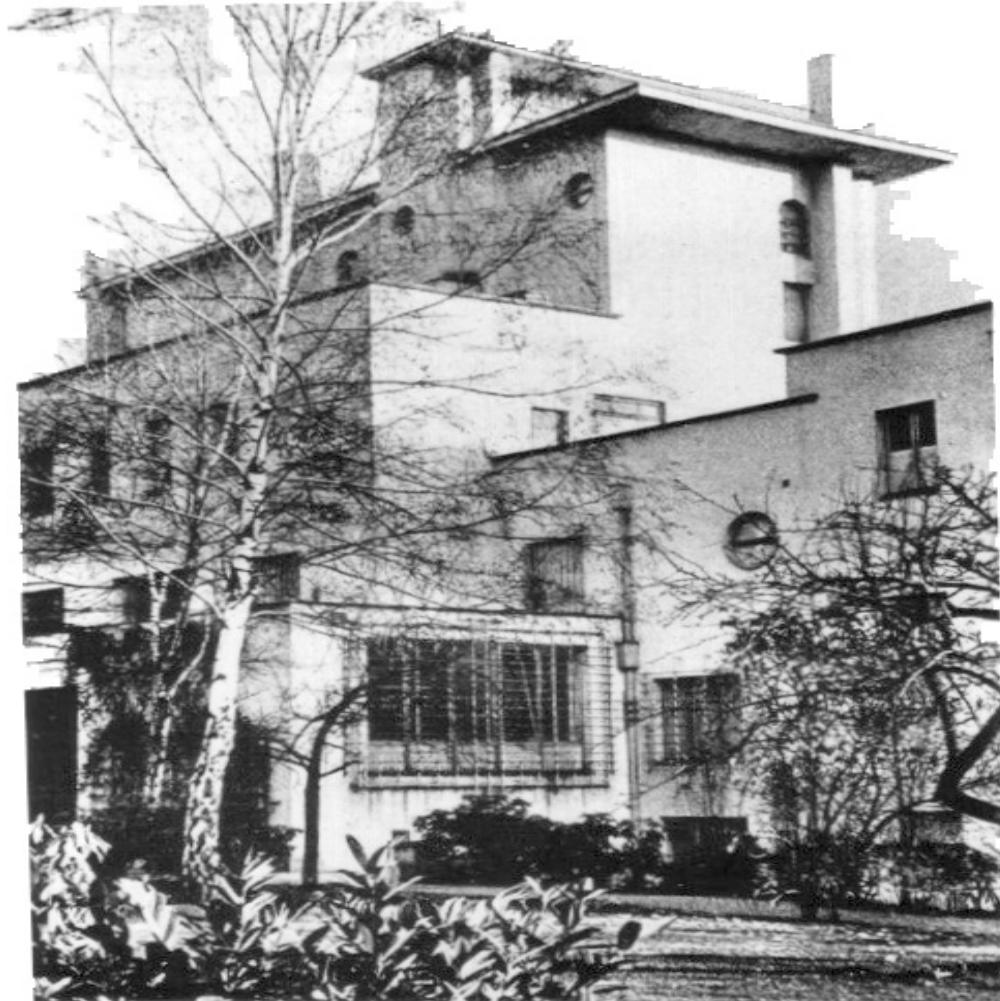


Friedrich Bergius

Friedrich Bergius (1884-1949)

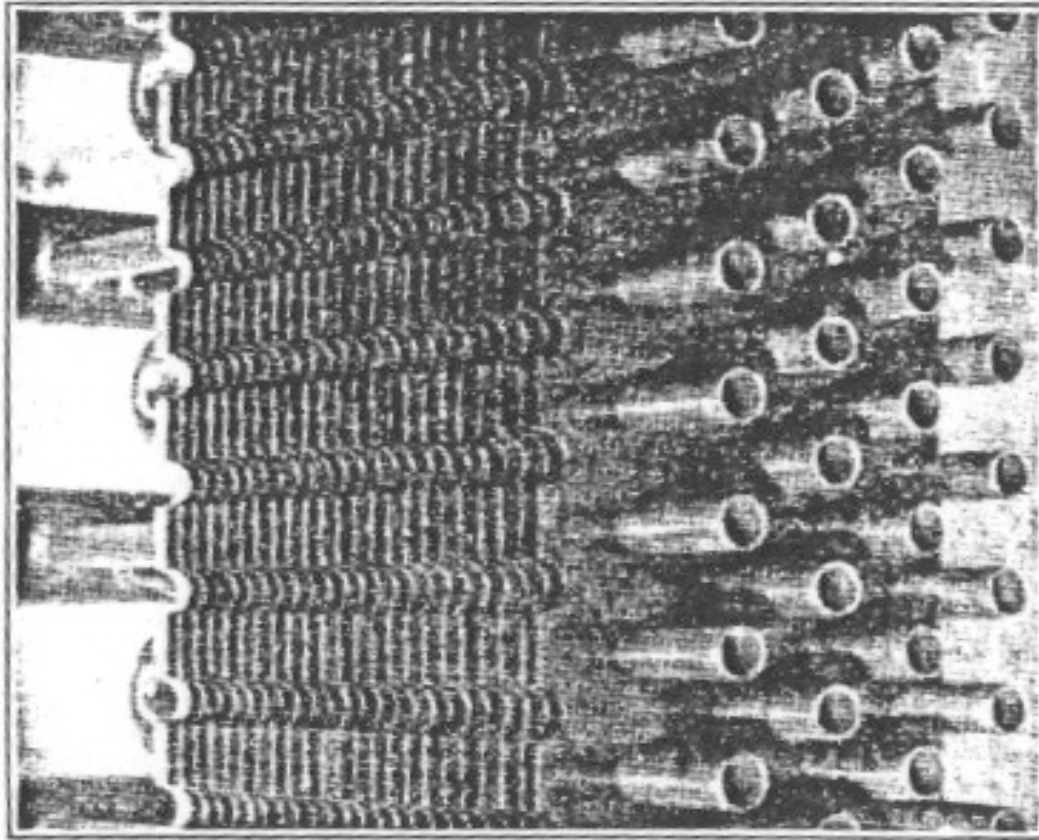


Bergius House Heidelberg

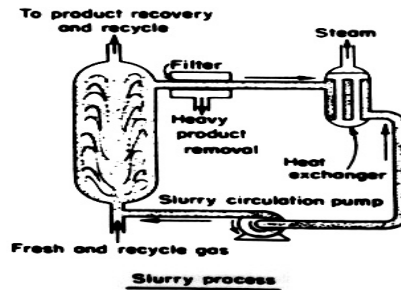
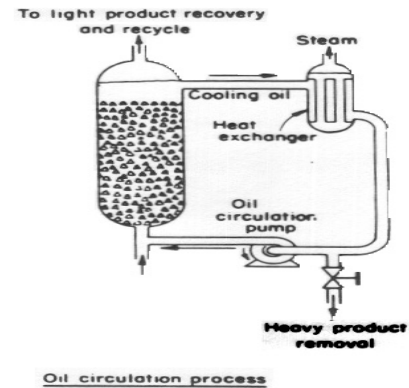
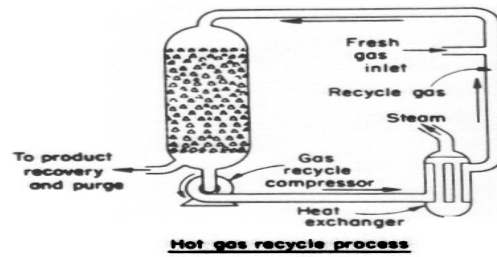
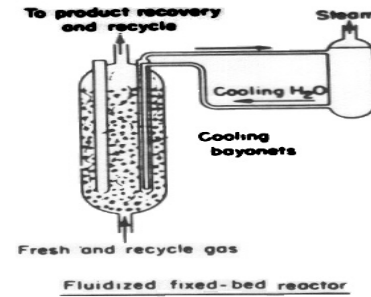
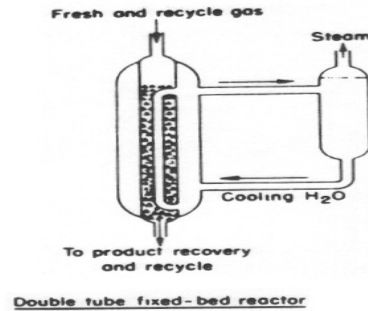


.Das Wohnhaus in Heidelberg. Albert Überlestraße 5

Atmospheric-Pressure Fischer-Tropsch Converter



Fischer-Tropsch Reactors



	Fixed-bed catalyst
	Catalyst suspended in gas
	Catalyst suspended in oil

Fischer-Tropsch Plants (1)

TABLE 1

FISCHER-TROPSCH PLANTS

PLANT	LOCATION	RAW MATERIAL (Coal)	PRODUCTION 1944	PRODUCTS	PRESSURE ATM	STARTED OPERATION
Ruhrbenzin AG	Oberhausen-Holten (Sterkrade-Holten), Ruhr	bituminous	62,200	motor fuel, lubricating oil	normal medium	construction started by Nov. 1935 in operation 1937
Steinkohlen-Bergwerk Rheinpreussen	Moers-Meerbeck (Homburg), Neiderrhein	bituminous	19,700	gasoline, diesel oil, hard and soft paraffin wax, oils for fatty acids	normal	construction started by Nov. 1935 in operation late 1936
Gewerkschaft Viktor, Klocknerwerke- Wintershall AG	Castrop-Rauxel, Ruhr	bituminous	40,380	primary oils	normal	Construction started by Nov. 1935 in operation second half of 1936
Braunkohle-Benzol AG (Brabag)	Ruhland-Schwarzheide (north of Dresden)	lignite	158,500	primary oils	normal	construction started by Nov. 1935 in operation in 1937
Mitteldeutsche Treibstoff und Öl Werke (Subsidiary of Wintershall AG)	Lützkendorf-Mücheln (Leipzig area)	lignite	29,320	primary oils	normal	1938
Krupp Treibstoffwerk	Wanne-Eickel, Ruhr		39,802	primary oils	normal medium	late 1938
Chemische Werke Essener Steinkohle AG	Kamen-Dortmund (Bergkamen), Ruhr	bituminous	86,580	primary oils	normal	1939
Hoesch-Benzol GmbH	Dortmund, Ruhr	bituminous	51,000	primary oils	medium	March 1939
Schaffgotsch Benzol GmbH	Deschowitz-Beuthen, Odertal (upper Silesia)	lignite	39,200	primary oils	medium	1941 plant completed in 1939

Coal Hydrogenation Plants (1)

TABLE 2

1927-1945 GERMAN COAL HYDROGENATION PLANTS

Plant Location	Operating Company	Construction started in	Construction completed in/started operation	Raw Material used
Ludwigshafen/Oppau	BASF (IG Farben)			
Leuna: central Germany near Merseburg	Ammoniakwerk Merseburg GmbH subsidiary of IG Farben	November 1926	1 April 1927	started with brown coal in 1927 switched to brown coal tar until 1931 when difficulties with brown coal overcome, oils
Böhlen: central Germany near Leipzig	Braunkohlen Benzin AG (Brabag founded 26 October 1934)	1935	first half of 1936	brown coal tar
Magdeburg: central Germany near Leipzig	Brabag	1935	fall 1936	brown coal tar
Scholven: west Germany near Gelsenkirchen	Hydrierwerk Scholven AG founded July 1935	fall 1935	fall 1936	bituminous coal
Welheim: west Germany near Gelsenkirchen	Ruhröl GmbH (established in 1935 by Mathias Stinnes)	July 1936	1937	coke-oven tar pitch
Gelsen: west Germany near Gelsenkirchen	Gelsenberg Benzin AG founded December 1936	15 November 1936	15 August 1938 (early 1939)	bituminous coal
Zeitz: central Germany near Leipzig	Brabag	1937	before WW II 1939	brown coal tar
Pölitz: north Germany near Stetin	Hydrierwerk Pölitz AG founded June 1937		June 1940	petroleum, bituminous coal, coke-oven tar, shale oil
Lützkendorf: central Germany near Merseberg	Wintershall AG		1940	petroleum residues, bituminous coal tar, oils
Wesseling: west Germany Near Bonn	Union Rheinische Braunkohlen Kraftstoff AG (founded January 1937)	1938	August 1941	Rhenish brown coal, shale oil
Brüx: Bohemia Czechoslovakia	Sudetenlandische Treibstoffwerke AG (founded October 1940)	May 1939	October 1942	Brüx tar
Blechhammer: Upper Silesia	Oberschlesische Hydrierwerke AG (founded 1939)		1942 (end of 1943?)	bituminous coal bituminous coal tar

Coal Hydrogenation Plants (2)

TABLE 2A

GERMAN COAL HYDROGENATION PLANTS

Plant Location	Process	Pressure (atm) liquid/vapor phase	Final Products	Plant Capacity and production, metric tons per year liquid products including LP gas, ca 1944
Ludwigshafen/Oppau				
Leuna	liquid and vapor phase	250/250	gasoline, diesel oil, LP gas	620,000 (640,000)
Böhlen	liquid and vapor phase	300/300	gasoline, diesel oil, LP gas	220,000 (275,000)
Magdeburg	liquid and vapor phase	300/300	gasoline, diesel oil, LP gas	220,000 (275,000)
Scholven	liquid and vapor phase	300/300	gasoline, LP gas	220,000 (240,000)
Welheim	liquid and vapor phase	700/700	gasoline, fuel oil	130,000 (145,000)
Gelsenberg	liquid and vapor phase	700/300	G\gasoline, LP gas	400,000 (430,000)
Zeitz	TTH process and vapor phase	300	diesel oil, wax, gasoline, lubricating oil, LP gas	250,000 (250,000)
Pölitz	liquid and vapor phase	700/300	gasoline, fuel oil (diesel oil), LP gas	700,000 (750,000)
Lützkendorf	liquid and vapor phase	700/700	gasoline, diesel oil, fuel oil	50,000 (12,000)
Wesseling	liquid and vapor phase	700/300	gasoline, diesel oil, LP gas	200,000 (230,000)
Brüx	liquid and vapor phase	300/300	gasoline, diesel oil, LP gas	400,000 (360,000)
Blechhammer	liquid and vapor phase	700/300	gasoline intended, fuel oil	60,000 (65,000)

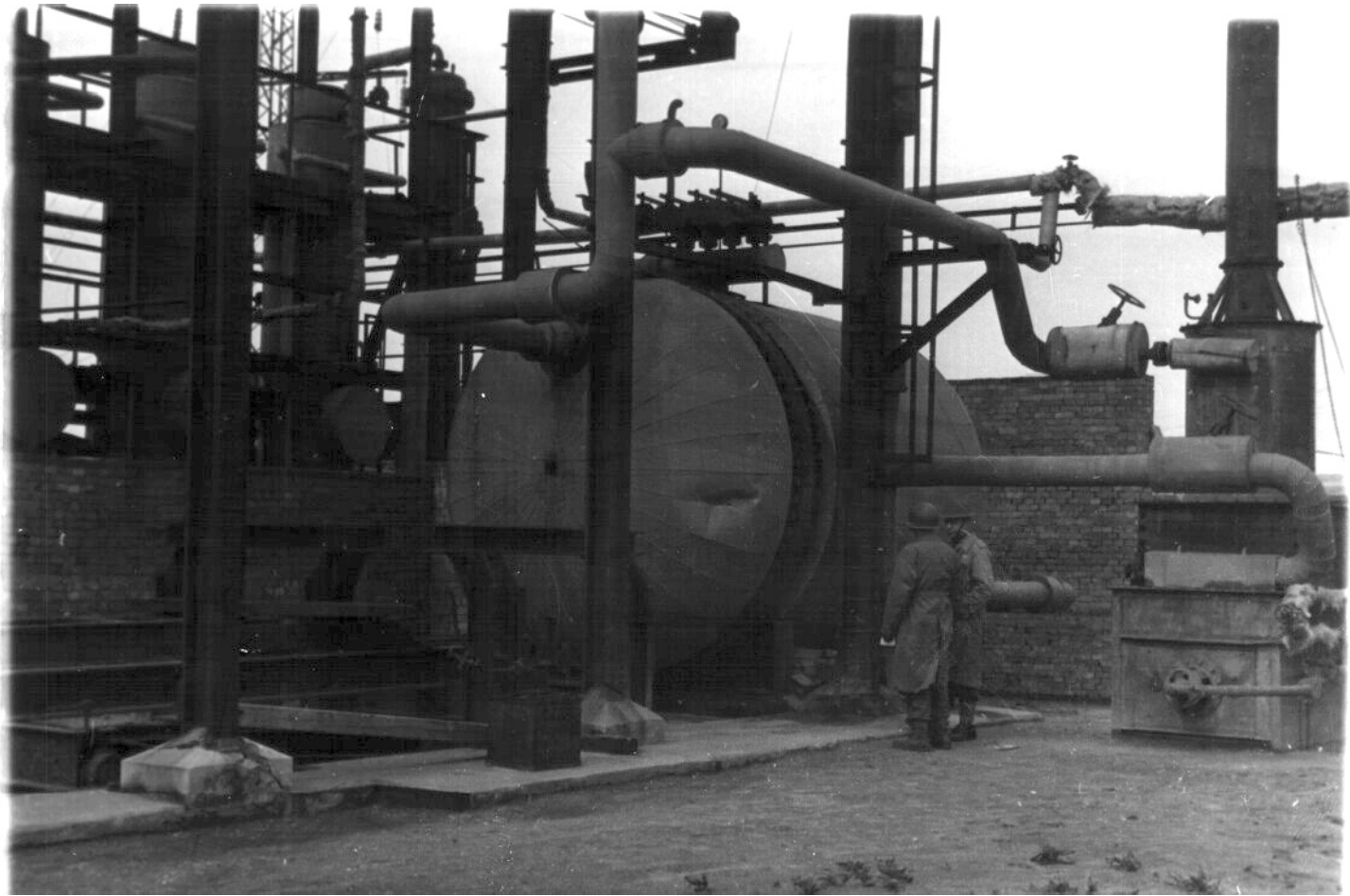
Total Liquid Fuels

TABLE 3

SUMMARY OF GERMAN OIL AVAILABILITY FROM VARIOUS SOURCES AT THE BEGINNING OF 1944

Type of oil production	Annual rate of production by						Total
	Hydrogenation	Fischer-Tropsch synthesis plants	Refining of German and Austrian petroleum	Brown coal and bituminous coal tar distillation	Benzole	Imports from Rumania and Hungary	
Aviation fuel	1,900,000	--	--	--	50,000	100,000	2,050,000
Motor spirit	350,000	270,000	160,000	35,000	330,000	600,000	1,745,000
Diesel oil	680,000	135,000	670,000	110,000	--	480,000	2,075,000
Fuel oil	240,000	--	120,000	750,000	--	--	1,110,000
Lubricating oil	40,000	20,000	780,000	--	--	--	840,000
Miscellaneous	40,000	160,000	40,000	50,000	--	--	290,000

Synthetic Fuel Plant Bombed (1)



Synthetic Fuel Plant Bombed (2)



Synthetic Fuel Plant Bombed (3)



Synthetic Fuel Plant Bombed (4)

