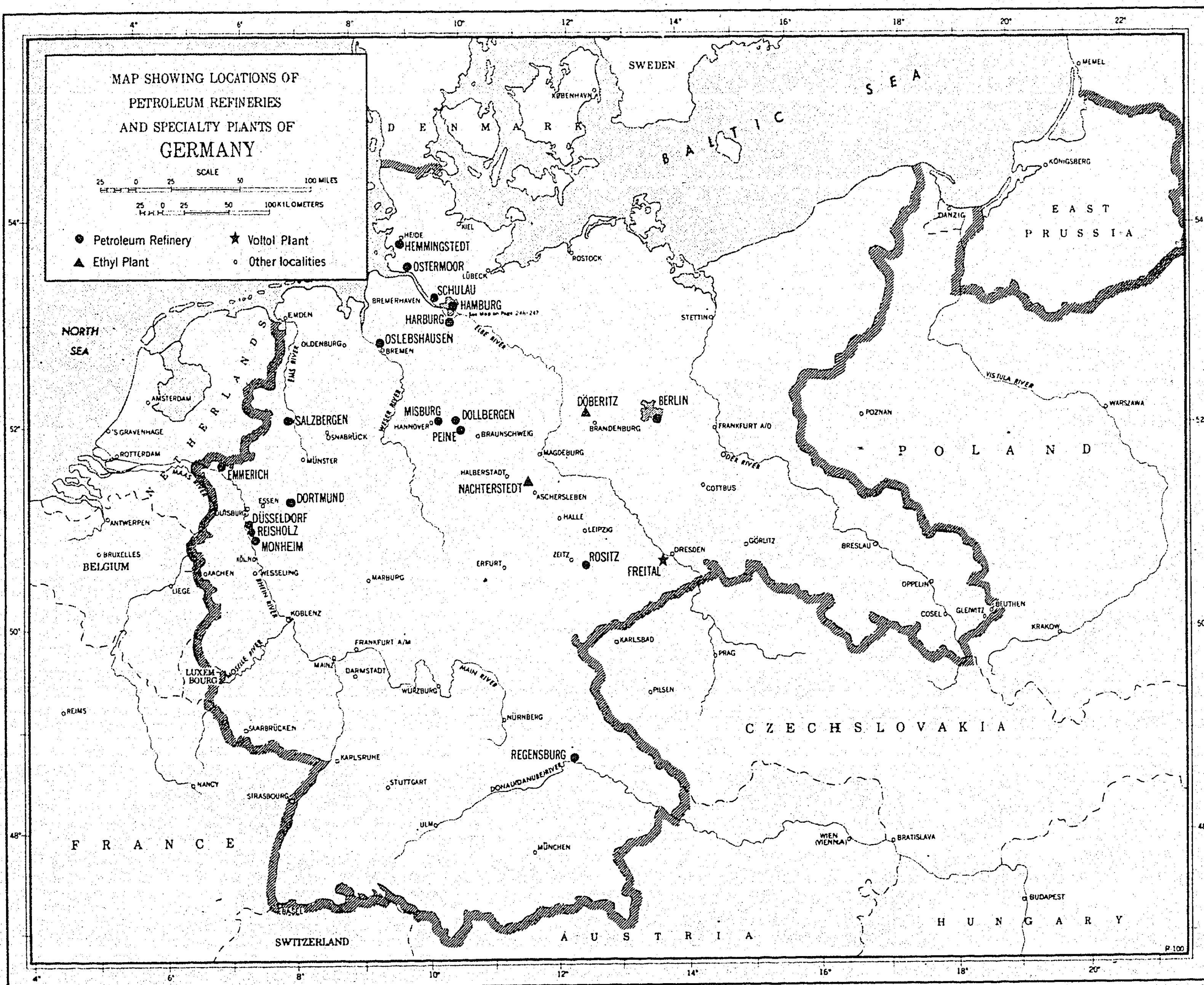




3.0 REFINING3.1 GENERAL

Since Germany's annual indigenous crude oil production in prewar years never exceeded 600,000 tons, her refineries were dependent upon imported supplies of crude oil, residues, and semi-finished products for the bulk of their feed stocks. Also, a large portion of Germany's total petroleum requirements were imported in a semi-finished or finished state. Hence, the total refinery capacity of approximately 3,000,000 metric tons was relatively small as compared to the country's over-all consumption, and much of it was designed for the processing and rerunning of residues and partly finished products, rather than complete refining of crude oils (a).

Prewar statistics compiled by the United States Mines Bureau show that approximately one-third of the gasoline and two-thirds of the lubricating oil imported underwent further processing in Germany. Since Germany formerly imported most of her gasoline requirements and during the war has obtained large quantities of gasoline from her new synthetic plants, and as cracking produces gasoline at the expense of diesel oil and lubricating oil stocks, only a few of the German refineries are equipped with cracking units. In a number of the important refineries the production of lubricants was, and is, given particular emphasis, and prior to the war Germany exported considerable quantities of special and high grade lubricants.

Statistics from British sources for three recent prewar years depict the general pattern of German refining activity prior to 1938.

German Refining Activity Prior to 1938
(In Metric Tons)

	1935	1936	1937
<u>Oils Treated:</u>			
Crude oil	847,800	968,100	1,172,900
Topped crude	330,400	458,800	424,400
Coal tar oils	377,900	582,200	840,600
Unfinished gasoline	137,700	202,500	205,400
Other semi-processed oils	340,100	809,200	845,800
	2,033,900	3,020,800	3,489,100
<u>Products Obtained:</u>			
Benzine and gasoline	577,000	877,800	1,259,700
Kerosenes	52,100	55,900	77,200
Gas and fuel oil	366,700	431,700	463,700
Crude lubricants and residues	207,100	270,200	341,700
Paraffin wax	20,200	26,500	28,000
Bitumen	406,200	538,800	582,500
Petroleum coke	43,500	50,300	68,400
Other Products	236,000	84,900	530,900
T O T A L	1,908,800	2,336,100	3,352,100

The largest concentration of refineries is at Hamburg where approximately 60 per cent of Germany's refinery capacity is located and where some 85 per cent of all imported crude and residues were refined. The large Deurag-Nerag refinery is located at Hannover and two smaller ones are located at Peine and Dolbergen in the Hannover area where 75 per cent of Germany's indigenous crude oil is produced.

(a) Prewar import and export statistics may be found on pages 222 and 223.

PRINCIPAL GERMAN PETROLEUM REFINERIES

Place	Company	Refinery Location	Yearly Capacity Metric Tons (Approx.)	Distillation and Cracking Facilities	Lubricating Oil Facilities	Total Tankage Capacity Metric Tons	Remarks
BERLIN							
Britz	"Brenntag" Brennstoff-Chemikalien und-Transport A.G.	In Britz district.	50,000	-	-	-	Formerly Philip Mulsam A.G.
Lichtenberg	Mineralölwerke Lichtenberg G.m.b.H. & Co. KG.	Herzbergstrasse 35, Lichtenberg, Berlin.	25,000	Distillation and rectification facilities.		4,000	
Tempelhof	Deutsch-Amerikanisch Petroleum Ges.	In Tempelhof district. Between Saalburgstrasse and Teltown Canal.	30,000	Rerunning plant, two small stills.	Nil	33,000	Owned by Standard Oil (N.J.). Small gasoline specialty only.
BREMEN							
Ostebshausen	Deutsche Vacuum Oil A.G.	Between Hüttenstrasse and Hafen C in Ostebshausen, a suburb NW. of Bremen.	80,000	Shell still and Foster-Wheeler pipe still--atm. and vacuum stage.	Duo-sol solvent treating. Benzol acetone dewaxing.	165,000	Owned by Socony-Vacuum Oil Co. Primarily a lubricating oil refinery for high quality oils and greases.
DOLBERGEN	Deutsche Gasolin A.G.	N. of RR. line just N. of Dolbergen. 22 miles E. of Hannover.	40,000	Shell stills. Pipe still, no cracking.	Axle oil only.	16,000	Primarily fuel oil and axle oil production from local crude. Plant enlarged during war.
DORTMUND	Westfälische Mineralöl und Asphaltwerke, W.H. Schmitz, K.G.	On N. side of Dortmund Petroleum basin on Dortmund-Ems Canal in the Ruhr.	20,000	Shell stills, no cracking.	-	-	Believed to manufacture low grade lubricants.
DUSSELDORF	Deutsche-Amerikanisch Petroleum Ges.	On Rhine River at Düsseldorf.	25,000	Rerunning plant only.	Nil	20,000	Owned by Standard Oil Co. (N.J.). Small gasoline specialty plant.
Reisholz	Rhenania-Ossag Mineralölwerke A.G.	Four miles SE. of Düsseldorf.	65,000	Rerunning plant. Shell stills.	Nil	40,000	Owned by Shell group. Rerunning plant for manufacture of white spirits and special benzines.
EMMERICH	Deutsche Gasolin A.G.	On N. side river harbor of Emmerich on Rhine near Netherlands border.	60,000	Pipe stills and small cracking unit.	Yes	-	Produces gasoline, gas oil, lubricants and greases.
HAMBURG							
Grasbrook	Mineralölwerke Albrecht & Co. K.G.	Adjoining other refineries on E. side Reiherstieg Canal just S. of Norder-Elbe River.	30,000	Nil	Acid and clay.	30,000	A lubricating oil plant.
	Rhenania-Ossag Mineralölwerke A.G.	On Reiherstieg Canal, just south of Norder-Elbe River in Grasbrook area of harbor.	130,000	Nil	Edeleanu plant. Acid and clay treating, solvent dewaxing and grease manufacturing.	60,000	Owned by Shell group. Manufacturers of turbine, white oils, and aviation oils. Operation complementary to Rhenania's Harburg plant. See page 121 (top).
	Ernest Schliemann's Ölwerke	Adjoining other refineries on E. side Reiherstieg Canal just S. of Norder-Elbe River.	65,000	Nil	Acid and clay	30,000	Produces white oils and ordinary lubricants.
Harburg	Ebano Asphaltwerke A.G.	On S. side of Süder-Elbe in Harburg section. 1½ miles west of Harburg bridges.	400,000	Two two-stage pipe stills, three asphalt oxidizing stills.	Nil	110,000	Owned by Standard Oil Co. (N.J.). Primarily an asphalt and black oil plant designed to operate on heavy Mexican or Venezuelan crude.
	Rhenania-Ossag Mineralölwerke A.G.	S. bank of Süder-Elbe in Harburg section. 1½ miles W. of Harburg bridges.	550,000	Atmospheric and vacuum pipe stills.	Acid treating and re-distillation. Edeleanu plant.	272,000	Owned by Shell group. Polymerization plant for aviation lubricants installed in 1939. See page 115.
Petroleum-hafen	Europäische Tanklager und Transport A.G. (Eurotank)	Just SE. of Neuer Petroleum-hafen on S. side of Elbe River west of Hamburg.	400,000	Combination Winkler-Koch topping and cracking plant.	Nil	-	Working agreements with Nitag and Wintershall. Undisclosed ownership control via Foreign Oil Co. Inc., Boston and HardyBank, Berlin. Large tankage.
Schulau	Deutsche Vacuum Oil A.G.	N. bank of Elbe just E. of village of Schulau, 19 miles downstream from Hamburg bridge.	20,000	Six 800 barrel shell stills for rerunning lub. oils. No cracking.	Acid and soda, wax pressing, lub. blending and grease manufacturing.	197,000	Owned by Socony-Vacuum Oil Co. Plant used for finishing lube distillates from Bremen and for manufacture of high grade greases.
Wilhelmsburg	Deutsche Petroleum A.G.	On N. side Reiherstieg Canal. 1½ miles W. of Wilhelmsburg R.R. station.	65,000	Shell stills, vacuum distillation. No cracking.	-	95,000	Subsidiary of Deutsche Erdöl A.G. (Deag).
	Ölwerke Julius Schindler G.m.b.H.	Between Neuhofer and Rethe Canals near juncture with Kohlbrand, in Neuhoof west of Wilhelmsburg.	40,000	Shell stills, atmospheric and vacuum	Acid and clay.	40,000	A lubrication oil plant. The Pure Oil Co. owns 49% stock interest.
	Rhenania-Ossag Mineralölwerke A.G.	On N. side of Reiherstieg Canal at bend halfway between Norder and Süder Elbe Rivers.	70,000	Shell stills and pipe stills	Nil	20,000	Owned by Shell group. Gasoline specialty and rerunning plant. See page 121 (bottom).

PRINCIPAL GERMAN PETROLEUM REFINERIES (Continued)

HANNOVER Misburg	Gewerkschaft Deutsche Erdöl- Raffinerie--- and Gewerkschaft Neue Erdöl-Raffinerie (Deurag-Neurag)	E. side of Weser-Elbe Canal at Misburg approximately 4 miles E. of Hannover.	300,000	Two two-stage pipe still for crude. Rerun pipe still, Dubbs crack- ing plant.	High vacuum Caborough unit. Purfurol-solvent extraction. Benzol, ace- tone dewaxing. Polymer- ization.	235,000	Two plants operated jointly. Deurag is primar- ily a gasoline plant. Neurag, completed just prior to war, specializes in high grade and ordinary lubricants.
HEIDE-HEMMING- STEDT	Holsteinische Erdölwerke G.m.b.H.	Near village of Hemmingstedt 2½ miles SSW of Heide. Approximately 10 miles NW. of Kaiser-Wilhelm (Kiel) Canal.	150,000	Two tube stills and frac- tionating columns.	-	28,000	Built since 1939. Equipped for extracting oil from oil sands mined nearby. Connected by pipe line to tankage at Schafstedt on Kaiser-Wilhelm Canal.
MONHEIM	Rhenania-Ossag Mineralöl- werke A.G.	On E. bank of Rhine, 10 miles SE of Düsseldorf.	115,000	Shell stills, some under vacuum.	Acid and clay. Small SO ₂ extraction unit.	45,000	Owned by Shell group. Rerunning plant formerly operated on Venezuelan distillates.
OSTERMOOR	Mineralöl und Asphaltwerke A.G. (MAVAG)	On Kaiser-Wilhelm (Kiel) Canal, near juncture with Elbe River, 40 miles down- stream from Hamburg.	150,000	Pipe still and shell stills. No cracking.	Nil	104,200	Inactive. Primarily an asphalt plant, formerly operating on heavy Venezuelan crude.
PEINE	Mineralölwerke Peine (Julius Schindler)	N. of R.R. line in eastern outskirts of Peine, 20 miles SSE of Hannover.	20,000	Shell stills	Axle oil only.	5,000	Small gasoline, tractor fuel, and axle oil production. Pure Oil Co. owns 49% stock interest.
REGENSBURG	Rhenania-Ossag Mineralöl- werke A.G.	At the Oelhafen south of the Danube in eastern outskirts of Regensburg.	30,000	Rerunning plant.	-	17,000	Small gasoline rerunning or specialty plant owned by Shell group.
ROSITZ	Deutsche Petroleum A.G.	South of Altenburg-Zeitz railway line. ½ mile ESE of village of Rositz about 21 miles S. of Leipzig.	120,000	-	-	-	Kdeleanu solvent extraction plant operating principally on L.T.C. tars from adjacent plants. Diesel oil is principal product.
SALZBERGEN	Erdöl-Raffinerie Salzbergen G.m.b.H. (Ersag)	1/2 mile S. of Salzbergen, 4-1/2 miles NW of Rheine on Ems River near Netherlands border.	50,000	Shell stills, pipe stills, small cracking unit.	High vacuum distillation and dewaxing.	35,000	Wintershall A.G. holds majority control. Plant capacity and underground tankage reported in- creased since beginning of war.

- = Information unavailable.

Important refineries also exist at Bremen, Heide, Monheim, Ostermoor and Salzbergen. The remaining refineries are in scattered locations and many of them are primarily rerunning and treating plants for special products and lubricants rather than complete refining units operating on crude petroleum. Though the production of indigenous German crude oil has been greatly increased since the war, it still amounts to only some 700,000 tons per year, or much below total refinery capacity. At the same time the greatest emphasis has been placed on the construction of synthetic oil plants. For these reasons German refineries have undergone little expansion. However, most of them have remained active--particularly those operating on indigenous German crude and those engaged in the production of lubricants. There are persistent rumors that the Germans have built a number of small refining units at dispersed locations, some of them said to be underground, in order to minimize the effects of aerial attacks. There is no definite confirmation of this and any such units would of necessity be small and of limited utility.

The principal German refineries are listed in the table on page 86, and the locations are shown on the map on page 84.

Refinery units operating in, or ancillary to, high temperature carbonization (H.T.C.) and low temperature carbonization (L.T.C.) tar plants and synthetic oil works, and which are properly a part of the synthetic oil industry, are not included herein (a). Also, there are a large number of small plants engaged in the production or treatment of industrial benzines, lubricants, and specialty products, which, though more or less related to the refining industry, cannot be identified and catalogued within the scope of this report (b). However, the Voltol lubricating oil plant and the two known tetra-ethyl-lead plants, due to their special significance, are described on pages 139 to 141. Since the beginning of the war a number of small plants have been very active in the regeneration of used lubricating oil. Plants known to have been so engaged are listed in Appendix 8. A number of new plants believed to be producing shale oil are listed on page 81 in the Producing section.

Data on many of the German refineries is meager, but the refineries are listed, by localities, alphabetically and information concerning each one is summarized, in the following pages. Where available, layout plans and photographs of the plants, from the files of parent companies or construction companies, are presented. These plans, of course, represent the prewar plants and do not indicate possible additions and changes during recent years. In most cases, however, such plans are not available but it has been possible to prepare general layout sketches from air cover. All the German refineries have been subjected to repeated bombing attacks and have been more or less severely damaged. However, contrary to some expectations, it has proven extremely difficult to entirely knock out a refinery and although their operations have been considerably hampered, the Germans have demonstrated an ability to rehabilitate the plants and keep them operating at higher rates than was at first thought possible. No effort is made in this report to evaluate the constantly changing status resulting from bomb damage and the refinery capacities listed are either actual or estimated figures for operating capacities under normal conditions (c).

-
- (a) Exception is made for the Deutsche Petroleum A.G. refinery at Rositz which, due to its size and the fact that it is thought to sometimes process natural petroleum, is listed with the oil refineries though its principal feed stock is probably L.T.C. tars.
 - (b) Among such plants are the Erdölwerke "Deutscher Adler" G.m.b.H. at Dolbergen, the Deutsche Viscobil Oel A.G. in Berlin, the Danubia A.G. für Mineralölinindustrie at Regensburg, Johann Halterman benzol refinery at Hamburg, the Mineralöl Raffinerie Rheinlan G.m.b.H. at Mannheim, the Mexas Kaltasphalt A.G. at Prina, the Mineralöl Raffinerie vorm. August Korff in Bremen, Zeller & Gmelin in Eislingen-Fils, Cölner Benzin-Raffinerie Kroseberg & Co., and Max Loeb Benzin-Benzol Mineralölwerk, both in Cologne.
 - (c) For the sake of uniformity, storage capacities for all plants are given in metric tons. A majority of the figures and estimates have been obtained from British sources and in many cases it appears that metric tons refer to a metric ton of water or the equivalent of one M³. For this reason the factor of 6.3 barrels per ton has been employed when calculating the capacities in barrels.

3.2 BERLIN

Refinery: "Brenntag" Brennstoff-Chemikalien- und Transport A.G.

Location: In the Britz district of Berlin.

Plans and Maps: None available. See page 331 for map of Berlin.

Description: Annual capacity is reported to be 50,000 metric tons. There is very little information on this small refinery and no plans nor location maps are available. It formerly belonged to Philip Mulham and is thought to be primarily a gasoline and benzine plant.

Refinery: Deutsch-Amerikanische Petroleum-Gesellschaft.

Location: Saalburgstrasse, 4, in the Tempelhof district of Berlin. The Teltow Canal bounds the plant on the north.

Plans and Maps: Layout plan on page 90. Location shown on map on page 331.

Description: Annual capacity 30,000 metric tons. This is a small rerunning plant with two small stills, agitator, and attendant equipment, for the production of special grades of gasoline, benzine, etc. There is a boilerhouse, pumphouse, and filling racks for tank cars, barges and trucks.

Total tankage amounts to 33,150 metric tons (209,000 barrels).

Refinery: Mineralölwerk Lichtenberg G.m.b.H. & Co., K.G.

Location: Herzbergstrasse, 35, in the Lichtenberg district of Berlin.

Plans and Maps: None available. See map on page 331 for approximate location.

Description: Annual capacity approximately 25,000 metric tons. This small plant is described as having distillation, rectification, and refining facilities but little data and no plans or maps are available. Tankage is estimated at 4,000 metric tons (25,200 barrels).

3.3 BREMEN

Refinery: Deutsche Vacuum Oel A.G.

Location: At Oslebshausen, a suburb northwest of Bremen. Latitude 53° 8' N, longitude 8° 43' E. The plant is located between Hüttenstrasse and Hafen G, on the north bank of the Weser River and is accessible to ocean tankers.

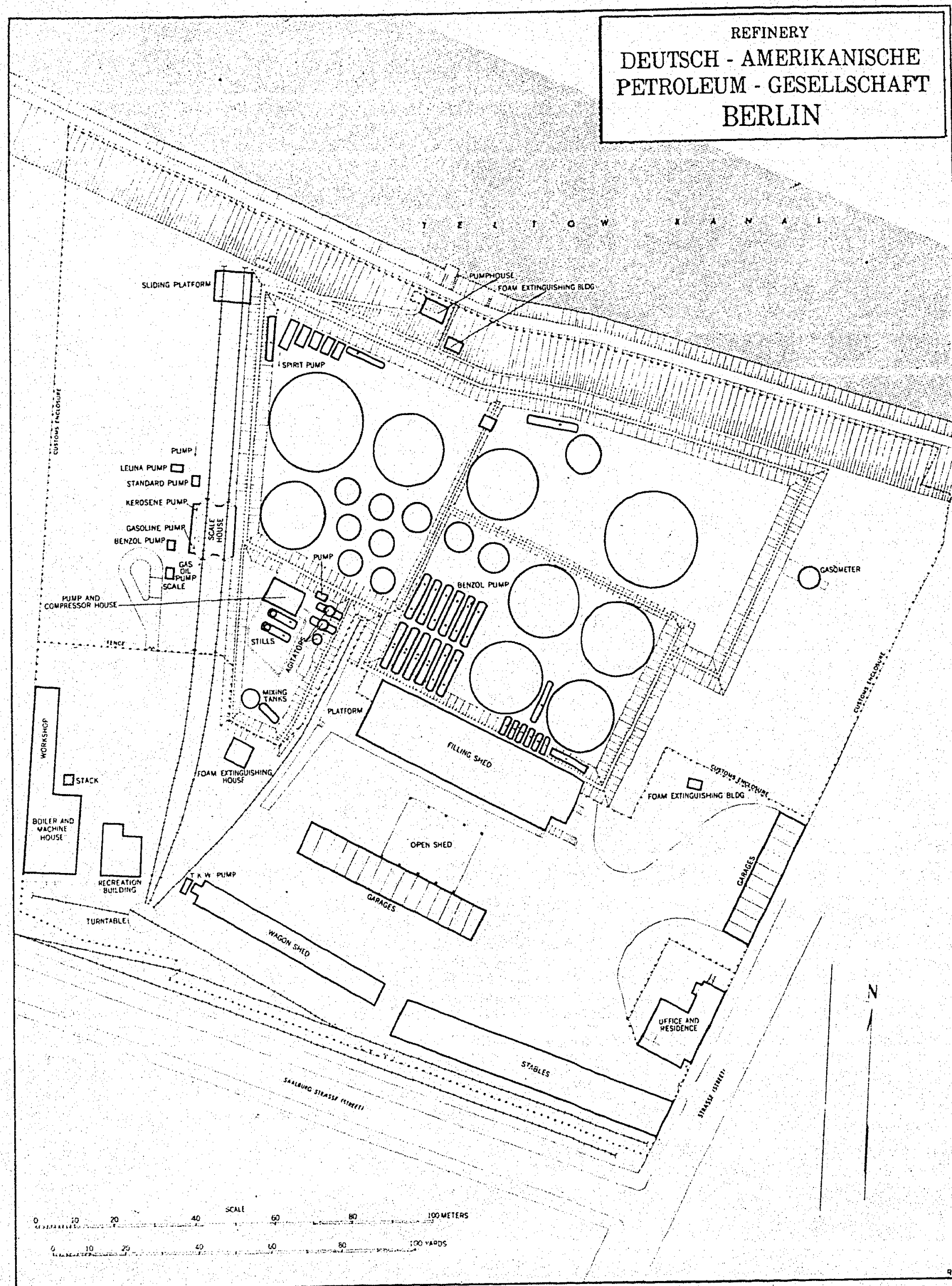
Plans and Maps: Layout plan on page 91. Location map on page 269. Photographs on page 92.

Description: Annual capacity 80,000 metric tons. This modern refinery processed indigenous German crude, primarily for the production of high grade lubricants and for this reason ranks high in importance among the German refineries.

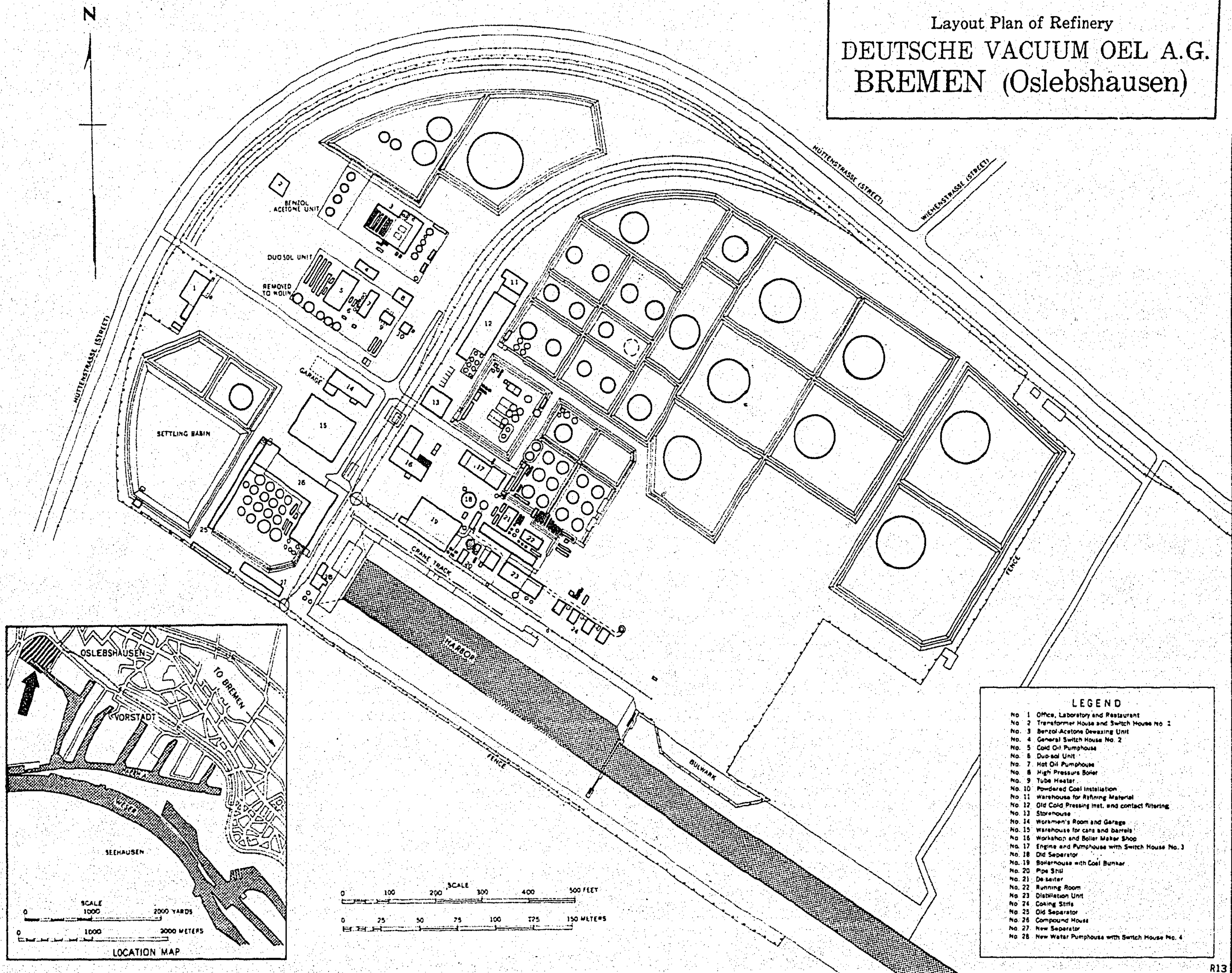
A portion of the lub. distillates produced by this plant were shipped by barge or rail tank car to the company's plant at Schulau, near Hamburg, for finishing, compounding, wax treatment, etc.

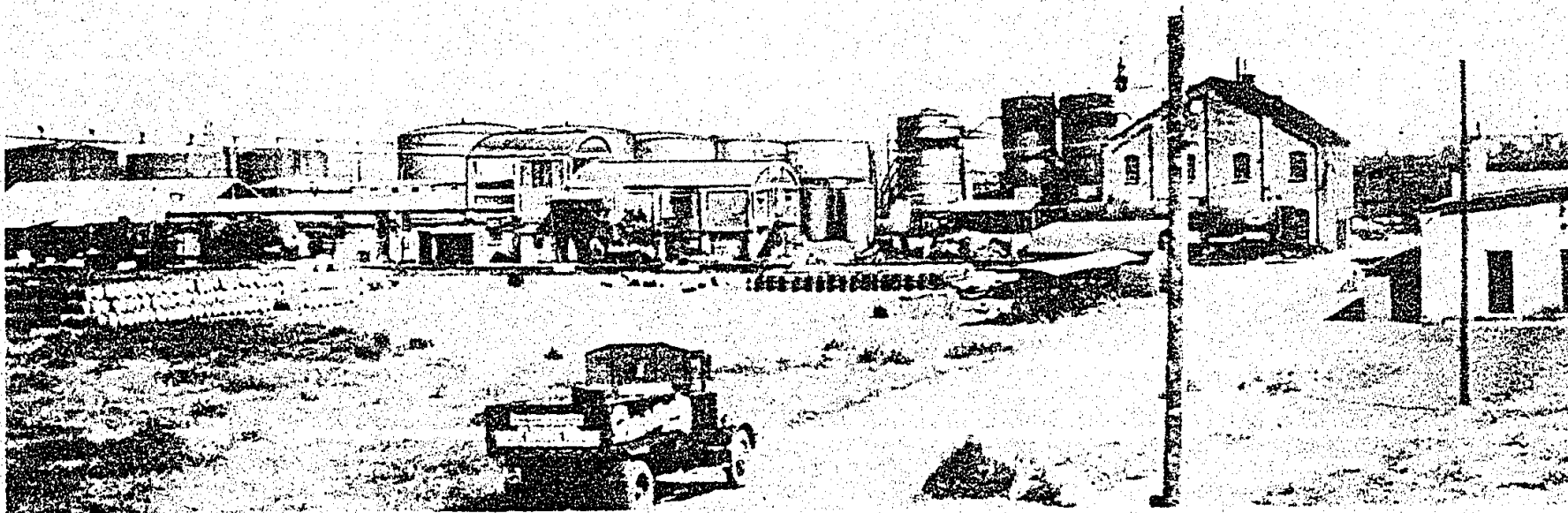
Principal items of prewar equipment are listed on page 93.

REFINERY
DEUTSCH - AMERIKANISCHE
PETROLEUM - GESELLSCHAFT
BERLIN

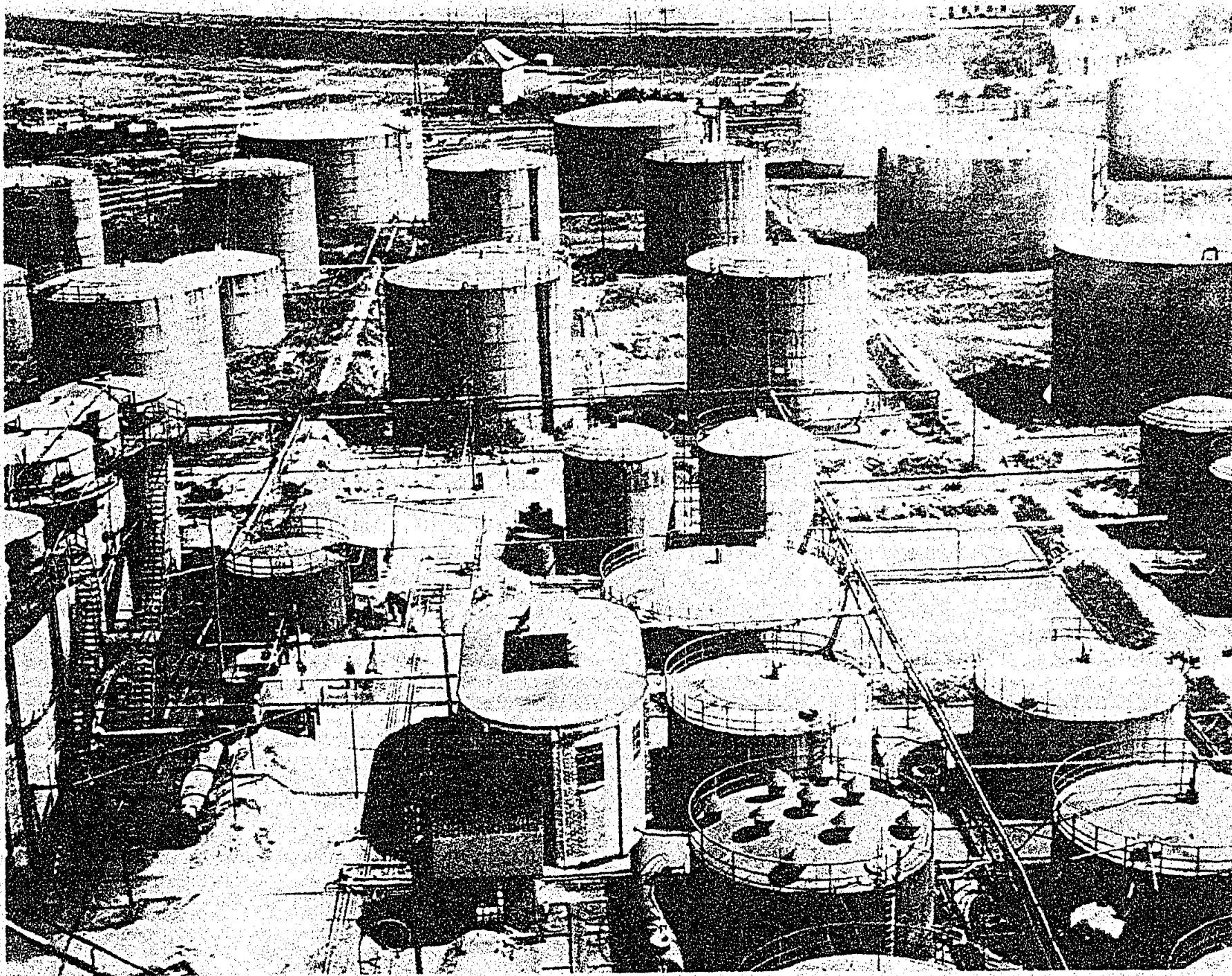


Layout Plan of Refinery
DEUTSCHE VACUUM OEL A.G.
BREMEN (Oslebshausen)





VIEW LOOKING EAST, REFINERY OF DEUTSCHE VACUUM OEL A.G., BREMEN (OSLEBSHAUSEN). STORAGE TANKS ARE LOCATED IN BACKGROUND ON THE LEFT, DISTILLATION SECTION IS ON THE RIGHT.



VIEW OF DEUTSCHE VACUUM OEL A.G. REFINERY, BREMEN (OSLEBSHAUSEN). FROM POWER STATION LOOKING NORTHEAST TOWARD STORAGE TANKS.

Daily Rated Capacity
Bbls. (42 Gals.)

1 Foster-Wheeler Pipe Still - Atmospheric & Vacuum Stage	1,000
Shell still	1,000
Duo-sol solvent treating of lube oils (intake)	950
Benzene-acetone dewaxing, Two filters, possibly a third installed	500
Contact filtration of lube oils	
Compounding and blending of lube oils	
Gasoline and kerosene treating	

Early in 1939, work was started to increase the rated capacity of the pipe still to 2,600 barrels per day and of the Duo-sol plant to 1,860 barrels per day.

Powerhouse.- A new powerhouse was projected in early 1939, the principal new equipment to be 2-40 atms. sectional boilers, 16 tons normal/h - 20 tons maximum, stoker fired; 2 turbo generators 6,000 v - 1,600 kw each; A permutite water treating plant; 3 feed water pumps; coal handling equipment, etc.

Total tankage capacity approximately 165,000 metric tons (1,039,500 barrels).

3.4 DOLBERGEN

Refinery: Deutsche Gasolin A.G.

Location: North of the railway line just north of the town of Dolbergen 22 miles east of Hannover. Latitude 52° 25' N, longitude 10° 11' E.

Plans and Maps: Layout sketch and location map, on page 124.

Description: Annual capacity: 40,000 metric tons. This refinery operates on German crude from the oil fields around Hannover and its primary object is the production of fuel oil and low grade lubricants such as railway axle oils. The refinery has shell stills and pipe stills but no cracking facilities. It has been kept in very active operation and has been enlarged during the war.

Adjoining this refinery to the southwest along the railway, lies the small works of the Erdölwerke "Deutscher Adler" G.m.b.H. This is believed to be a lub. oil treating plant processing low grade oils supplied by the Deutsche Gasolin A.G. refinery.

Total tankage: Estimated at 16,000 metric tons (100,800 barrels).

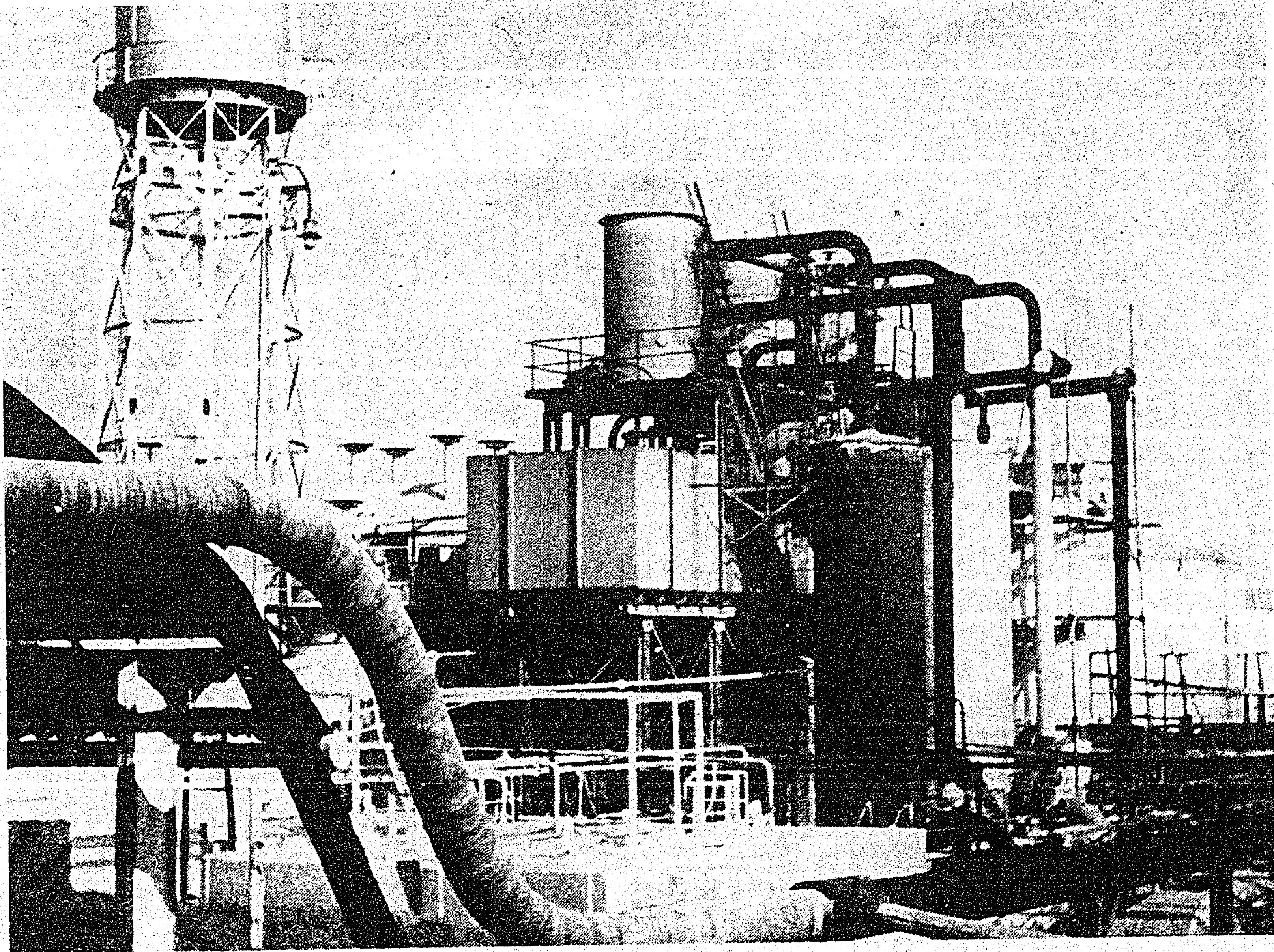
3.5 DORTMUND

Refinery: Westfälische Mineraloel- und Asphaltwerke, W.H. Schmitz K.G.

Location: On the north side of the Dortmund petroleum basin on the Dortmund-Ems Canal in the Ruhr. Latitude 51° 32' N, longitude 7° 26' E.

Maps and Plans: Layout plan, not available. Location shown on map on page 163.

Description: Annual capacity 20,000 metric tons. Little data is available on this small refinery. It has shell stills but no cracking equipment and is believed to manufacture low grade lubricants.



VIEW OF DISTILLATION SECTION, REFINERY OF DEUTSCH AMERIKANISCHE PETROLEUM-
GESELLSCHAFT, DÜSSELDORF

3.6 DÜSSELDORF

Refinery: Deutsch-Amerikanische Petroleum-Gesellschaft

Location: On Rhine River harbor at Düsseldorf. Street address, Fringstrasse 24.
Latitude 51° 13' N, longitude 6° 47' E.

Maps and Plans: Layout plan, page 96. Location map, below. Photograph, page 94.

Description: Annual capacity 25,000 metric tons. This small plant is a combination bulk plant and gasoline rerunning unit. It is equipped with a still, run-down tanks, agitators and process tanks. The plant also has a boiler and pumphouse, and filling racks for railway tank cars, barges and trucks.

Total tankage: Approximately 20,000 metric tons (126,000 barrels).

Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: At Reisholz on the north bank of the Rhine, four miles southeast of Düsseldorf. Latitude 51° 10' N, longitude 6° 51' E. A large power station adjoins the plant on the west.

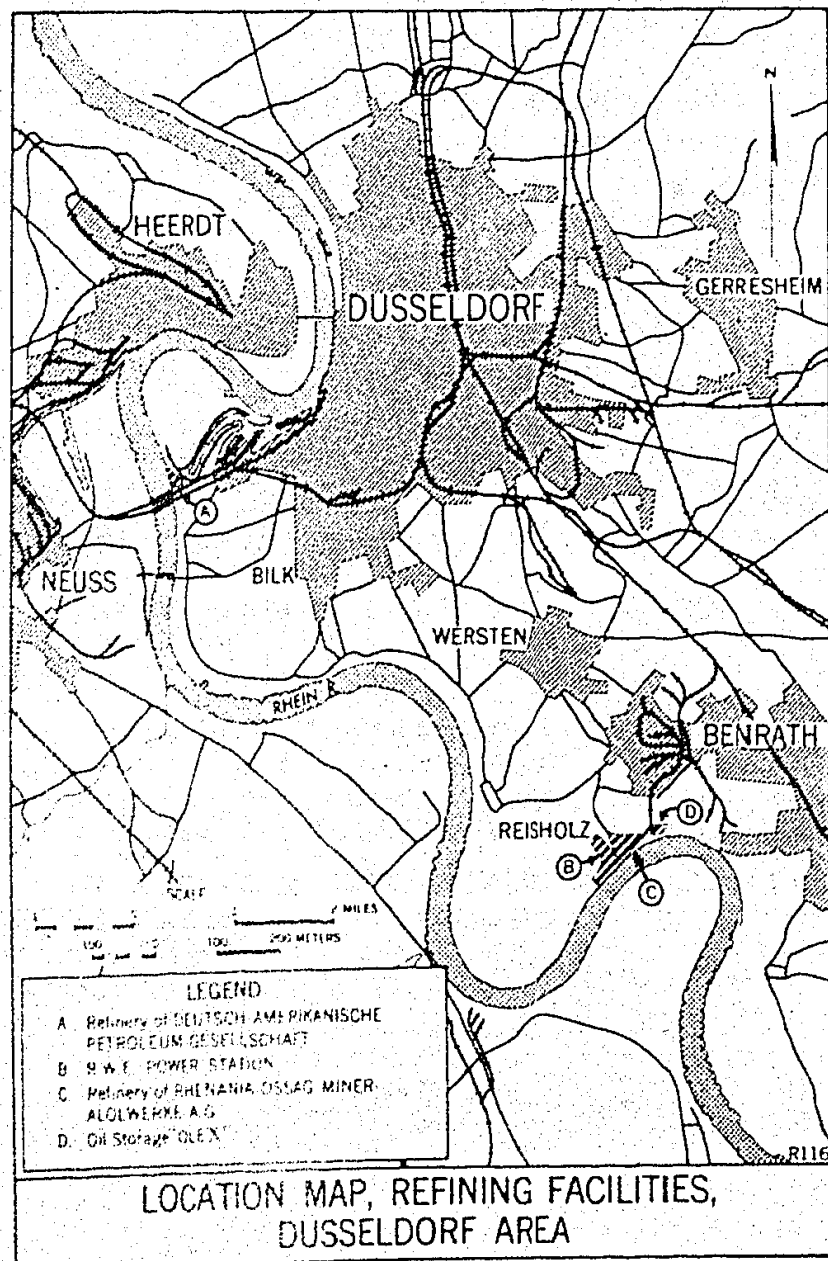
Maps and Plans: Layout plan, page 97. Location map below. Photograph, page 98.

Description: Annual capacity 65,000 metric tons. This is a rerunning plant equipped with shell stills and manufactures white spirits, special benzines and gasolines. It is accessible by road, rail and barge. Prior to the war stocks were normally received by river tank barges coming from Rotterdam, the port of importation in the Netherlands.

Total tankage: A prewar tankage list is given below. It has not been possible to definitely identify the tanks listed with those shown on the layout plan on page 97.

Details of Tankage

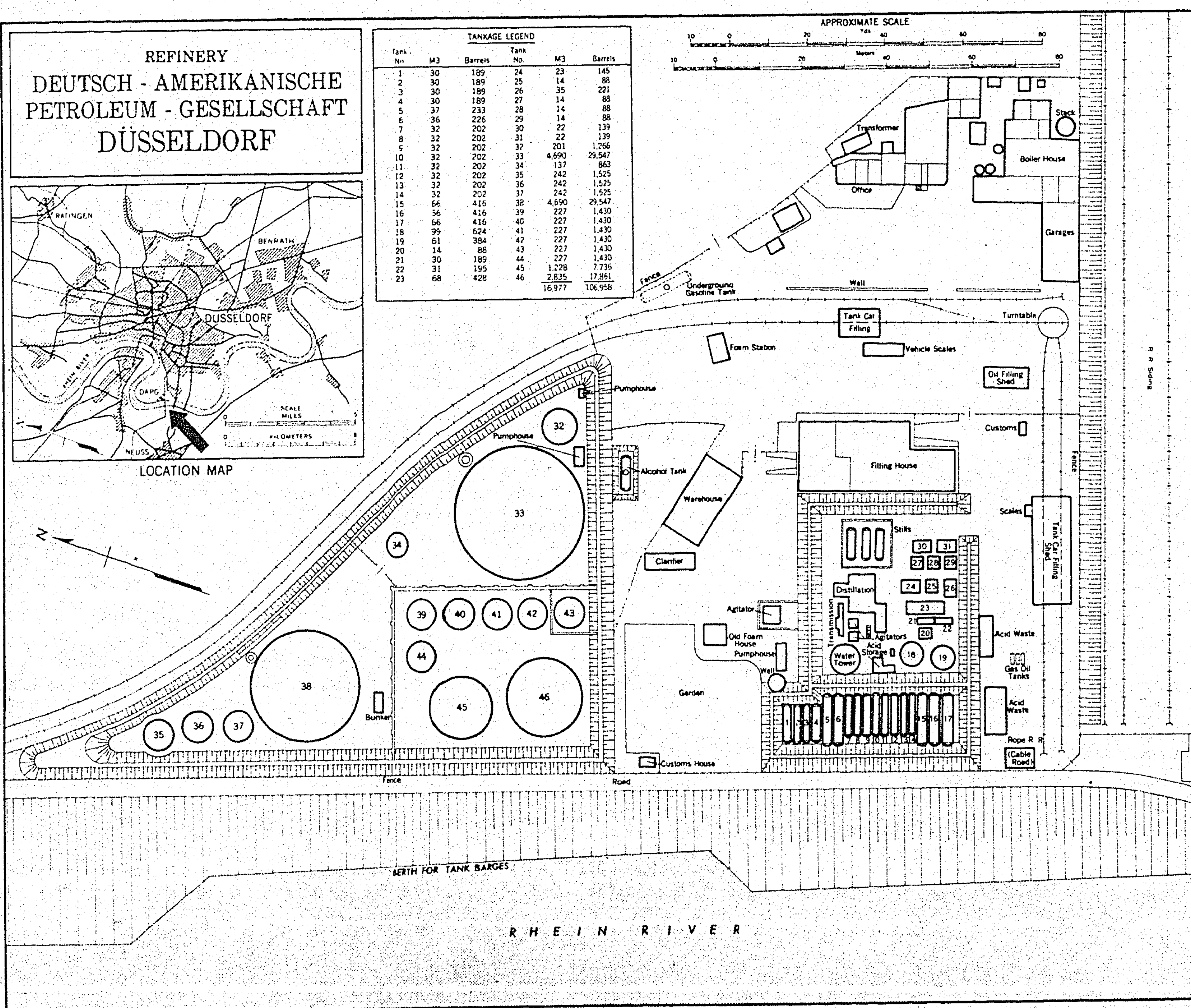
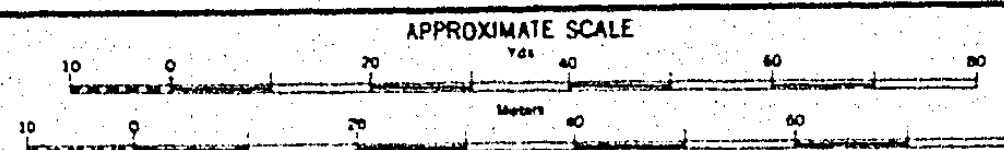
Tank No.	Product	Capacity	
		M ³	Barrels
A	Gasoline	2,656	16,733
B	"	4,325	27,248
C	"	1,471	9,267
D	Gas oil	1,471	9,267
E	Gasoline	1,048	6,602
F	"	654	4,120
G	"	656	4,133
H	"	5,192	32,710
I	"	5,182	32,647
K	"	2,915	18,365
L	"	2,032	12,802
1	"	622	3,919
2	"	709	4,467
3	"	624	3,931



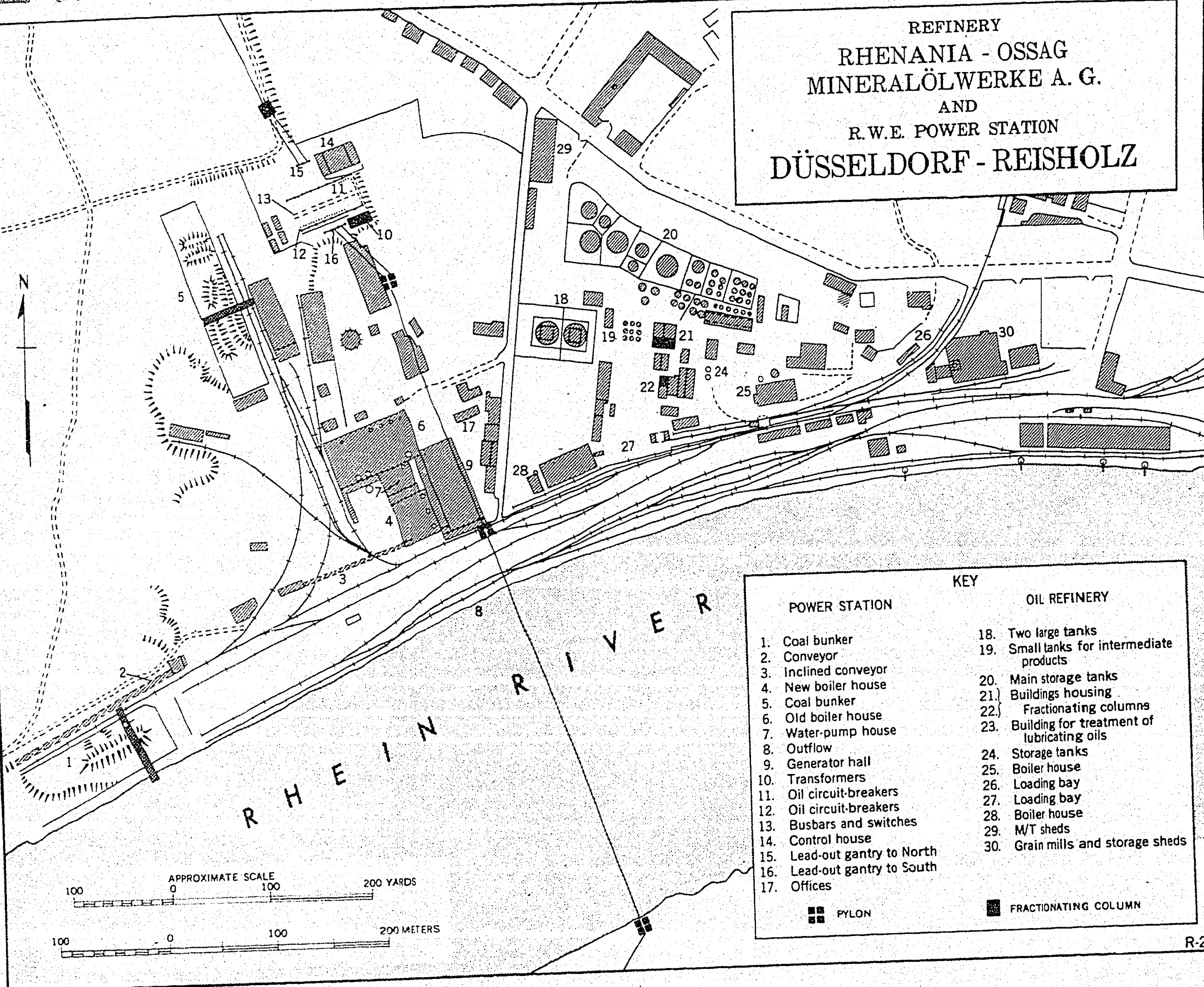
A map of the Düsseldorf region. The Rhine River is shown winding through the area. Major roads are depicted with solid lines, and smaller roads with dashed lines. Shaded areas represent urban or developed regions. Labels include 'RATINGEN' in the top left, 'BENRATH' in the top right, 'DUSSELDORF' in the center, 'DARG' (Düsseldorf Airport) near 'NEUSS' at the bottom, and 'DIESEL' near the airport. A large black arrow points to the 'DARG' area. A scale bar at the bottom right shows distances in miles (0 to 5) and kilometers (0 to 8).

LOCATION MAP

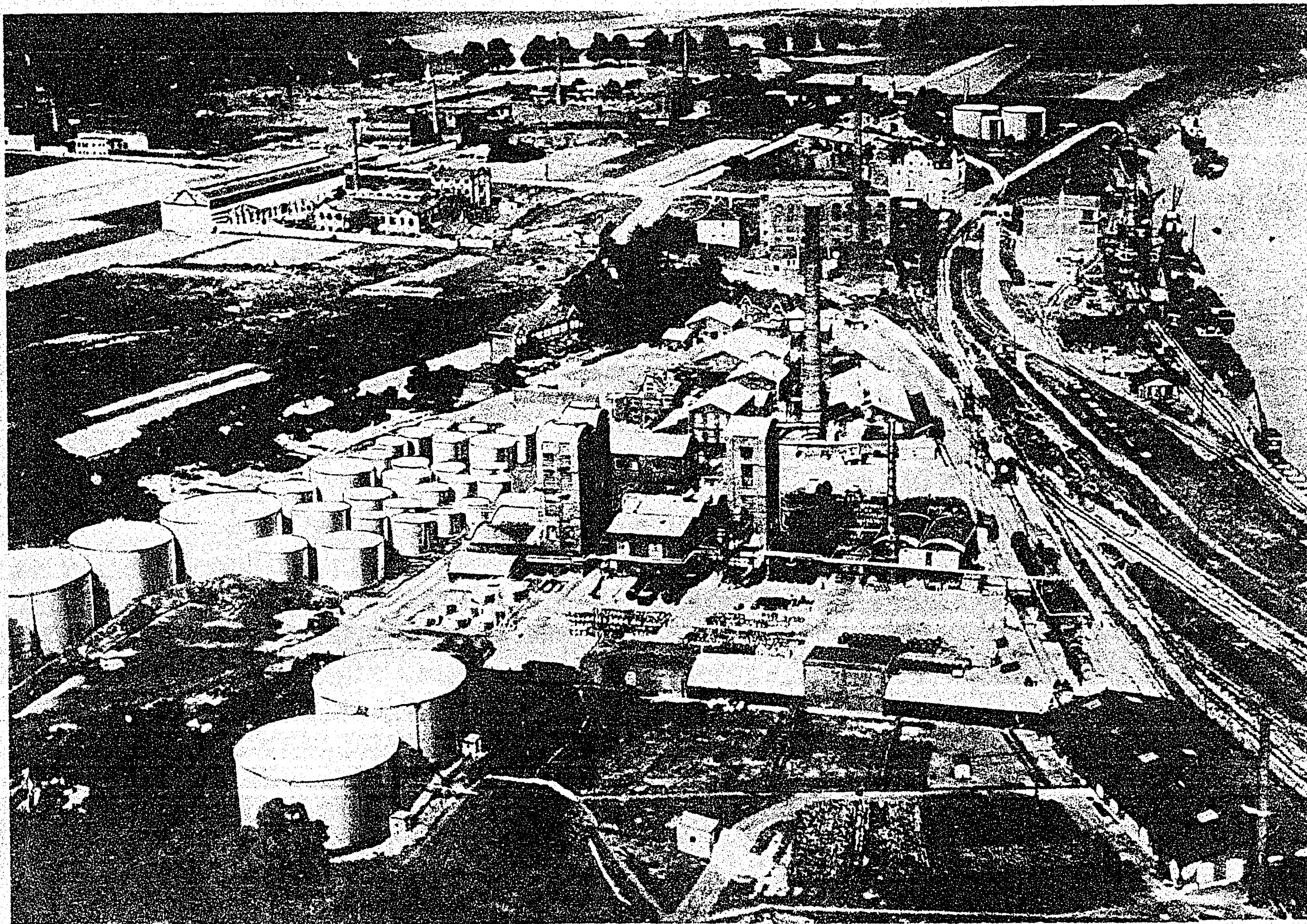
Tank No.	M3	Barrels	Tank No.	M3	Barrels
1	30	189	24	23	145
2	30	189	25	14	88
3	30	189	26	35	221
4	30	189	27	14	88
5	37	233	28	14	88
6	36	226	29	14	88
7	32	202	30	22	139
8	32	202	31	22	139
9	32	202	32	201	1,266
10	32	202	33	4,690	29,547
11	32	202	34	137	863
12	32	202	35	242	1,525
13	32	202	36	242	1,525
14	32	202	37	242	1,525
15	66	416	38	4,690	29,547
16	56	416	39	227	1,430
17	66	416	40	227	1,430
18	99	624	41	227	1,430
19	61	384	42	227	1,430
20	14	88	43	227	1,430
21	30	189	44	227	1,430
22	31	195	45	1,228	7,736
23	68	428	46	2,835	17,861
					16,977
					106,958



REFINERY
RHENANIA - OSSAG
MINERALÖLWERKE A. G.
AND
R.W.E. POWER STATION
DÜSSELDORF - REISHOLZ



KEY	
POWER STATION	OIL REFINERY
1. Coal bunker	18. Two large tanks
2. Conveyor	19. Small tanks for intermediate products
3. Inclined conveyor	20. Main storage tanks
4. New boiler house	21. Buildings housing
5. Coal bunker	22. Fractionating columns
6. Old boiler house	23. Building for treatment of lubricating oils
7. Water-pump house	24. Storage tanks
8. Outflow	25. Boiler house
9. Generator hall	26. Loading bay
10. Transformers	27. Loading bay
11. Oil circuit-breakers	28. Boiler house
12. Oil circuit-breakers	29. M/T sheds
13. Busbars and switches	30. Grain mills and storage sheds
14. Control house	
15. Lead-out gantry to North	
16. Lead-out gantry to South	
17. Offices	
 PYLON	 FRACTIONATING COLUMN



VIEW LOOKING NORTHEAST, REFINERY OF RHENANIA-OSSAG MINERALÖLWERKE A. G.
REISHOLZ (NEAR DÜSSELDORF) Pre-war photograph, date unknown
Tankage belonging to "OLEX" bulk plant can be seen in upper right background

Details of Tankage (Continued)

Tank No.	Product	Capacity	
		M ³	Barrels
4	Gasoline	330	2,079
5	"	286	1,802
6	"	286	1,802
7	"	285	1,796
8	"	330	2,079
9	"	329	2,073
12	"	293	1,846
16	"	262	1,651
17	"	261	1,644
18	"	261	1,644
19	"	262	1,651
20	"	261	1,644
21	"	261	1,644
N 1	"	205	1,292
N 2	"	204	1,285
N 3	"	204	1,285
N 7	"	293	1,845
7	less than 200 M ³ Gasoline	1,251	7,881
18	Receiving Tanks Gasoline	451	2,841
39	Filling tanks Gasoline	971	6,117
T o t a l		36,843	232,112

3.7 EMMERICH

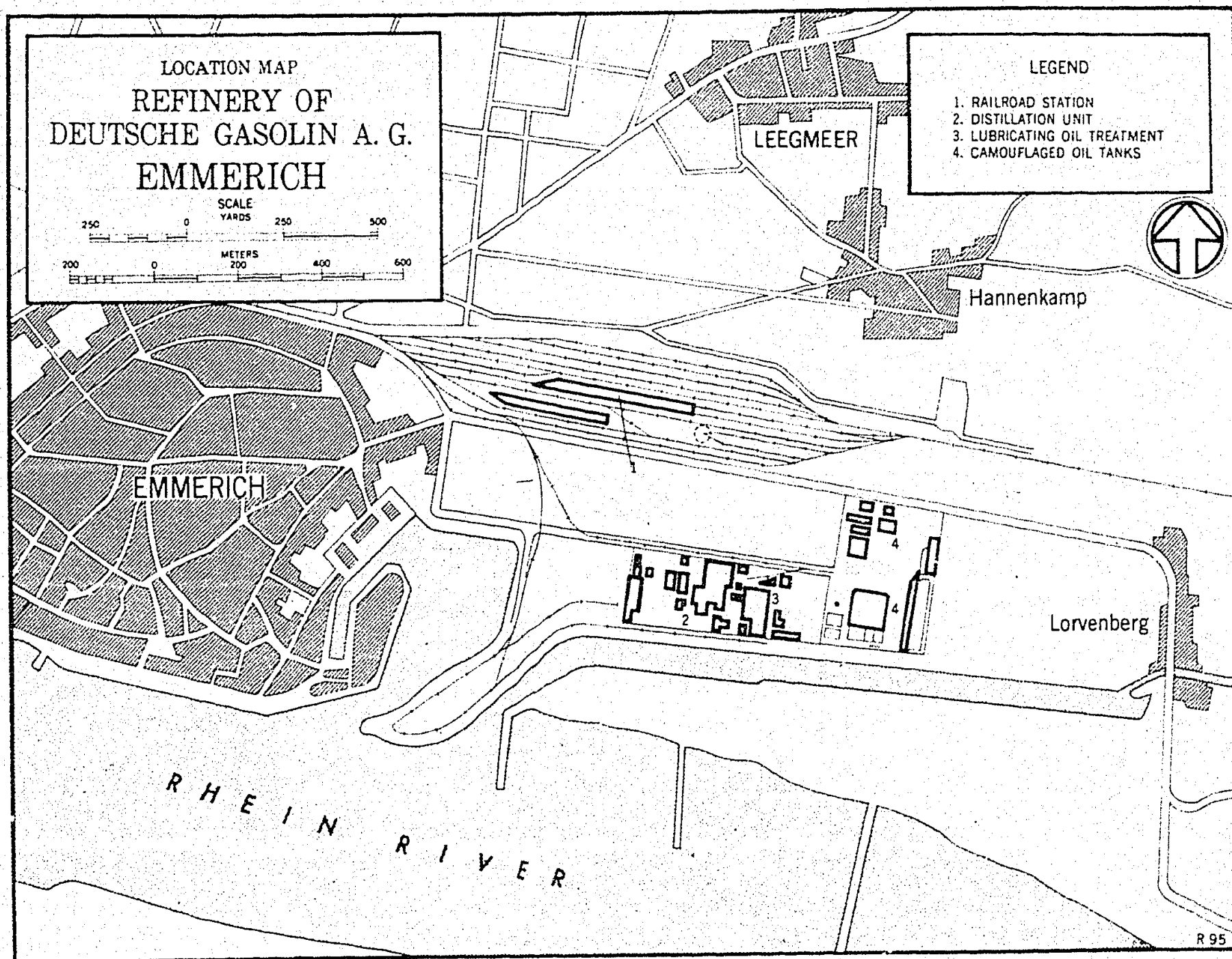
Refinery: Deutsche Gasolin A.G.

Location: At Emmerich on the north bank of the Rhine, near the Netherlands border. Latitude 51° 50' N, longitude 6° 16' E. The plant lies between one arm of the river harbor for barges, and the railway yard.

Maps and Plans: Layout plan, page 100.

Description: Annual capacity 60,000 metric tons. This refinery is equipped with pipe stills and a small cracking unit. It processes indigenous German crude oil and produces gasoline, gas oil, lubricants and greases.

Total tankage is unknown but at least ten large partially buried storage tanks are reported.



3.8 HAMBURG

Refinery: Deutsche Petroleum A.G.

Location: On the north side of the Reiherstieg Canal in the Wilhelmsburg area of Hamburg harbor, approximately 1-1/2 miles west of the Wilhelmsburg railway station. Adjoins the Rhenania-Ossag Mineralölwerke A.G. Wilhelmsburg refinery.

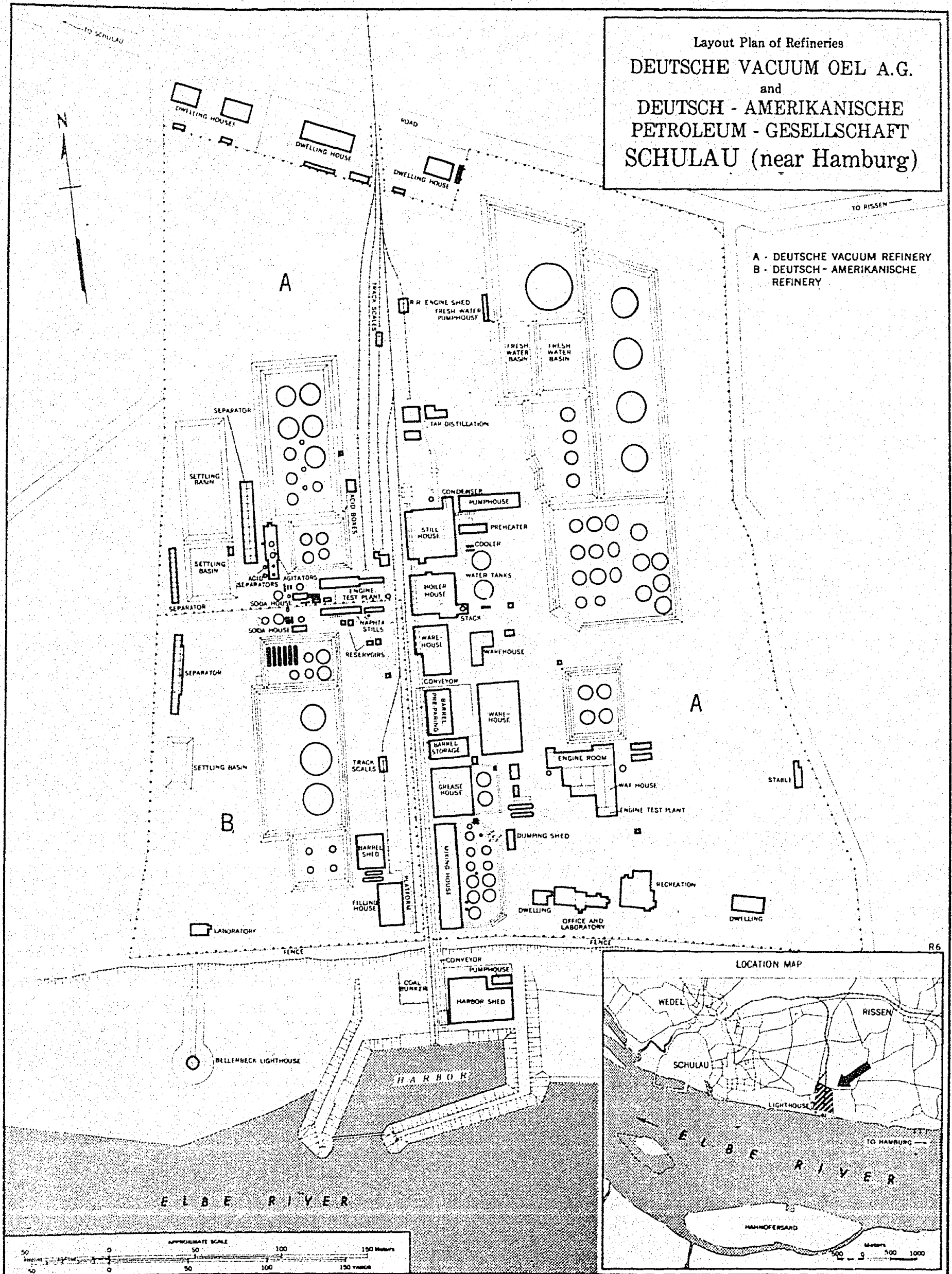
Maps and Plans: Layout plan, page 123. Location shown on pages 116 and 246-247.

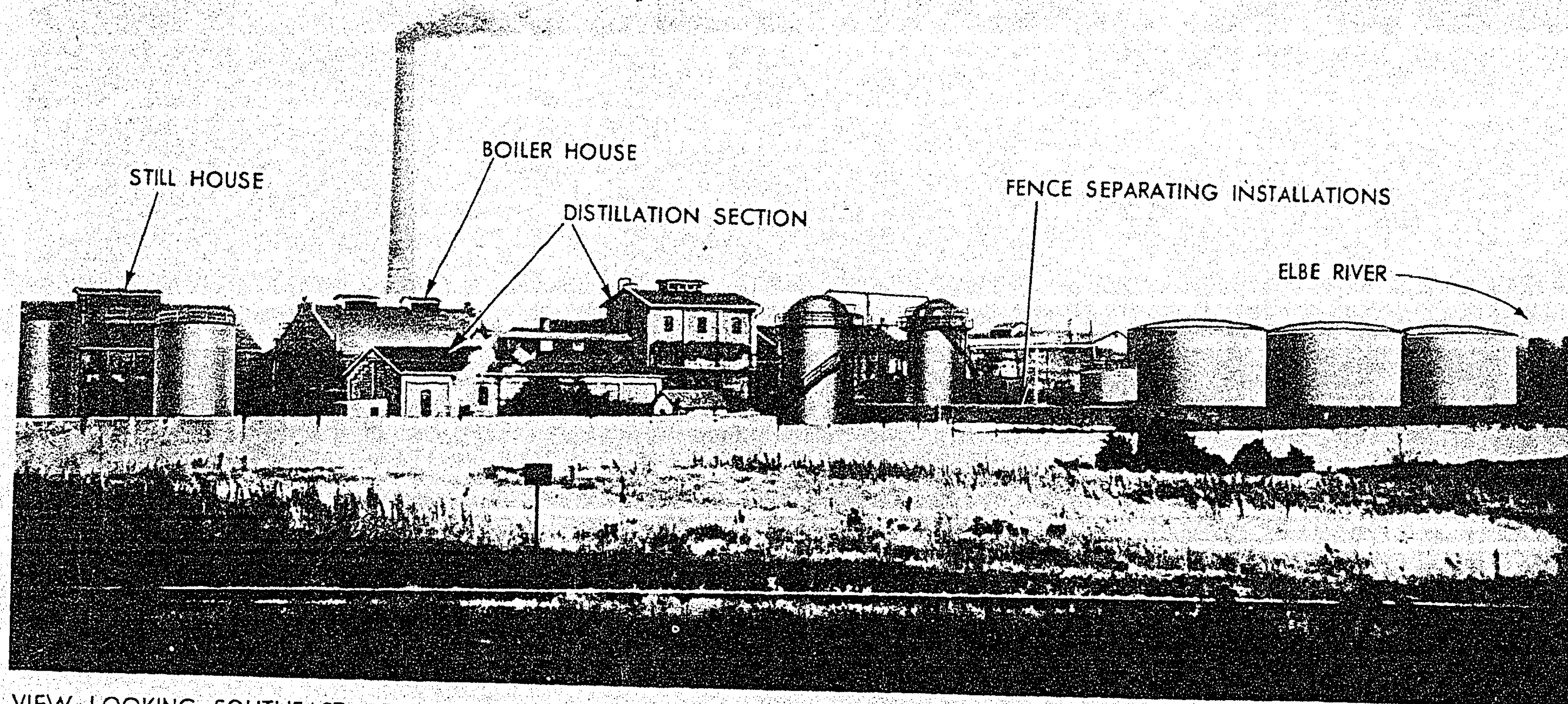
Description: Annual capacity 65,000 metric tons. This refinery is equipped with shell stills and vacuum distillation but has no cracking equipment. A detailed description is not available. The layout plan on page 123 is drawn from air cover.

Tankage is estimated at 95,000 metric tons (598,500 barrels)

Refinery: Deutsche Vacuum Oel A.G.

Location: At Schulau on the north bank of the Elbe. Schulau, latitude 53° 34' N, longitude 9° 43' E, is just southeast of the village of Wedel and some 19 miles downstream from the Hamburg bridge.





VIEW LOOKING SOUTHEAST, REFINERIES OF DEUTSCHE VACUUM OEL A.G. & DEUTSCH AMERIKANISCHE PETROLEUM-GESELLSCHAFT SCHULAU (NEAR HAMBURG). THE DEUTSCHE VACUUM REFINERY IS IN THE LEFT FOREGROUND AND RIGHT BACKGROUND. THE DEUTSCH AMERIKANISCHE REFINERY IS IN THE RIGHT FOREGROUND.

Maps and Plans: Layout plan, page 101. Location shown on map on pages 246-247. Photograph on page 102.

Description: Annual capacity 20,000 metric tons. This plant was equipped with a shell still, with a daily capacity of 1,000 barrels but was not equipped for full refining operations. Wax distillates shipped by barge or railway tank car, from the company's refinery at Bremen were pressed and the plant was designed primarily as a lubricating oil and grease treating blending and compounding plant manufacturing high grade lubricants.

In one corner of the plant the Deutsch-Amerikanische Petroleum-Gesellschaft operated a small gasoline rerunning still and treating plant of about 10,000 metric tons per annum capacity.

Tankage: Total tankage at Schulau was approximately 197,000 metric tons (1,241,100 barrels).

Refinery: Ebano Asphalt-Werke A.G.

Location: On the south bank of the Süder-Elbe River in the Harburg section of Hamburg harbor. Latitude 53° 33' N, longitude 10° 0' E.

Maps and Plans: Layout plan, page 105. Location shown on map on pages 246-247.

Description: Annual capacity, 400,000 metric tons. This plant was designed as an asphalt refinery to operate on heavy Mexican or Venezuelan crudes. The plant can receive ocean tankers and has barge and rail car loading facilities.

There were two stage pipe stills, each with an atmospheric stage and vacuum stage fractionating towers. The capacities of the two distillation units were:

	Unit No. 1	Unit No. 2
	Barrels per day	
Maximum capacity	4,800	5,100
Average actual capacity	4,200	4,500

There is no cracking equipment nor lubricating oil facilities.

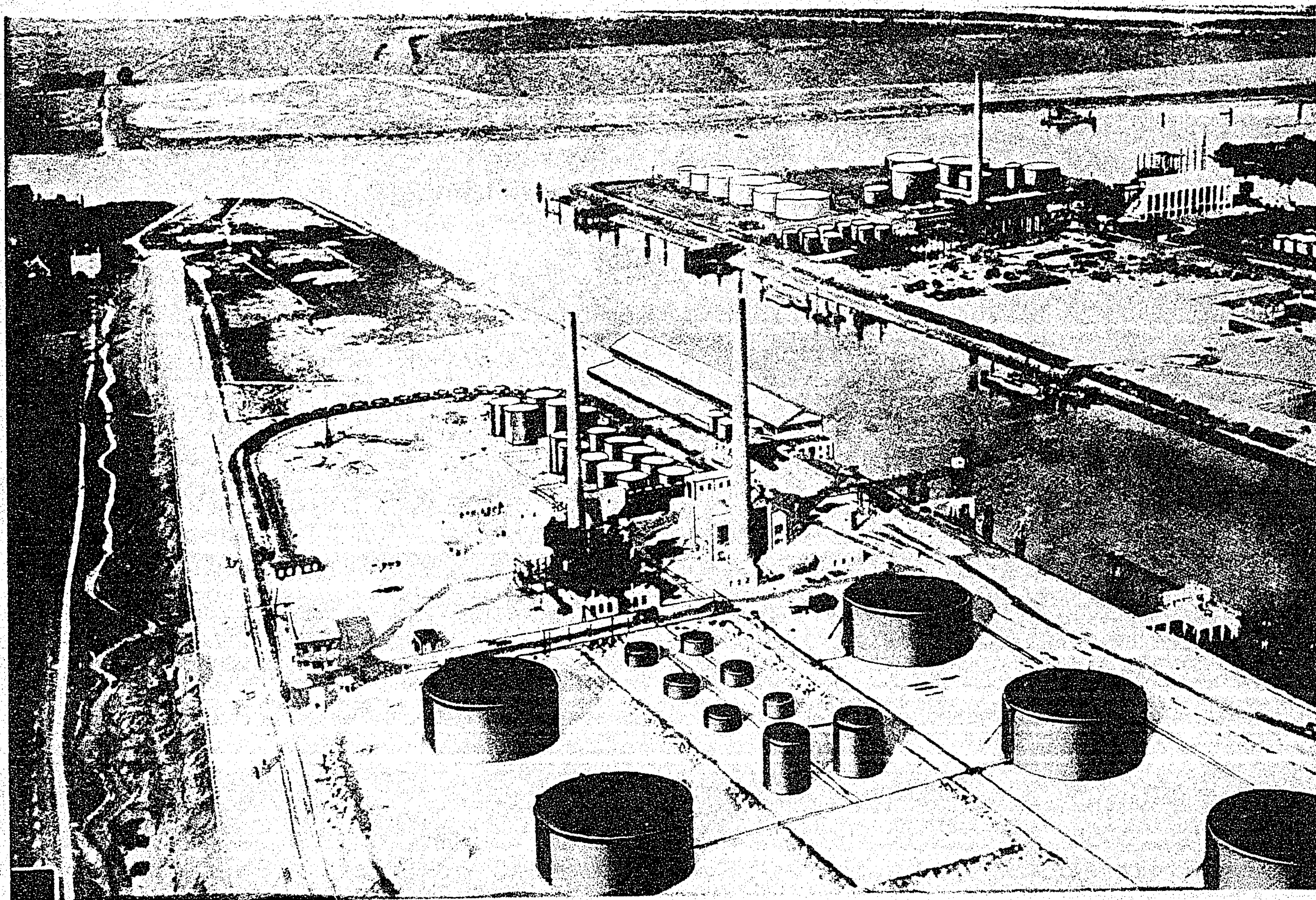
The asphalt oxidizing plant contains two horizontal and one vertical batch stills of 700 barrels capacity each, scrubbers, blowers, and cut-back tanks with electric motor-driven paddles.

The boiler plant contains three 323 B.H.P. boilers, operating pressures 150 pounds per square inch. The boilers and the stills are all coal fired. Electric power is obtained from the city lines, but a 40 kw. emergency generator was installed in the plant.

The numerous process pumps, transfer and loading pumps and fire pumps are steam-driven while the fresh water pumps are electrically-driven.

Water for the refinery operations is taken from the river.

The plant has a foamite fire protection system and also all tanks are equipped with sprinklers.



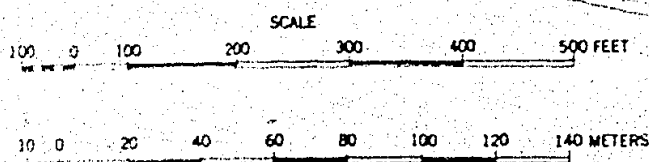
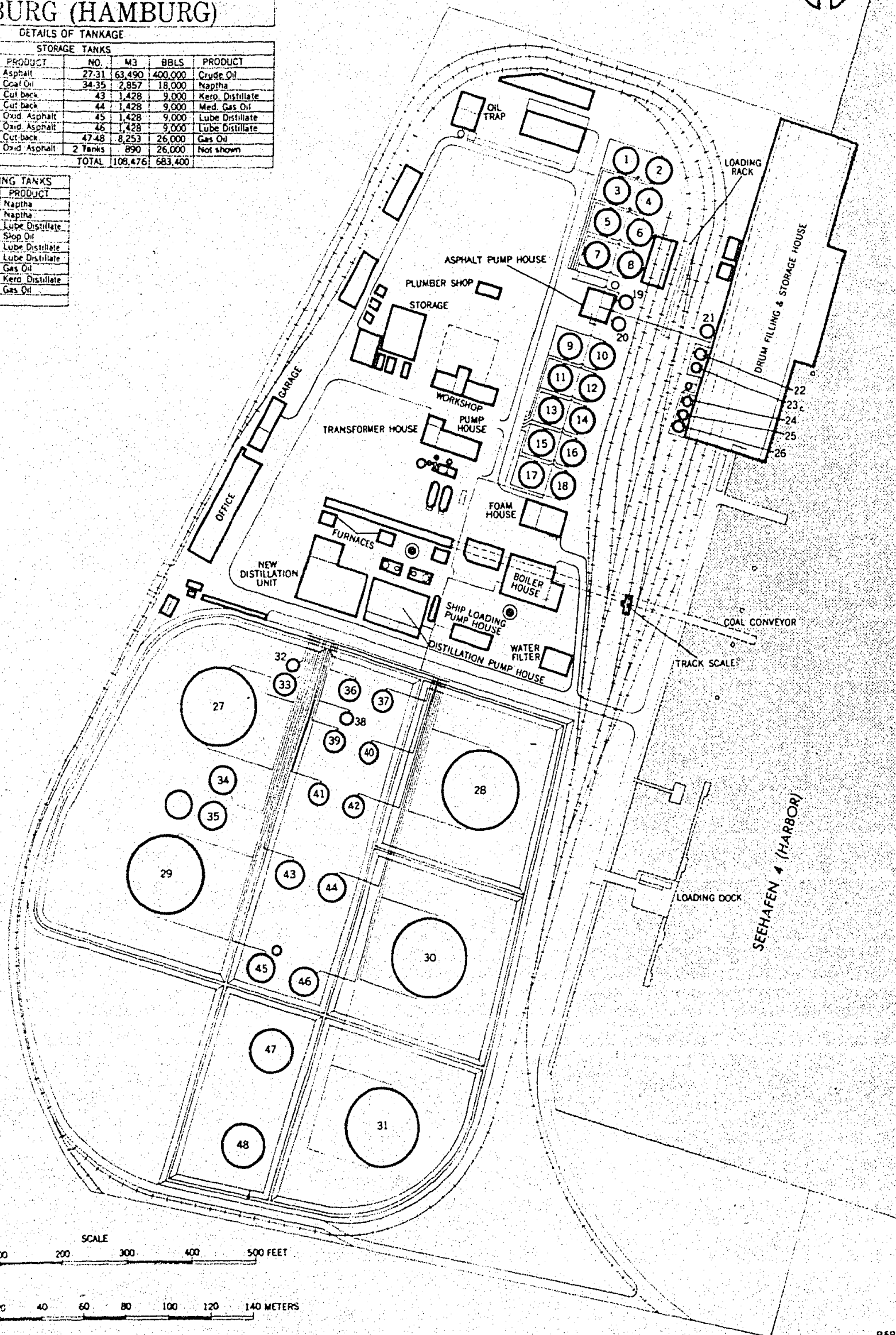
VIEW LOOKING NORTH, REFINERIES OF EBANO ASPHALT-WERKE A. G. (IN FOREGROUND) AND
RHENANIA-OSSAG MINERALÖLWERKE A. G. (IN BACKGROUND) AT HARBURG (HAMBURG)

PLAN OF EBANO ASPHALT-WERKE A. G. HARBURG (HAMBURG)

DETAILS OF TANKAGE

STORAGE TANKS							
NO.	M3	BBLS	PRODUCT	NO.	M3	BBLS	PRODUCT
1-18	25,714	162,000	Asphalt	27-31	63,490	400,000	Crude Oil
19-20	540	3,400	Coal Oil	34-35	2,857	18,000	Naptha
21	120	750	Cut back	43	1,428	9,000	Kero. Distillate
22	180	1,130	Cut back	44	1,428	9,000	Med. Gas Oil
23	180	1,130	Oxid. Asphalt	45	1,428	9,000	Lube Distillate
24	180	1,130	Oxid. Asphalt	46	1,428	9,000	Lube Distillate
25	180	1,130	Cut back	47-48	8,253	26,000	Gas Oil
26	180	1,130	Oxid. Asphalt	2 Tanks	890	26,000	Not shown
TOTAL		108,476		683,400			

RUNDOWN & WORKING TANKS			
NO.	M3	BBLS	PRODUCT
32	49	310	Naptha
33	238	1,500	Naptha
34	238	1,500	Lube Distillate
35	238	1,500	Stop Oil
36	49	310	Lube Distillate
37	238	1,500	Lube Distillate
38	238	1,500	Gas Oil
39	238	1,500	Kero. Distillate
40	238	1,500	Gas Oil
41	238	1,500	Kero. Distillate
42	238	1,500	Gas Oil
TOTAL		11,120	



Details of Tankage

	Capacity	
	Metric Tons	Barrels
Run-down tanks	1,765	11,120
Storage tanks	108,476	683,400
T o t a l	110,241	694,520

Refinery: Europäische Tanklager- und Transport A.G. (Eurotank).

Location: Just southeast of the Neuer Petroleumhafen which is on the north side of the Elbe River in the western part of Hamburg. Numerous petroleum terminals are located in this vicinity.

Maps and Plans: Layout plan, page 108. Flow diagrams, pages 111 to 113. Location shown on map on pages 246, 247-248. Photographs, pages 107, 110, and 114.

Description: Annual capacity: 400,000 metric tons. The rated capacity is 7,500 barrels daily of East Texas crude oil or similar oils in balanced operation. However, actual capacity, according to Winkler Koch Engineering Co., who designed the plant, is 9,000 barrels daily of East Texas crude in balanced operation; and up to 11,000 barrels daily of other crudes in operations when high gasoline yields are not sought.

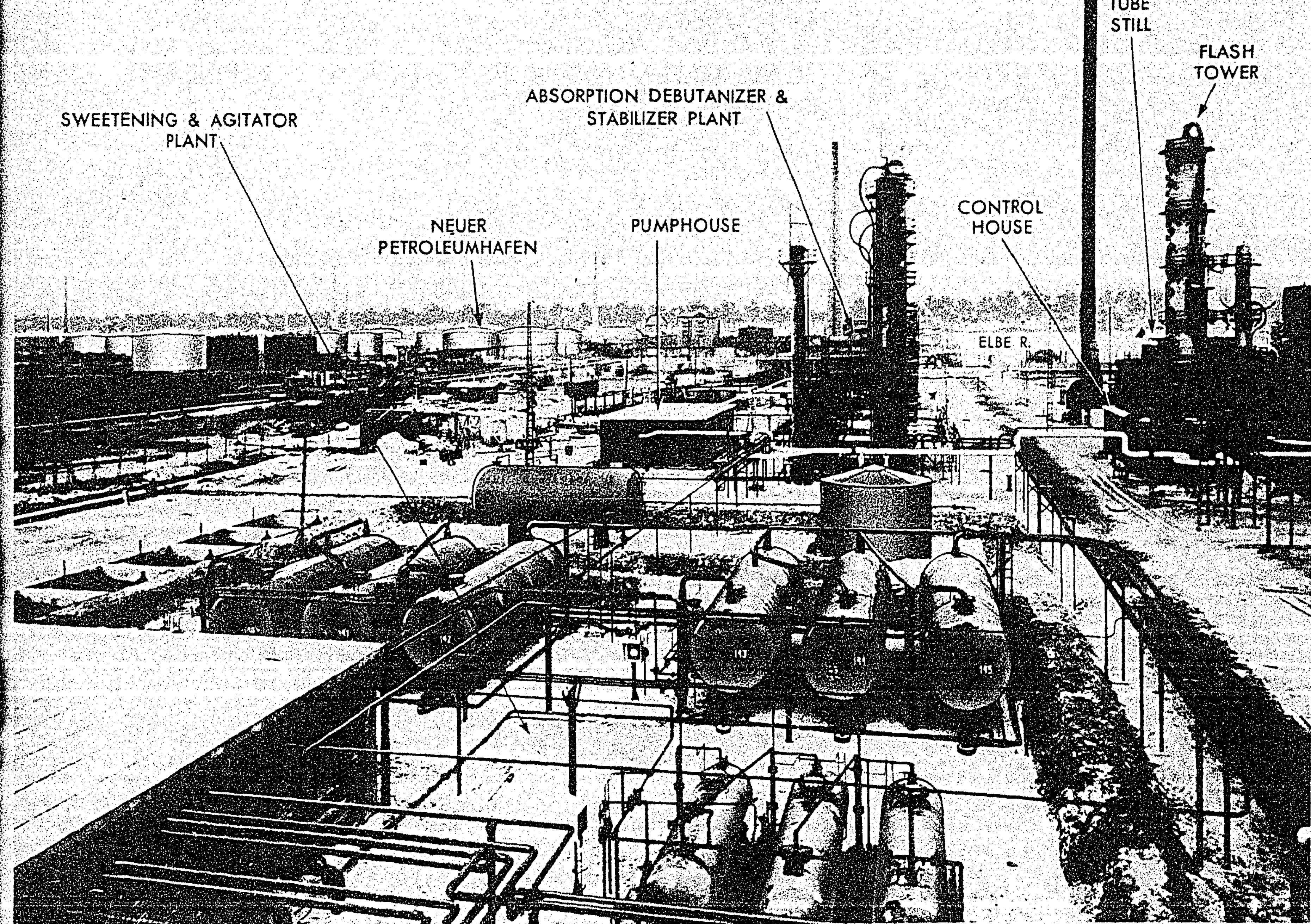
From a mixture of East Texas and Mid-Continent crude, the following yields are obtained when running somewhat above the guaranteed capacity of 7,500 barrels per day:

Gasoline - 390-400° E.P. - 10 lb. Reid Vapor Pressure.	65%	by Vol.
Kerosene or Light Gas Oil	10%	" "
Fuel Oil (lighter than Bunker C)	20%	" "
Gas Loss	5%	" "

The refinery originally started up on a mixture of Mid-Continent and East Texas crude oils. It has since used Rumanian crude and residues, Coastal U.S.A. crudes, Mexican crude and naphthas, German crude, and other crudes, topped crudes, gas oils, and straight run naphthas.

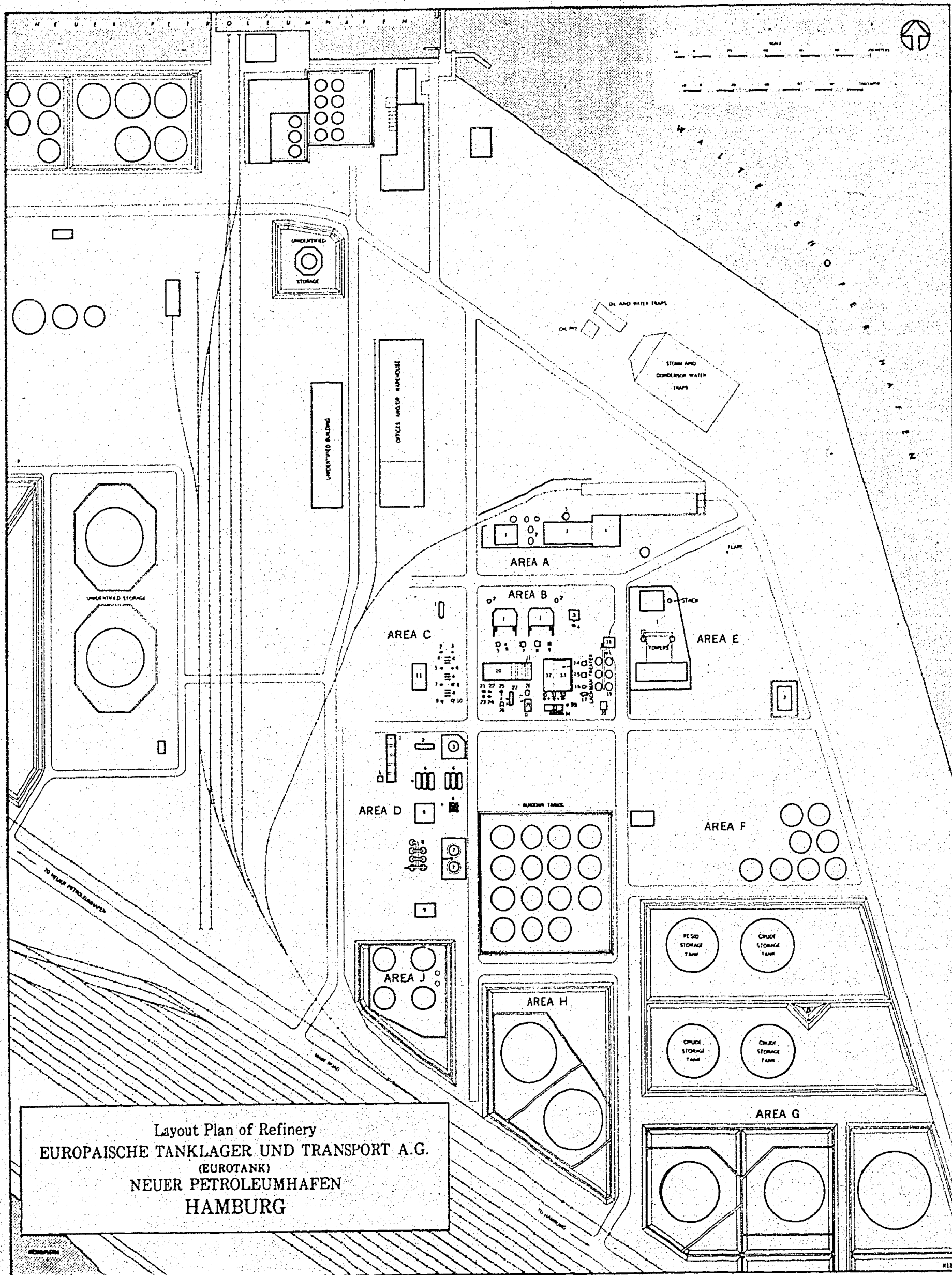
This refinery was completed in 1935 and though designed by Winkler Koch Engineering Co. all the materials were made in Germany except a few hot oil pumps, instruments, control valves, and other incidentals which came from the United States. Among the German refineries it is second only to the Rhenania-Ossag's Harburg refinery in capacity.

Processing equipment consisted of a combined skimming, cracking, and reforming unit. All the heat for topping is obtained entirely by heat exchange. In this topping operation the crude first went through heat exchanger and into a crude debutanizer, operating at up to 50 pound pressure, where a light straight run gasoline was flashed off. Then through additional heat exchanger into a crude flash tower, operating at approximately atmospheric pressure, where an overhead stream of a heavy straight run gasoline, and two side streams, one of kerosene and one of diesel gas oil, were removed. A total of about 50 per cent overhead could be taken from East Texas crude. The bottoms then went directly to the vapor separator of the cracking still where they acted as quench oil and where heavier gas oils were distilled out of them. The bottoms from the vapor separator went to a vacuum tower where a high melting point pitch was produced. Some of this pitch was sold for asphalt. The penetration, melting point, etc., of pitch could be rather well controlled. Ordinarily, however, it was cut back with a non-viscous diluent from the side stream of the cracking still bubble tower and sold as residual fuel oil.



VIEW LOOKING NORTH, VARIOUS PROCESSING UNITS, "EUROTANK" REFINERY, NEUER PETROLEUMHAFEN, HAMBURG

REFINING
"Eurotank" refinery, Hamburg



Refinery of
EUROPAISCHE TANKLAGER UND TRANSPORT A.G., NEUER PETROLEUMHAFEN, HAMBURG
(EUROTANK)

LEGEND

AREA A. Power Station
& Fire House

1. Fire House
2. Fuel Oil Tanks
3. Boiler House
4. New Addition to Boiler House
5. Stack

AREA B. Topping Cracking
& Lachman Unit

1. Tube Still
2. Stack
3. Steam Superheater
4. Steam Separator
5. Flash Tower
6. Naptha & Gas Oil Stripper Tower
7. Vapor Separator
8. Bubble Tower
9. Hot Accumulator
10. Gasoline Condenser
Box
11. Cooler Box
12. Hot Oil Pumphouse
13. P.D. & Lachman Condenser Box
14. Contact Tower
15. Sludge Accumulator
& Fractionating Tower
16. Lime Rock Tower
17. Lime Rock Tower
& Bottoms Separator

} Control
House

18. Filter Press House
19. Zinc Chloride Storage Tanks
20. Zinc Chloride Sump
21. Gasoline Reflux Drum
22. Naptha Reflux Drum
23. Gasoline After Cooler
24. Kerosene Reflux Drum
25. Debutanizer Reflux Drum
26. Debutanizer Tower
27. Water Settler
28. Vacuum Bubble Tower
29. Vacuum Equipment
30. P.D. Gas Separator
& After Cooler
31. Water Separator
32. Lachman Gas Separator
33. Cracked Gas Oil & Resid.
Cooler Box
34. Zinc Chloride Sludge Bottom
and Lachman Fractionating
Tower Cooler Box

AREA C. Absorption Debutanizer
& Stabilizer Plant

1. Fuel Gas Surge Drum
2. Light Gasoline Stabilizer
Reflux Drum
3. Light Gasoline Stabilizer
4. Heat Exchangers, Coolers
& Reboilers

5. Gasoline Debutanizer Gas
Separator

6. Gasoline Debutanizer
7. Make Tank
8. Stripping Still
9. Reabsorber
10. Absorber
11. Pumphouse

AREA D. Sweetening & Agitator
Plant

1. Treater Trap
2. Light Gasoline Surge Drum
3. Lean Oil Balancing Tank
4. Water & Doctor Settling Tanks
5. Pumphouse
6. Oil Pit
7. Agitators
8. Lime, Caustic & Doctor
Solution Tanks
9. Transfer Pumphouse

AREA E

1. New Processing Unit
2. Water Pumphouse

AREA F. Unidentified Tankage

AREA G. Unidentified Tankage

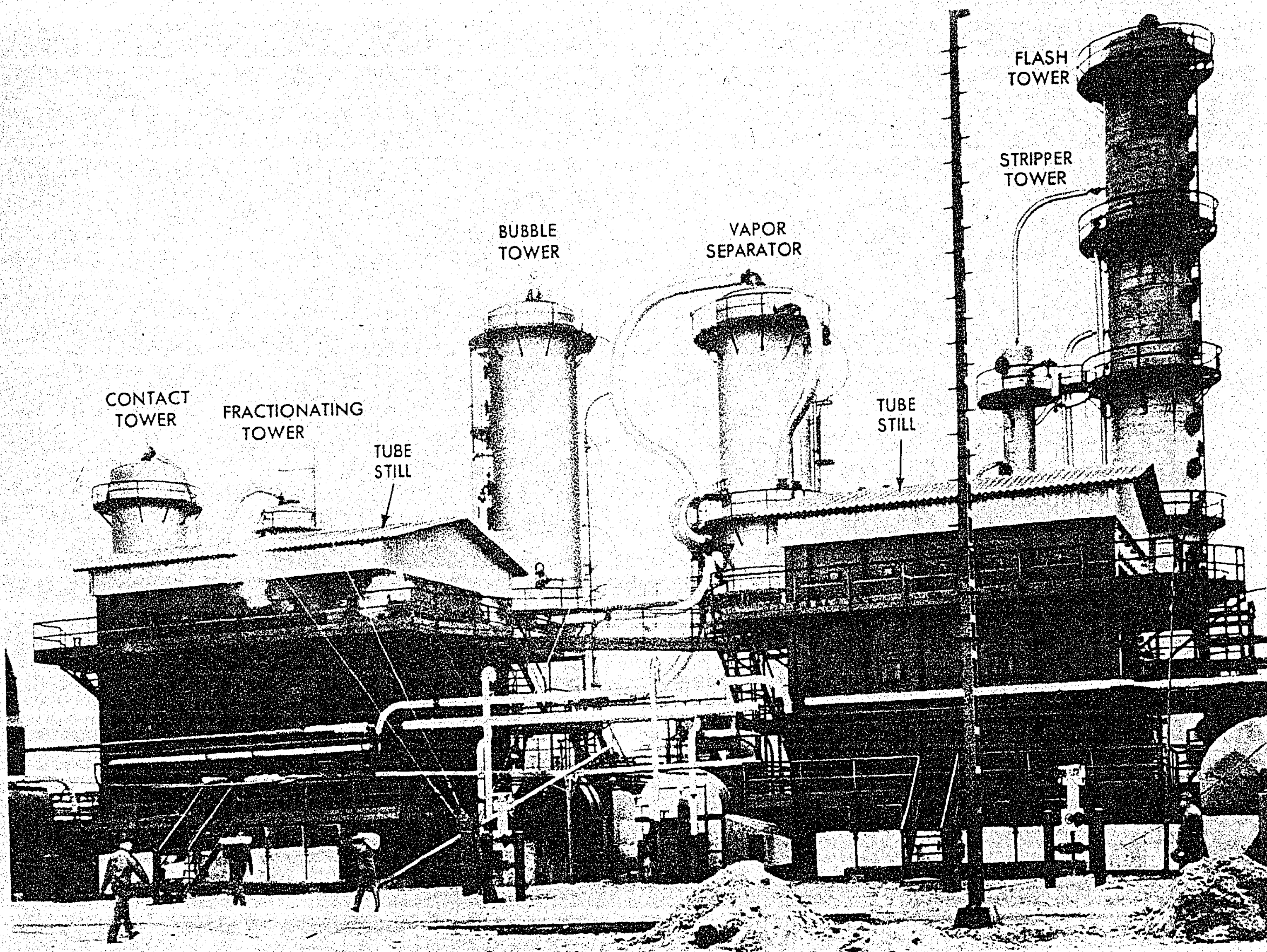
AREA H. Unidentified Tankage

AREA J. Unidentified Tankage

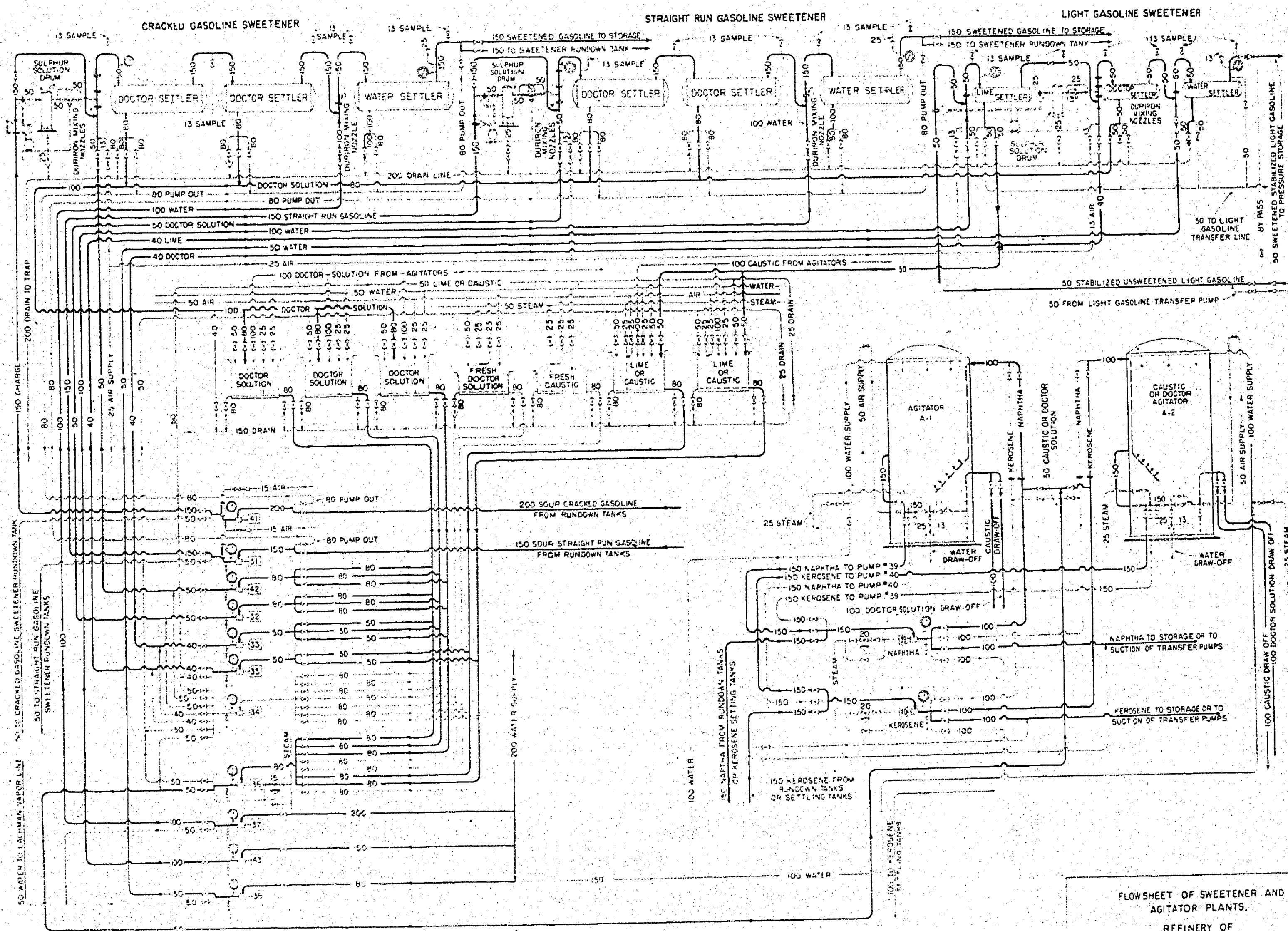
Vapors from the cracking still bubble tower, exclusive of reflux, went through a Lachman treater, and the condensed treated raw cracked gasoline went direct to a cracked gasoline debutanizer. (See page 111 to 113). The overhead from the debutanizer together with the overhead from the crude debutanizer went to a final light gasoline stabilizer. Wet fixed gas was put through a conventional absorption recovery system, the condensate from the absorbent oil still also going to the final stabilizer. The tower system on the cracking part was designed for 100 pounds operation and operated at around 50 pounds. The absorbent oil still was good for around 100 pounds and operated at around 75 pounds. The final stabilizer was good for operating at 300 pounds. Soon after the refinery was started, arrangements were made to sell C₃ - C₄ surplus condensate from the stabilizer. The Lachman treated cracked gasoline was sweet, and no ammonia was required in the rock tower. However, there was enough Mid-Continent crude oil mixed with the East Texas crude so that the kerosene was sour. Conventional sweetening equipment was provided for gasoline and kerosene.

It is believed that a Winkler-Koch de-salting equipment unit was added to this plant, as well as a Bosig fractionation unit. The latter was installed for the purpose of rerunning gasolines or naphthas to make a line of finished technical naphthas. While later plans included coking equipment, it is believed that this equipment was never installed.

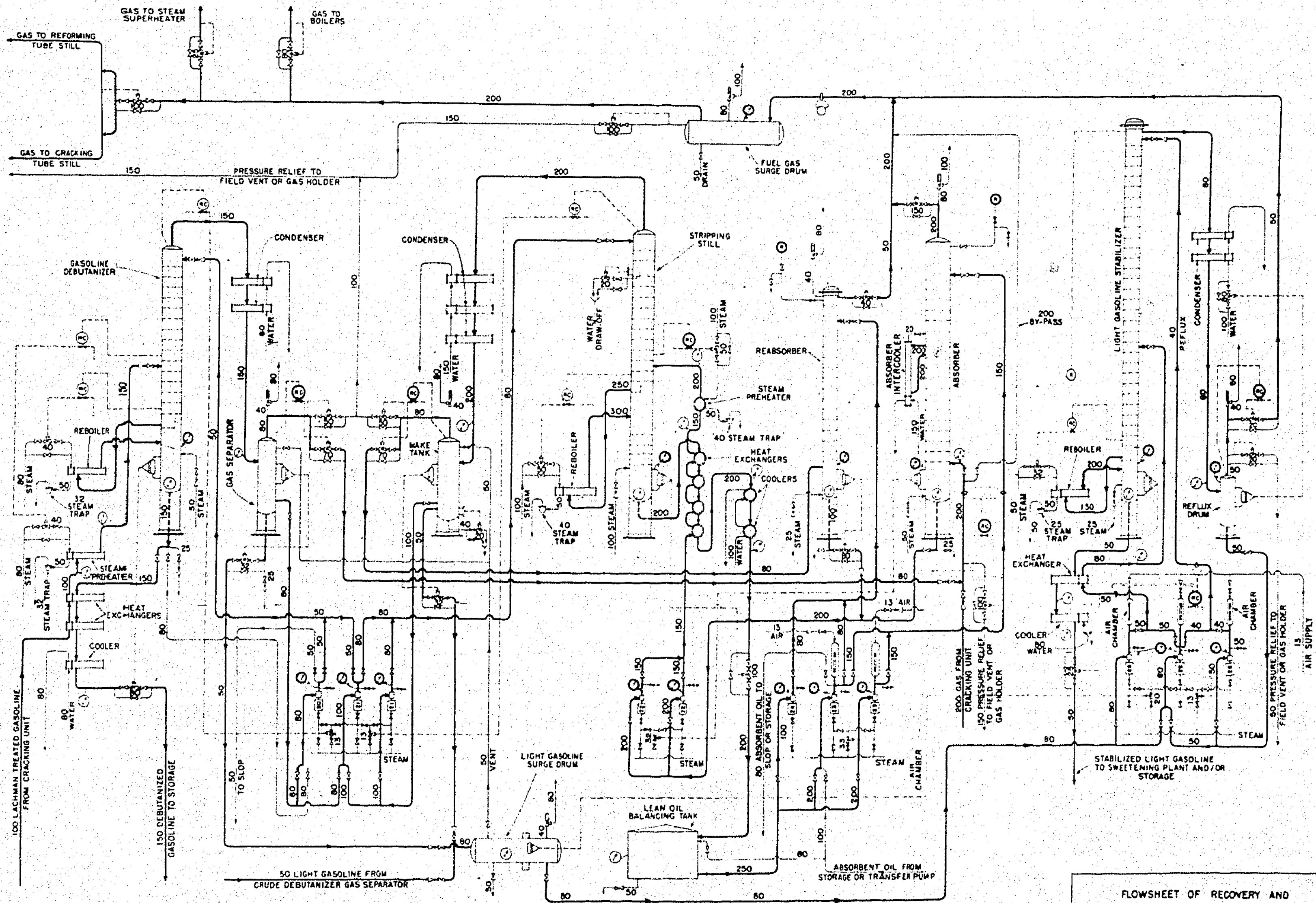
Electric power, it is believed, comes from local public service lines. Not much power is used in the refinery, however, inasmuch as most of the pumps



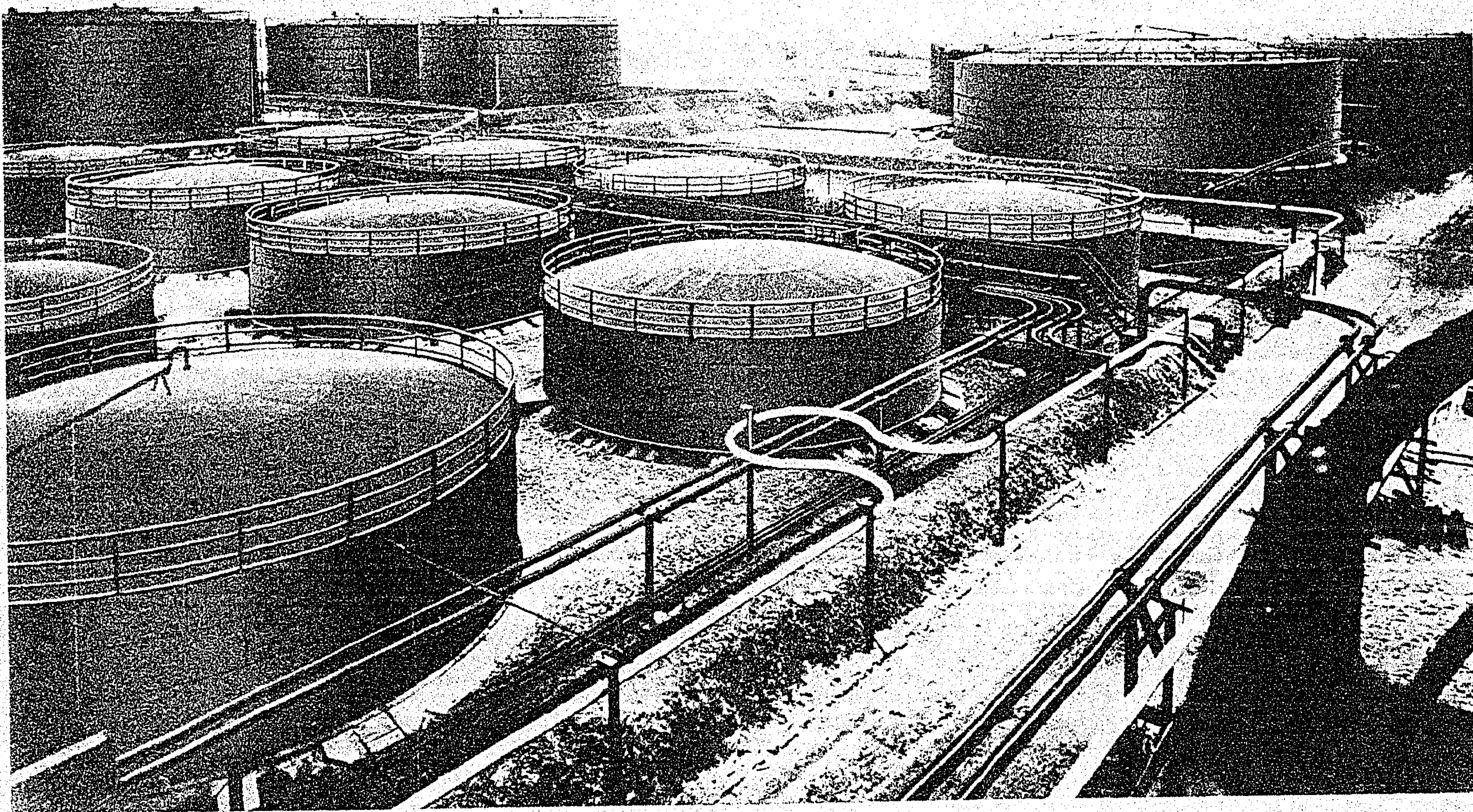
VIEW LOOKING SOUTH, CRACKING & LACHMAN PLANT, "EUROTANK" REFINERY, NEUER PETROLEUMHAFEN, HAMBURG



FLWSHEET OF SWEETENER AND
AGITATOR PLANTS,
REFINERY OF
EUROPAISCHE TANKLAGER UND
TRANSPORT,
NEUER PETROLEUMHAFEN,
HAMBURG



FLOWSHEET OF RECOVERY AND
 STABILIZATION PLANTS,
 REFINERY OF
 EUROPÄISCHE TANKLAGER UND
 TRANSPORT,
 NEUER PETROLEUMHAFEN,
 HAMBURG



VIEW LOOKING SOUTHEAST, RUNDOWN TANKS (IN FOREGROUND) AND STORAGE TANKS,
"EUROTANK" REFINERY, NEUER PETROLEUMHAFEN, HAMBURG

are steam-driven, the steam being supplied by a boilerhouse. Condensing and cooling water is taken directly out of the Elbe River and put through the condensers and coolers, through a large trap, and back into the river.

No details of tankage are available, but the tankage at the refinery and the Petroleumhafen terminals was extensive.

Refinery: Mineralölwerke Albrecht & Co. K.G.

Location: On the east side of the Reiherstieg Canal in the Grasbrook area of Hamburg harbor. Just south of Rhenania-Ossag refinery and adjacent to Ernest Schliemann's Oelwerke.

Maps and Plans: Layout sketch, page 117. Location is shown on map on pages 246-247.

Description: Annual capacity: 30,000 metric tons. This is a lubricating oil plant and has no crude distillation nor cracking facilities. No detailed description is available, but plant is reported to produce white oils and ordinary lubricants by acid and clay treatment.

Tankage capacity is approximately 30,000 metric tons (189,000 barrels).

Refinery: Oelwerke Julius Schindler G.m.b.H.

Location: Between the Neuhofer Canal and the Rethel Canal near their juncture with the Kohlbrand, in the Neuhof section of the Wilhelmsburg area. Just east of the Deutsche Erdöl terminal.

Maps and Plans: Layout sketch, page 116. Location shown on map on pages 246-247.

Description: Annual capacity: 40,000 metric tons. This is a lubricating oil refinery equipped with shell stills, atmospheric and vacuum stage, but no cracking equipment. Lubricants are treated by acid and clay. No other details are available.

Tankage capacity estimated at 40,000 metric tons (252,000 barrels).

Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: On the south bank of the Süder-Elbe, 1-1/2 miles west of the Harburg bridges in the Harburg section of Hamburg harbor.

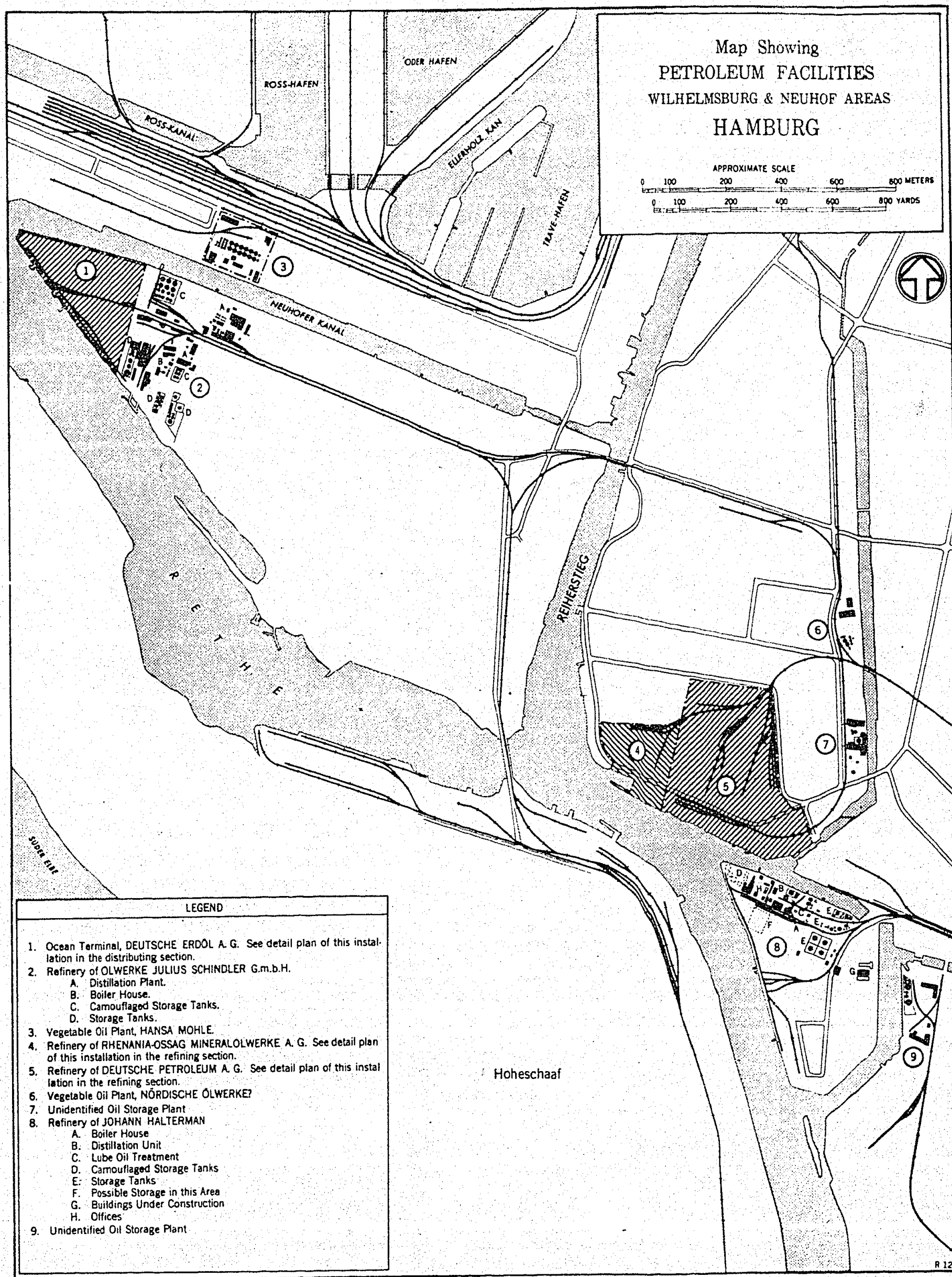
Maps and Plans: Layout plan, page 118. Location is shown on map on pages 246-247. Photograph on page 119.

Description: Annual capacity: 550,000 metric tons. This is the more important of the three Rhenania-Ossag refineries in the Hamburg area, and is the largest refinery in Germany. It was designed to process indigenous German crudes and Venezuelan residues. Distillation facilities include atmospheric and vacuum pipe stills for crude and topped crude, but no gasoline cracking equipment. There are also stills for lubricating oils and a vacuum still for asphalt.

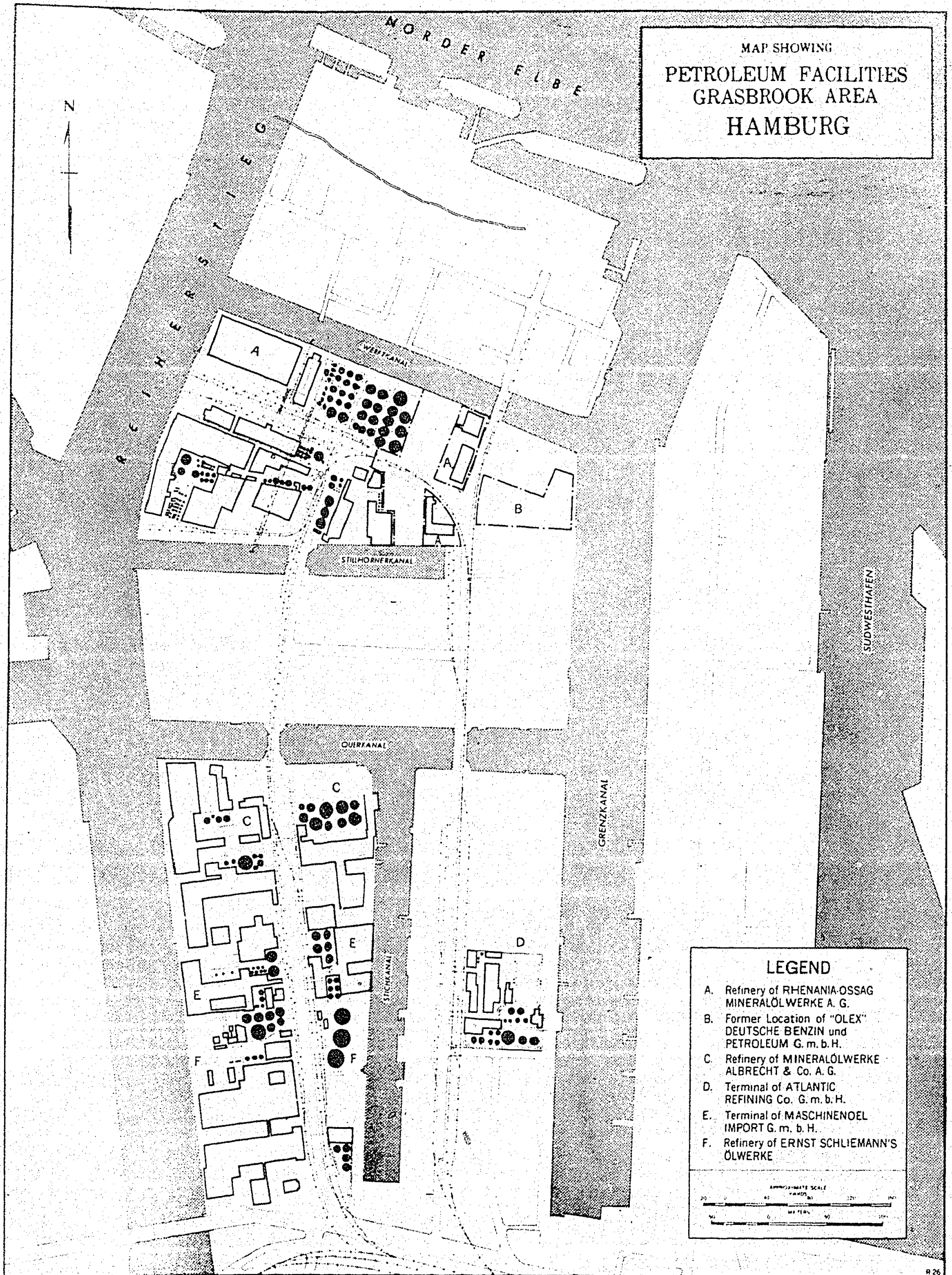
The plant was originally equipped for the redistillation and acid treating of lub. oils. In 1939 an Edelleanu plant was added with polymerization and a synthetic lubricating oil plant with acetone-benzol dewaxing and wax cracking facilities for the purpose of producing high grade aviation lubricants.

Some of the unfinished lubricants produced at this refinery are finished at the company's Grasbrook refinery a few miles away.

Tankage capacity is approximately 272,000 metric tons (1,713,600 barrels).

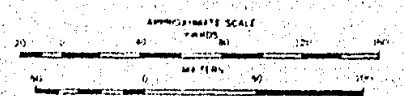


MAP SHOWING
PETROLEUM FACILITIES
GRASBROOK AREA
HAMBURG



LEGEND

- A. Refinery of RHENANIA-OSSAG MINERALÖLWERKE A. G.
- B. Former Location of "OLEX" DEUTSCHE BENZIN und PETROLEUM G. m. b. H.
- C. Refinery of MINERALÖLWERKE ALBRECHT & Co. A. G.
- D. Terminal of ATLANTIC REFINING Co. G. m. b. H.
- E. Terminal of MASCHINENOEL IMPORT G. m. b. H.
- F. Refinery of ERNST SCHLIEMANN'S ÖLWERKE



REFINERY OF
RHENANIA-OSSAG MINERALÖLWERKE A. G.
HARBURG (HAMBURG)

DETAILS OF TANKAGE

A - Gasoline

NO. TANKS	M ₃	BBLS	TOTAL M ₃	TOTAL BBLS
3	8750	55,125	26,250	165,375
2	6600	41,580	13,200	83,160
1	3610	22,743	3,610	22,743
1	2610	16,443	2,610	16,443
1	1800	11,340	1,800	11,340
2	1160	7,308	2,320	14,616
1	200	1,260	200	1,260
TOTAL FOR UNIT			49,990	314,937

B - Lube Oil & Topped Crude - Partial List of Tanks

4	8,783	55,332	35,132	221,328
---	-------	--------	--------	---------

C - Distillate

3	4,636	29,207	13,908	87,621
3	1,540	9,702	4,620	29,106

D - Receiving Tanks

E - Finished Oil Products

F - Brown Asphalt

G - Asphalt

H - Service Tanks - Solvent Treatment Unit

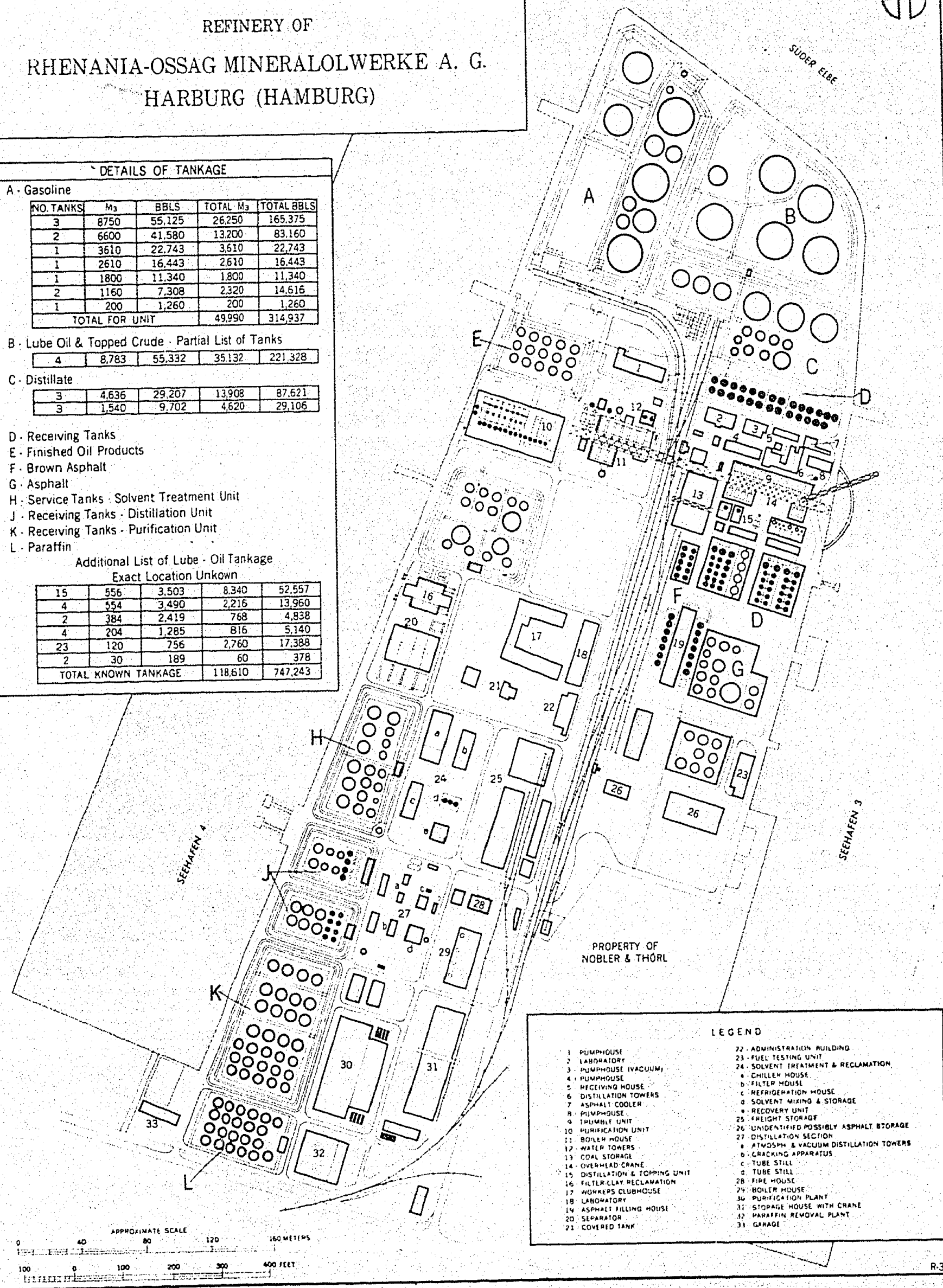
J - Receiving Tanks - Distillation Unit

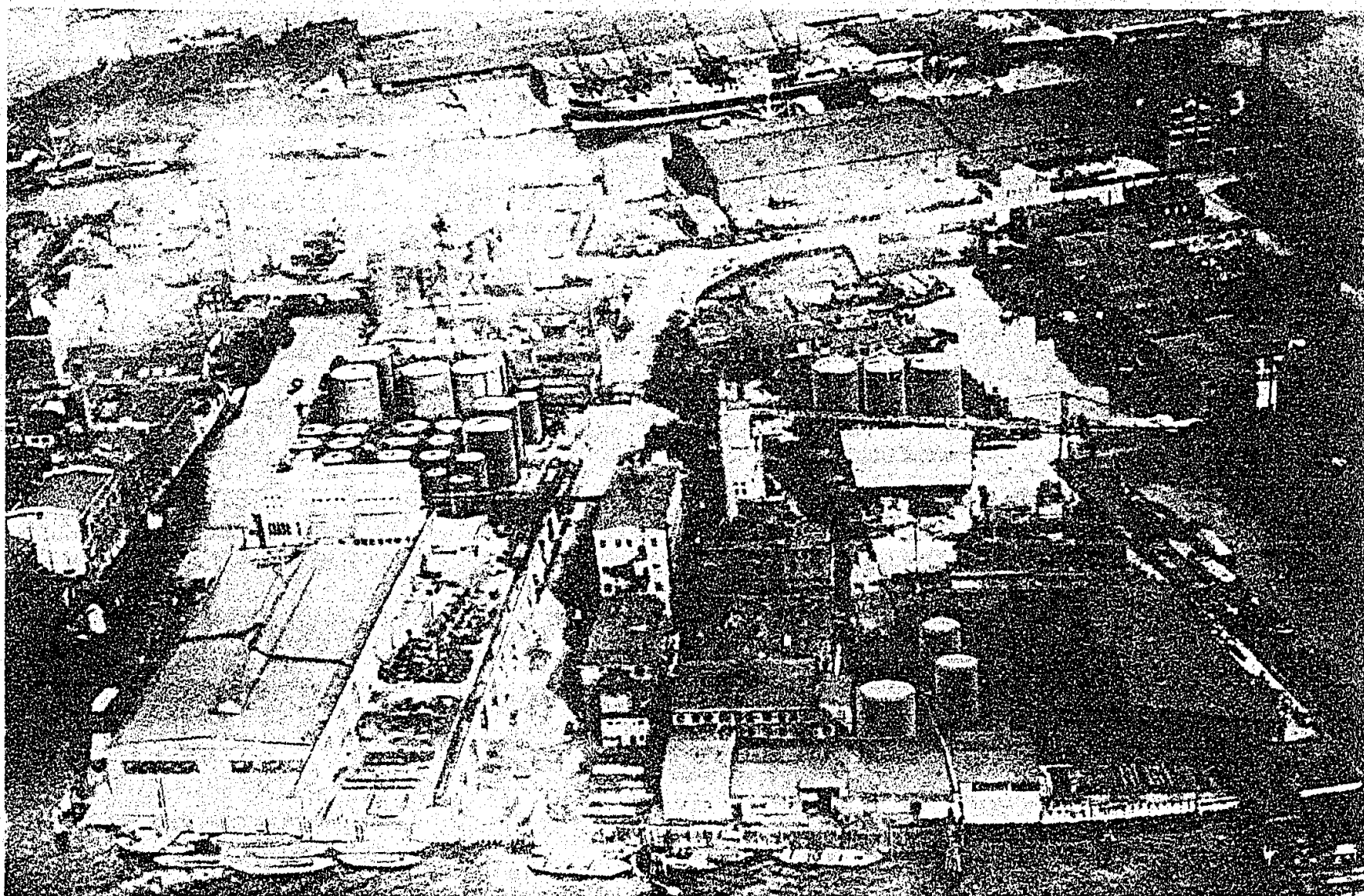
K - Receiving Tanks - Purification Unit

L - Paraffin

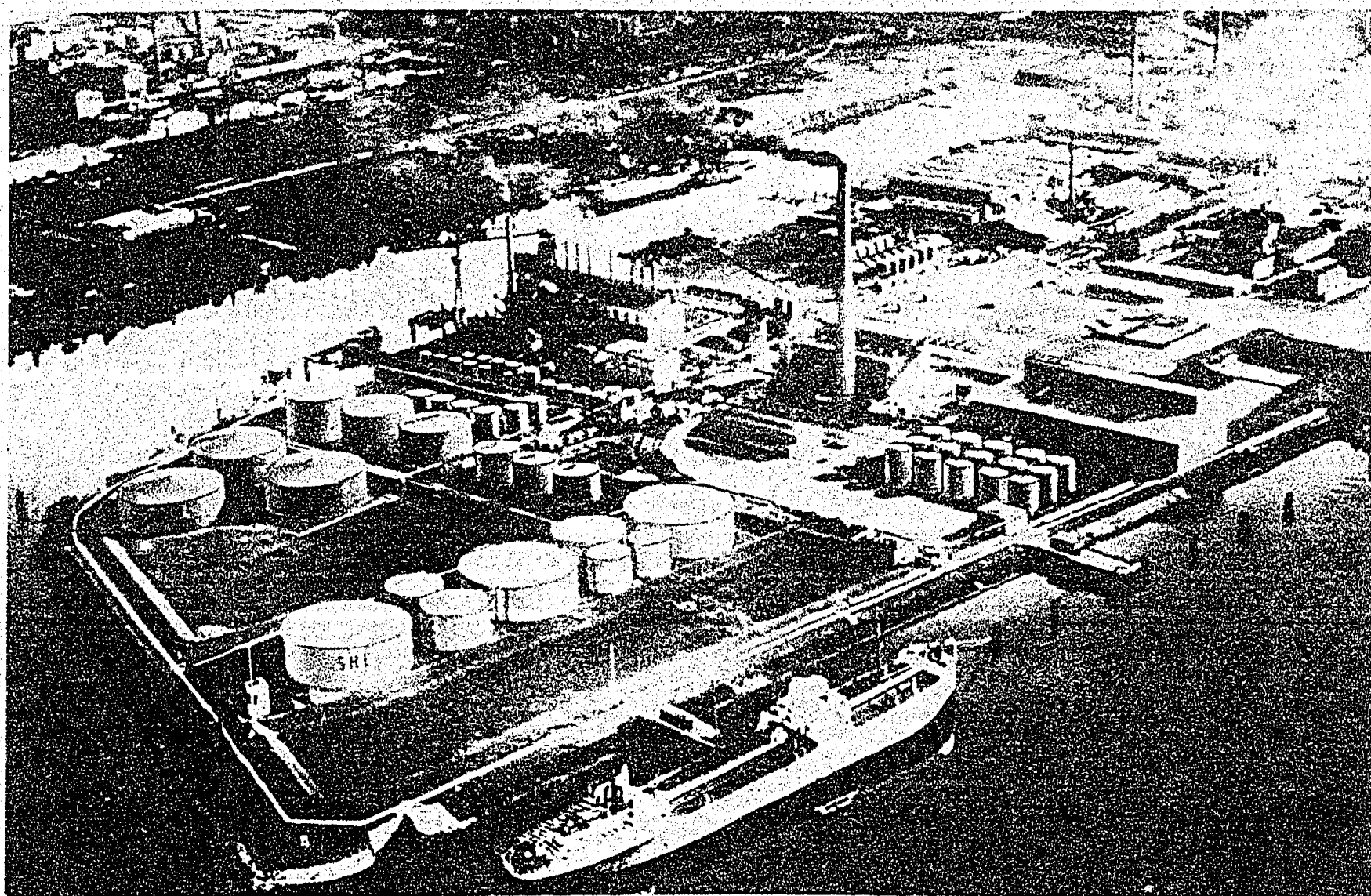
Additional List of Lube - Oil Tankage
Exact Location Unknown

15	556	3,503	8,340	52,557
4	554	3,490	2,216	13,960
2	384	2,419	768	4,838
4	204	1,285	816	5,140
23	120	756	2,760	17,388
2	30	189	60	378
TOTAL KNOWN TANKAGE			118,610	747,243



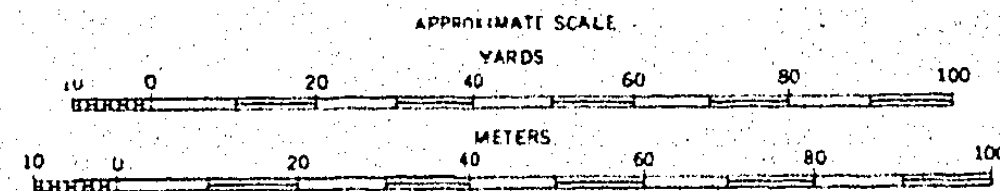


VIEW LOOKING EAST, REFINERY OF RHENANIA-OSSAG MINERALÖLWERKE A.G. HAMBURG-GRASBROOK



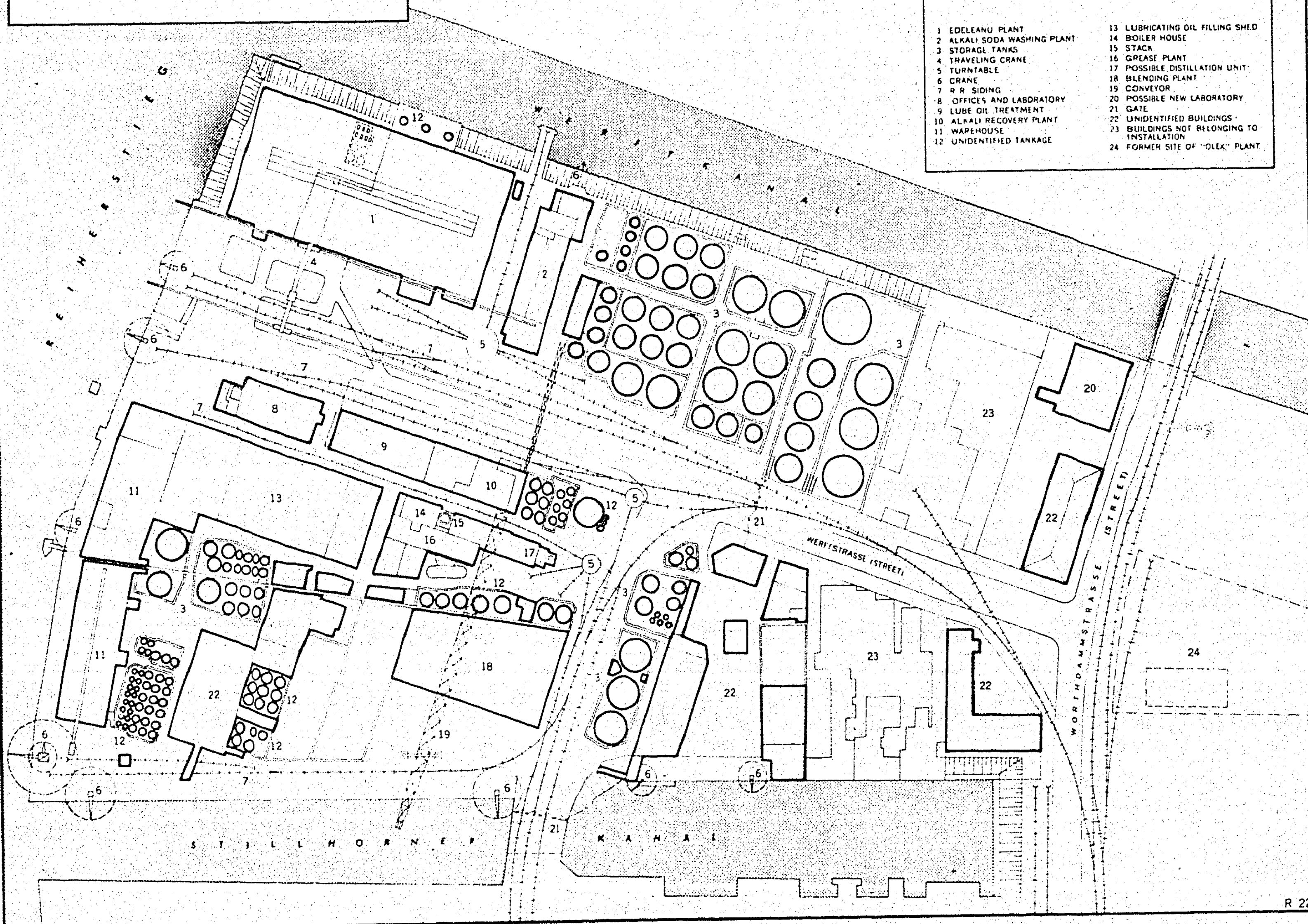
VIEW LOOKING SOUTH, REFINERY OF RHENANIA-OSSAG MINERALÖLWERKE A.G. HAMBURG-HARBURG

REFINERY
RHENANIA - OSSAG
MINERALÖLWERKE A. G.
HAMBURG - GRASBROOK



LEGEND

- | | |
|-----------------------------|--|
| 1 EDELEANU PLANT | 13 LUBRICATING OIL FILLING SHED |
| 2 ALKALI SODA WASHING PLANT | 14 BOILER HOUSE |
| 3 STORAGE TANKS | 15 STACK |
| 4 TRAVELING CRANE | 16 GREASE PLANT |
| 5 TURNABLE | 17 POSSIBLE DISTILLATION UNIT |
| 6 CRANE | 18 BLENDING PLANT |
| 7 R R SIDING | 19 CONVEYOR |
| 8 OFFICES AND LABORATORY | 20 POSSIBLE NEW LABORATORY |
| 9 LUBE OIL TREATMENT | 21 GATE |
| 10 ALKALI RECOVERY PLANT | 22 UNIDENTIFIED BUILDINGS |
| 11 WAREHOUSE | 23 BUILDINGS NOT BELONGING TO INSTALLATION |
| 12 UNIDENTIFIED TANKAGE | 24 FORMER SITE OF "OLEX" PLANT |



Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: On the Reiherstieg Canal just south of the Norder-Elbe River in the Grasbrook area of Hamburg harbor.

Maps and Plans: Layout plan, page 120. Location shown on map on pages 117 and 246-247. Photograph on page 119.

Description: Annual capacity: 130,000 metric tons. This is a lubricating oil refinery and operates in conjunction with, or complementary to, the Rhenania-Ossag's Harburg refinery described above. Production includes turbin and white oils and medium and low grade lubricants and greases.

The plant has no primary distillation equipment. Its lubricating oil facilities include an Edeleanu plant, clay and acid treating, solvent dewaxing and a grease plant.

Total tankage capacity is reported to approximate 60,000 metric tons (378,000 barrels), (139 tanks). A prewar statement of storage and filling tanks is given below, but it has not been possible to definitely identify these tanks on the plan on page 120.

Details of Tankage

No. of Tanks	Product	Capacity	Total Capacity	
		M ³	M ³	Barrels
6	Lubricating oil	2,500	15,000	94,500
5	" "	1,900	9,500	59,850
2	" "	1,100	2,200	13,860
14	" "	650	9,100	57,330
6	" "	600	3,600	22,680
2	" "	350	700	4,410
2	" "	300	600	3,780
4	" "	250	1,000	6,300
45	less than 200 M ³ Lubricating oil		4,550	28,665
T O T A L			46,250	291,375

Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: In the Wilhelmsburg area on the north side of the Reiherstieg Canal at the bend halfway between the Norder and the Süder-Elbe Rivers. Just west of Deutsche Petroleum A.G. refinery. Halfway between Rhenania-Ossag's other refineries at Harburg and Grasbrook.

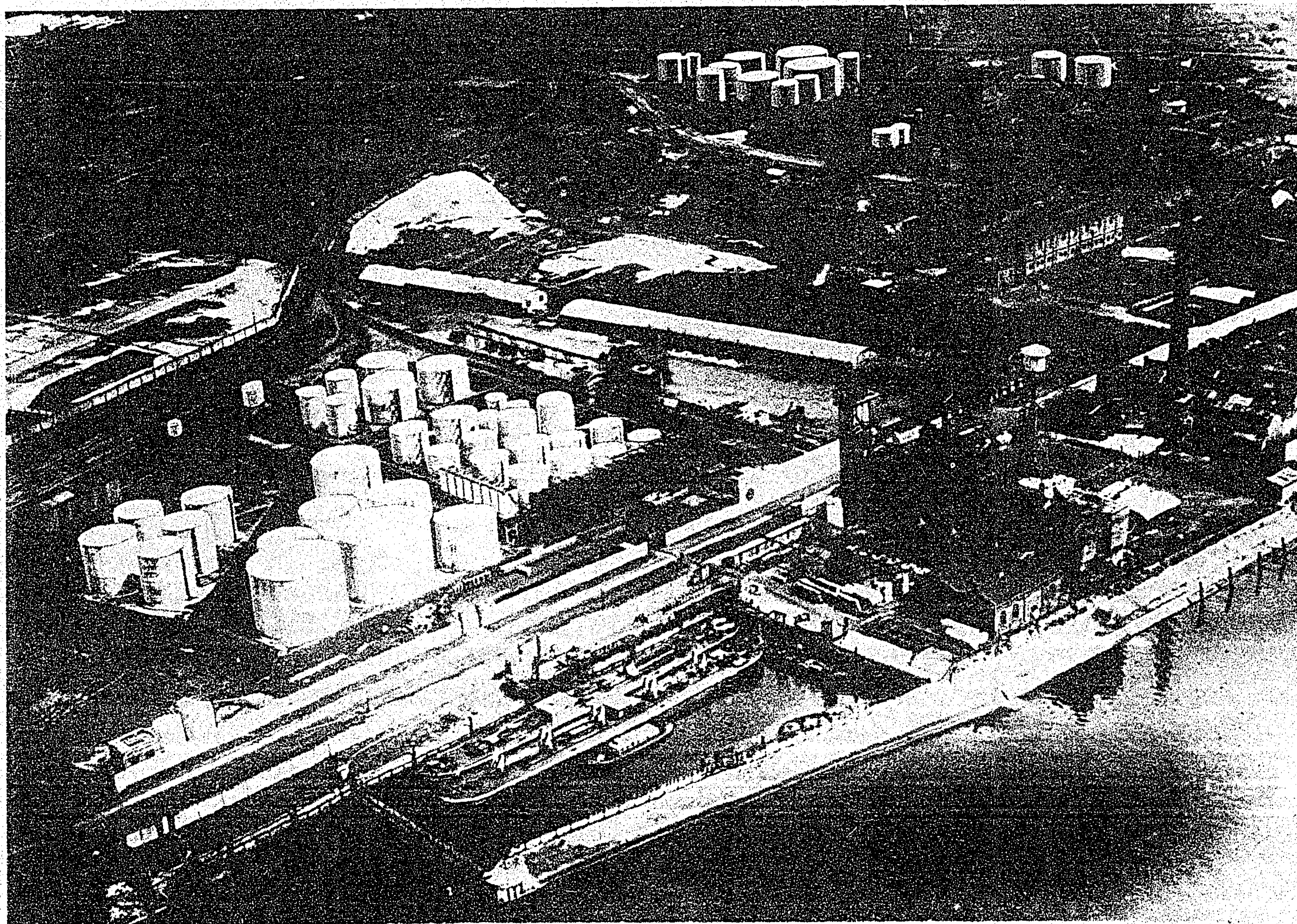
Maps and Plans: Layout plan on page 123. Location shown on pages 116 and 246-247.

Description: Annual capacity: 70,000 metric tons. This, the third Rhenania-Ossag refinery at Hamburg, is a gasoline specialty rerunning plant. It has shell and pipe stills, but no cracking or lubricating oil facilities.

Tankage capacities total approximately 21,000 metric tons (132,300 barrels).

Refinery: Ernst Schliemann's Oelwerke

Location: On the east side of the Reiherstieg Canal south of the Rhenania-Ossag refinery and adjoining the Mineralöl Albrecht & Co. refinery in the Grasbrook area of Hamburg.



REFINERIES OF RHENANIA-OSSAG MINERALOLWERKE A. G. (IN FOREGROUND) AND DEUTSCHE PETROLEUM A. G. (IN BACKGROUND) AT HAMBURG-WILHELMSBURG



RHENANIA - OSSAG MINERALÖLWERKE A.G.

TANKAGE DETAIL

TANK NO.	REMARKS	M3	BARRELS	TANK NO.	REMARKS	M3	BARRELS
1	GASOLINE	2,280	14,364	20		710	4,473
2		2,280	14,364	21		260	1,638
3		1,400	8,820	22		705	4,442
4		725	4,548	23		705	4,442
5		725	4,548	24		400	2,520
6		725	4,548	25		400	2,520
7		725	4,548	26		400	2,520
8		785	4,912	27		400	2,520
9		785	4,912	28		400	2,520
10		785	4,912	29		408	2,570
11		285	1,794	30		408	2,570
12		285	1,794	31		408	2,570
13		285	1,794	32		740	4,642
14		285	1,794	33		740	4,642
15		285	1,794	34		18,391	
16		285	1,794				
17		285	1,794				
18		260	1,638				
19		260	1,638				
		TOTAL				21,358	134,543

LEGEND

- | | | | |
|---------------------|------------------------|-----------------------|---------------------------|
| A. REFINING | G. BOILER HOUSE | M. LOADING PLATFORM | T. H. SHED |
| B. DISTILLATION | H. LURE OIL FILLING | O. TRUCK WEIGHING | U. RESIDENCE |
| C. FRACKING COLUMNS | J. OFFICES | P. FILLING HOUSE | V. WAREHOUSE |
| D. COAL BURNER | K. CUSTOMS SHED | Q. BARREL CONVEYOR | W. SULPHURIC ACID STORAGE |
| E. TRAVELING CRANE | L. BARREL STORAGE SHED | R. NARROW GAUGE R. W. | X. WATER TOWER |
| F. STACK | M. TANKCAR WEIGHING | S. GASOMETER | |

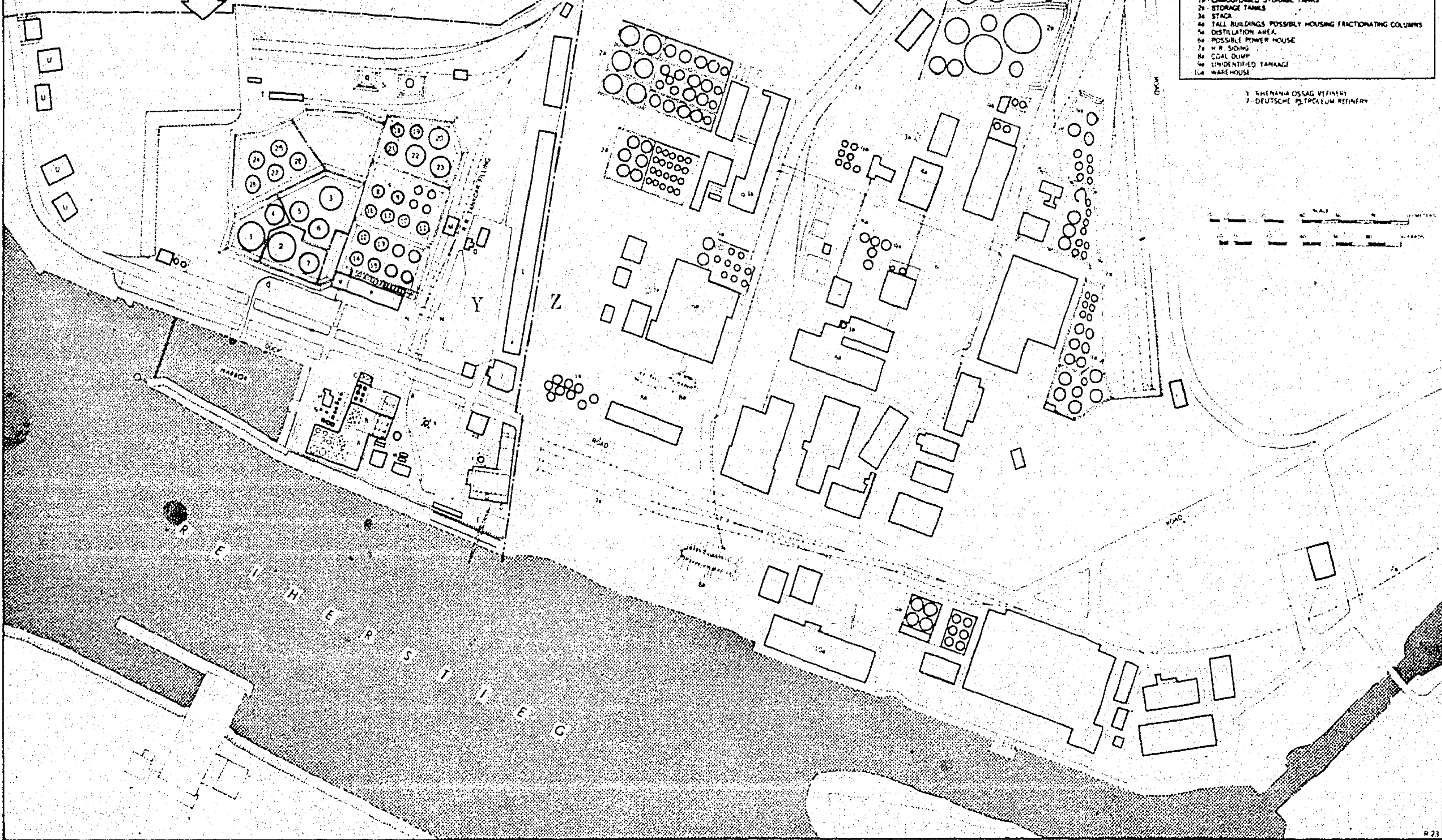
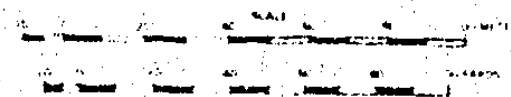
REFINERIES OF RHENANIA - OSSAG MINERALÖLWERKE A.G. AND DEUTSCHE PETROLEUM A.G. HAMBURG - WILHELMSBURG

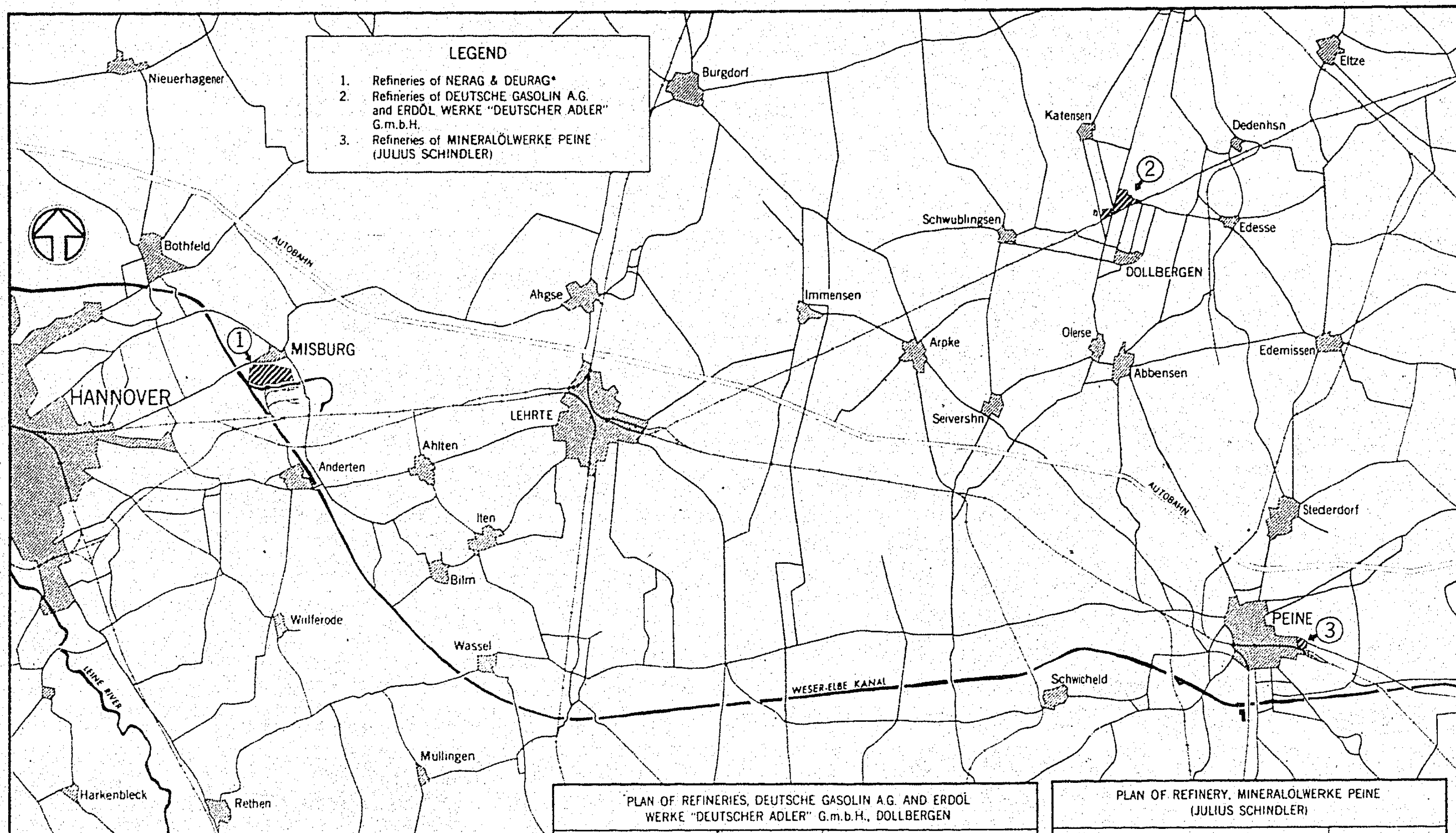
DEUTSCHE PETROLEUM A.G.

LEGEND

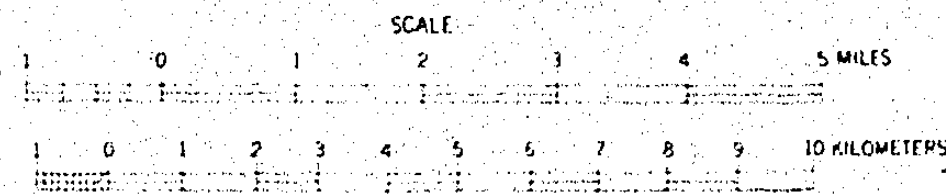
- 19. CAMOUFLAGED STORAGE TANKS
- 20. STORAGE TANKS
- 21. STACK
- 22. TALL BUILDINGS, POSSIBLY HOUSING FRACTIONATING COLUMNS
- 23. DISTILLATION AREA
- 24. POSSIBLE POWER HOUSE
- 25. H. R. SHED
- 26. COAL DUMP
- 27. UNIDENTIFIED TANKAGE
- 28. WAREHOUSE

- 1. RHENANIA OSSAG REFINERY
- 2. DEUTSCHE PETROLEUM REFINERY





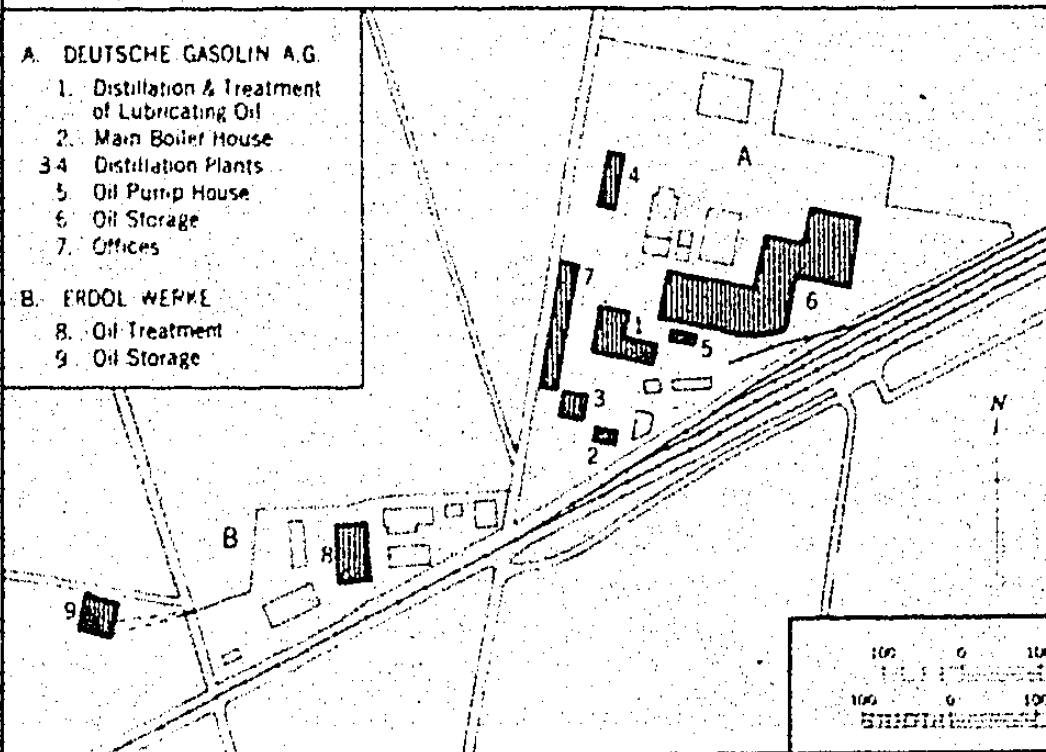
MAP SHOWING
REFINING FACILITIES
HANNOVER AREA



*See detailed plan of this installation on page 127.

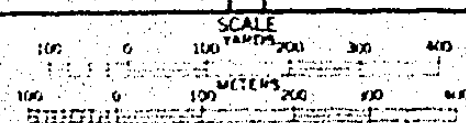
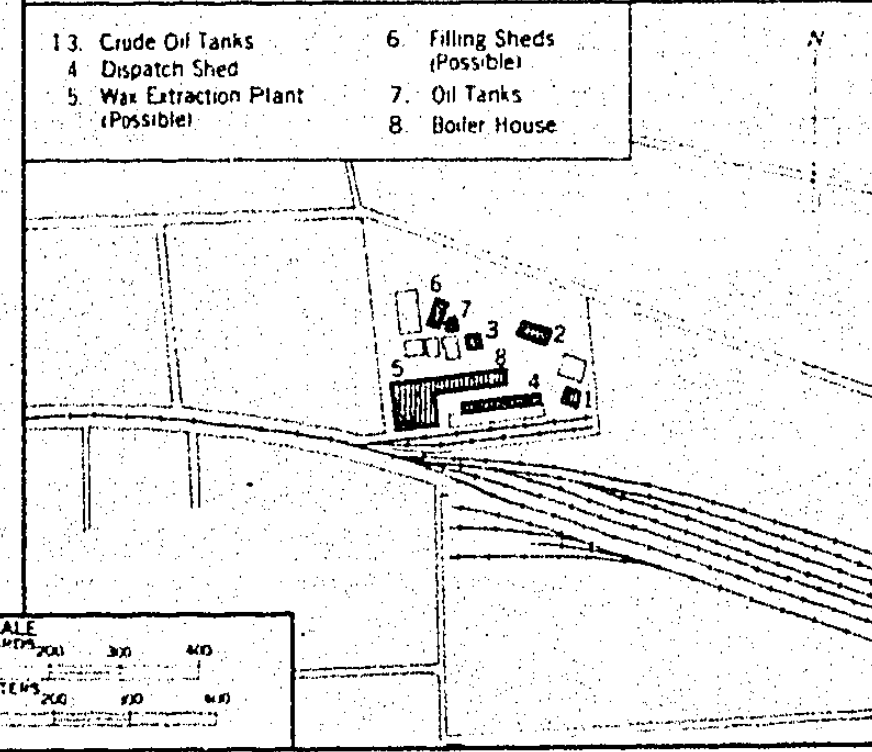
PLAN OF REFINERIES, DEUTSCHE GASOLIN A.G. AND ERDÖL WERKE "DEUTSCHER ADLER" G.m.b.H., DOLLBERGEN

- A. DEUTSCHE GASOLIN A.G.
1. Distillation & Treatment of Lubricating Oil
 2. Main Boiler House
 - 3, 4. Distillation Plants
 5. Oil Pump House
 6. Oil Storage
 7. Offices
- B. ERDÖL WERKE
8. Oil Treatment
 9. Oil Storage



PLAN OF REFINERY, MINERALÖLWERKE PEINE (JULIUS SCHINDLER)

- 1, 3. Crude Oil Tanks
4. Dispatch Shed
5. Wax Extraction Plant (Possible)
6. Filling Sheds (Possible)
7. Oil Tanks
8. Boiler House



Maps and Plans: Layout sketch on page 117. Location shown on map on pages 246-247.

Description: Annual capacity: 65,000 metric tons. This is a small lubricating oil works with acid and clay treating facilities, but no crude distillation facilities. The plant produces white oils and ordinary lubricants. Detailed information is lacking. This company has been mentioned as having a small compounding plant in the Wilhelmsburg area, but this is unconfirmed.

Tankage is estimated to total 30,000 metric tons (189,000 barrels).

3.9 HANNOVER

Refinery: Deurag-Nerag (Gewerkschaft Deutsche Erdöl-Raffinerie and Gewerkschaft Neue Erdöl-Raffinerie).

Location: At Misburg, on the east side of the Weser-Elbe Canal approximately four miles east of Hannover. Latitude 52° 23' N, longitude 9° 51' E.

Maps and Plans: Layout plan on page 127. Location map on page 124. Flow diagram, page 129. Photographs, page 126.

Description: Annual capacity: 300,000 metric tons. This plant, commonly called the Deurag-Nerag refinery, consists of two refineries operated jointly and constitutes one of the most important units of the German refining industry. The Gewerkschaft Deutsche Erdöl-Raffinerie (Deurag) is the older of the two and is primarily a gasoline plant designed to operate on indigenous German crude oil.

The cracking unit is a Dubbs, continuous coking, with separate black oil heater. Capacity is 2,500 barrels per day of gasoline and 600 barrels per day of kerosene, or 3,000 barrels per day of diesel fuel plus 900 barrels per day of gasoline and 600 barrels per day of kerosene.

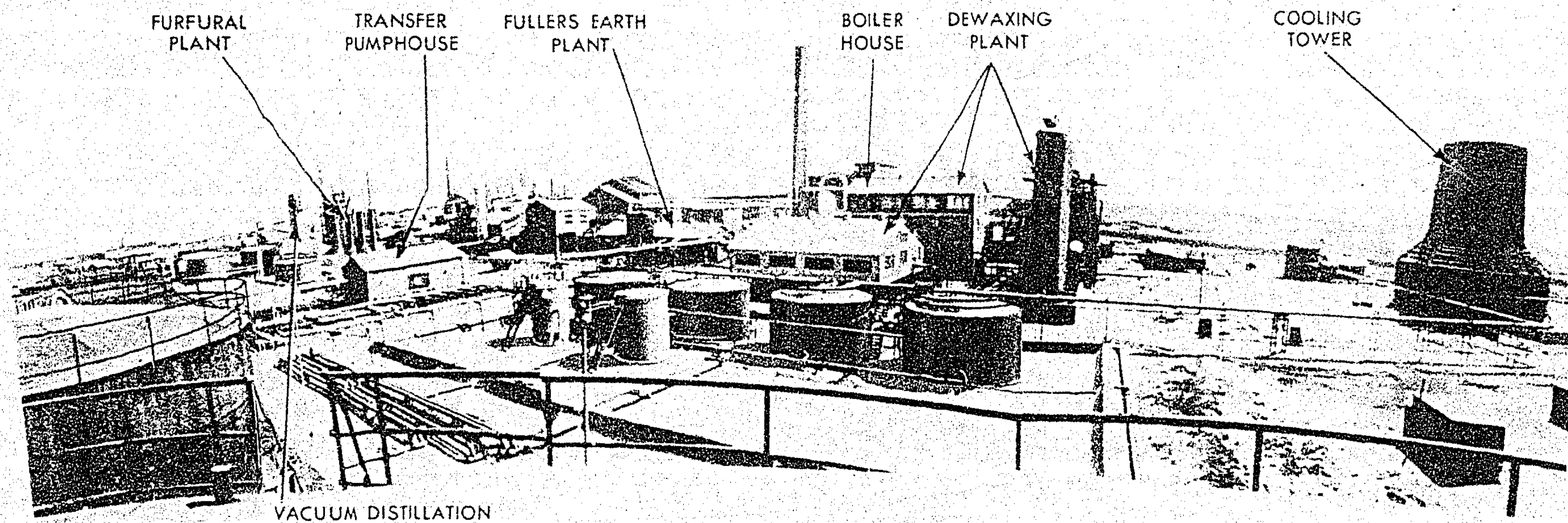
Other units include two crude topping units, gasoline treating, benzol and alcohol blending, gasoline stabilizer, gas compression plant, propane treating and loading plant, crude and finished oil storage.

Electric power is purchased. Cable crosses canal just south of railroad bridge adjacent to plant.

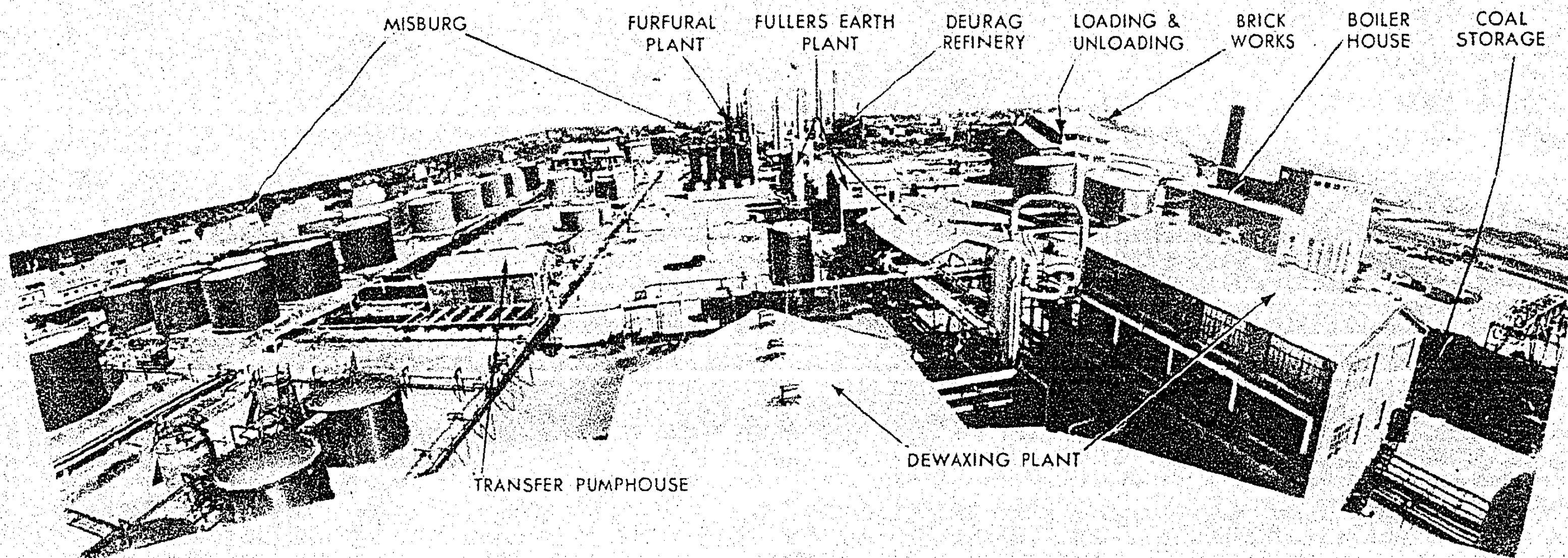
The steam plant with oil and gas fired boilers has capacity only for the Deurag plant. Boiler feed water is obtained from the Misburg municipal system.

The Gewerkschaft Neue Erdöl-Raffinerie (Nerag) is a modern lubricating oil refinery built in 1935/36 and put into operation early in 1937. It is designed to operate on indigenous German crude and topped crude in conjunction with the Deurag plant. It is primarily a lube oil plant, all other products being by-products. This plant takes some reduced crude from the adjacent Deurag plant and returns asphalt, waxes, extracts and other by-products as cracking unit feed stock to the Deurag plant.

The Nerag plant originally produced 1,000 to 1,500 barrels per day of high quality refined and dewaxed lube oil, plus 300 to 400 barrels per day very low quality lube oil for industrial uses, 650 barrels per day straight-run gasoline, 700 barrels per day kerosene distillate, and 400 barrels per day diesel fuel (gas oil). In addition, 200 to 400 barrels per day of crystalline wax is available. In the Fall of 1939, consideration was being given to hydrogenating 1/2 of this quantity to fatty oils for use in soaps, etc. A further breakdown of 1939 production rates per calendar operating day, based on the average of a 30 to 40 day period of complete plant operation is given on page 130.



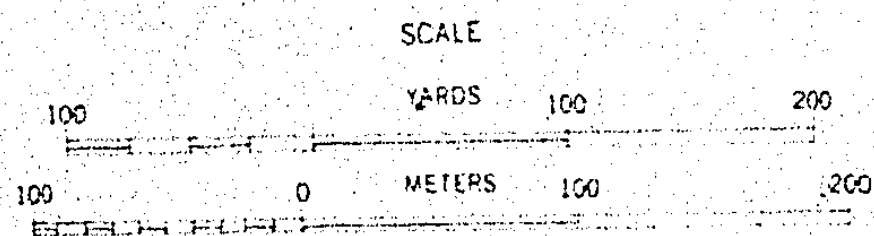
VIEW FROM NORTHWEST



VIEW FROM WEST

VIEWS OF NERAG & DEURAG REFINERY, MISBURG (NEAR HANNOVER)

REFINERIES OF
GEWERKSCHAFT NEUE ERDÖL
RAFFINERIE (NERAG)
AND
GEWERKSCHAFT DEUTSCHE
ERDÖL RAFFINERIE (DEURAG)
MISBURG (Near Hannover)



DETAILS OF TANKAGE

GROUP A-DEWAXING CHARGE
19 Tanks, Capacity 21,600 M³-136,080 Bbls

GROUP B-CLAY CONTRACTING OR ACID TREATING
11 Tanks, Capacity 9,200 M³-57,960 Bbls

GROUP C-ACID TREATING, FURFURAL & COUBROUGH CHARGES
15 Tanks, Capacity 16,500 M³-103,950 Bbls

GROUP D-CONTACTING & DEWAXING RUNDOWN
14 Tanks, Capacity 2600 M³-16,380 Bbls

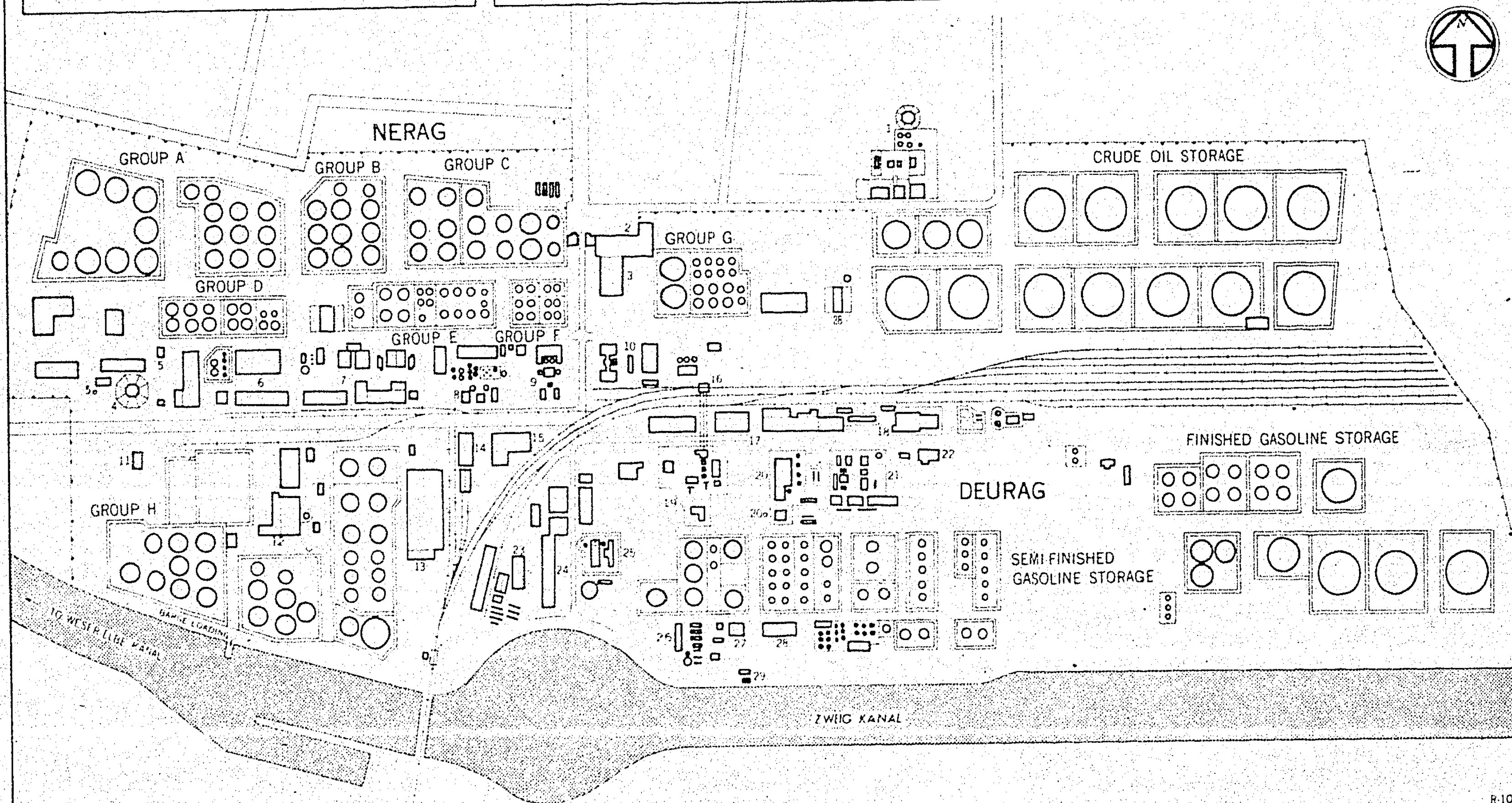
GROUP E-CONTACTING & FURFURAL RUNDOWN TANKS
20 Tanks, Capacity 3900 M³-24,570 Bbls

GROUP F-COUBROUGH UNIT
12 Tanks, Capacity 800 M³-5040 Bbls

GROUP G-ATMOSPHERIC & VACUUM RUNDOWN
18 Tanks, Capacity 5400 M³-34,020 Bbls

GROUP H-FINISHED PRODUCT STORAGE
30 Tanks, Capacity 27,520 M³-173,376 Bbls

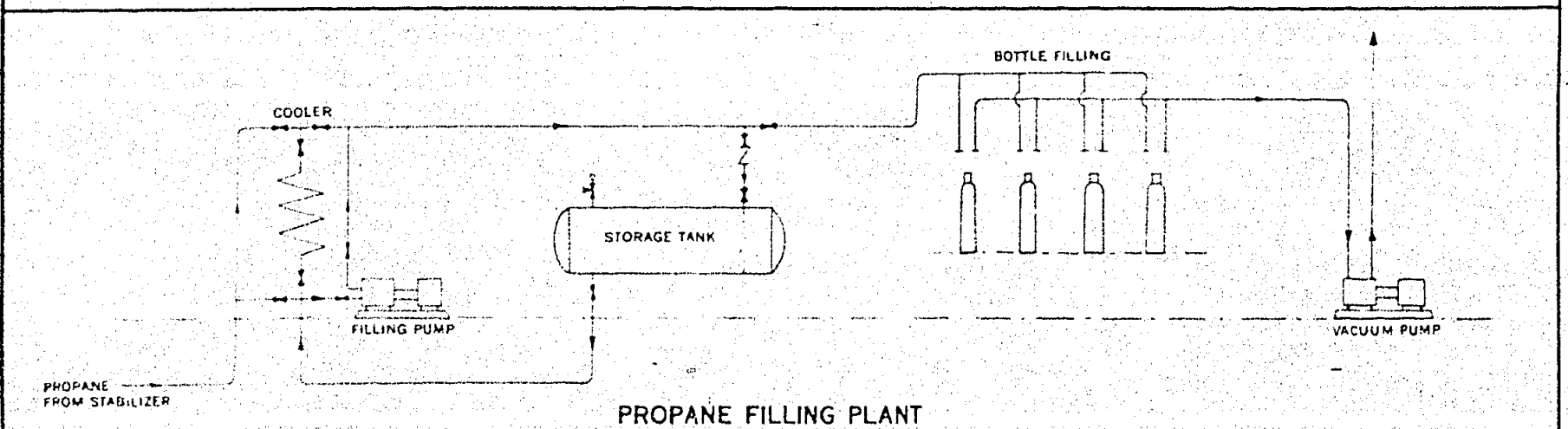
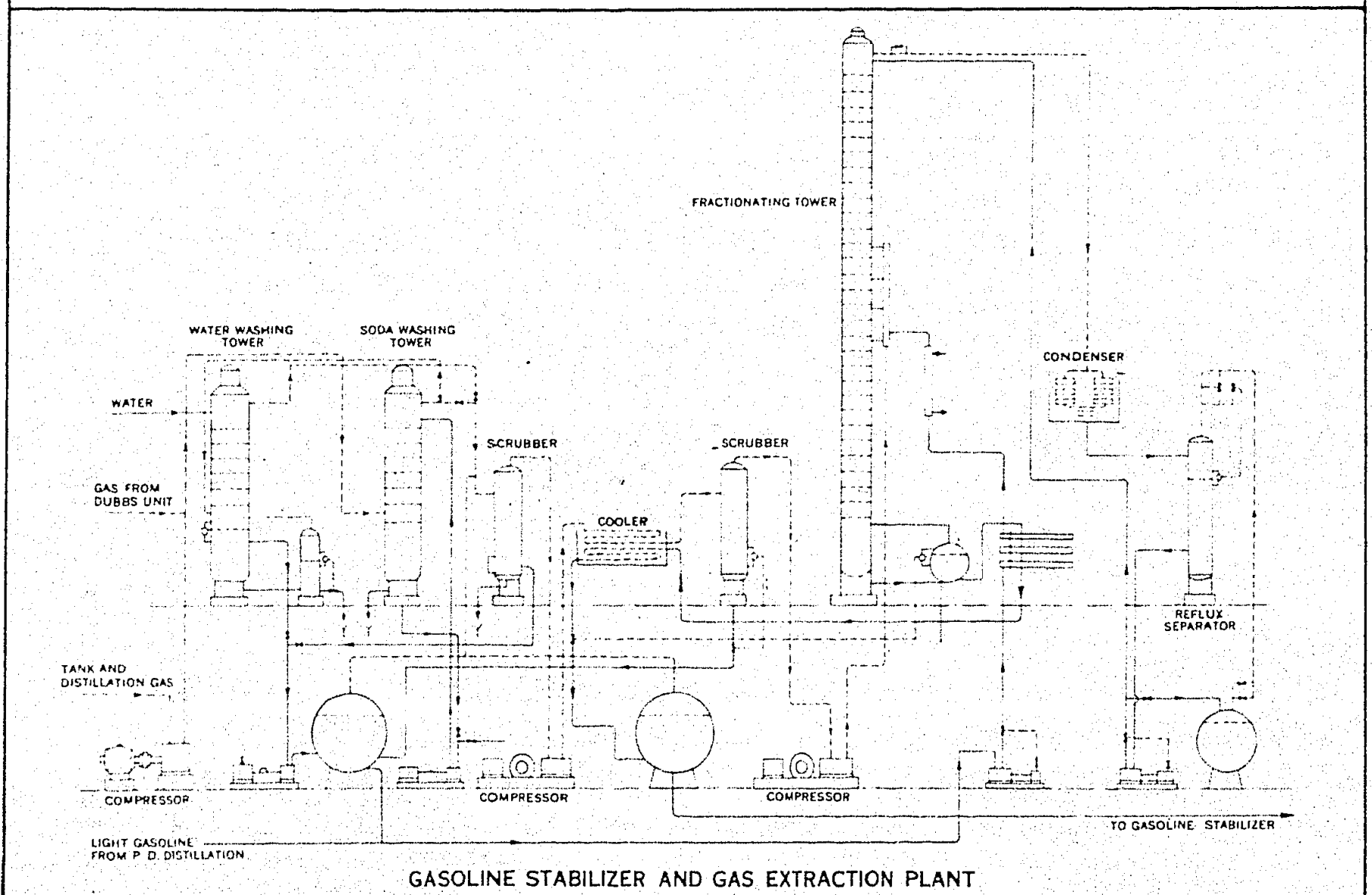
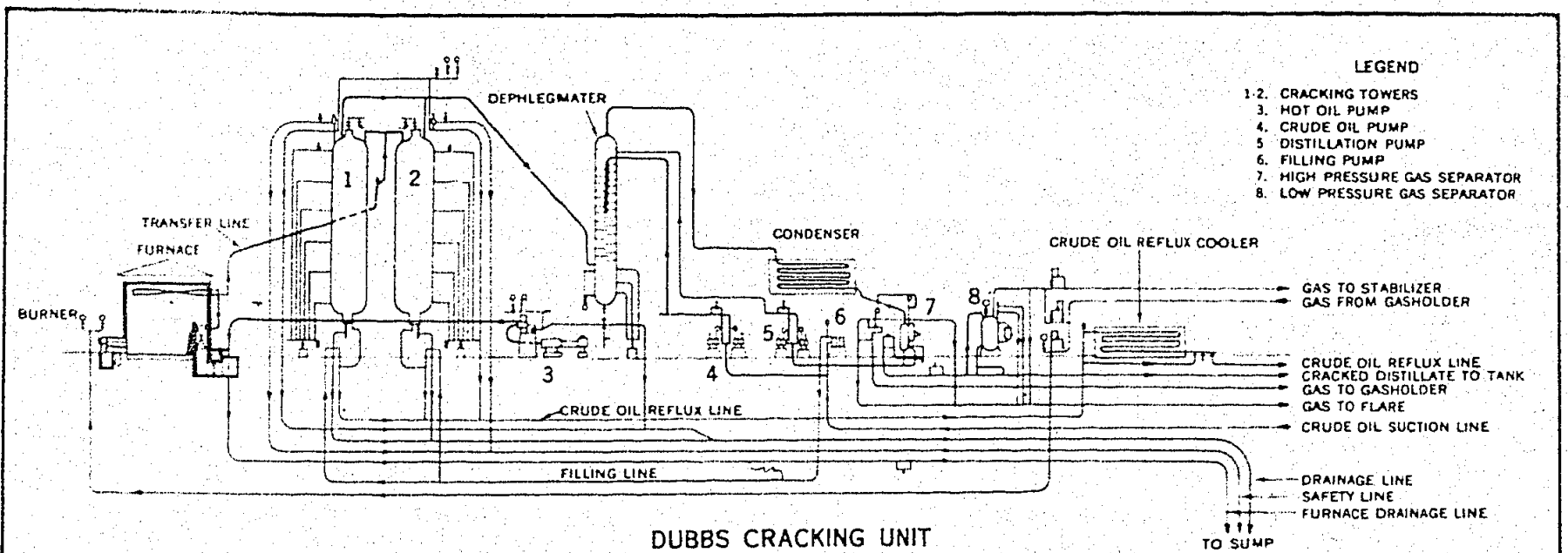
LEGENDS	
1 De-Asphalting Plant	14 Office
2 Garages	15 Offices & Warehouse
3 Locker Room & Washroom	16 Coke Conveyor
4 Cooling Tower	17 Storage & Workshops
5 Contact Filtration Plant	18 Laboratory
5a Pump House	19 Dubbs Cracking Plant
6 Dewaxing Plant	20 Boiler Plant
7 Fullers Earth Plant	20a Transformer Station
7a Acid Treating	21 Crude Oil Distillation Plant
8 Furfural Plant	22 Asphalt Laboratory
8a Pump House	23 Propane Disposal Plant
9 Vacuum Distillation Plant	24 Cooling Tower
9a Pump House	25 Oil Separator Pumps
10 Atmospheric Vacuum Distillation	26 Polymerization & Stabilizer Units
11 Oil Separator	27 Compressor House
12 Boiler House	28 Transfer Pump House
13 Freight Handling	29 Water Intake & Pump House



TANKAGE LIST, NERAG LUBE OIL REFINERY, 1939

Tank No.	Unit Group	Service	Capacity	
			M ³	Barrels
41 to 48 Incl. Plus 4 new tanks)	"Deurag" Topping Units	(Crude Storage &) (Unit Chg. Tks.)	6,000 M ³ each	72,000
				453,600
101	Coubrough - Charge	Reithbrook Red. Crude	1,000	6,300
102	"	"	1,000	6,300
103	Run-down	Reithbrook Vac. Gas Oil	50	315
104	"	"	50	315
105	"	Spindle	50	315
106	"	"	50	315
107	"	Neutral	100	630
108	"	"	100	630
109	"	Cylinder	50	315
110	"	"	50	315
111	"	Residuum	100	630
112	"	"	100	630
113	"	"	50	315
114	"	"	50	315
115	Furfural Charge	Cylinder	1,200	7,560
116	"	"	1,200	7,560
117	"	Neutral	1,600	10,080
118	"	Nienhagen	1,600	10,080
119	Acid Treating Charge	Reithbrook Cylinder	1,200	7,560
120	"	"	1,200	7,560
121	Furfural Charge	Nienhagen Cylinder	1,600	10,080
122	"	"	1,600	10,080
123	Acid Treating Charge	"	1,600	10,080
124	Furfural Run-down	Neutral	400	2,520
125	"	"	400	2,520
126	"	Cylinder (Both Crudes)	400	2,520
127	"	"	400	2,520
128	"	Cylinder Extracts (Both Crudes)	100	630
129	"	"	100	630
130	Clay Contacting Charge	Nienhagen Spindle	800	5,040
131	"	"	800	5,040
132	"	Neutral	800	5,040
133	"	"	800	5,040
134	"	"	800	5,040
135	"	"	800	5,040
136	"	Cylinder	1,200	7,560
137	"	"	1,200	7,560
138	"	"	1,200	7,560
139	Run-down	"	200	1,260
140	"	"	200	1,260
141	Dewaxing Charge	"	800	5,040
142	"	Neutral	800	5,040
143	"	"	800	5,040
144	"	"	800	5,040
145	"	Special Products	500	3,150
146	"	Aero Oils	500	3,150
147	"	Nienhagen Cylinder	1,200	7,560
148	"	"	1,200	7,560
149	"	Neutral	1,200	7,560
150	Run-down	Spindle & Neutral	200	1,260
151	"	"	200	1,260
152	"	Cylinder (Both Crudes)	200	1,260
153	"	"	200	1,260
154	"	Slack Wax	50	315
155	"	"	50	315
156	Finished Storage	Nienhagen Spindle	800	5,040
157	"	"	800	5,040
158	"	Neutral	1,200	7,560
159	"	"	1,200	7,560
160	"	Cylinder	800	5,040
161	"	Aero Oils	800	5,040
162	"	Special Products	500	3,150
163	"	"	500	3,150
164	"	Nienhagen Spindle	1,600	10,080
165	"	Neutral	1,600	10,080
166	"	Asphalt	1,600	10,080
167	"	"	1,600	10,080
168	"	"	400	2,520
169	Slop Storage	Coubrough Carrier	400	2,520
170	Dubbs Charge	Gas Oil, Extract & Wax	400	2,520
171	Clay Contact Charge	Cracking Stock	1,000	6,300
172	"	Aero Oils	400	2,520
173	Dewaxing Charge	Special Products	400	2,520
174	"	Reithbrook Cylinder	400	2,520

Tank No.	Unit Group	Service	Capacity	
			M ³	Barrels
175	Bonded Tank	Special Products	400	2,520
176	"	Aero Oils	400	2,520
177	Slop Storage	Slop	100	630
178	Fuel Oil Storage	Plant Fuel	100	630
179	"	"	100	630
180	Finished Storage	Fin. Motor Oils-1st Qual.	340	2,142
181	"	"	340	2,142
182	"	"	340	2,142
183	"	"	600	3,780
184	Water Storage	Treated Boiler Feed	600	3,780
185	"	"		
186	"	"		
187	Separator	"		
188	"	"		
201	New Atm. & Vacuum Run-down	Nienhagen Residuum	200	1,260
202	"	"	200	1,260
203	"	Gasoline	200	1,260
204	"	"	200	1,260
205	"	Kerosene	200	1,260
206	"	"	200	1,260
207	Run-down	Vac. Gas Oil	100	630
208	"	"	100	630
209	"	Neutral	100	630
210	"	"	100	630
211	"	Lube Dist.	100	630
212	"	"	100	630
213	"	Atm. Gas Oil	50	315
214	"	"	50	315
215	"	Spindle	50	315
216	"	"	50	315
217	Propane Deasph. Charge	Residuum	1,600	10,080
218	"	"	1,600	10,080
219	Run-down	Deasph. Cylinder	200	1,260
220	"	"	200	1,260
221	"	Resins & Asphalt	200	1,260
222	"	"	200	1,260
223	"	Deasphalting Slop	50	315
224	Acid Treating Charge	Nienhagen Spindle	2,500	15,750
225	Furfural Charge	Aero Oils	800	5,040
226	Acid Treating Charge	Nienhagen Cylinder	1,600	10,080
227	Furfural Run-down	Reithbrook Neutral	100	630
228	"	"	100	630
229	"	Neutral Extracts	100	630
230	"	"	100	630
231	Contacting Run-down	Nienhagen Spindles & Neutral	400	2,520
232	"	"	400	2,520
233	Present Charge Contact Plant	Spindle	800	5,040
234	Dewaxing Charge	Neutral	1,600	10,080
235	"	Reithbrook Cylinder	1,600	10,080
236	"	Nienhagen Spindle	2,500	15,750
237	"	"	2,500	15,750
238	New Contact Plant Charge	Reithbrook Cylinder	1,600	10,080
239	"	Neutral	1,600	10,080
240	Dewaxing Run-down	Slack Wax	100	630
241	"	Slop	100	630
242	"	Nienhagen Spindle & Neutral	500	3,150
243	New Contact Run-down	Reithbrook Cylinder	200	1,260
244	"	"	200	1,260
245	"	Neutral	200	1,260
246	"	"	200	1,260
247	Finished Storage	"	1,000	6,300
248	"	"	1,000	6,300
249	"	"	1,600	10,080
250	"	Cylinder	1,600	10,080
251	"	Nienhagen Cylinder	1,200	7,560
252	"	"	1,200	7,560
253	"	Axle Oils	1,000	6,300
254	"	"	1,000	6,300
255	Mixing Tanks	"	100	630
256	"	"	100	630
257	Finished Storage	Fin. Motor Oils - 2nd Qual.	400	2,520
258	"	"	400	2,520
259	"	Reithbrook Machine Oils	500	3,150
260	"	Fin. Superheated Steam Cyl.	1,600	10,080
261	"	Reithbrook Spindle Dist.	1,200	7,560
262	"	Fin. Reithbrook Cylinder	1,600	10,080
263	Propane Unit Charge	Superheated Steam Cyl. Oil	1,200	7,560
264	Dewaxing Charge	"	1,600	10,080
T O T A L			170,770	1,075,851



"Nerag" Lube Oil Plant

Daily Production (Basis 1939 Projects Completed)
Misburg - Hannover, Germany

P r o d u c t	Production Per Operating Day Bbls.(42 Gals.)	Means of Disposal
Gasoline	653	Market
Kerosene	705	"
Light gas oil	75	To Deurag cracking plant or diesel fuel market
Heavy gas oil	458	" " " " "
Spindle oil	174	Market
Neutral (light motor oil)	743	"
Cylinder (heavy motor oil)	856	"
Journal oils	190	"
Asphalts, resins and slop oils	609	To Deurag cracking plant or refinery fuel
Finished asphalt	350	Market
Extract	129	To Deurag cracking plant
Slack wax	268	" " " "
Gas produced, acid sludge and general plant losses	336	Part recovered as refinery fuel
Total crude and reduced crude required	5,546	

A polymerization unit is believed to have been completed in 1942 and also the refining capacity was probably increased.

Refining processes included in the original plant included:

- (a) Atmospheric and vacuum distillation units
- (b) Propane de-asphalting unit
- (c) Furfural refining unit
- (d) Acid treating facilities
- (e) Fullers earth decolorizing
- (f) Acetone benzol dewaxing
- (g) Blending, barrelling and shipping facilities

No cracking facilities are included in this plant.

Power originally was purchased, common cables with Deurag plant with a separate transformer being used. Plans were underway in the Fall of 1939 to install a powerhouse in conjunction with the new boilerhouse. This was to be completed by the end of 1940 and was to produce approximately 3/4 of the power required by Deurag and Nerag plants.

The steam boiler plant, when completed, was to have capacity sufficient for both the Deurag and Nerag plants. Boiler plant ordinarily uses soft coal as fuel but emergency oil burners are installed to carry approximately 50 per cent of normal steam load.

Drinking water and emergency boiler feed water are obtained from Misburg municipal supply. Condenser cooling water is obtained from the Branch Zweig Canal pumped through the plant, part of the exit heated water passes over a natural draft cooling tower at the east end of the plant so that the total exit water will re-enter the main Weser Elbe Canal at a temperature no higher than 30° C to satisfy local ordinances. Operation of this cooling tower would not be essential under emergency conditions; the hot water would simply return to the main canal directly opposite junction of the Zweig-Weser Canals, causing a foggy condition at this point during cold weather.

Tankage was extensive and is estimated to total 235,000 metric tons (1,480,500 barrels) for the two refineries. Tankage in the Nerag lub. oil plant, as of 1939, is listed on pages 128.

3.10 HEIDE - HEMMINGSTEDT

Refinery: Holsteinische Erdölwerke G.m.b.H.

Location: Near the village of Hemmingstedt, 2-1/2 miles SSW of Heide. Latitude 54° 9' N. longitude 9° 5' E. Approximately ten miles NNW of the Kaiser-Wilhelm (Kiel) Canal.

Maps and Plans: Layout plan, page 132. Location maps, pages 50 and 132.

Description: Annual capacity: approximately 115,000 metric tons. This refinery has been built since 1939 and little data are available. It contains two tube stills and fractionating columns and is equipped for extracting oil from the oil sands mined nearby.

Tankage is estimated to total 28,000 metric tons (176,400 barrels). The refinery is connected by pipe line to additional tankage of approximately 48,000 M³ (302,400 barrels) capacity at Schafstedt on the Kaiser-Wilhelm Canal.

3.11 MONHEIM

Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: About 1/2 mile north of the village of Monheim and ten miles southeast of Düsseldorf. The plant is located on the east bank of the Rhine, and is accessible to river barges. Latitude 51° 6' N, longitude 6° 53' E.

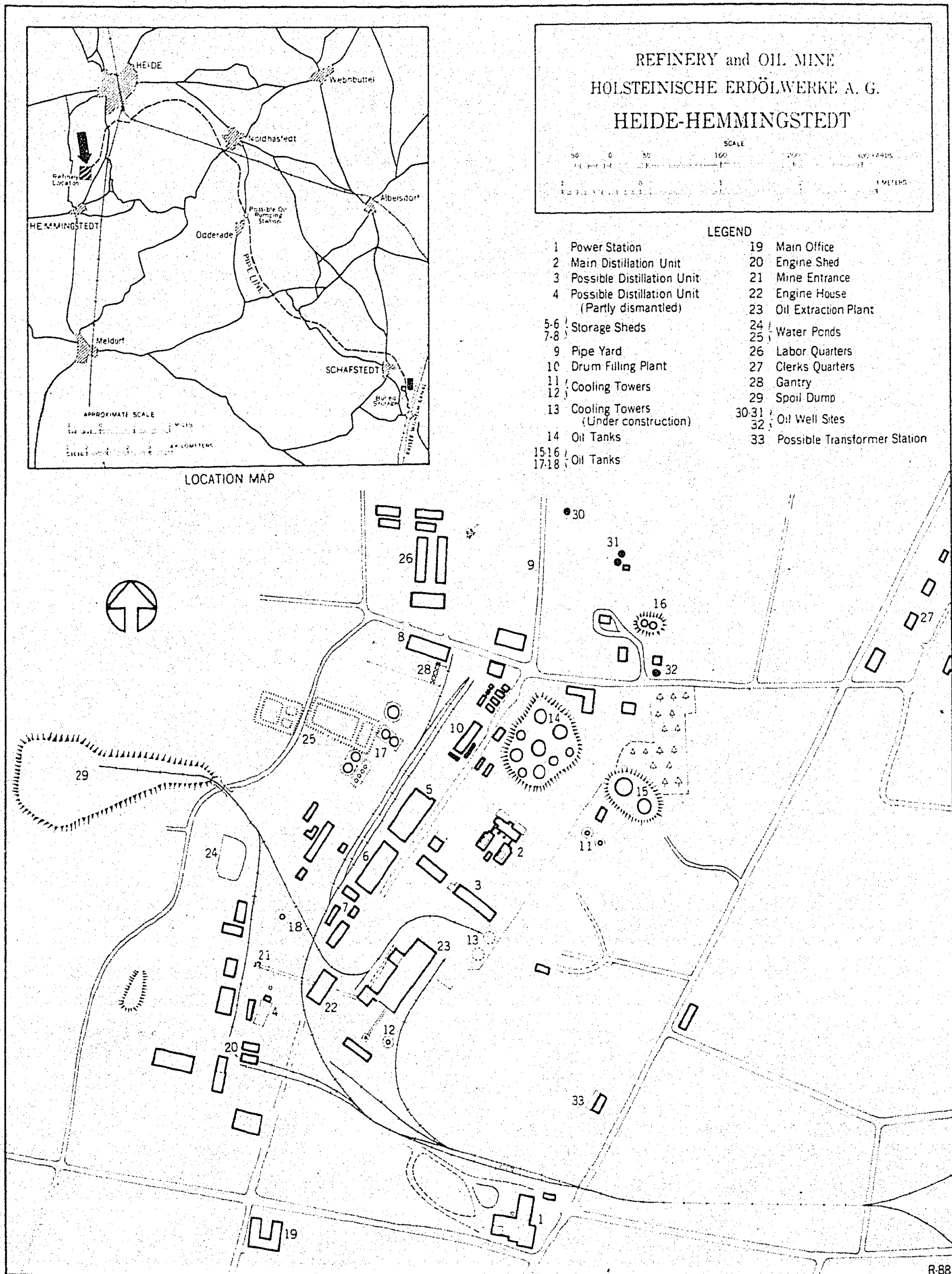
Maps and Plans: Layout plan, page 133. Location maps, pages 133 and 336. Photograph page 134.

Description: Annual capacity: 115,000 metric tons. This is a medium sized re-running plant formerly operating on Venezuelan distillates. Stocks were received by river tank barges coming from Rotterdam, the port of importation in the Netherlands.

The distillation unit consists of shell stills, some under vacuum, but no cracking equipment. There is acid and clay treating equipment for lub. oil and a small SO₂ extraction unit, capacity 8,000 metric tons per year.

The principal products produced are asphalt, gas oil, and lubricants.

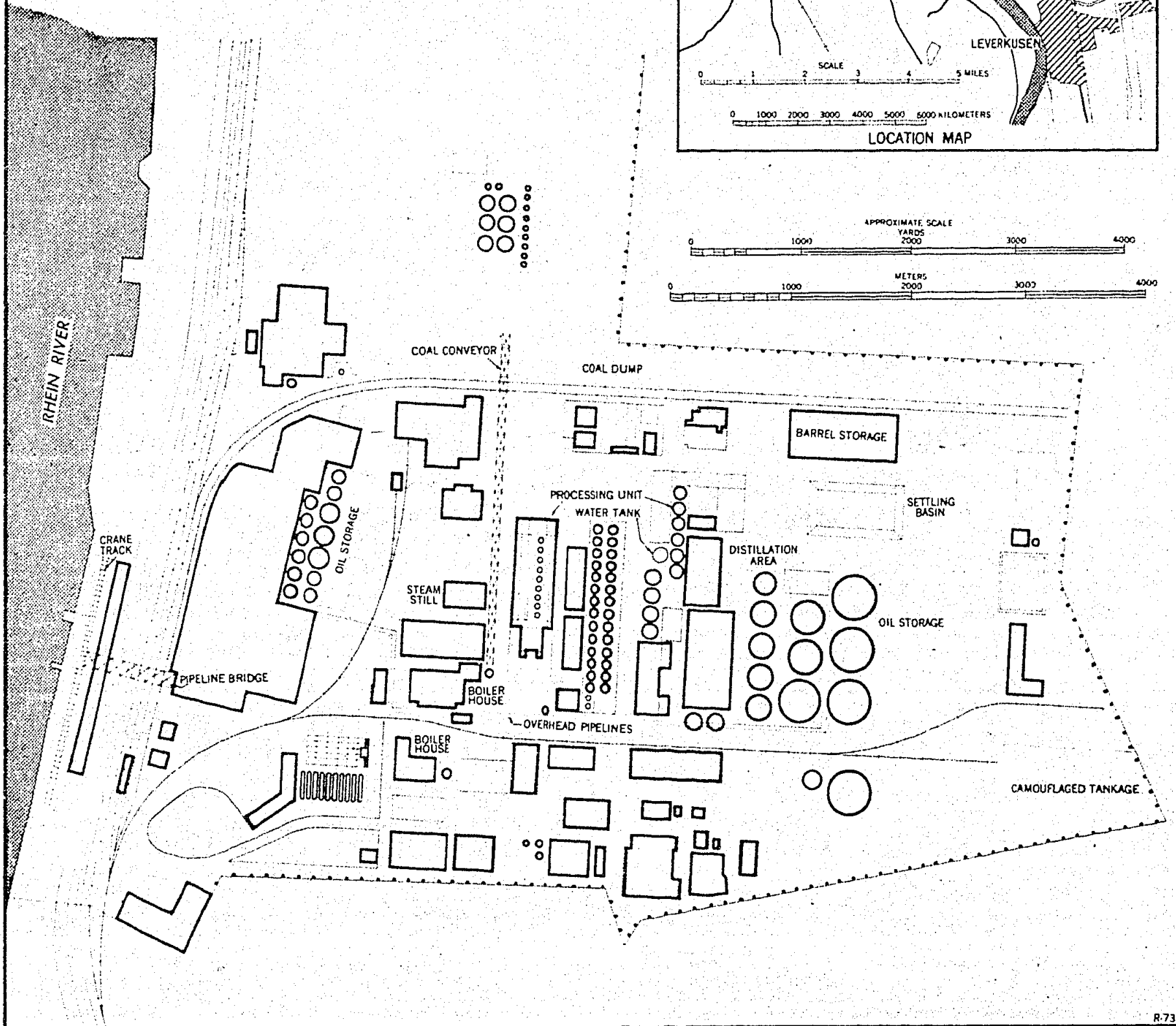
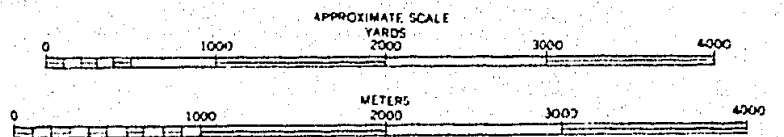
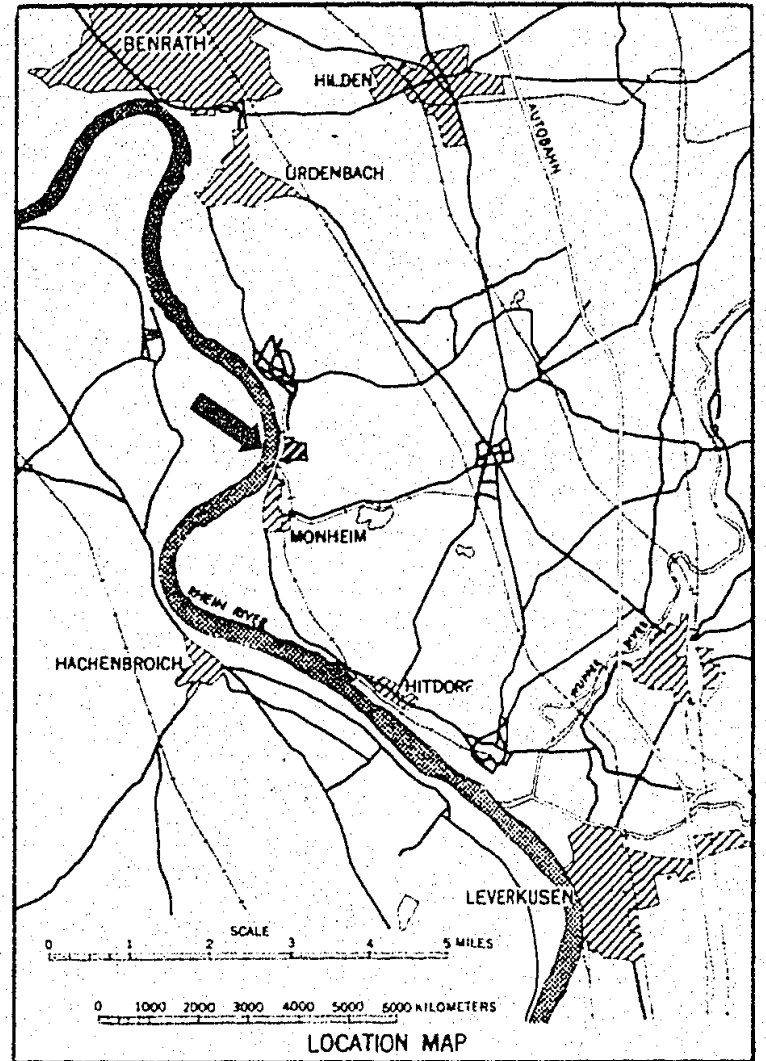
Tankage totals some 47,700 metric tons (300,510 barrels).

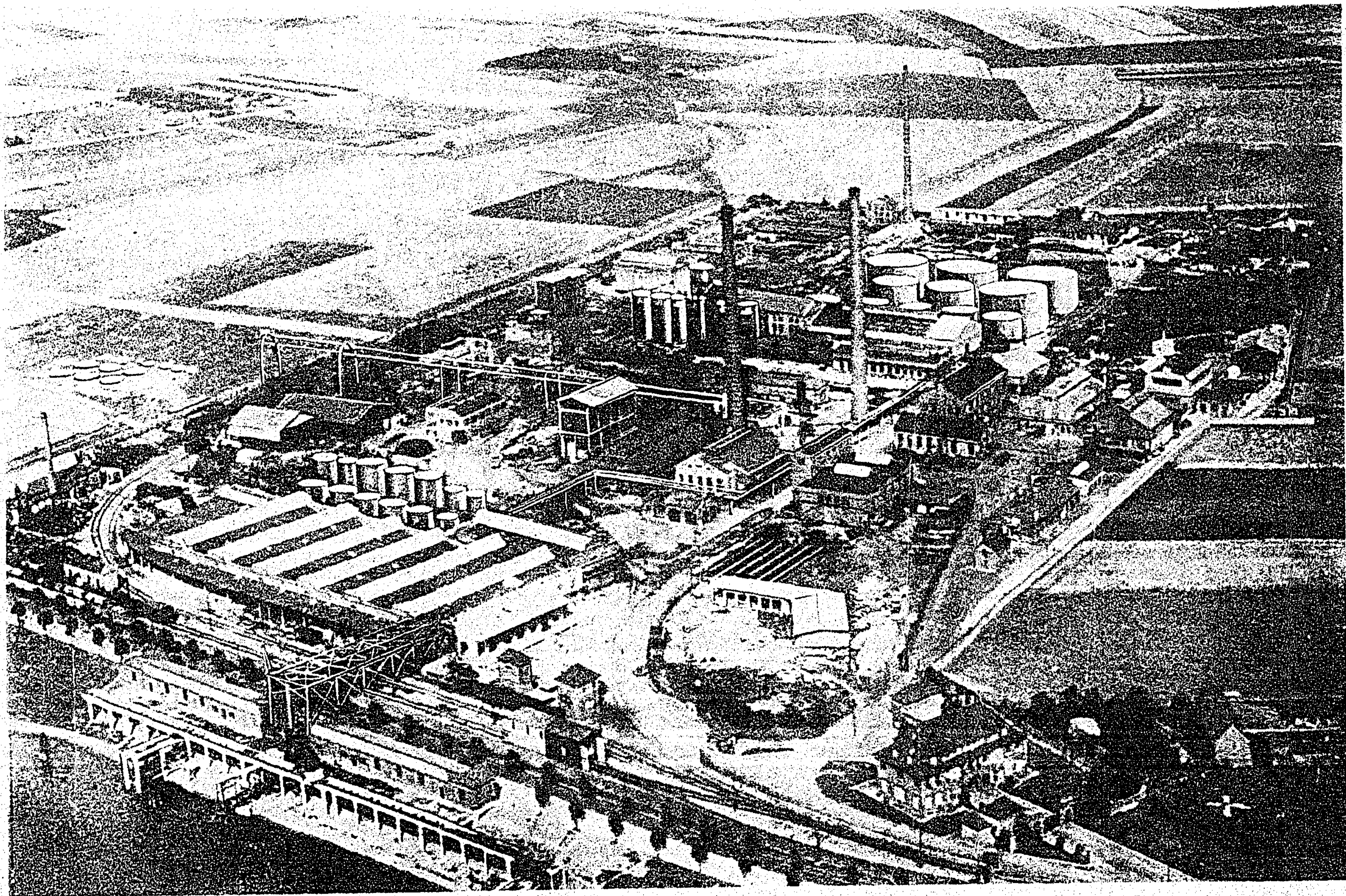


REFINERY
RHENANIA - OSSAG
MINERALÖLWERKE A. G.
MONHEIM

DETAILS OF LUBE OIL TANKAGE*				
No of Tanks	M3	Bbls	Total M3	Total Bbls
4 Each	5,080	32,004	20,320	128,016
2 Each	2,544	16,027	5,088	32,054
2 Each	1,328	8,366	2,656	16,732
4 Each	1,230	7,749	4,920	30,996
3 Each	556	3,503	7,668	10,509
8 Each	555	3,497	4,440	27,974
2 Each	460	2,898	920	5,796
9 Each	250	1,575	2,250	14,175
3 Each	204	1,285	612	3,855
104 Each	under 200	under 1,260	3,813	24,022
141		Totals	46,687	294,129

*This is pre-war Tankage list. Individual tanks unidentifiable





REFINERY OF RHENANIA-OSSAG MINERALÖLWERKE A.G.
MONHEIM, NEAR DÜSSELDORF

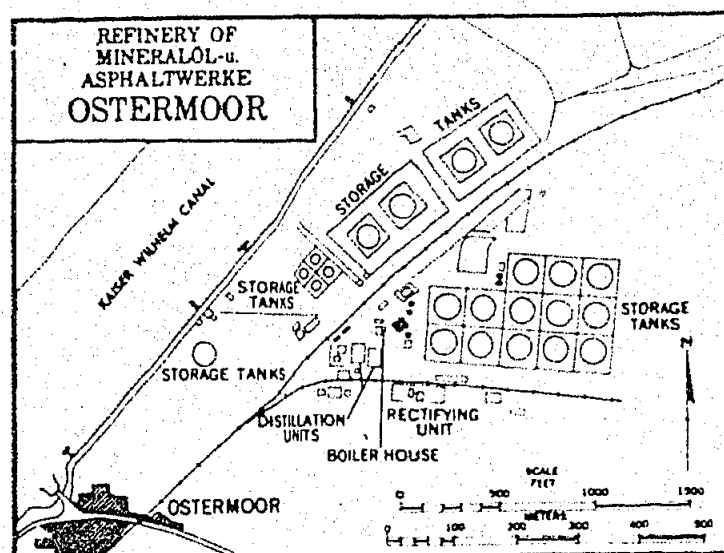
3.12 OSTERMOOR

Refinery: Mineralöl und Asphaltwerke A.G.

Location: On southeast bank of the Kaiser Wilhelm (Kiel) Canal near the juncture of the canal with the Elbe River. Some 40 miles downstream from Hamburg. 1-3/4 miles from Brunsbuttelkoog. Latitude 53° 55' N, longitude 9° 11' E.

Maps and Plans: Layout sketch on this page. Location shown on map on page 260.

Description: Annual capacity: 150,000 metric tons. This plant is primarily an asphalt refinery and formerly operated on heavy Venezuelan crude. It has been heavily bombed and has been inactive during most of the war.



The plant contained pipe stills and shell stills but no cracking nor lub. oil equipment.

Tankage capacities are reported to be as follows:

No. of Tanks	Diameter in Feet	Capacity Each Metric Tons	Total Capacity	
			Metric Tons	Barrels
4	120	11,000	44,000	277,200
1	85	5,000	5,000	31,500
13	80	4,000	52,000	327,600
4	35	800	3,200	20,160
22	T o t a l		104,200	656,460

3.13 PEINE

Refinery: Mineralölwerke Peine (Julius Schindler)

Location: On north side of the railway in eastern outskirts of Peine. Latitude 52° 19' N, longitude 10° 15' E. Approximately 20 miles ESE of Hannover.

Maps and Plans: Layout sketch and location map, page 124.

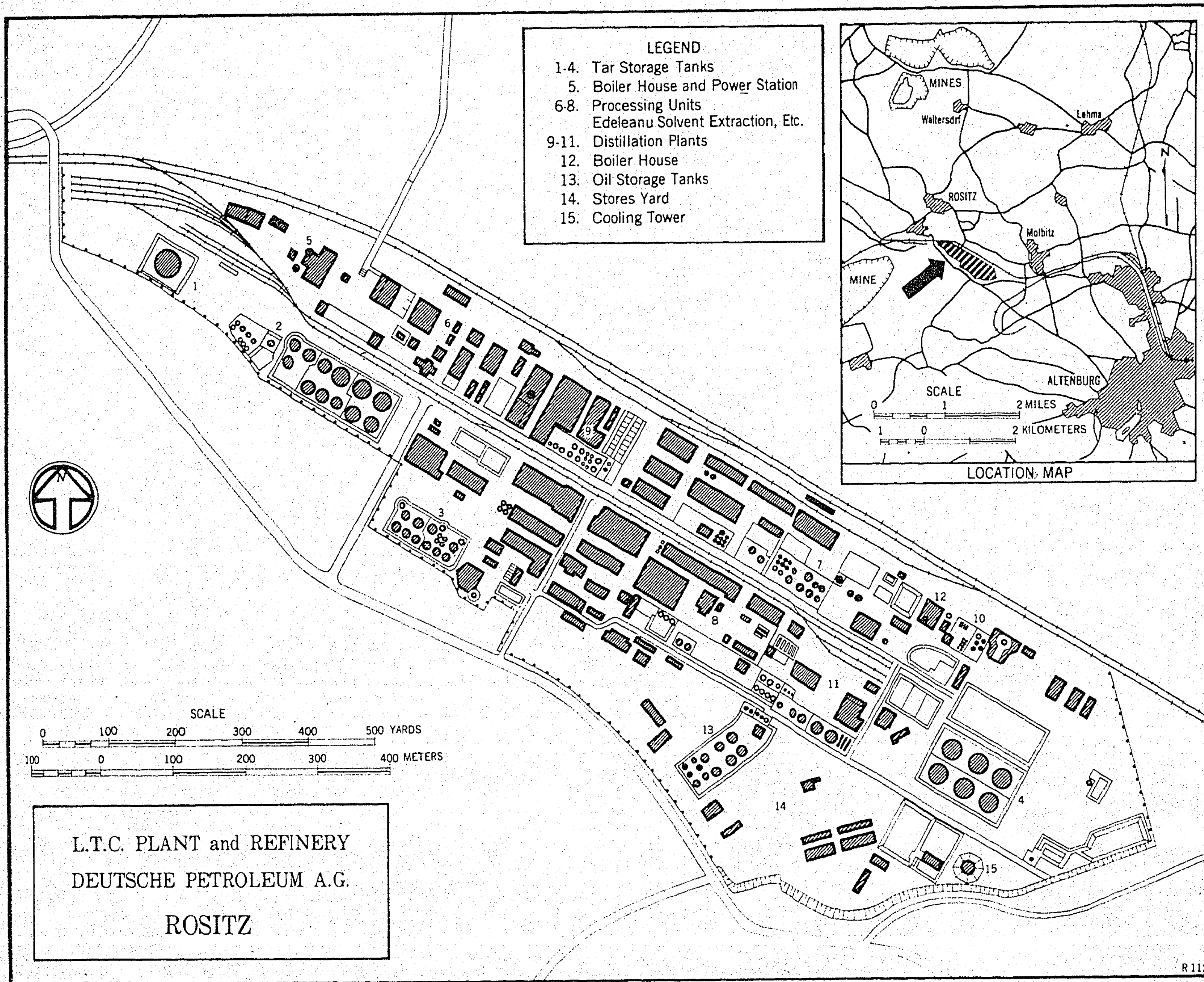
Description: Annual capacity: 20,000 metric tons. This is a small refinery operating on German crude from the fields in the Hannover area. It is equipped with shell stills and produces gasoline, tractor fuel and low grade lubricants such as axle oil.

Tankage is limited and estimated at a total of 5,000 metric tons (31,500 barrels).

3.14 REGENSBURG

Refinery: Rhenania-Ossag Mineralölwerke A.G.

Location: On the north side of the Oelhafen, south of the Danube River in the eastern outskirts of Regensburg. Latitude 49° 1' N, longitude 12° 8' E.



Maps and Plans: Location sketch on page 345.

Description: Annual capacity: Estimated at 30,000 metric tons. This is reported to be a small rerunning plant for the treating of gasoline and hardly classifies as a refinery. No details are available (a).

A prewar tankage list is given below:

Details of Tankage

No. of Tanks	Capacity Each M ³	Total Capacity	
		M ³	Barrels
1	2,553	2,553	16,084
1	2,530	2,530	15,939
1	2,530	2,530	15,939
1	1,877	1,877	11,825
1	1,841	1,841	11,598
3	460	1,380	8,694
5	264	1,320	8,316
46 less than 200 M ³		2,401	15,126
T o t a l		16,432	103,521

3.15 ROSITZ

Refinery: Deutsche Petroleum A.G.

Location: 1/2 mile east-southeast of the village of Rositz about 21 miles south of Leipzig. The plant lies on main road from Rositz to Altenburg and south of the Altenburg-Zeitz railway line. Numerous lignite mining pits in the vicinity.

Maps and Plans: Layout plan and location sketch on page 136.

Description: Annual capacity: Estimated at 120,000 metric tons. This refinery is reported to contain a low temperature carbonization plant and a solvent extraction plant using the Eddeleanu process. The principal feed stock appears to be tar, obtained by the low temperature carbonization of brown coal (lignite) at the refinery and at other L.T.C. plants in the vicinity. However, it is also suggested the refinery sometimes processes natural crude oils.

Diesel oil is reported to be the principal product produced.

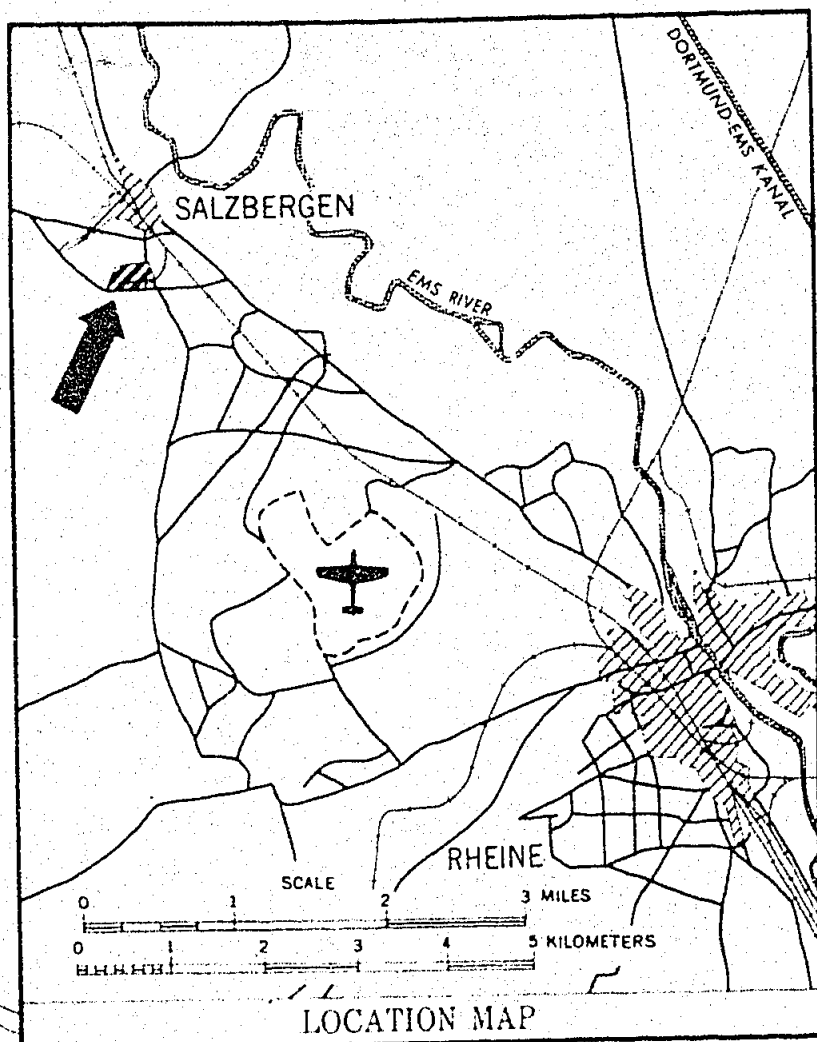
No information on tank capacities is available.

3.16 SALZBERGEN

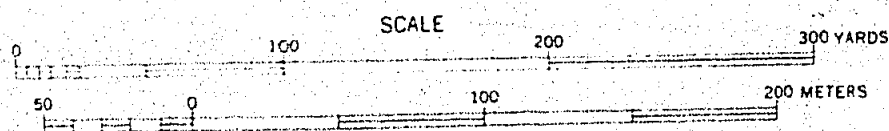
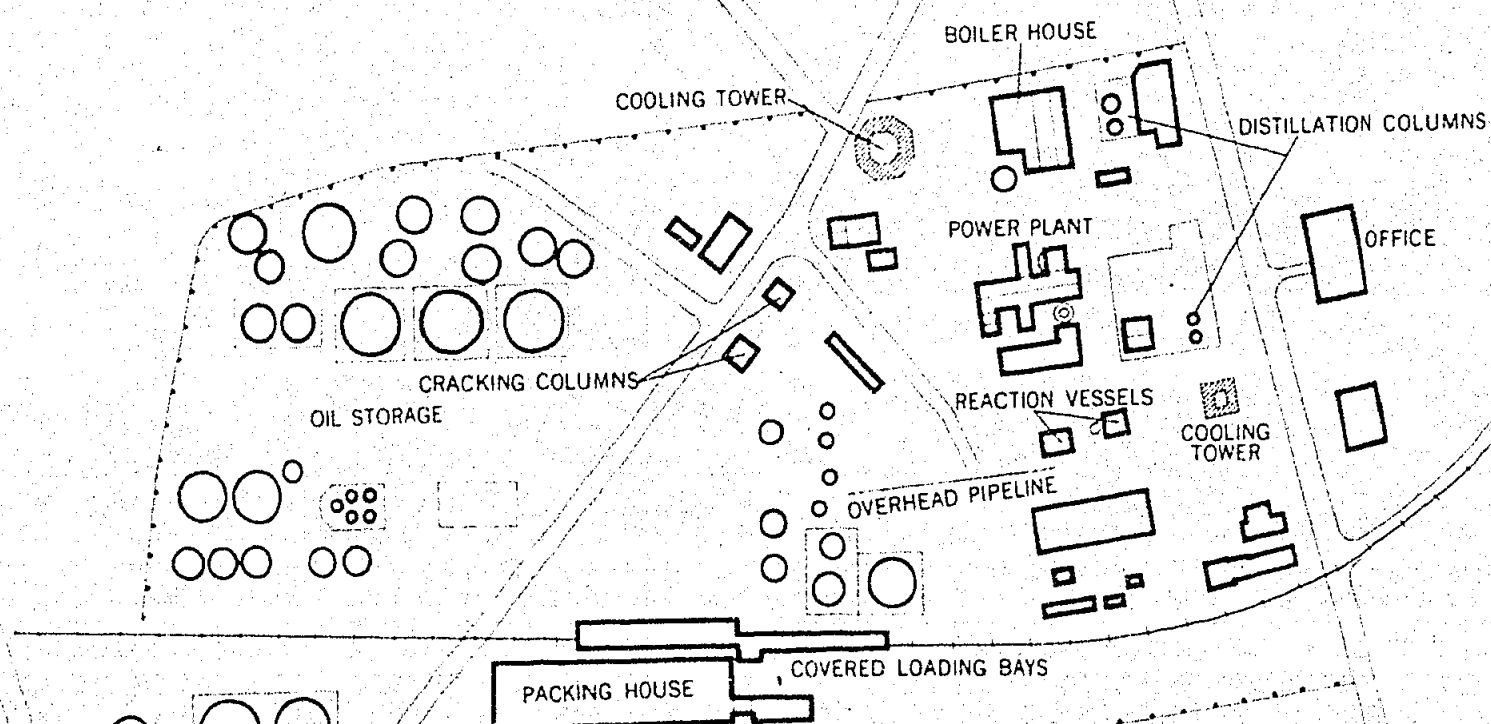
Refinery: Erdöl-Raffinerie Salzbergen G.m.b.H. (Ersag).

Location: 1/2 mile south of the village of Salzbergen. Latitude 52° 19' N, longitude 7° 21' E. 4½ miles NW of Rheine on the Ems River, near the Netherlands border.

(a) Another plant described as a small refinery belonging to Danubia A.G. für Mineralölwerke is reported at this same location, but confirmation is lacking.



PLAN OF
ERDÖL RAFFINERIE
SALZBERGEN (ERSAG)
SALZBERGEN



Maps and Plans: Layout plan, and location sketch, page 138.

Description: Annual capacity: 50,000 metric tons. This small but complete refinery has been very active and its capacity may have been increased. It is equipped with shell stills, pipe stills and a small cracking unit. Lub. oil facilities include high vacuum distillation and dewaxing for the production of high grade lubricants. Exact details are not available.

Tankage is estimated at 36,000 metric tons, (226,800 barrels) but it is reported that additional underground tankage has been installed.

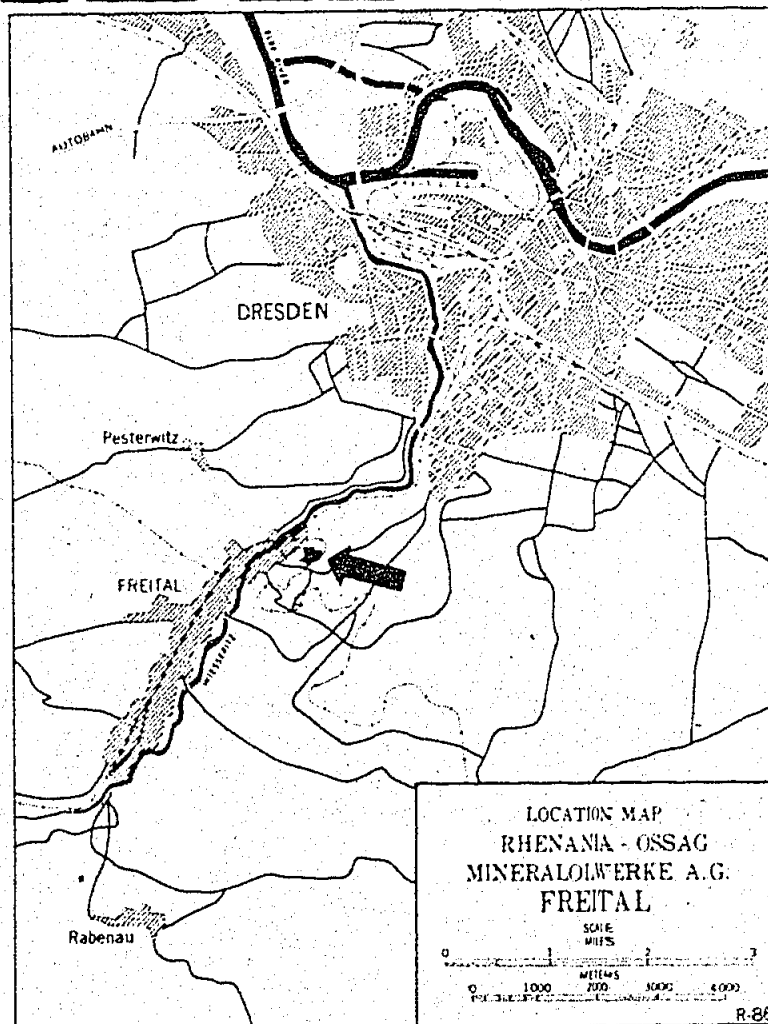
3.17 VOLTOL LUBRICATING OIL PLANT, DRESDEN

Plant: Rhenania-Ossag Mineralölwerke A.G.

Location: On northeast outskirts of Freital four miles southwest of Dresden. The plant lies in a loop of a branch railway line 1/2 mile east of the main railway from Chemnitz to Dresden. Latitude $51^{\circ} 0' N$, longitude $13^{\circ} 40' E$.

Maps and Plans: Layout plan, unavailable. Location sketch on this page.

Description: Annual capacity: 6,000 metric tons. This small specialty plant manufactures special oils by the Voltol process and its products are used as blending agents in the manufacture of high grade aviation lubricants. Therefore, this plant, while not a true refinery, is of considerable importance. Tankage is limited and prior to the war consisted of two tanks of 200 M³ and 22 tanks of less than 200 M³, the grand total amounting to only 756 M³ (4,762 barrels).



The process, which is also employed in the Elektrion plant at Gent, Belgium treats fatty or vegetable oils by means of electrical discharge. A brief description of the process is as follows:

Principal reactions. - It is believed that most of the reactions which occur during voltolizing are the result of electron bombardment. The principal reactions are: (1) Polymerization; (2) Dehydrogenation; (3) Rupture of carbon-carbon bonds, especially those in long-chain hydrocarbons.

All vegetable oils with a high iodine number can be voltolized. In this process hydrogen is intermediately produced and then is added to the unsaturated bonds. During voltolizing of the vegetable oil the iodine number is reduced. Voltolization of rapeseed oil increases the viscosity from 59 to about 300 seconds Saybolt Universal at 210°F.

If vegetable oil alone is voltolized and no mineral oil is added during the process, then, after a certain time, over-voltolizing is observed, which results in sedimentation of fatty acids in the oil. A fatty oil not diluted with the mineral oil reaches, during voltolization, a viscosity limit which does not increase substantially during continued operation. Tests indicated that voltolization proceeds more quickly if Edeleanised mineral oil (SO₂ raffinate) is added than is the case when only acid-treated mineral oils are used. Straight mineral oils, which voltolize badly, have been found to voltolize rapidly when combined with fatty oils.

The yield in the Voltol process is 100 per cent because, through the influence of the glow discharge, only a re-arrangement of molecules and polymerization takes place.

Description of the process.- In the commercial voltolization of rapeseed oil, at least as practiced in Freital, Germany, in 1936, pure rapeseed oil was voltolized until the viscosity reached 275 S.U. seconds at 210°F. Two parts of mineral oil were then added and voltolization continued until the final product had a viscosity of about 800 S.U. seconds at 210°F. Further voltolization would yield a product that could not be successfully blended with mineral oil to give a final blend that would not separate on standing. It is believed that dilution during the voltolization process is practiced simply to reduce the viscosity of the oil during the final stages of the process, although it may also aid in promoting solubility of the Voltol in the final blend by inter-polymerization of mineral oil and rapeseed oil molecules.

The partly voltolized rapeseed oil before dilution is usually called "Rapeseed Mild Voltol" whereas the voltolized blend of two parts of mineral oil and rapeseed mild Voltol is called "Voltol". The final lube oil which consists of about 5 per cent of Voltol and 95 per cent of a suitable mineral oil is called "Voltolized oil".

Operating conditions.- The voltolization operation is carried out at a temperature of about 140°F, using a glow discharge produced by a high frequency current of 2,000 to 5,000 volts, 2 amperes, and 6 kilocycles. The power consumption is roughly 0.5 KWH per kilogram of oil (70 KWH per barrel). It is desirable to apply the lowest possible temperature and working pressures in order to avoid the formation of higher polymers on the electrodes. Owing to the rather great consumption of current and elaborate equipment, this procedure is rather expensive.

Properties of Voltolized oils.- The addition of about ten per cent of Voltol oil to mineral lubricating oils results in the following improvements of lubricating oil: (1) Increase of viscosity and viscosity index of the oil: The viscosity of the mixture is increased so that, if necessary, bright stock can be saved. The viscosity index of the final blend is a maximum of some 20 points higher than the viscosity index of the mineral oil. (2) Pour reduction: The addition of Voltol to mineral lubricating oils decreases the pour point of the oil. (3) Improvement of oiliness: It has been found that the addition of Voltol oil improves the oiliness. Moreover, voltolized oils lead to cleaner engines due to the sludge-dispersing properties of the Voltol oil.

Available data indicate that for luboils used for aircraft engines, the amount of Voltol oil which can be added is limited to about 5 per cent, as, due to the thermal instability of the vegetable oil content, it is believed that a larger percentage of Voltolized vegetable oils in the final blend would, owing to the high temperature, cause some decomposition in aircraft engines.

3.18 TETRA-ETHYL LEAD PLANTS

Prior to the war Germany had only one tetra-ethyl lead plant, that of the I.G. Farbenindustrie at Gaspel near Döberitz. Since the war a new and larger plant has been built at Nachterstedt in the Harz Mountains. Available information on each one of these plants is given below.

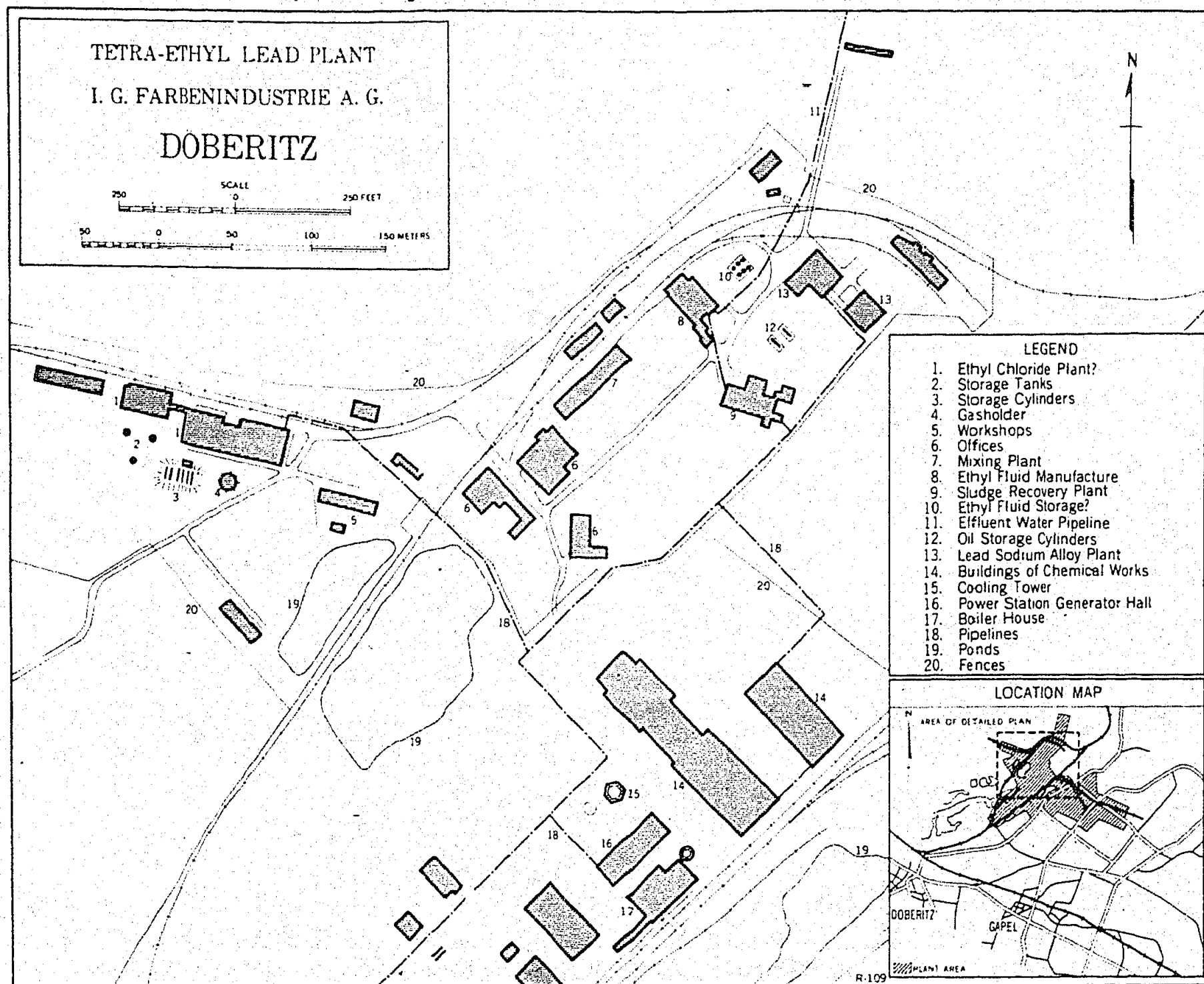
3.18.1 Döberitz

Plant: I. G. Farbenindustrie A.G.

Location: Near the village of Gaspel about two miles east of Döberitz, lying on the main road and railway about halfway between Brandenburg and Rathenow. Latitude 52° 32' N, longitude 12° 24' E.

Maps and Plans: Layout plan and location sketch on this page.

Description: Estimated output 1,400 metric tons per year. This T.E.L. plant was built some years prior to the war alongside an existing I.G. Farbenindustrie chemical works, which produced ammonia, nitric acid, and explosives.



3.18.2 Nachterstedt

Plant: I. G. Farbenindustrie A.G.

Location: At Nachterstedt, latitude 51° 50' N, longitude 11° 22' E, in the Harz Mountains. Between Aschersleben and Halberstadt.

Maps and Plans: No layout plan or location map available. See general map on page 84.

Description: Reports that since 1939 I.G. Farbenindustrie had built a new T.E.L. plant in the locality have been confirmed by aerial reconnaissance. The air cover discloses a large plant covering an area of 800 ft. x 2,900 ft. and served by a branch from the Aschersleben-Halberstadt railway line.

There appear to be two ethyl-fluid units within the plant and annual capacity is estimated to equal 3,500 metric tons.

Power and steam are supplied from a large power station at Grube concordia about 2/3 of a mile to the northwest.