XXV. BRUX.

Introduction:

Several bus-loads of staff and workmen from the Hermann Goering Works at Brux arrived at Leuna on the night of 12/13th May. They had left Brux on the night of 7th/8th May just before the Russian entry. The party included Dr.Damm, the managing director and Dr.Amon, the chief engineer. Dr.Ottens, the chief chemist of the plant had been separated from the main party en route and was expected later. Dr.Damm had no papers and was in no condition to give a detailed account of the plant and its operations. He disclosed that arrangements had been made in March to evacuate to Schwarzenfeld, near Amberg, Bavaria, in the event that a Russian occupation of Brux appeared likely. When the Western advance developed, this plan was dropped but a considerable number of documents were evacuated to the Porceline Fabrik Buchtal A.G. at Schwarzenfeld. A further batch of documents had been sent to the Kohlen Chemische Institut at Claustal in the Hartz Mountains. Others had been hidden in the central shaft of the brown coal mine at Brux.

It was the intention of the Brux staff to proceed to the Hermann Goering Works at Walenstadt, near Brunswick, where they hoped to work out a plan for distribution of people to other works.

General Outline of the Brux Factory.

The plant, erection of which was commenced in 1939, consisted of the following sections:

(a) Brown Coal Carbonisation.

This consisted of four groups of 20 carbonisation units designed by Lurgi to operate with recycle gas. The coal carbonised was the local hard brown coal containing 30% water. Each unit had a throughput of 250-300 tons/day of wet coal. Parts of this plant commenced operation in 1942 and by May 1944, when the programme began to be interrupted by air raids, 60 units had been erected and 55 were working. Tar yield was 10-12% by weight on the coal carbonised and middle oil and heavy tar were produced separately by fractional condensation of the tar vapours. It was proposed to sell the middle oil as heating oil after topping it to increase the flash point to $> 85°C$. The heavy tar was to be the feed to the hydrogenation plant.

(b) Hydrogen Production.

Six large Winkler Generators, each with a capacity of 20,000 M^3/hour water gas, were installed, together with Linde

units for oxygen manufacture. The hydrogen plant for completion of the reaction $CO + H_2O = CO_2 + H_2$ operated at 12 ats pressure. Nine hydrogen plant units were installed at Brux. They were all Bamag design.

The anticipated steam savings were not achieved and initially trouble was experienced by salting up and corrosion of parts of the plant. Trouble was also experienced with the life of catalyst which had to be removed every 4-6 weeks for cleaning by rumbling and sieving. At times, the operation of the hydrogen units definitely limited plant operation and Dr.Dana was firmly of the opinion that atmospheric pressure hydrogen sets are to be preferred.

(c) Hydrogenation Plant.

The hydrogenation plant was in two sections, each consisting of two liquid phase stalls, two pre-saturation and two splitting hydrogenation stalls. Each stall had four converters operating at 325 ats. The anticipated output of final liquid products from this plant, i.e. fuel oil from carbonisation + petrol and diesel oil from the hydrogenation units, was 600,000 tons/year. The plant began operations in May 1943 and by May 1944 output had been brought up to 45,000 tons/month. Bombing commenced in May 1944 and continued at regular intervals. The output of the plant was greatly reduced as a result and in the last 6 months of 1944 was only 20,000 tons of liquid product. Output during 1944 was 100-120,000 tons. It was considered that, apart from air raid damage, the output of the complete plant could have been easily increased from 600,000 to 1,000,000 tons/year liquid product by the addition of two more liquid phase stalls and by increasing the capacity of the carbonisation plant.

(d) Phenol Extractions.

The brown coal tar was very rich in phenols. Aqueous liquors produced in the carbonisation and hydrogenation plants were extracted with phenosolvan as at Blechhammer. Phenols from the crude cold catchpot product of the hydrogenation plant were recovered by a method developed by Koppers. The product was subjected to steam distillation and the distillate passed through caustic soda solution and maintained at about 100°C, the resulting phenate being worked up in the ordinary way. A third source of phenol was the light oil from the carbonisation units, which was extracted with caustic soda.

The phenosolvan extract was very rich in catechol. The crude extract was purchased by the I.G. and was worked up at Leuna. The rest of the caustic soda extracted phenols were worked up at Brux and sold through the Phenols Sales Board in

Berlin. Refining was not carried beyond the crude carbolic acid and crude cresols stages although it was intended later to instal plant for the production of pure phenolic products.

Operation of the Hydrogenation Units.

The heavy brown coal tar was hydrogenated in much the same way as employed at Leuna. The heavy tar was mixed with the cold catchpot product and fractionated into middle oil boiling up to 325°C and heavy oil, the latter being fed to the liquid phase hydrogenation stalls and hydrogenated, using a suspended iron on Grude catalyst.

The Brux tar was quite different from Middle German brown coal tar. In addition to its higher content of phenols, including catachol, it had a considerably higher asphalt content. It was also apt to contain arsenic compounds which gave rise to considerable trouble in the plant. Arsenic compounds were found in deposits in the pre-saturation hydrogenation stall interchangers and on the catalyst. The source of the arsenic was thin bands of high arsenic content Pyrites in the coal. As a temporary measure, trouble was minimised by careful selection of the coal but it was intended to instal a coal washery, operating the flotation process, in order to remove Pyrites from the coal carbonised.

Dr. Amon stated that ordinary gas-fired preheaters were used for the liquid phase and the splitting hydrogenation stalls but the preheaters for the pre-saturation stalls were electrically heated.

Costs.

At the full output of 600,000 tons/year liquid products, it had been calculated that motor gasoline would cost 260 marks/ton at Brux. This assumes that crude wet coal costs 12 marks/ton delivered, and is made up as follows:-

Raw materials	120	marks/ton
Operating costs	80	" "
Capital charges	60	" "

The corresponding cost of heating oil was estimated to be 220 marks/ton.

Present Condition of Brux Plant.

When the staff left Brux, 16 carbonisation units were capable of operating and another six could have been put on line very quickly. Dr. Damm considered that within 12 weeks, 30 carbonisation units could be in operation. Three Winkler gas Generators were in operating condition and it was estimated that the Linde plant could be made to operate at half capacity in 1-2 months' time, given freedom from air raids. The same was

considered to apply for the hydrogen sets CO_2 and CO removal and compression.

As far as the hydrogenation plant was concerned, one liquid phase unit was in running order and a second could be put on line in four weeks. Two saturation and two splitting hydrogenation stalls were in working order.

Storage tanks had suffered badly in air raids but Dr.Damm considered that sufficient tanks were available for operation of the plant at roughly half its flowsheet output. Most of the storage tanks were sunk about one-third of their height below ground and were surrounded with 18" concrete walls.

Underground Hydrogenation Plant.

The Hermann Goering Works at Brux had started work on an underground hydrogenation plant at Bad-Schandau in Polenstal. This plant was intended to make 5,000 tons/month of petrol from tar. It consisted of two liquid phase and two vapour phase stalls and was known as Schwalbe III.

TABLE IX.

	Motor Spirit	Aviation Base VT.702	DHD Aviation Vase.VT.342	Diesel Oil 1	Diesel Oil 2	Marine Fuel Oil
Density at 15°C	0.735-0.765	0.715-0.730	0.760-0.810	0.845-0.865	0.820-0.840	0.845-0.865
Boiling Range	35°-200°C	40°-145°C	40°-175°C	200°-330°C	115°-285°C	200°-330°C
Flash Point	-	-	-	55°C	21°C	65°C
Aneline Point	-	max.52°C	max.10°C	-	-	-
Vapour Pressure.ats at 40°C	0.6 - 0.8	max.0.5	max.0.5	-	-	-
Residue on distillation	10 mgs.max.	5 mgs.max.	5 mgs.max.	-	-	-
Sulphur Content % by wt.	max 0.1	max.0.05	max.0.05	max.0.5	max.0.5	max.0.5
Freezing Point.	below -25°C	below -60°C	below -60°C	-	-	-
Aromatic Content % by wt.	-	max 15	40 - 55	-	-	-
Min. temperature for filtrability.	-	-	-	at least -5°C	at least -30°C	at least 0°C
Pour Point	-	-	-	at least -10	at least -40	at least -5
Viscosity at 20°C(Engler)	-	-	-	1.5 min.	1.2 min.	1.5 min.
Ash & Hard Asphalt Content	-	-	-	-	-	-
Octane No.	min.65	min.70	min.78	-	-	-
Octane No. with 0.09% by vol.of lead.	-	min.87	min.87	-	-	-
Cetane No.	-	-	-	45	40	45

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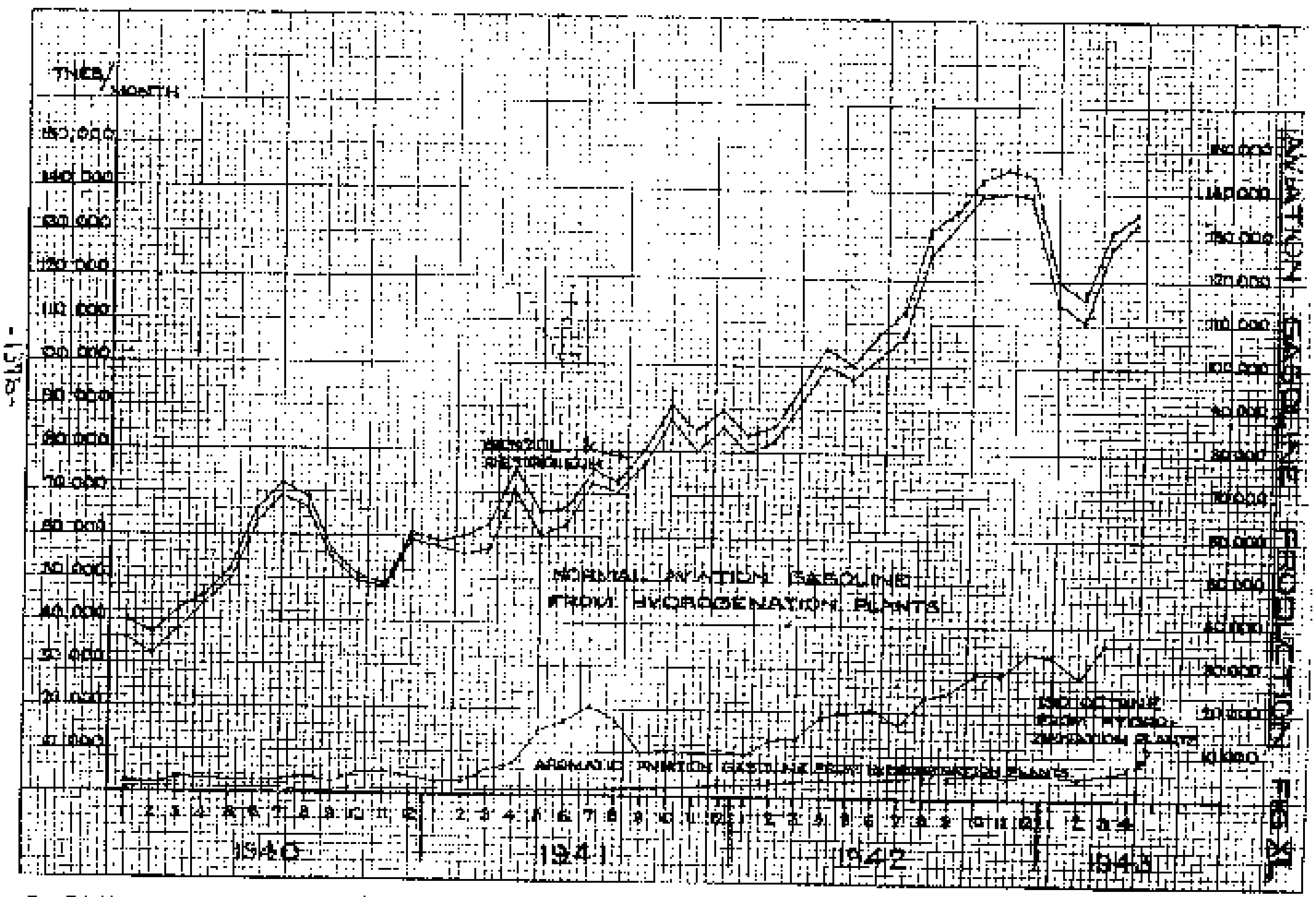

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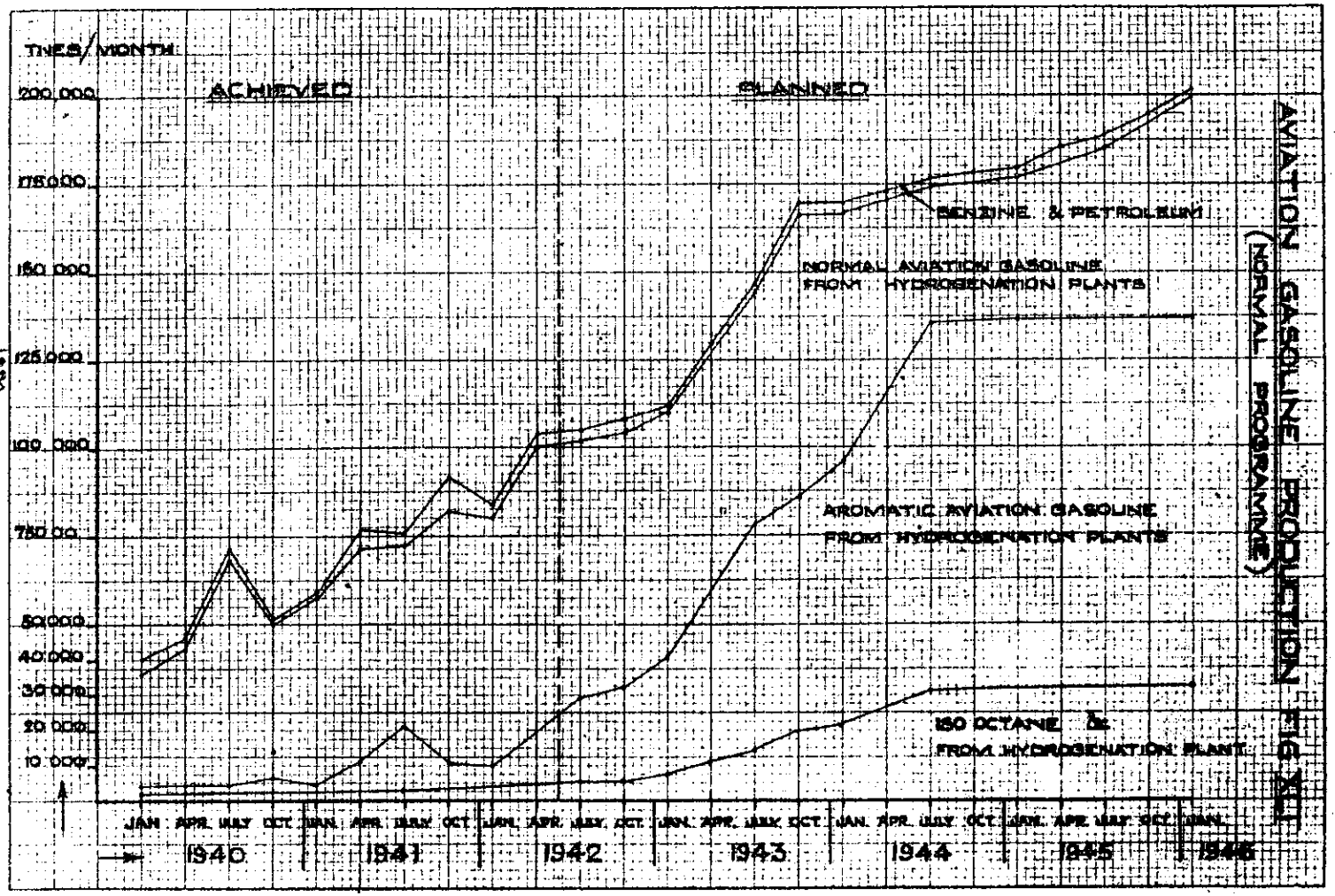
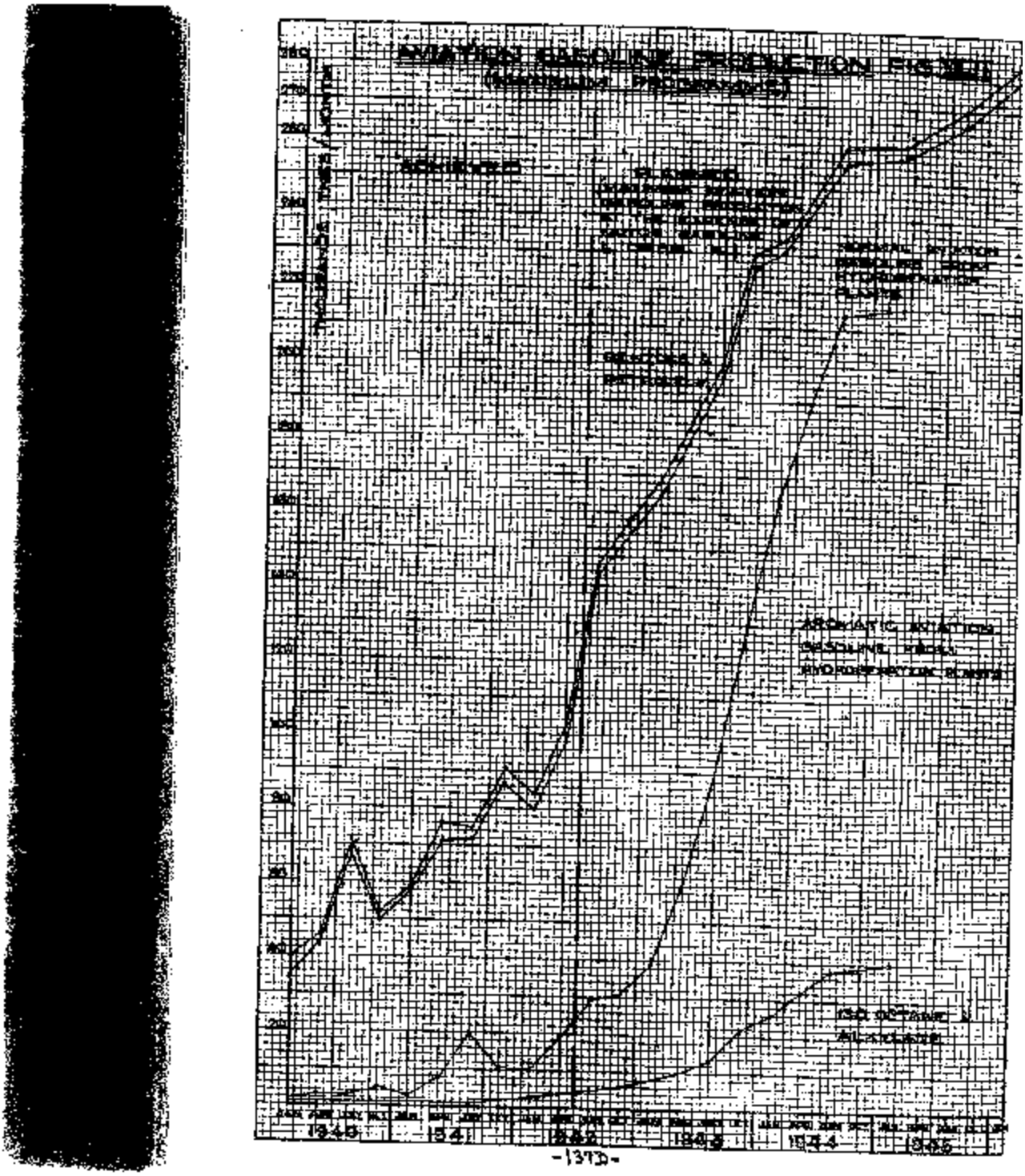
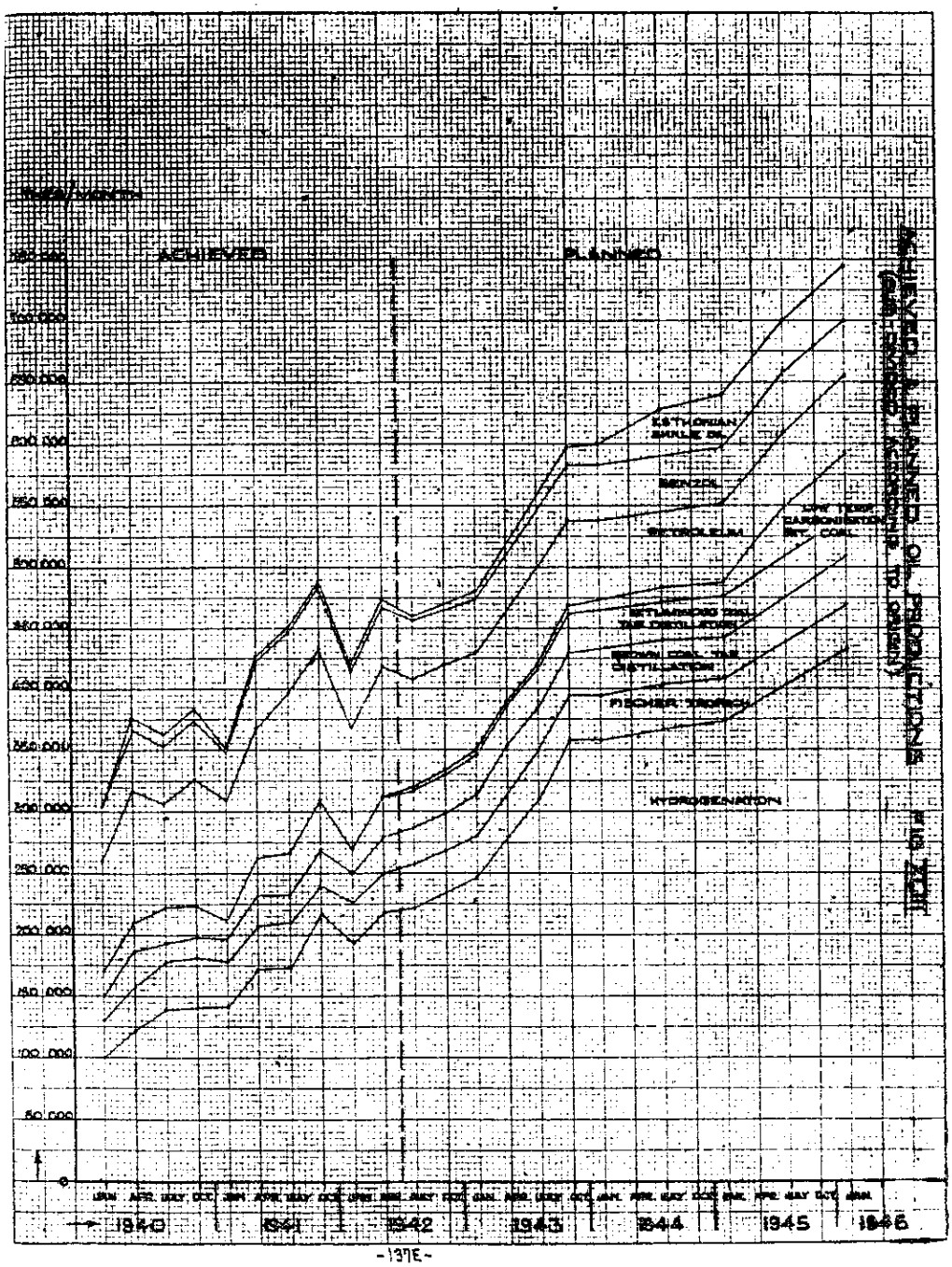
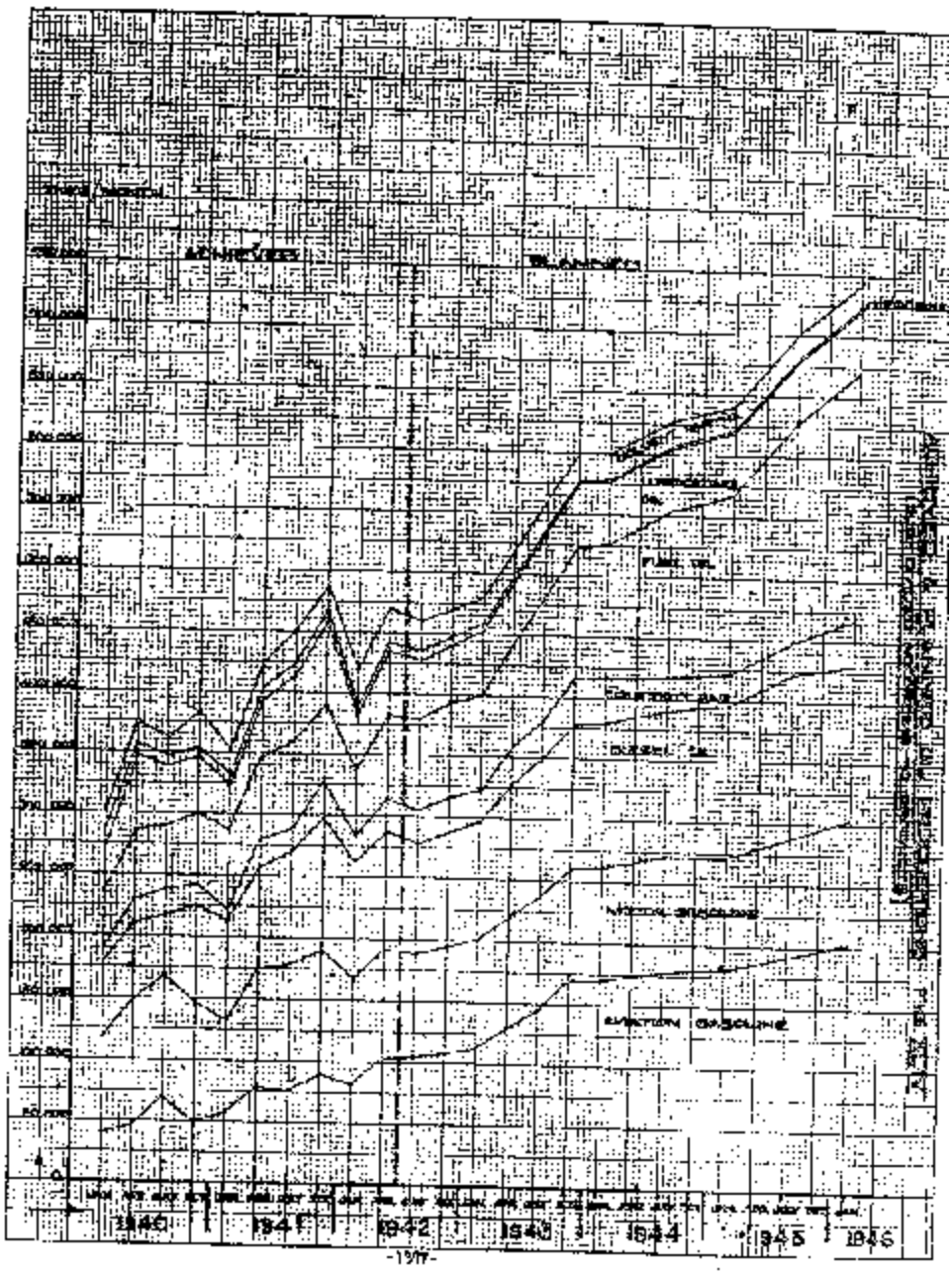
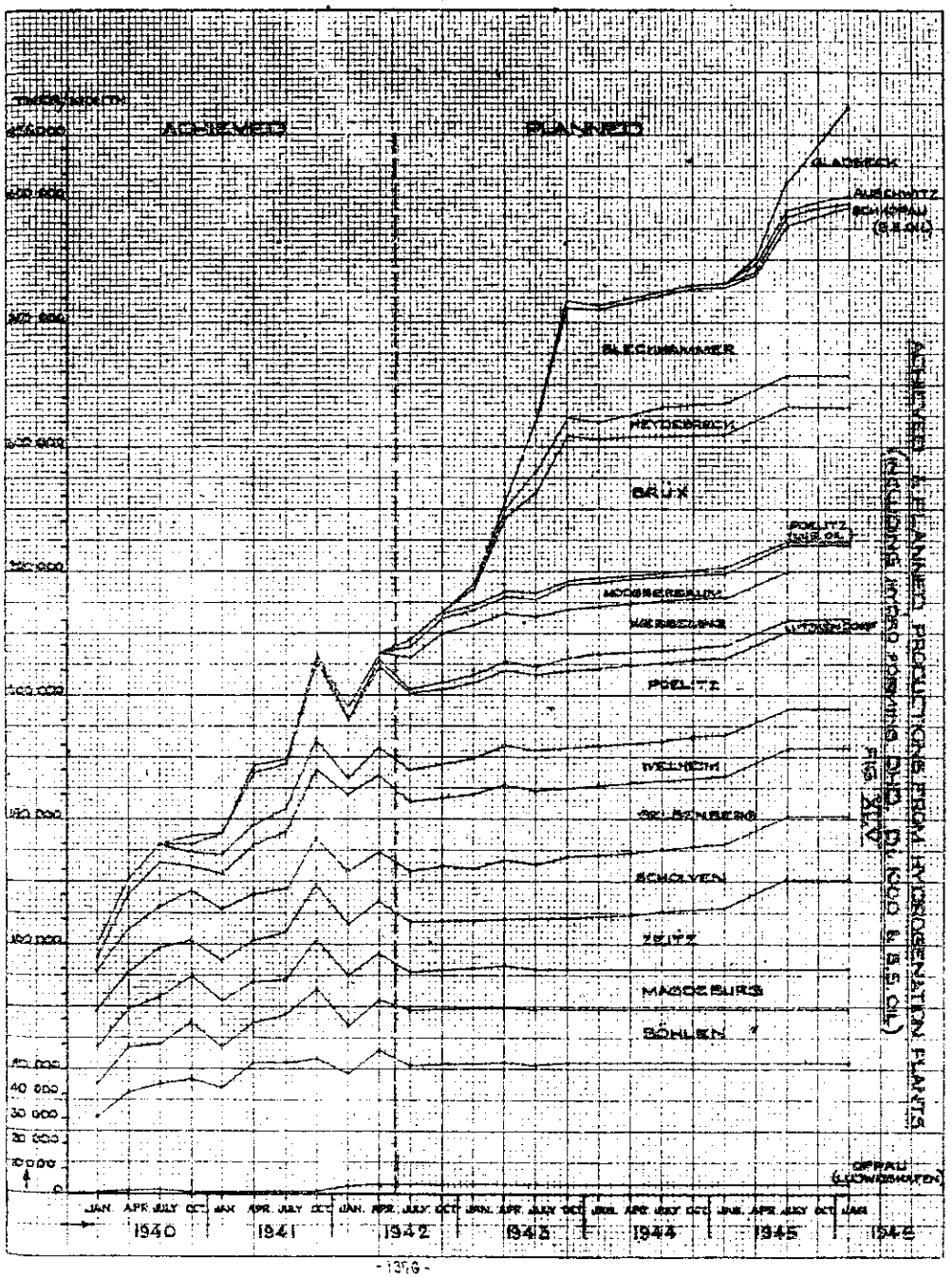
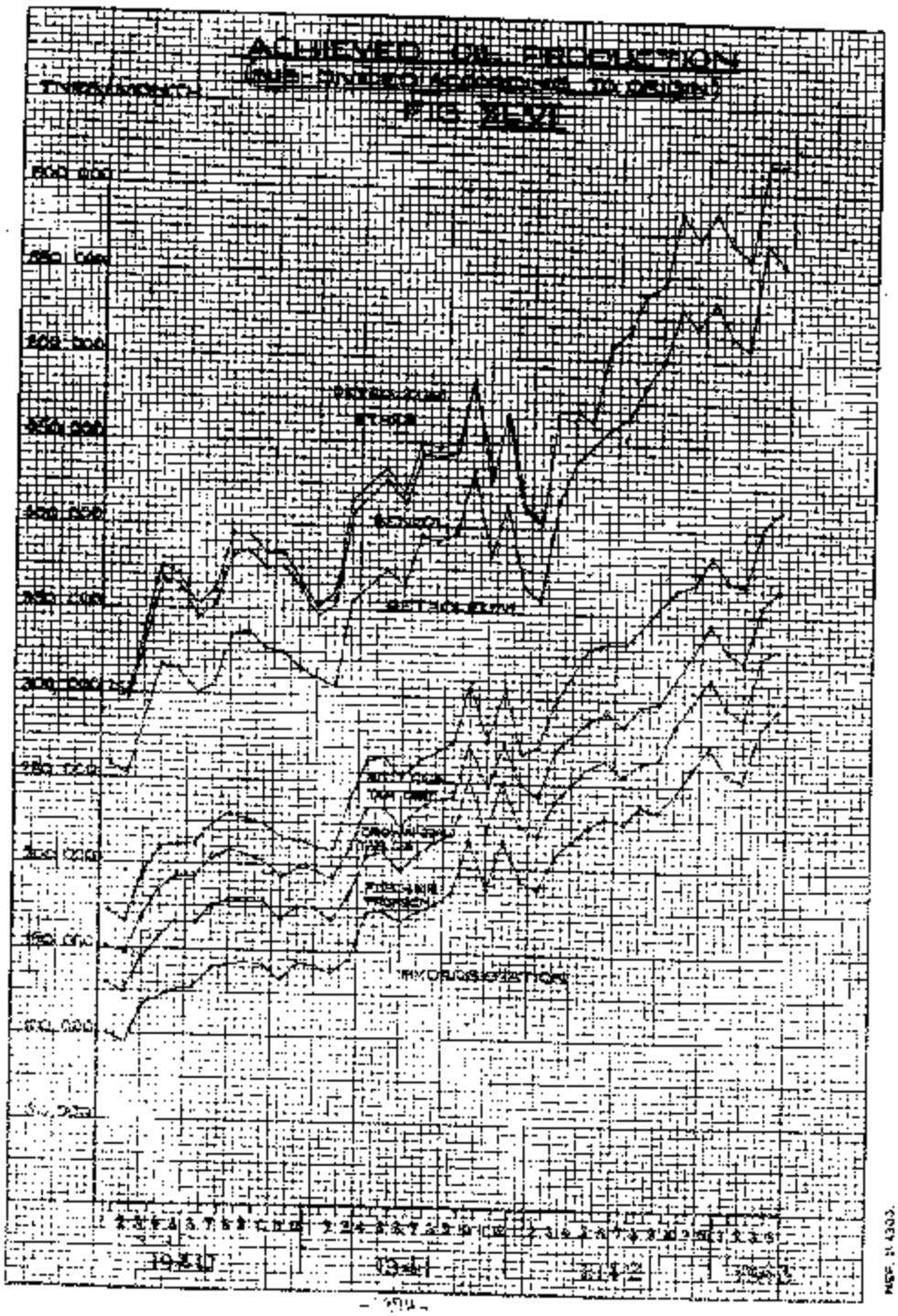

TINES/MONTH
200,000
175,000
150,000
125,000
100,000
75,000
50,000
40,000
30,000
20,000
10,000
ACHIEVED
PLANNED
BENZINE & PETROLEUM
NORMAL AVIATION GASOLINE FROM HYDROGENATION PLANTS
AROMATIC AVIATION GASOLINE FROM HYDROGENATION PLANTS
150 OCTANE &c FROM HYDROGENATION PLANT
JAN APR JULY OCT JAN APR JULY OCT JAN APR JULY OCT JAN APR JULY OCT JAN APR JULY OCT JAN APR MAY OCT JAN
1940
1941
1942
1943
1944
1945
1946
AVIATION GASOLINE PRODUCTION FIG XIII
(NORMAL PROGRAMME)

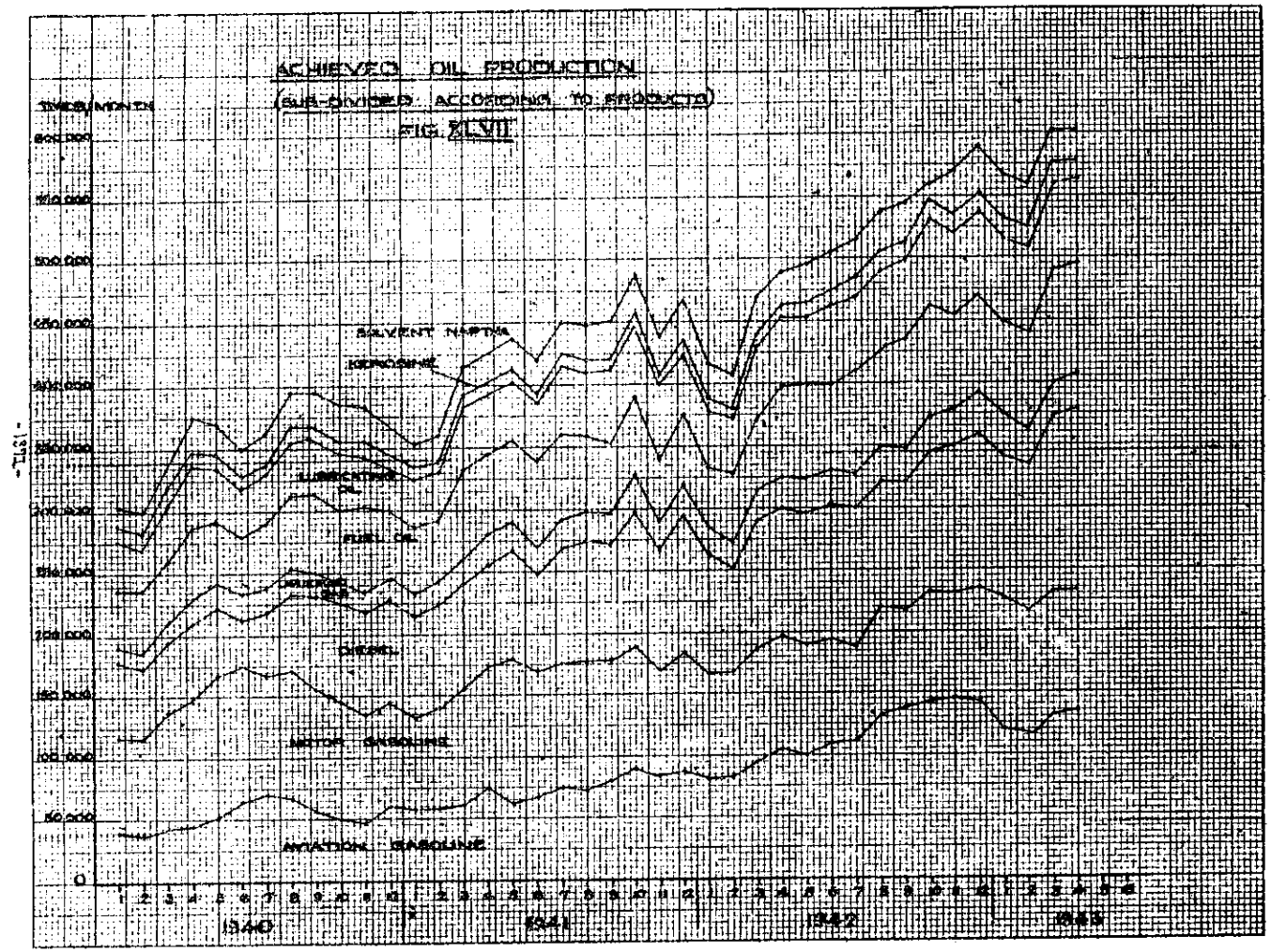

AVIATION GASOLINE PRODUCTION FIGURES
1940
1941
1942
1943
1944
1945


ACHIEVED
PLANNED
ESTHONIAN SHALE OIL
BENZOL
SYNTHOLEUM
LOW TEMP. CARBONISATION BIT. COAL
HYDROGENATION
1940
1941
1942
1943
1944
1945
1946


1940
1941
1942
1943
1944
1945
1946


ACHIEVED
PLANNED
GLADBECK
AUSCHWITZ
SCHKOPAU (BUNA)
BLECHHAMMER
HEYDEBRECK
BRUX
MOSSBERGLIN
WESSELING
POELITZ
WELHEIM
SCHOLVEN
ZEITZ
MAGDEBURG
SÖHLEN
ODERAU (LOWENHAFEN)
1940
1941
1942
1943
1944
1945
1946


ACHIEVED OIL PRODUCTION
FIG 2E2E


ACHIEVED OIL PRODUCTION
(SUB-DIVIDED ACCORDING TO PRODUCTS)
FIG. XLVII
TONS/MONTH
SOLVENT NAPTHA
KEROSINE
LUBRICATING OIL
FUEL OIL
DIESEL
MOTOR GASOLINE
AVIATION GASOLINE
1940
1941
1942
1943

[redacted]

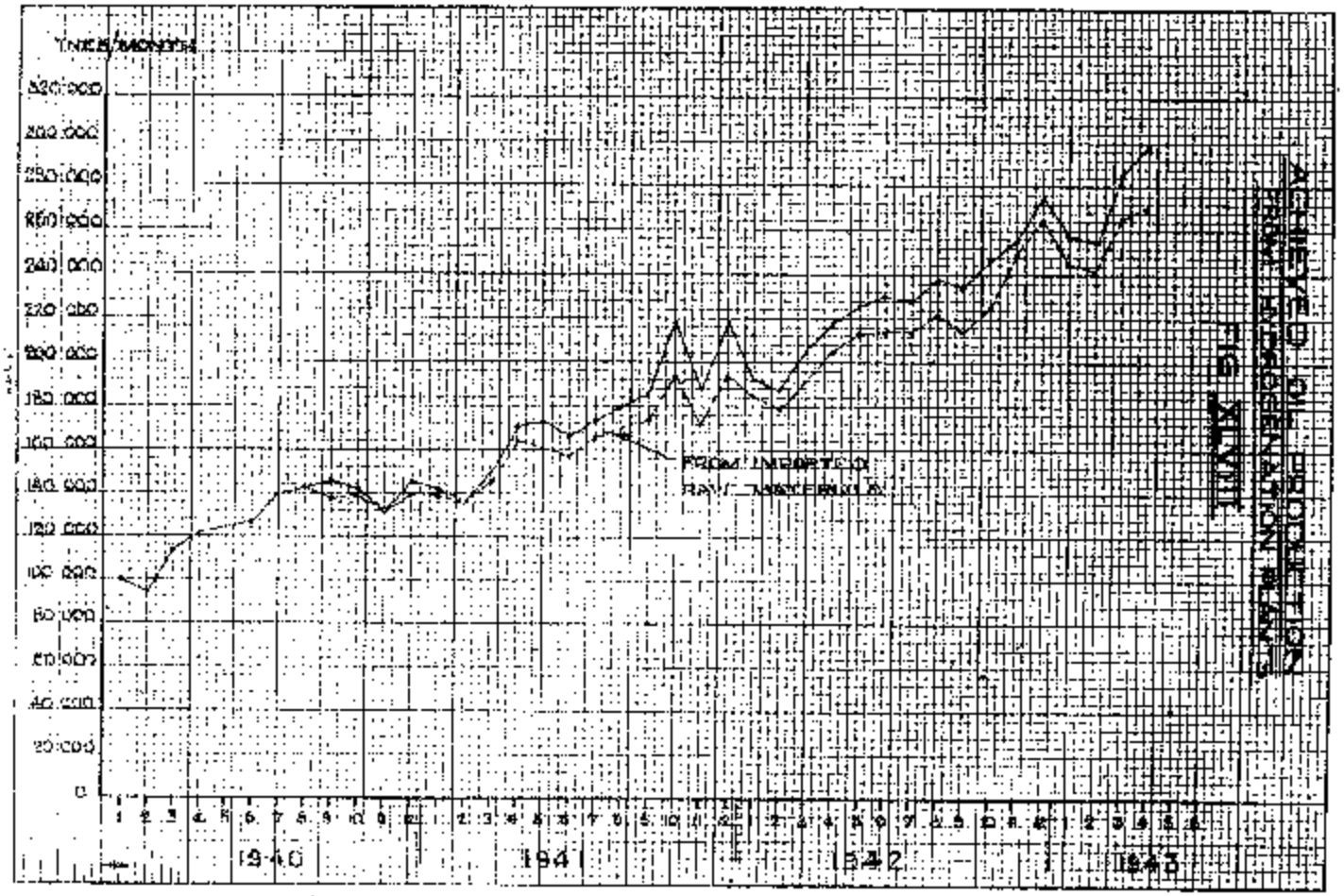

TONS/MONTH
320 000
280 000
240 000
200 000
160 000
120 000
80 000
40 000
0
1940
1941
1942
1943
FROM IMPORTED RAW MATERIALS
ACTIVITY OF PRODUCTION PLANTS

TABLE X

GERMAN OIL PRODUCTION DATA.

Hydrogenation Plants		Capacity in 1000 Tonnes/year				Actual normal monthly production in late 1943 and early 1944						
		Total Petrol	Aviation base	Alkylate & Octane	DHD petrol in Aviation Base	Aviatn base inc DHD	Motor Spirit	Diesel Oil	Fuel Oil	Lube Oil	Misc.	Alkylate & Octane
Leuna	1)	600	350	60	(300) 100	20	10	20				
Böhlen	1)	240	180	(30)	(200)	15	12 x	11				
Magdeburg	1)	220	120				9	9				
Zeitz	1)	280					5	12		2.5	3.5	
Scholven	1)	216	216	60	(200) 100	16						
Gelsenberg	1)	350	350			29						
Pölitz	1)	600	540	64	(300) 100	45			5	1.0		
Wesseling	1)	200	144	(20)		10		7				
Welheim	2)	160	50			4			9			
Brüx	1)	(400)	250	(24)	(300)	20		8	4			
Blechhammer	1)	(425)	(205)	(40)	(200)		1		1			
Lützkendorf	1)	50					2	1				
Oppau	5)	50	50	4	50	4						
Heydebreck	7)			(50) 12		1	0.3					
Auschwitz	7)			(24)	(140)							
Moosbierbaum	5)	106	106		106	7						
Hüls	6)	12	12		(20) 12	0.7						
Schkopau	6)	9	9		9	0.6						
Total		3,918				172.3	27.3	57	19	3.5	3.5	16.0

[redacted]

TABLE X (Cont'd)

Fischer Tropsch Plants.	Total Petrol	Aviatn. base	Alk.& Octane	DHD pet. in Avn. base.	Av. base inc. DHD	Motor Spirit	Diesel Oil	Fuel Oil	Lube Oil	Misc.	Alk.& Octane
Ruhrchemie 3+4)	72					2.1	0.8		1.2	1.4	
Victor Rauxel 3)	40					1.5	1.0			0.8	
Rheinpreussen 3)	70					2.8	2.1		0.2	1.1	
Krupp Benzin 3+4)	60					2.2	1.1			1.7	
Essener Benzin 3)	80					4.1	1.8			0.8	
Hoesch Benzin 4)	47					0.5	1.2		0.2	2.0	
Schwarzheide 3)	170					8.4	2.5			3.1	
Schafgotsch 4)	40					0.7	0.8			1.8	
Lützkendorf 3)	(70) 12					0.2	0.1			0.7	
	591					22.5	11.4		1.6	13.4	
Brown coal for distillation	50					3.0	9.5	27		4.3	
Total Hydrogenation + Fischer + Carbonisation.					172.3	52.8	77.9	46	5.1	21.2	
German Petroleum	1920					13	56	10	65	3.5	
Bit.Coal Tar Distn.								32			
Benzol etc.					4	27					
Bit.Coal Carbonisation.	36							3			
Grand Total German Production:					176.3	92.8	133.9	91	70.1	24.7	
Imports from Rumania & Hungary.					8	50	40				