staff illustrate the operation of the Pölitz plant. It should be borne in mind, however, that under war conditions there were considerable variations in the relative amounts of the various raw materials treated.

The interesting statement was made in connection with the 700 atmospheres liquid phase hydrogenation of pitch that it is beneficial to saturate the feed oil with H_2S (.3 to .4 by weight on the feed oil).

Hydrogen was made at Pölitz partly from coke water gas and partly from hydrogenation plant lean gases using the methane steam process. This process was substantially the same as that operated at Baton Rouge and at Billingham and appears to be the only large scale methane steam plant which has been installed in Germany. Pölitz did not employ the pressure water gas shift process.

Plant for dehydrogenation of butane and for production of Alkylate was installed at Pölitz and Alkylate production was stated to be about 5,000 tons/month.

Refined wax was cracked to olefines of C_5-C_{10} molecular weight range and these were polymerised to lubricating oil using Aluminium chloride as catalyst. The output of these synthetic lube oils at Pölitz was approximately 20,000 t/year.

Pölitz had a catalyst factory making 5058, 6434, 8376 and D.H.D. catalyst. This particular plant was very badly damaged by air raids.

The first raid on Pölitz was in August 1940 when the CO_2 removal plant was hit and the whole factory put out of action for $2\frac{1}{2}$ days. There was a second raid in October 1940 in which 30 tanks were destroyed and production was stopped for $2\frac{1}{2}$ weeks. No more raids occurred until May 1944 after which it rapidly became impossible to operate the hydrogen plant with any appreciable output. In the early months of 1945 the only production of gasoline at Pölitz resulted from operation of the cracking plant and the use of the D.H.D. units and the coal hydrogenation sludge ovens as improvised cracking units for crude petroleum.

X. I.G./JAPANESE ARMY NEGOTIATIONS

Before the war the Japanese had several preliminary discussions with International Hydrogenation Patents on the question of acquiring rights of the hydrogenation process. Similar discussions have apparently taken place from time to time with the I.G. during the war years, but it was not until late in 1944 that the I.G. were instructed by the German Government that it was essential that they should conclude an agreement with the Japanese Army.

Serious discussions began in November 1944, centering round the erection of a plant at Kinsei in Manchukuo for the production of 70-100,000 tons/year of aviation gasoline from Fupin coal. A document

TABLE V

HYDROGENATION OF UTIBUTI COAL

	1	2	2a	3
	100,000 M^3 = 73,000 t. Av. Petrol. by direct Coal Hydrog.	100,000 M^3 = 73,000 t. Av.Petrol.by combined coal & tar hydrogenation	128,000 M^3 = 93,000 t. Av. Petrol. from coal and tar.	100,000 M^3 = 73,000 t. Av. Petrol. from tar only.
Raw Materials T/yr.				
Coal (5% Ash,2%wtr)	165,000	85,000	110,000	0
L.T. Coal Tar	0	54,000	68,000	107,000
Coal or coke for gas manufacture. (H_2M^3/hr)	180,000 (28,000)	120,000 (22,000)	160,000 (28,000)	85,000 (15,500)
Energy requirements				
Electricity KW.	28,000	21,000	28,000	16,000
Steam T/hr.	50	42	53	31
Water M^3/hr.	10,500	9,000	11,500	6,500
Of which fresh water is M^3/hr	1,600	1,300	1,600	1,000
Approx. coal or coke for energy prodn.	155,000	120,000	155,000	90,000
Converters				
Liquid Phase	5(1,200mm)	4(1,200mm)	5(1,200mm)	2.5(1,000mm)
Vapour Phase	4(1,000mm)	4(1,000mm)	6(1,000mm)	4(1,000mm)
Carbonisation.(L.T)				
Coal t/yr.	0	390,000	500,000	780,000
Tar t/yr.	0	54,000	68,000	107,000
Coke t/yr.	0	250,000	320,000	500,000
Coke in excess of that for comb.L.T. carbonation and hydrogenation.t/yr.	0	ca 0	ca 0	ca 325,000
Total Coal. T/yr.	500,000	475,000	610,000	780,000

TABLE VI

List of Drawings handed to the Japanese Army.

A. LIQUID PHASE

1.	Coal stall line diagram	N 3194-2
2.	Arrangement of Liquid Phase converter. 1200 mm dia.x 18 M.long.	N. 954-1
3.	Convertor body. 1000mm dia.x 18 M long.	N 892-1
4.	Convertor body. 1200mm dia.x 18 M long.	N 890b-1
5.	Arrangement of Interchanger.	N 1834-1
6.	Interchanger Body. 600mm dia.x 18 M long.	N 2112c-2
7.	Arrangement of Hot Catchpot.	N 939-1
8.	Hot Catchpot and Neutralisation vessel Body. 1200 mm dia.x 9 M long.	N 1572d-1
9.	Arrangement of Oil Washer.	N 1520-2
10.	Washer Body. 1300mm dia.x 15 M long.	N 1036-2
11.	Cold Catchpot without fittings. 1000mm dia.x 6 M long.	N 2105-2
12.	Cold Catchpot with fittings.1000mm dia.x 6 M long.	N 2241-2
13.	Various vessels.	N 4759a-2 N 4760d-2
14.	Gas Cooler	N 2368-2
15.	Gas-fired Preheater.	L 2714-1
16.	Paste Injector.	N 1013-1
17.	Let-Down Engine.	N 598-1

B. VAPOUR PHASE

18.	6434 Stall line diagram.	N 5416a-2
19.	5058 Stall line diagram.	N 3108b-2
20.	Arrangement of Vapour Phase Convertor. 1000mm dia.x 18 M long.	N 972-1
21.	Convertor body. (Identical with item No.3)	N 892-1
22.	Arrangement of Interchanger.(Identical with item 5)	N 1834-1
23.	Interchanger body. (Identical with item no. 6)	N 2112e-2
24.	Cold Catchpot body without fittings.(Identical with item no.11)	N 2105-2
25.	Cold Catchpot with fittings (Identical with item no.12)	N 2241-2
26.	Various vessels. (Identical with item no.13)	N 4579e-2 N 4760d-2
27.	Gas-fired Preheater.(Identical with item no.15)	L 2714-1
28.	Electric Preheater.	N 2341-2
29.	Injector line diagram.	N 1546-16

C. CO PURIFICATION.

30.	Scrubber Body. 800 mm dia.x 15 M long.	N 2117-2

was found which gave an extremely rough sketch showing the proposed site for this plant. This is reproduced as Fig. XXVI. The same document mentioned, incidentally, that a new port which can be used by 10,000-ton ships has been built on the island of Koro.

The Fupin coal after washing contains 6% of water and 3% of ash and the a.m.f. coal has a carbon content of 79%.

In mid-January 1945 the Japanese changed their plan regarding the location of the first hydrogenation plant and decided on a site in South Sakhalin using Utibuti coal. This coal has a lower carbon content, 72-73% on the a.m.f. coal. The I.G. provided detailed flow-sheets for the production of 73,000 tons/year aviation petrol by (a) direct coal hydrogenation, (b) by combined coal and tar hydrogenation and (c) by hydrogenation of tar alone. It was assumed that the tar would be obtained by low temperature carbonization of the Utibuti coal. (Yield 17-18% by wt. on coal carbonized).

Information supplied by the I.G. was limited to 300 ats. coal hydrogenation technique and no data were supplied concerning naphtha dehydrogenation or alkylate synthesis processes. Details of the flow-sheet information supplied by the I.G. are given in Figures XXVII & XXVIII and in Table V. The drawings shown in the attached list (Table VI) were also handed to the Japanese.

A general hydrogenation licence agreement between the I.G. and the Japanese Army was signed on the 11th January 1945. This agreement provided for the use of the hydrogenation process in Japan, Manchukuo and China for the production of gasoline of all types, hydrocarbon gases, burning oil, gas oil, fuel oil, lubricating oil and paraffin wax from crude petroleum, bituminous coal, brown coal, peat, wood, shale or from products derived from these raw materials. The I.G. agreed to hand over their knowhow and patent rights as far as they were able to do so in view of the I.H.P. agreement. There is a special clause in the agreement to the effect that the Japanese were solely responsible for the legality of any compulsory licensing of I.H.P. patents. The Japanese Army agreed to pay the I.G. a lump sum of 18,000,000 marks, there being no additional running royalty. 20% of this lump sum was to be paid on signing the agreement, 30% within 6 weeks after the supply of all the necessary information for erection of the first industrial size Japanese plant and 50% spread over the next five years. The I.G. agreed to send specialised technical personnel to Japan for the erection and start up of the new plant and to afford facilities for training of Japanese technicians in German plants. It was agreed that the Japanese and the I.G. should continue to exchange technical information. The agreement was for a period of 10 years after which time the Japanese should continue to have free use of patents, irrespective of whether the agreement was renewed or not.

It was intended that there should be separate building agreements for each plant. A draft building agreement for the first hydrogenation plant is amongst the evacuated documents and this provides for a lump sum of 800,000 marks to be paid to the I.G. to compensate them

FIG XXVI

LOCATION OF PLANT AT KINSEI.

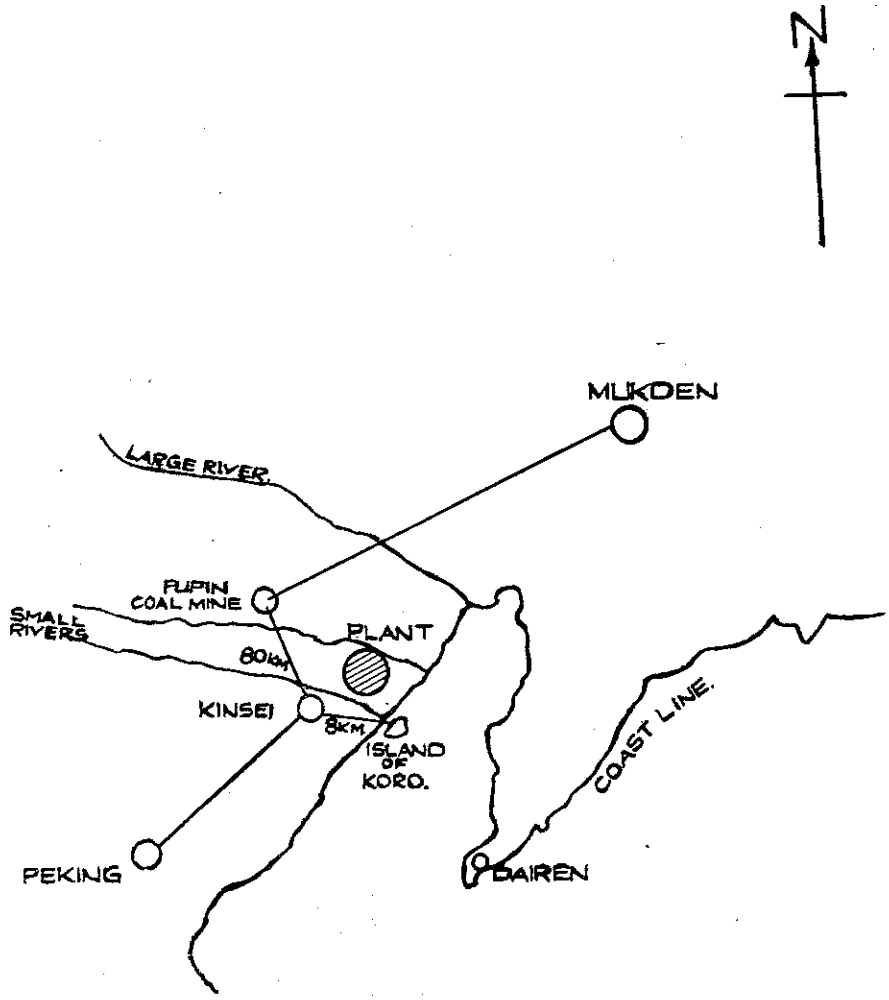
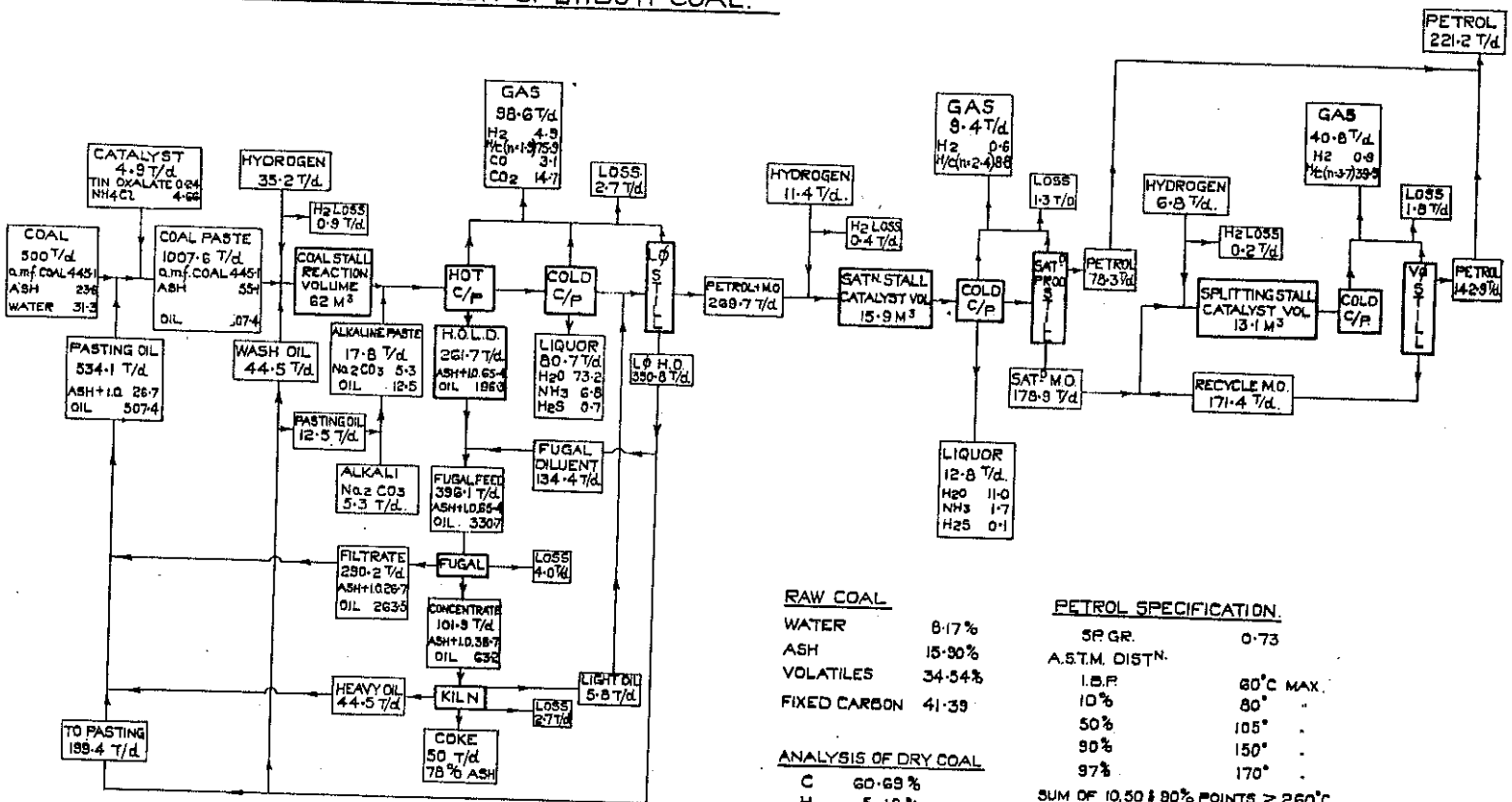


FIGURE XXVII

FLOWSHEET FOR PRODUCTION OF 73,000 T/YEAR AVIATION PETROL BY HYDROGENATION OF LITIBUTI COAL.



MATERIALS & SERVICES.

		COAL
COAL FOR HYDROGENATION		165,000 T/YEAR
HYDROGEN; 28,000 M³/HR. REQUIRING COKE FROM		180,000 "
ELECTRIC POWER.	28,000 KW.	155,000 "
STEAM.	50 T/HR.	
WATER.	10,500 M³/HR. INCLUDES 1600 M³/HR FRESH WATER.	
TOTAL COAL REQUIREMENT		500,000 T/YEAR.

RAW COAL

WATER	8·17%
ASH	15·90%
VOLATILES	34·54%
FIXED CARBON	41·39

ANALYSIS OF DRY COAL

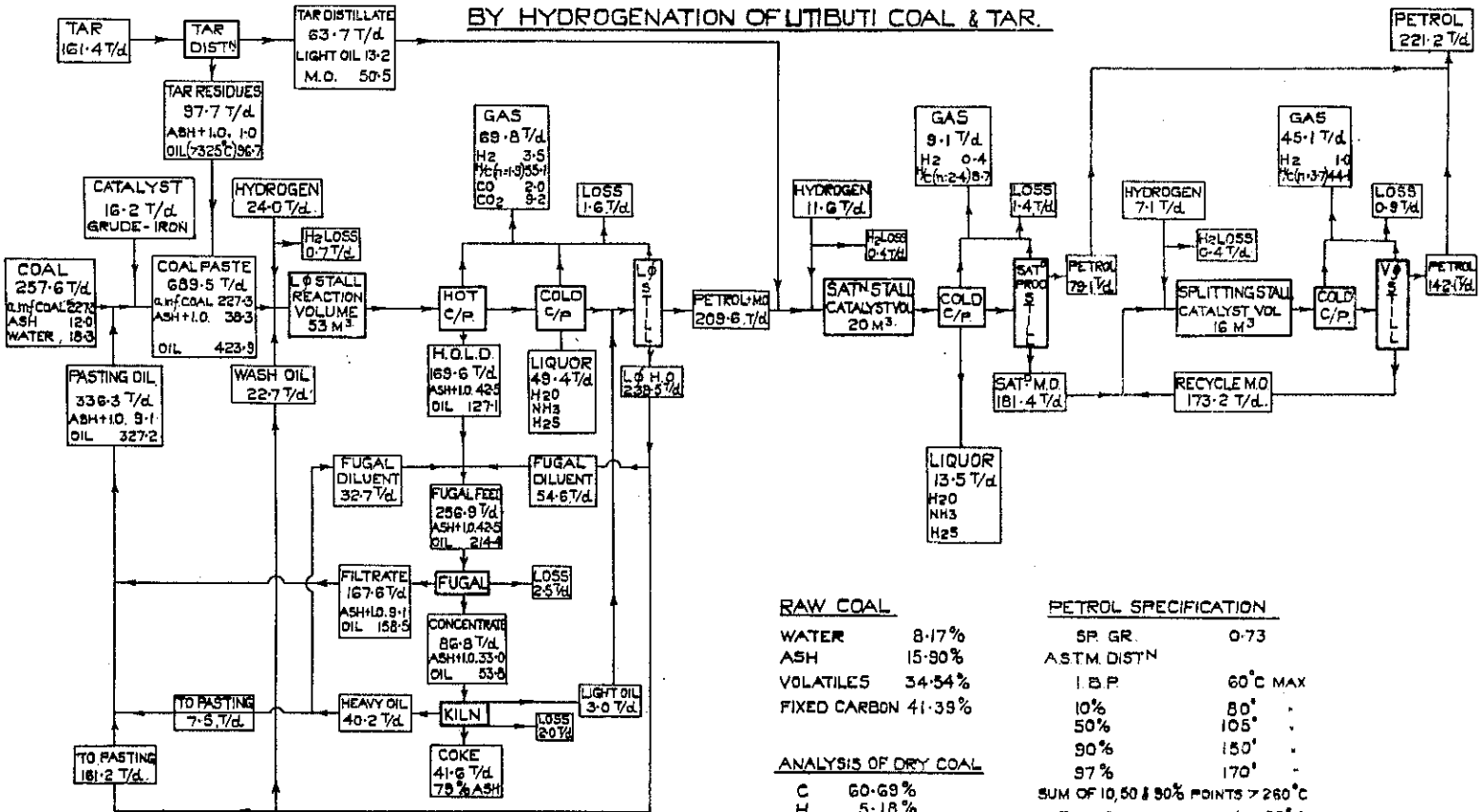
C	60·69%
H	5·18%
O	16·78%
N	1·32%
Cl	
S	0·14% (COMBUSTIBLE)

PETROL SPECIFICATION.

SP GR.	0·73
A.S.T.M. DISTN.	
I.B.P.	60°C MAX.
10%	80° "
50%	105° "
90%	150° "
97%	170° "
SUM OF 10, 50 & 90% POINTS > 260°C	
FREEZING POINT < −50°C.	
R.V.P.	8·9 LB/IN² MAX.
GUM CONTENT	5 mg/100 ml "
S CONTENT	0·1% "
C.F.R. (M.M) O.N.	70-72 CLEAR
	81 ATTAINABLE WITH 4·5 ml T.E.L./IMP. GALL.

FIG. XXVIII.

FLOWSHEET FOR THE PRODUCTION OF 73,000 T/YEAR AVIATION PETROL BY HYDROGENATION OF UTIBUTI COAL & TAR.



RAW COAL

WATER	8·17%
ASH	15·90%
VOLATILES	34·54%
FIXED CARBON	41·39%

ANALYSIS OF DRY COAL

C	60·69%
H	5·18%
O	16·78%
N	1·32%
Cl	
S	0·14% (COMBUSTIBLE)

PETROL SPECIFICATION

SP. GR.	0·73
A.S.T.M. DISTN	
I.B.P.	60°C MAX
10%	80° "
50%	105° "
90%	150° "
97%	170° "
SUM OF 10, 50 & 90% POINTS > 260°C	
FREEZING POINT	< -50°C
R.V.P.	8·9 LBS/IN² MAX.
GUM CONTENT	5 mg/100 ml "
S. CONTENT.	0·1% "
C.F.R. (M.M) O.N.	70-72 CLEAR 91 ATTAINABLE WITH 4·5 ml. T.E.L/IMP. GALL.

MATERIALS & SERVICES.

		COAL
COAL FOR HYDROGENATION.		85,000 T/YEAR.
TAR FOR HYDROGENATION; 54,000 T/YEAR REQUIRING.		390,000 "
HYDROGEN	22,000 M³/HR.	
ELECTRIC POWER	21,000 K.W.	
STEAM	42 T/HR.	
WATER	9,000 M³/HR. INCLUDES 1300 M³/HR. FRESH WATER.	
		475,000 T/YEAR.

NB. THE 250,000 T/YEAR OF COKE BALANCES ALMOST EXACTLY THE REQUIREMENT (240,000 T/YR) FOR HYDROGEN AND ENERGY PRODUCTION.

for their costs in designing the plant. It is uncertain whether this building agreement was ever signed, although a special Design Department was actually set up by the I.G. and this operated for a time in Heidelberg and was later transferred to Unterlockwitz.

From the start of the discussions, the Japanese were anxious to obtain a full description of the German hydrogenation plants and processes in advance of flowsheet and design data on the new Japanese project. They were also anxious to get the German technicians out to Japan immediately. From letters written at the end of February and beginning of March 1945, it seems doubtful whether the Japanese seriously intended building a new plant and that the main object in concluding a general hydrogenation agreement with the I.G. was to secure the necessary information to operate existing Japanese plants.

Extremely little information concerning these Japanese plants was available either from documents or from interrogation of the I.G. staff. It is understood that there are three plants for the hydrogenation of tar. These are located in Kinsei, Mukden and Hokkaido.

There is some confusion as to whether these plants have a rated capacity for gasoline production of 50,000 tons/year each or whether their combined capacity is this figure. The plants are built for 300 ats. pressure operation and comprise liquid phase and vapour phase stalls. The converters are 10 m. long and 600 mm. internal diameter. Chlorine is used as a catalyst in both liquid and vapour phase and considerable difficulty has been experienced due to corrosion. There is also a hint that other substances were used as catalyst in one or both of the hydrogenation steps and that difficulty was experienced in maintaining their activity.

In a cable from the I.G. agent in Japan (Herr Ruhl) there is an indication that the achieved production of these plants was of the order of 10,000 tons/year of gasoline each.

The I.G. asked for more specific details of the operation of the Japanese plants and of the difficulties which were being experienced, but the Japanese representatives appeared to be out of touch with the plants and were unable to produce the information. A questionnaire was sent to Japan, but there is no evidence in the captured documents that any reply was received.

Interrogation of Dr. Pier and Dr. Donath at Heidelberg produced only vague information on Japan's general fuel production position. It was stated that the Japanese had a licence for the Fischer process some years before the war and that they have a plant somewhere in Manchuria. The Japanese have also a carbonisation plant of their own construction for Fushun shale and it is thought that they have a cracking plant, probably of U.O.P. design, which has been very much enlarged during the war. At least 300,000 tons of shale oil is treated.

The Japanese have several carbonisation plants using Lurgi ovens and it was suggested that the members of the Lurgi organization in Germany might be able to give more information on the Japanese oil position.