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THE PRESENT STATUS OF THE OIL-SHALE INDUSTRY IN ESTONIA.

By P. N. KOGERMAN, M.Sc. (Lond.), D.I.C., F.C.S., M.A.C.S. (Member).

Short History of Development.—The Estonian oil-shale, known as "*Kukersite*,"[1] was discovered by Engelhardt in the neighbourhood of Kohala 135 years ago, but it was only during the Great War that the importance of kukersite, as a substitute for coal and as a source of gas and oil production, came into prominence.

The idea of exploiting oil-shale as fuel for direct combustion was first brought forward by the late Russian Fuel Commission in Petrograd (now Leningrad) in 1916, when a shortage of fuel was being experienced in the Petrograd district. The Commission appointed a geologist, N. F. Pogrebov, to investigate the deposits of oil-shale and to estimate the supply available. In May, 1916, Pogrebov and his co-workers investigated the oil-shale deposits over an area of about 50 square kilometres along the Tallin (Reval)-Petrograd railway line,[2] and a production of 2 tons of shale per square metre was estimated. Trials on a large scale, carried out at the Petrograd Gas Works, having given satisfactory results, it was decided to start mining operations at Kohtla for the production of 150,000 tons[3] of shale annually. The preliminary work in this mine had to be suspended in October, 1917, owing to the Bolshevist Revolution. During the German Occupation of Estonia, from February to November, 1918, the Germans also tried to exploit the oil-shale, and samples were sent to Berlin for analysis. In November, 1918, the Estonian Government took over the mine from the German authorities. Up to this date only the preliminary work, which consisted of drainage and the building of a railway line 2½ miles long to Kohtla Station, had

[1] The name "*Kukersite*" is derived from the village "Kukruse" in the vicinity of which F. Schmidt collected and investigated the fauna of the above-mentioned seams.

[2] Approximately 100 miles east of Tallinn.

[3] Throughout this article "metric ton" is used

been completed. A gravel pit about 50 metres long and 4-5 metres wide represented the whole mine, and the only equipment left by the German authorities was 3 locomotives and 60 dumping-cars.

The actual exploitation of oil-shale was started by the Estonian Government on May 5, 1919, and has continued since without interruption. For the working of the mine the "State Oil-Shale Industry," financed by the State, was established, and under this administration two mines are now working: the Kohtla Mine, open cut mining, and Kukruse Mine, with underground working system. The mines are situated 4-5 kilometres north of the Tallinn-Narva railway line, between the stations, Jõhvi and Kohtla. In addition to these mines a third one, the Vanamõisa Mine, which has lately been transferred to a private company, the "Estonian Oil-Shale Development Syndicate, Limited," working with British capital, was established.

Figure 1 shows the mining operations in the State Oil-Shale Mines. In 1922 a fourth mine, owned and managed by the "Eesti Kiviõli Company," started work at the station, Püssi. The Government has recently issued 23 permits for the prospecting for oil-shale.

The mining of oil-shale has made a rapid progress in the last four years, the annual production of the State mines being as follows:—

TABLE I.

OUTPUT OF OIL-SHALE IN THE STATE MINES.

Years.	Kohtla. M. Tons.	Kukruse. M. Tons.	Vanamõisa. M. Tons.	Total. M. Tons.
1918-1919	9,648	—	—	9,648
1920	45,844	—	281	46,125
1921	84,511	3,740	7,276	95,527
1922	127,410	11,522	—	138,932
1923	177,000	29,000	—	206,000
Total	445,000	45,000	7,557	497,000

TABLE II.

OUTPUT OF PRIVATE COMPANIES.

	M. Tons.
Eesti Kiviõli Company in 1922	3,200
Eesti Kiviõli Company in 1923	6,600
Estonian Oil Development Syndicate in 1923 ..	3,340
Total	13,140

At present the State Works at Kohtla-Jaerve Mine own 21 locomotives and more than 600 dumping cars, the railway line is 25 miles long, and the colony consists of 66 dwelling houses and 332 tenements. In addition there are two distillation plants, power stations, work shops, lime kilns, storage rooms, etc. The old power station has a capacity of 75 kilowatts, and the new power station has a capacity of 500 kilowatts. The cost of the buildings[4] and equipment amount to 108,000,000 Estonian marks (approximately £67,500[5]) and the cost of materials and transport means, 58,000,000 Estonian marks (approximately £36,250).

There is also a post office, bank, school, hospital, and an efficient telephone system, etc. The "State Oil-Shale Industry" employs 25 chemists and engineers, 200 clerks and foremen, and 1,400 workmen. The output per head was 134 tons in 1923.

The total area excavated up to November 25th, 1923, was 310,411 square metres. At the Vanamõisa Mine an oil distillation plant with a pair of "Fusion" retorts has been erected. The company does not market the oil-shale, but uses it only for distillation at its own mine. The "Eesti Kiviõli" Company also is using the oil-shale for distillation purposes. The above-mentioned companies employ 200-300 workmen. The mining is carried out on the same system as in the Kohtla Mine. The soil and glacial deposits are usually removed by a steam shovel (excavator), being transported by electrically driven conveyors to the places where mining operations have been completed. Operating in this way, the exploited land can be transformed again into ground suitable for cultivation.

The Estonian oil-shale, which is one of the richest known, has attracted the interest of several foreign countries and many reports about it have been published, but so far the reports which have appeared have been neither up to date nor complete.

The Estonian oil-shale is not a new subject for this Institution, a brief account of it having been given by E. H. Cunningham-Craig.[6] Since then more experimental work, both industrial and research, has been carried out.

The Geological Structure and Properties of the Oil-Shale.—It is not the intention of the author to deal to any extent in this article with the geology of the oil-shale. This was recently reviewed by

[4] The buildings are most of limestone, which is obtainable in the mines.

[5] The present rate of exchange is 1600—1700 E. marks to the £.

[6] "Kukkersite, the Oil-Shale of Esthonia," *Journ. Inst. Petr. Techn.*, VIII., 32, pp. 349–375, July, 1922.

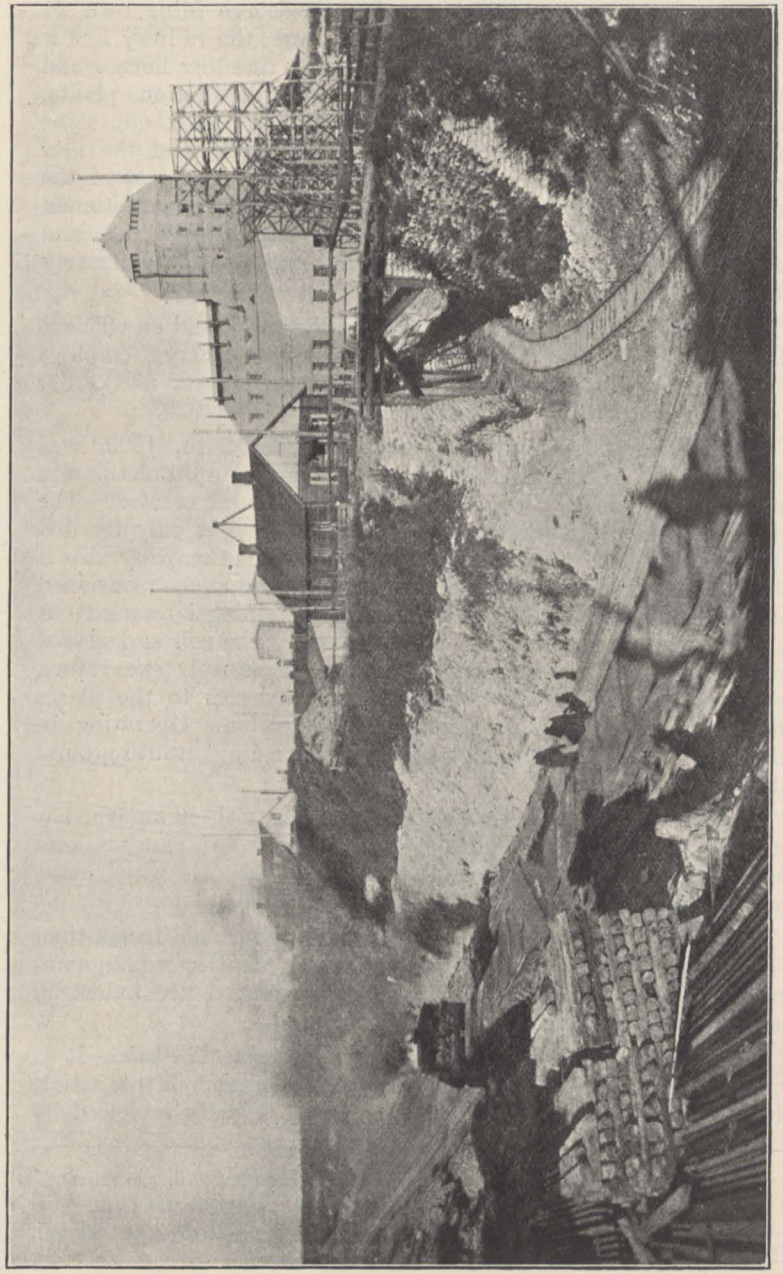

FIG. 1.
THE STATE OIL SHALE MINE AT KOHTLA.

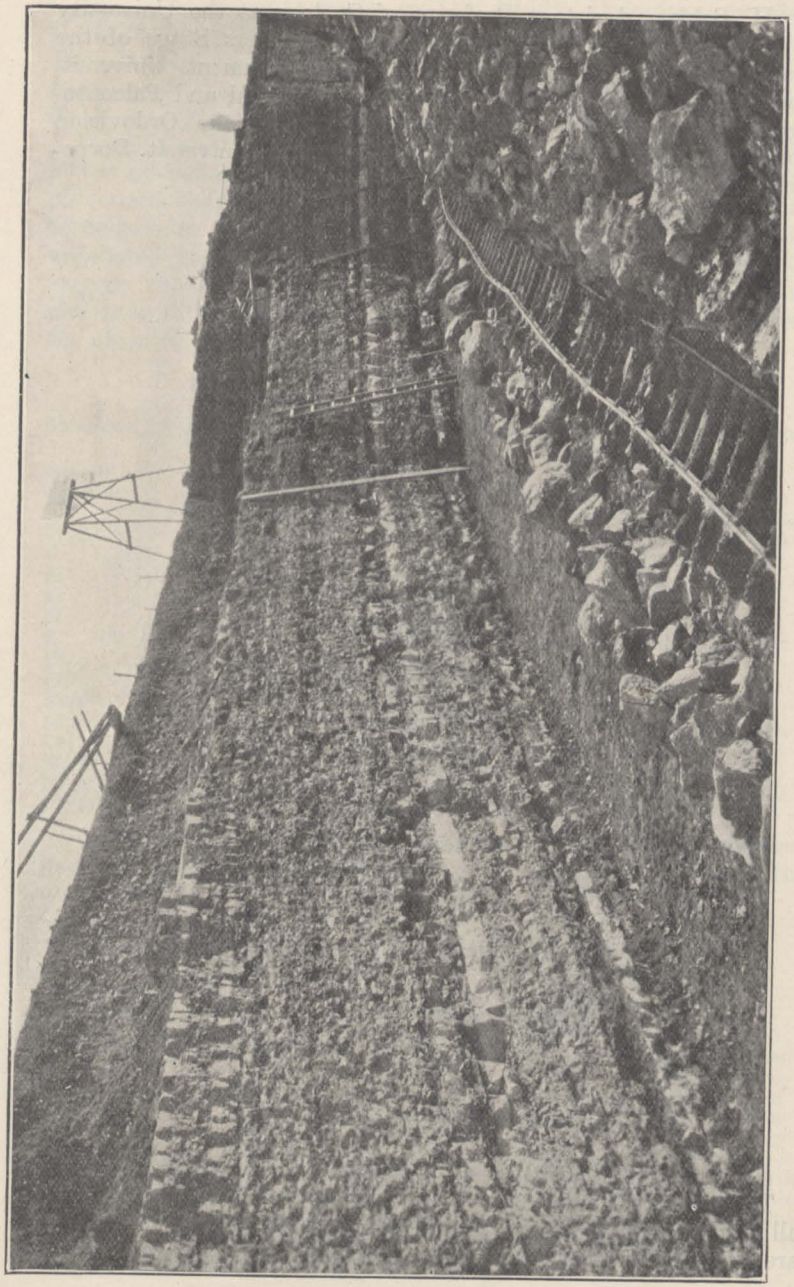

FIG. 2.
A SECTION OF KOHTLA MINE.

Dr. H. Bekker, Assistant Professor of Geology at the University of Tartu, Estonia, in his articles, "The Kuckers Stage of the Ordovician Rocks of N.E. Estonia" (Acta et Comment. Universit. Dorpatensis A., II., i., 1921) and "Stratigraphical and Paleontological Supplements on the Kukruse Stage of the Ordovician Rocks of Eesti (Estonia)" (Acta et Comment. Universit. Dorpatensis A., VI., 1924).

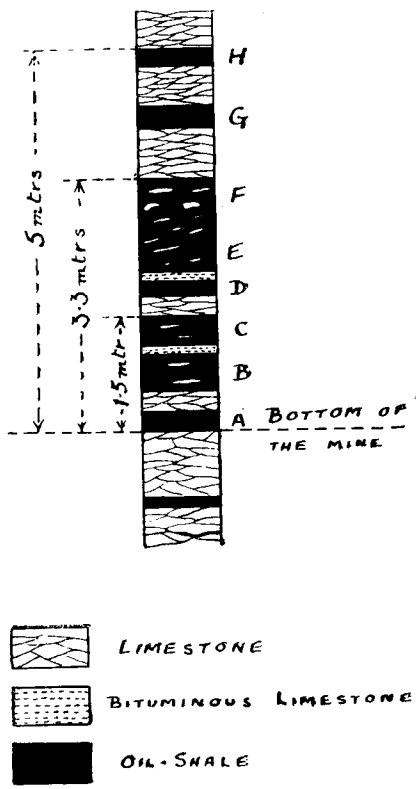

FIG. 3.

TYPICAL SECTION OF KOHTLA MINE.

The previous Russian and German reports, on which nearly all the articles which have appeared outside Estonia are based, are not up to date, some of the material being even incorrect.

The shale deposits occur in the Middle Ordovician Strata,[7] the whole formation attaining a total average thickness of 2·4 metres. The oil-shale seams are interstratified by lime-stone beds. The bedding of these seams is nearly horizontal with a slight dip (0·11′-0·13′) to the south and south-west. [Fig. 2.]

Fig. 3 shows the typical section of the Kohtla Mine.—The colour of the oil-shale varies from greenish-yellow to reddish. Air dried pulverised shale from the seams A and B looks very much like cocoa-powder. The freshly mined oil-shale is hard, only the weathered shale is soft and brittle. The hardness of oil-shale exceeds that of coal. The chemical composition of the organic matter in different seams does not vary greatly. Table III. shows the chemical composition of different oil-shale seams :—

TABLE III.

COMPOSITION OF AIR-DRIED OIL-SHALE.

(Analysis by Prof. M. Wittlich and N. Veshnjakov, University of Tartu, Estonia.)

Seams	A.	B.	C.	D.	E.	F.
Sp. gr.	1·57	1·56	1·61	1·81	1·54	1·65
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
H_2O	3·1	1·3	2·7	2·1	2·5	2·3
C	35·6	37·5	35·8	25·4	37·4	34·1
H	4·2	4·5	4·2	3·1	4·4	4·1
O	9·9	9·6	10·1	7·2	9·6	9·2
N	0·1	0·1	0·1	0·07	0·1	0·1
S	0·7	1·5	0·6	0·4	0·8	0·5
CO_2	10·3	13·1	8·6	10·4	9·4	12·3
SiO_2	15·3	9·4	18·0	26·4	14·7	14·4
Fe_2O_3	1·3	2·9	2·0	1·9	1·8	2·0
Al_2O_3	4·0	2·1	4·0	4·6	4·1	3·5
CaO	13·3	16·8	11·9	13·8	12·6	15·6
MgO	0·6	0·5	0·9	1·4	0·7	0·6
Na_2OK_2O	1·9	1·2	1·0	3·1	2·3	2·0
P_2O_5	Traces.					

According to the author's experiments the percentage of sulphur in all seams is slightly higher (1·0-1·4 per cent.), than given in the above table.

TABLE IV.

CHEMICAL COMPOSITION OF THE ORGANIC MATTER OF OIL-SHALE.

	A.	B.	C.	D	E.	F.
Organic substance of air-dried oil-shale, per cent.	49·8	51·7	50·2	35·7	51·5	47·5
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
C	71·5	72·4	71·3	71·1	72·4	71·6
H	8·4	8·7	8·4	8·6	8·5	8·6
O	19·9	18·7	20·1	20·0	18·9	19·6
N	0·2	0·2	0·2	0·3	0·2	0·2

[7] Dr. H. Bekker writes as follows: If the development of the forms in Estonia has proceeded on parallel lines to those in Great Britain, the kukruse stage would appear to lie about midway between the lower Llandeilo limestones and the lower Caradoc beds. They would probably therefore be slightly earlier than the *Nemagraptus gracilis* beds.

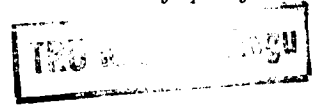

TABLE V.

COKING (CRUCIBLE) TEST OF OIL-SHALE.

Seams	A.	B.	C.	D.	E.	F.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Volatile subst.	56·7	60·1	54·2	42·7	56·6	50·4
Coke	4·8	2·9	6·4	4·3	7·4	9·7
Ash	38·5	37·0	39·4	53·0	36·0	39·9

The State oil-shale mines are marketing the oil-shale in three different qualities, which are described as follows :—

TABLE VI.

QUALITIES OF MARKETABLE OIL-SHALE.
(Analysis Kohtla Laboratory.)

Quality	I.	II.	III.
Description of shale	Sieved lumps.	Unsieved lumps and fine.	Fine, soil-like oil-shale.
Percentage of moisture—			
In summer	13—18	15—20	15—25
In winter	18—25	20—30	20—30
Percentage of ash/mineral ash plus CO —:			
In raw oil shale	37—43	39—47	42—51
In the dry substance	50	55	60
Percentage of combustible substance	38—44	31—39	28—34
Calorific value	3000—3500 cals./kilo.	2300—2700	2200—2400
Price f.o.r. at the mine—			
In E. Mk. per pood (36lb.)	10	7·50	5·00
Per ton	7s. 9d.	5s. 10d.	3s. 10½d.

The calorific value of an air-dried average sample is 4400 cals./kilo (9900 B.Th.Us. per lb.).

Oil-Shale Resources.—Recent investigation with diamond drill bores has shown that kukersite strata worth mining cover an area of 1900 square kilo-metres, so that the investigated shale reserves amounts to 3800 million tons. More oil-shale will certainly be found in unexplored areas, so that, including the probable shale reserves, the total amount would reach about 5000 million tons. The oil-shale strata in Estonia show nearly an uninterrupted geological structure.

THE USES OF OIL-SHALE.

1. *The Consumption of Oil-Shale as Fuel.*—The consumption of oil-shale as fuel for all kinds of boilers has been steadily growing. Experiments made during the year 1919–1920, showed that furnaces, with fire grates constructed for the burning of coal or wood, were not suitable for burning raw oil-shale and therefore furnaces of a special, semi-producer type, have been constructed. At present several large factories in Estonia have had their boilers fitted with special fire grates and are using oil-shale for power production. Oil shale is the cheapest fuel available in Estonia.

Results of a trial of a water tube boiler with 143 sq. metres heating surface fired by oil-shale.

At R. Mayer's factory, Tallinn, September 18 and 19, 1922. The shale was burnt in an ordinary fire grate, constructed for burning peat and wood.

During this trial 40 cu. ft. of wood and 770 poods[8] of oil-shale (in lumps) was consumed. The cost of the fuel consumed in 24 hours was 9215 E.Mks. To raise the same amount of steam, firing by peat, the cost of the fuel amounted to 19,600 E.Mks., and firing by wood, 17,200 E.Mks. A pressure of 12 atmospheres was maintained in the boiler during this trial.

The combustion of oil-shale was not complete and a black smoke arose from the chimney.

The State Railway have partially adopted oil-shale as fuel for locomotives. Of the locomotives owned by the State thirty-five are heated with oil-shale.

In February, 1924, the Ministry of Communications appointed a Committee to inquire into the fuel problem of the State Railways. After investigation a final report was drawn up and accepted by the Committee on October 23, 1924, which may be summarised as follows :—

" At the present cost of fuels, oil-shale is the cheapest. If employed instead of coal in the heating of locomotives, there is an economy of 22 per cent., and if employed instead of wood the economy is much greater, amounting to 43 per cent.

2. At the oil-shale mines, oil-shale can be used for burning lime in kilns and for heating of houses.

3. The biggest consumers of oil-shale have so far been the Portland Cement factories. The cement works, Port Kunda and Aseri (Asserin), are using the cheap oil-shale of the third quality. The oil-shale is dried, pulverised and injected (by air), into revolving kilns. The oil-shale ash remains as an ingredient part of cement clinkers. The quality of the cement is the same as obtained by the using of coal.

4. *Oil-Shale consumed for the Production of Gas.*—The gas plants at Tartu (Dorpat) and Tallinn have only partially adopted oil-shale for gas production. The oil-shale is carbonised in old type, horizontal retorts, which, of course, are not quite suitable for the carbonisation of shale. The yield of gas is 10,000 cu. ft. (283 m³)

[8] One pood = 16·4 klgr.

per ton of shale, the yield of tar 4–5 per cent. The chemical composition of the gas is given as below :—

TABLE VII.

CHEMICAL COMPOSITION OF OIL-SHALE GAS.

	Per cent.
Hydrogen	37·6
Methene	25·8
Heavy hydrocarbons	1·6
Carbon monoxide	19·1
Carbon dioxide	13·3
Nitrogen	2·6

Calorific value of the gas 4260–4500 cals. per cu. metre. The use of coal for gas plants is preferred mainly for two reasons : (1) to obtain the extremely valuable by-product—coke, and (2) to avoid the cost of ash removal.

The Use of Ash.—The ash remaining from oil-shale after carbonization and burning is finely ground and has the properties of Roman cement ; it is used as a binding material for building purposes. Table VIII shows the composition of the ash :—

TABLE VIII.

RANGE OF COMPOSITION OF ASH.

	Per cent.
CaO	26—50
SiO_2	27—51
$Al_2O_3Fe_2O_3$	12—17
MgO	1·5—3
K_2O, Na_2O	3—6
S	0·5—3

THE DISTILLATION OF KUKERSITE FOR THE PRODUCTION OF OIL.

The production of oil from the shale is the most important of its uses. This main branch of oil-shale industry has a world-wide importance and is a most difficult problem to deal with.

I. LABORATORY EXPERIMENTS.

It is well known that the character of the yield of liquid distillates from a given fuel varies greatly, being dependent upon the temperature and manner of distillation. In all earlier investigations of kukersite no exact information is given as to the temperature of distillation or the method of operation. Some of the divergences in the results of distillations evident in the reports can be avoided by using standard methods of distillation.

During the years 1919-1920 the author carried out a series of experiments at the Fuel Laboratories, Imperial College, South Kensington. The method of operation is described in an article, "The Chemical Composition of the Estonian M.-Ordovician Oil-Bearing Mineral 'Kukersite'" (Acta et Comment. Universit. Dorpatensis A., III., 6). The results[9] of first series of experiments are given below :—

TABLE IX.

DISTILLATION OF OIL-SHALE AT VARIOUS TEMPERATURES.

Temp. ° C.	Percentage yield.	Yield of oil Galls. per ton.	Yield of gas cu. ft. per ton at 0° and 760 mm.	Yield of ammonia.	Calorific value of oils in B.Th.U.
410	27·1	63·3	1900	—	—
500	29·7	72·9	2250	—	17,028
600	30·8	74·8	3000	0·02	17,428
700	27·5	65·0	4500	0·04	—
900	21·7	49·7	7200	0·11	—

The yield of the oil is also dependent upon the weathering of raw oil-shale. Table X shows the results of distillation of four different samples of oil-shale.

TABLE X.

RESULTS OF DISTILLATION OF OIL-SHALE, FROM SEAM B (KOHTLA), SHOWING THE EFFECT OF WEATHERING UPON THE YIELD OF OIL.

(Analysis by Kohtla Laboratory.)

	Unweathered.		Weathered.	
	Moist. Per cent.	Dry. Per cent.	Slightly. Per cent.	Strongly. Per cent.
Analysis of the shale—				
CO_2	12·6	12·6	10·4	6·6
Ash	38·9	38·9	33·7	46·8
Organic matter	48·5	48·5	55·9	46·6
Distillation—				
Oil	34·1	33·0	33·2	21·3
H_2O	2·2	3·5	4·5	5·0
Coke	55·7	56·4	54·1	65·2
Gas (by difference)	8·0	7·1	8·2	8·5
Specific gravity of oil	0·923	0·912	0·923	0·922
Analysis of coke—				
CO_2	21·5	21·2	18·4	10·1
Ash	68·2	68·3	61·9	71·3
Organic matter	10·5	10·5	19·7	18·6
The coefficient of utilisation of organic matter—				
Oil	70·3	68·0	59·4	45·7
Water	4·5	7·2	8·0	10·7
Coke	11·8	12·6	19·1	26·0
Gas	16·5	14·6	14·5	18·2
	103·1	102·4	101·0	100·6
Per cent. of unsaturated compounds	—	83·0	77·0	69·0

The distillation tests were carried out in F. Fischer's aluminium apparatus.

The results given in Table X show that the yield of oil from weathered shale is lower than from the unweathered.

[9] The results, calculated on dry oil-shale.

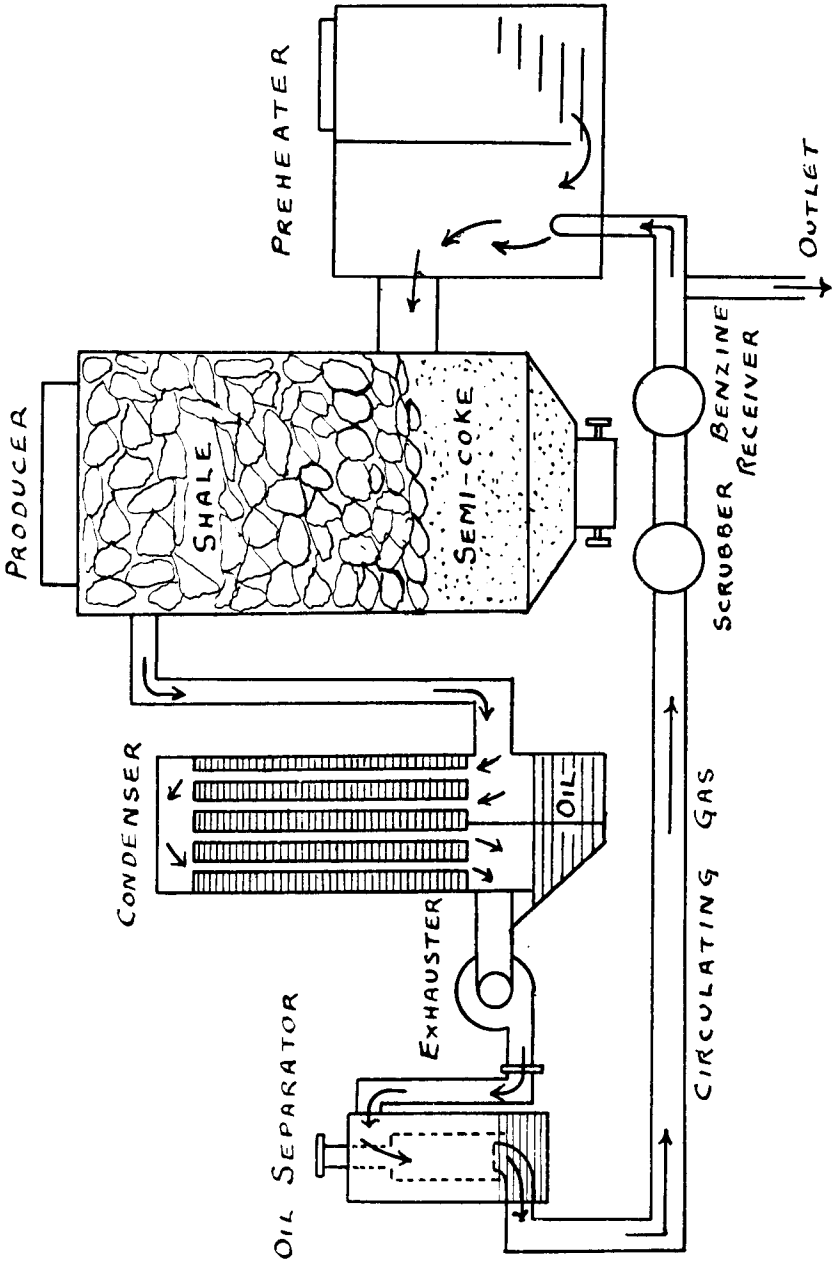

FIG. 4.
SCHEME OF THE KOHTLA EXPERIMENTAL OIL-SHALE DISTILLATION PLANT.

EXPERIMENTAL DISTILLATION ON A COMMERCIAL SCALE.

At present three experimental plants are working on a large scale. The first at the Kohtla Mine of producer type, designed by J. Pintsch and Co., Berlin; the second at Pussi Mine, also with internal heating, but of different type; and a third at the Vanamöisa Mine, with a pair of "fusion" retorts externally heated, well known in this country. By the kind permission of the administration of the "State Oil-Shale Industry" the author is in a position to put before the Institution the results of experiments obtained at the Kohtla distillation plant. With regard to the experiments of private companies, only some general observation may be given.

THE METHOD OF OPERATION AT KOHTLA OIL-SHALE DISTILLATION PLANT.

For distillation the shale used is in small lumps, which are easily obtained by sieving the mined raw shale. Breakers are not used. A vertical cast-iron shaft oven with a fire-brick lining inside forms the producer. The external diameter of the producer is 2 metres and the height 5 metres. The shale sinks in the producer by its own weight. The top of the producer is provided with holes for cleaning and the discharging of semi-coke is done by hand.

The producer-retort works continuously. The throughput in 24 hours amounts to 500 poods (approximately 8 tons). The yield of crude oil is 20 per cent. of the weight of the raw shale.

The "burning zone" lies outside the producer (Fig. 4 shows the sketch of the Kohtla plant). The necessary amount of heat required for distillation is supplied by hot gases, which are generated in a pre-heater. In the pre-heater the semi-coke is burned on an inclined firegrate. The draught is regulated in such a manner that no free air (oxygen) is able to enter the producer.

The semi-coke gives a sufficient amount of heat without any other source of fuel. The hot gases enter the producer at the bottom heating the shale, and together with the oil vapour and the permanent gases of distillation pass further into a condenser which is water cooled. Next to the condenser is an exhauster, from which the gases pass into the scrubber.

The producer is provided with pyrometers to register the temperature in the retort, which is kept at 500° C. The permanent gases leaving the scrubber remain at the temperature

of 65-70° C. One part of the permanent gases is sent back in the pre-heater, the other part has not been used so far.

Owing to the scrubber not being large enough at this plant, about 2 per cent. of light oil is lost.

The analysis of the products of distillation are given in the Table XI:—

TABLE XI.

	Analysis of the oil-shale used. Per cent.	Analysis of semi-coke obtained. Per cent.	Analysis of ash obtained. Per cent.
H_2O	13·8	—	—
CO_2	9·8	15·81	3·33
Ash	34·8	68·38	89·83
Organic matter	41·6	15·81	6·84

From the above given data, the yield of semi-coke and ash is as follows:—

TABLE XII.

YIELD OF SEMI-COKE AND ASH.

	Per cent.	Per cent.	Per cent.
H_2O	13·8	—	—
CO_2	9·8	8·05	0·98
Ash	34·8	34·80	34·80
Organic matter	41·6	8·05	2·65
	100·0	50·90	38·43

The semi-coke contains on an average 15-17 per cent. of fixed carbon.

THE PROPERTIES OF THE CRUDE OIL.

Sp. gravity of crude oil (with 1 per cent. of H_2O only) is 1·009 at 15° C. viscosity—5·5 (Engler) at 50° C. The results of distillation tests are given below (Engler-Levin's method was used).

TABLE XIII.

DISTILLATION TEST OF CRUDE OIL.

	Per cent.
Up to 220°	1·2
220—240	2·2
240—260	5·3
260—280	6·5
280—300	5·4
300—320	6·4
320—340	10·0
340—360	13·7
Total	50·7

Professor A. Franks, of the Colorado School of Mines, compared the properties of Scottish and Estonian shale-oils, and the results he obtained are given below:—

TABLE XIV.

COMPARATIVE DISTILLATE IN TESTS.

Scottish. Sp. gr. at 25° C., 0·864.				Estonian. Sp. gr. at 25° C., 0·937.			
Yield. Per cent.	Temp. ° C.	Sp. gr. 25° C.	Saturation. Per cent.	Yield. Per cent.	Temp. ° C.	Sp. gr. 25° C.	Saturation. Per cent.
1st Drop	85	—	—	1st drop	66	—	—
5	173	0·775	68·4	5	135	—	—
10	196	—	—	10	154	0·761	54·0
20	227	0·806	65·0	20	207	0·823	46·0
30	261	0·825	64·0	30	257	0·876	38·6
40	292	0·846	60·0	40	279	0·928	28·3
50	314	0·857	62·4	50	330	0·966	13·0
60	344	0·867	60·0	60	348	0·977	8·0
70	360	0·870	58·0	70	365	—	12·0
80	365	0·873	58·0	80	375	0·967	9·0
90	373	0·878	56·0	Coke 6·3 per cent. by weight.			
96·6	—	0·880	53·0				

The ultimate composition of oil is as follows:—C-81·26 per cent., H-10·15 per cent., O-7·26 per cent., S-1·08 per cent., and N-0·25 per cent. The dry shale-oil contains:—

	Per cent.
Neutral bodies (chiefly hydrocarbons)	72·1
Phenols (higher)	22·4
Carboxylic acids	4·0
Bases	0·2
Loss	1·3

The Uses of the Crude Oil.—The Kohtla crude oil is used at present mainly as fuel oil, fractionation being carried out on a limited scale only. The light oil obtained by steam distillation at 100° C. is suitable for motor-cars. The next fraction up to 280-300° C. is "motor-oil" for oil engines, and the residue is a pitch "shale asphalt" of high quality. Chemical refining is not used.[10]

On the basis of the above-mentioned experimental achievements a large oil distillation plant with a battery of 6 retorts (of slightly different designs)[11] has been erected and will start operations shortly. The throughput of the new distillation plant is 200 tons of oil-shale in 24 hours, and the quantity of crude oil would amount to 40 tons daily.

Distillation in the "fusion" retorts yields a crude oil of sp.gr. 0·958/15°. The crude oil is less viscous than that obtained at the Kohtla distillation plant.

[10] The fraction 230—270° C. contains cresols and may be used as disinfectant.

[11] In the plant the producer-retort and pre-heater form one vertical unit.

Finally the crude oil, obtained at Püssi Plant, stands somewhat midway between the above-described crude-oils.

With regard to the "Eesti Kiviöli" Company distillation plant the author has to mention that the plant is working under management of highly qualified men. The research laboratory at Püssi Mine is well equipped, and many interesting results have been obtained.

Some Problems of the Future.—Up to the present the Oil-Shale Mines have chiefly supplied the home market with the solid and liquid fuel.

The consumption of oil-shale has been as follows:—

TABLE XV.

THE CONSUMPTION OF OIL-SHALE (In metric tons).

Consumers.	1918-19.	1920.	1921.	1922.	1923.	Total.
Portland cement factories	1,135	12,288	37,244	113,554	102,995	267,216
Railway	424	8,923	9,234	14,903	34,209	67,693
Fuel, gas factories and experiments ..	8,089	24,914	10,824	5,775	18.856	68,458
Kohtla experimental oil factory ..	—	—	981	2,202	3,200	6,383
Total	9,648	46,125	58,283	136,434	159,260	409,750

The annual fuel requirements in Estonia for oil-shale alone is given below:

TABLE XVI.

OIL-SHALE REQUIREMENTS IN ESTONIA.

	M. tons.
Portland cement work	170,000
Other factories	340,000
Railways	200,000
Small consumers	40,000
	750,000

From the Table XVI. above it follows that consumption of power in Estonia is very small indeed.

The oil-shale industry in Estonia must be developed on much broader lines. The favourable geographical position justifies the prediction of a prosperous future for the *shale-oil* industry in Estonia. At present the shale-oil is the cheapest crude oil in Estonia, and will be probably the cheapest oil in the North of Europe.

In the present distillatian operation on a large scale about 80 per cent. of the laboratory yield has been obtained, but there is another problem to be solved in the near future to convert as big as possible a portion of the crude oil into light oils, for which there exists a great demand on the world market.

Finally, it must be borne in mind that the oil-shale industry is not "a poor man's game." Only when properly organised and financed will desirable results be obtained.

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