COCONUTS.

THE GROWTH AND DECLINE OF THE COCONUT OIL INDUSTRY IN JAVA.

At the request of the Low-country Products Association a report has been secured from the Department of Agriculture, Industry and Commerce, Java, on the Coconut Oil Industry of that country. This report has been translated and has been submitted to the Estates Products Committee of the Board of Agriculture for its information.

Only after the year 1907 did the oil industry in Java really develop. Before that time almost all the coconut oil was produced by the indigenous population by the very primitive methods which had been in use for centuries.

Before tracing the development of the oil industry to its modern manufacturing status it may perhaps be interesting to describe this method which is, even at the present time, employed. The great economic importance of this primitive home industry is quite apparent from the fact that the major portion of the oil consumed by a population of about 35 millions is yet prepared in this simple manner, so that, roughly 80 per cent. of the total coconut product of Java is manufactured in this way.

In the indigenous method of manufacture, unlike the modern European industry which employs only copra, the *fresh kernel* of the coconut is used. The kernel is grated finely by hand and the grated meat is put into a plaited bamboo basket which is placed in a wooden trough. The mass of grated coconut kernel is then mixed with warm water and kneaded by hand or by treading under foot. The milky fluid (an emulsion of oil in proteinaceous water) passes out through the plaiting of the basket. This accumulates in the trough and is then transferred into larger earthenware vessels. The liquid is allowed to remain for some time in the vessels. Here it settles into two layers, the upper of which has a thin pulpy consistency and contains nearly all the oil, whilst the lower layer is made up of the water.

The upper layer is now decanted and evaporated in iron pans. On heating, the oil separates from the water, whilst the proteins contained in the kernel are precipitated. When the water has been evaporated, the oil is strained through a gunny in order to free it from the sediment. This sediment is again pressed for procuring the last remnants of oil in it. This last operation is carried out in very primitive wooden presses in which pressure is brought to bear on the meal by means of a wedge that is driven in with a hammer. The cake that is left behind is a valuable by-product and is used as food.

The following data gathered from various districts in which oil is prepared by the indigenous population in the manner described above give an idea of the results obtained. It may be taken that, on an average, from

300 ripe coconuts about 37½ litres of oil are obtained, which amounts to a yield of about 50 per cent. reckoned on copra.

The year 1907 has been mentioned above as being of importance in the history of the development of the oil industry in Java. In that year two oil factories were erected by the "Maatschappij van Heel" in the district of Kediri. These have really been the beginning of an oil industry which developed extraordinarily within a few years. With modest beginnings and even working according to the primitive indigenous methods, the company, encouraged by satisfactory results, set about extending the industry, which was modernised, and provided with the first hydraulic press imported into Java. This press was of the Seiher type. As a result, the capacity for production was considerably augmented and the cost of production per unit was considerably lowered. One of the advantages of the increased capacity for production was that foreign orders for oil could be executed more speedily and opportunities of favourable situations in the market taken advantage of.

These factories worked successfully, and following them, several others belonging to, and carried on by Chinese were erected. All these worked exclusively for the inland market. The relatively low capacity of the new factories did not permit of their exporting oil.

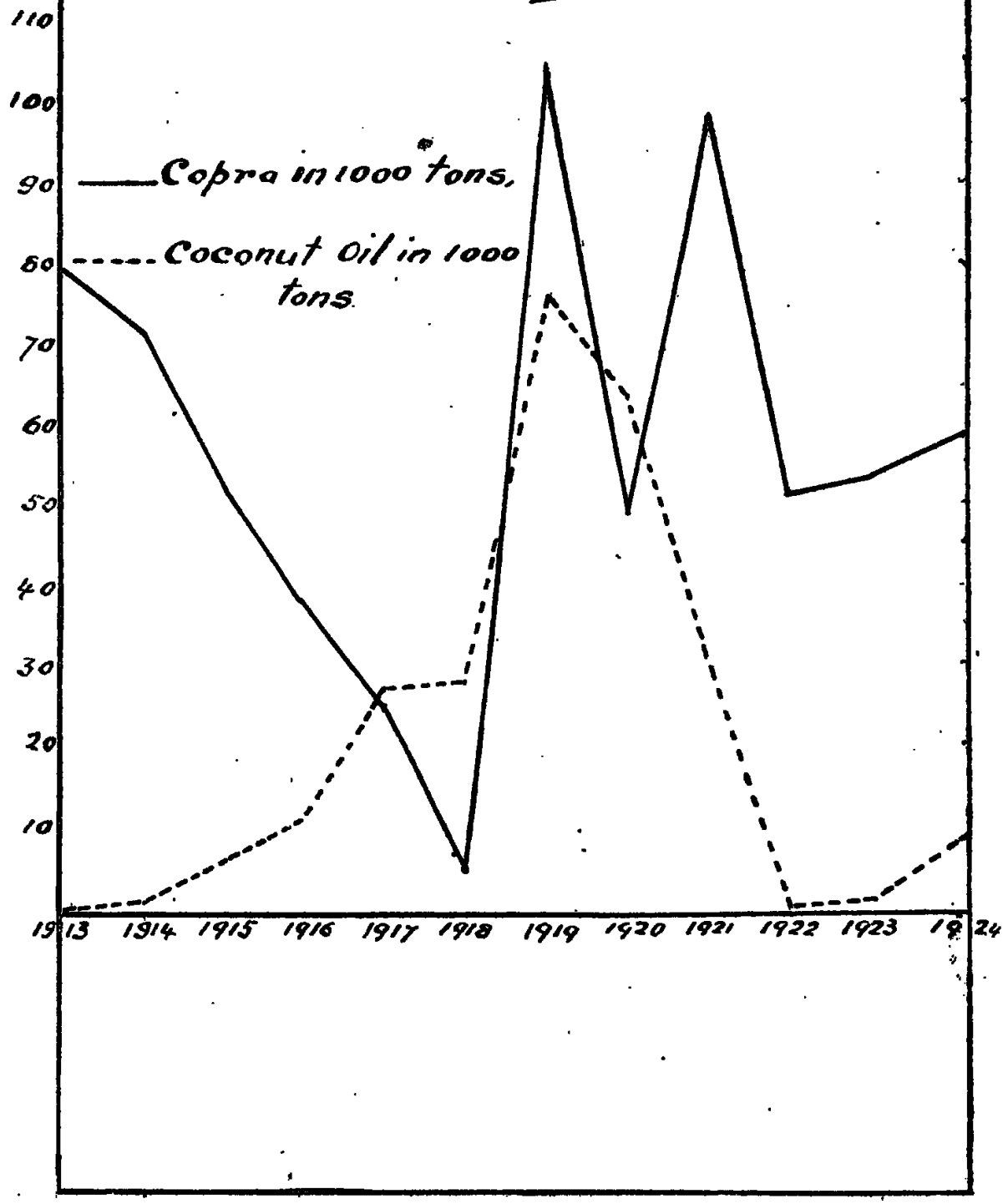
In 1913 there came a change when both the oil factories of the "Maatschappij van Heel" referred to above came into the possession of a newly formed company, the R. V. "Oliefabrieken Insulinde." From the beginning this company included within its scope, the provision of inland demand as well as the exporting of oil. Immediately after the purchase of the two factories, the company effected improvements in order to increase their capacity for production. The same year (1913) saw the origin of another company, namely, the "Oliefabrieken van Dongen" which is the only large concern in this district. This company yet exists and did not collapse as the result of the wide-spread economic crisis after the War.

When the great European War broke out in 1914 there was a great stimulus to the further growth of the oil industry in Java. Germany, the greatest purchaser of Java copra and the greatest oil producing country of the continent, was almost immediately cut out of the world's economic system. Yet, at the beginning of the War, considerable quantities of Java copra found their way into Germany *via* Holland. But the situation was totally reversed as soon as copra was declared by the Allies to be contraband. All the copra that used to be exported into Germany, which before the War took quite 50 per cent. of the Java produce, was thereby held up. As a consequence of this and the consequently increasing difficulties with regard to the means of transport, the copra supply had to be stored. The continuously increasing want of shipping accommodation, added to the enormous demand on the part of the Allies for prepared oil furthered the extraordinarily quick development of the Java oil industry in the direction of an export trade.

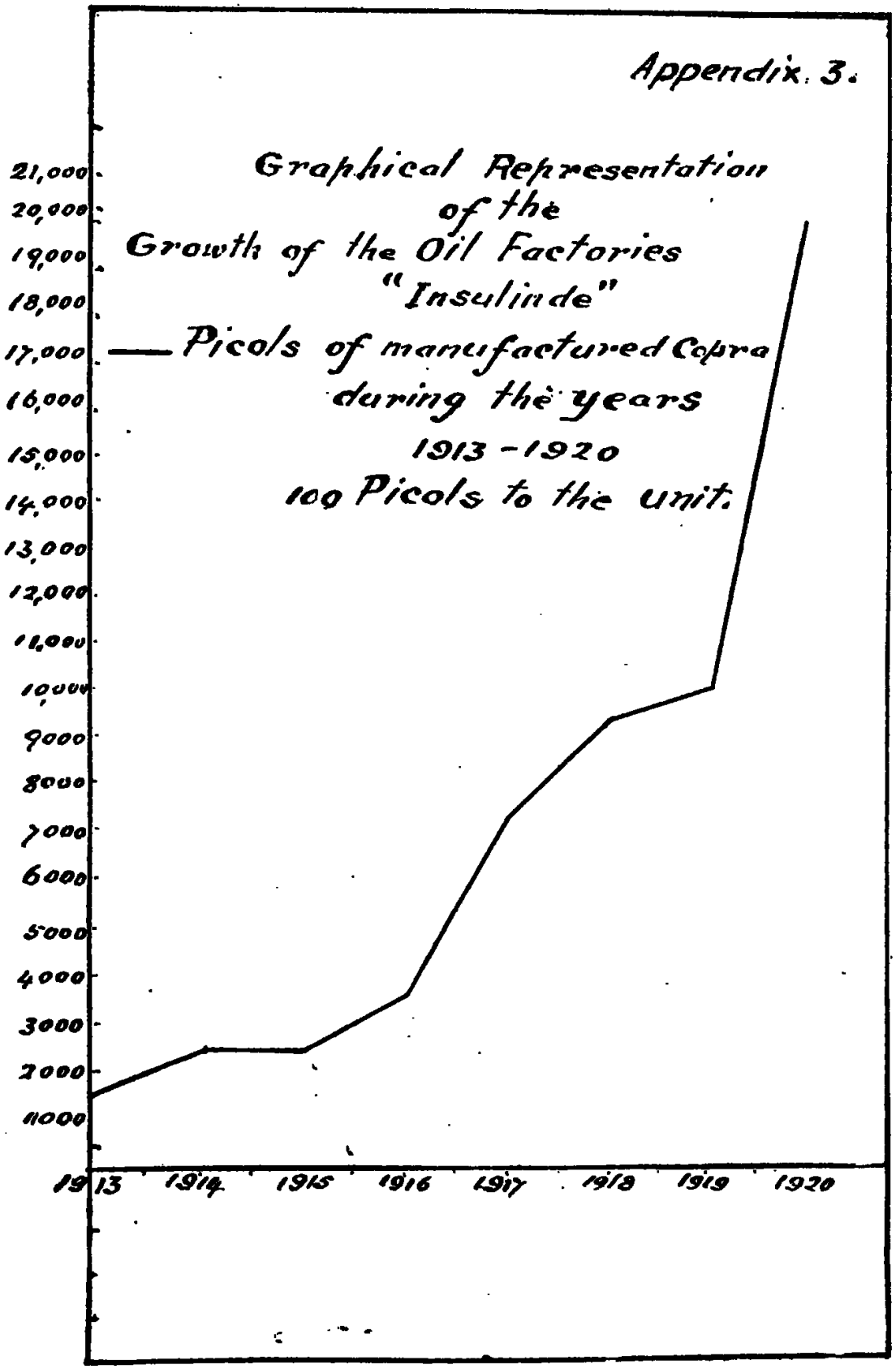
Although the question of export facilities had already been considered, yet, were it not for the World War, the development of the industry would have taken place only very gradually.

Appendix 2.

Graphical Representation of the Export of Copra and Oil In the years 1913-1924



Appendix. 3.


Graphical Representation
of the
Growth of the Oil Factories
"Insulinde"
— Picols of manufactured Copra
during the years
1913 - 1920
100 Picols to the unit.
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9000
8000
7000
6000
5000
4000
3000
2000
1000
1913
1914
1915
1916
1917
1918
1919
1920

During the War not only did both the larger and smaller factories progress rapidly, but the concerns previously existing increased their producing capacity. The following figures give an idea of the rapid growth of this industry (See Appendix 1.)

The relative significance of these figures stand out more clearly when they are presented graphically (Appendix 2.) From the sense of the lines it is clearly seen that in proportion to the progress of the oil industry, in other words in proportion to the increase of export in oil, there is a corresponding fall in the export of copra. The influence of the War period is also clearly seen in the graph.

The year 1919 was the 'top' year for the export of oil which was then 76 million litres. It is more remarkable that, as regards copra export too, 1919 was an exceptionally prosperous year. This sudden rise in the export of copra was due to the termination of the War, which enabled many factories in Europe to revive the industry. There arose then a lively demand for copra and for oleagenous products in general. Since shipping now offered much less difficulty, the copra supplies that had been accumulated during the War were exported. After 1919 there occurred a rapid retrogression in the oil industry in Java. The causes of this will be dealt with later.

In order to illustrate the enormous rise of the oil industry during the years of the War we may make mention of the rapid increase in the producing capacity of the largest company which could be considered to have been most advanced and which therefore exemplifies the nature of the general development. (Appendix 3.)

The graph shows that the course of the line representing the increase in capacity has rather a steep rise. That this increase in capacity was not larger was to some extent the result of the War conditions which in other respects had entailed encouraging results. The delivery of the required machinery was very difficult. Delivery up to time, especially, could not be guaranteed on account of the lack of shipping accommodation, which also caused much trouble in the shipping of oil.

As regards the transport of oil, the following remarks may be made. Originally the oil was offered for sale on the inland market only. At this stage it was packed in petroleum tins, the means of packing available in the Indies. When the export was beginning to assume larger proportions it soon became evident that another means of packing should be used. Besides the fact that tins were always rather difficult to procure, the considerable losses due to frequently occurring leakages could not be overlooked. The use of iron drums was therefore soon resorted to. They were satisfactory, but they began to be more and more expensive as the War progressed until at last they were no longer procurable. It should also be mentioned that even packing in wooden vats was tried. To one of the largest factories even a cooperage was attached. However, since no suitable kind of wood in sufficient quantities was available in the country itself, wood had to be imported from other countries, and this has presented no difficulties.

In order to meet the growing difficulties of transport, the transporting of oil in bulk was tried, and, with the co-operation of steam navigation companies, some ships were converted into tankers for this purpose.

During the course of the War, one of the greatest oil manufactories established a transporting enterprise as a subsidiary undertaking, and this company at the end of 1920 had three large tank ships afloat.

The chief objection against exportation in bulk was that it made the oil become sour, and as a result the oil depreciated in value as an article of food. This supposed difficulty regarding the rise in acid as a result of bulk export does not really exist, as it is apparent from Appendix 4, in which results of analyses of specimens taken from oil exported in bulk are taken both in the Indies at the beginning of the voyage, and on the arrival of the oil in Europe.

The figures show that only a very small rise of acid has taken place, so that it may be considered settled that bulk export is possible without entailing any effects prejudicial to the quality of the oil.

The difficulty that accompanies transport in tank ships is however more of an economic than of a technical nature : there yet exists some doubt as to whether the transport of oil in special tank ships is really cheaper than transporting in ships, which can count on being freighted on the return voyage too, whilst a return freight is denied to tank ships. With regard to this matter too, experience, from which Java has benefitted for a short time only, must in time show which is more profitable. It would be rash to draw conclusions from the little experience gained under very abnormal conditions which have prevailed since the experiment began.

What has been said before concerns marine transport. On account of the rapidly growing export, transportation by land too had to be provided for. Packing in petroleum tins or even in wooden or iron vats was sufficient in view of the available means of transport. But with the enormous increase in production and the accompanying shortage of packing material, the large factories took to the use of special tank-waggons, which saved much labour, time and packing material. Both on the factory grounds as well as at the export stations of Tandjong Priok, Tjilatjap, Soerabaja and Banjoewangi large tank installations were set up, whilst one of the largest enterprises erected tanks in foreign ports, namely in San Francisco, California and Amsterdam. Where the port arrangements permitted it, the oil was pumped from the storing tanks into the holds of the ships. Otherwise, tank boats were used to convey the oil from the shore to the ships.

From the financial aspect too the oil industry showed vast expansion. The company capital of those factories whose increase in producing capacity was mentioned above, grew from 1—2 million florins in 1913 to 30 millions in 1920 and this enormous increase was necessary for the financing of the continuous expansion.

About 1919/1920 the total capacity of the oil factories in Java was reckoned to be approximately 200.000 tons of copra. But of all these concerns only one, namely the Oliefabrieken van Dongen, has been able with great effort to maintain itself. The other companies could not survive the difficulties of the years 1921 and 1922.

After the end of the War the oil factories of Europe and elsewhere came again into operation—thereby the demand for oil decreased on the world's market, whilst the demand for raw materials increased. Besides

the factories in the country itself, those of foreign countries competed in the market for raw materials, with the consequence that there was an enormous rise in the prices of copra, a rise that for a time reached such a height that the prices of oils were lower than those of copra and a paying industry was therefore quite out of the question. In addition, the industry in Java was not quite free from being affected by the widespread social difficulties which it experienced chiefly in the rise in wages at the most inconvenient period. Such conditions forced most of the factories to close down and as there was no speedy improvement in the situation they had to liquidate. The export figures for coconut oil show this very clearly : from over 76 millions of litres in 1919 the figures dwindled down as shown to nothing in 1922. Only very lately have signs of recovery, by an increase in the export of oil, become apparent. Appendix 5 shows which markets used to take in Java oil. From the statement it is apparent that the United States, as well as the Northern Countries, have been important importers of Java oil as well as copra cake.

In the foregoing pages the general development of the oil industry in Java and the débâcle that followed have been traced.

Now we may mention the methods which this industry employs.

Modern methods of obtaining oil from vegetable products can generally be divided into two classes that are essentially different, namely, (1) by extraction, (2) by pressing.

In the first method the power of certain liquids to liberate oil is made use of whilst in the second method the oil is obtained by the aid of great pressure.

The first method is *not* employed in Java ; it has not yet gone beyond the experimental stage. Just when the large installations had been imported and were about to be erected the crash came.

The second method, on the contrary, is the one that is most commonly followed here. The following scheme may he drawn up for factories that manufacture dry copra :

Cleaning
Grating
Crushing
Warming
Pressing
Filtering

The copra that the factories receive is generally very much soiled by dust and sand. In order to eliminate these impurities, as far as possible, the copra is placed in a round rotating sieve or an oscillating sieve, and in some factories the copra thus cleansed is made to pass through a magnetic apparatus in order to remove any portions of iron that may damage the machinery during the processes of manufacture that are to follow.

Two types of machines are used in the grating of copra. The type most commonly used is that known as the copra disintegrator, which is used especially in the smaller factories. These machines are of this principle ; two discs both provided with sharp points rotate in opposite directions. The copra is brought between these two discs and is finally pared. This

machine has the advantage of being of low cost. Hence, as has been stated above, it is generally used in small factories. It has the disadvantage, however, of requiring much power. On this account, therefore, large factories prefer mills that require less power, in which copra is finely milled between shiftable deep-grooved rollers.

Experience has shown that very much attention should be paid to the preliminary work, since the removal of impurities has a great deal of influence on the colour of the oil, whilst the grating considerably influences the quantity yielded on pressing.

The grated copra is now pressed on to the crusher which is fitted with what is known as the Anglo-American rollers. The rollers, three or five in number, are placed one vertically above another. The impelling force is made to bear on the undermost roller and by means of cog-wheels the movement of the other rollers is effected. The top-most rollers are grooved, while the lowest are smooth. The finely grated copra comes into the feeder, a funnel-shaped trough which is kept in motion, and then falls on to a slanting plate which directs it between the rollers. In a crusher fitted with five rollers the copra is crushed four times. The crusher bruises the copra and thereby the cells in which the oil lies are burst. It is an extremely important process of oil manufacture.

From the crusher the meal is passed on to the boilers in which it is warmed and at the same time moistened till it has a moisture content of 12-14 per cent. The purpose of this operation is to aid formation of the cake that does not crumble.

The boilers are double walled so as to admit of the warming being done by means of steam. Further, they have a stirring apparatus, and, below, a filler that can be worked by hand as well as automatically.

Warming is generally done by steam at 2-3 atmospheres. The purpose of this operation is to thinly liquefy the oil and thereby facilitate pressing. At the same time it helps to coagulate the proteins present in the meal, and thereby prevents them from being pressed out with the oil. The larger factories generally use double boilers. These are more advantageous than single boilers as warming goes on more regularly in them.

Now follows the pressing of the warmed meal. The pressing apparatus consists of hydraulic presses of the Sieher type provided with a sieve or lath-work mantle. The press tubs may be warmed by means of steam and the warming is done as the pressing starts. The pressure used is from 300-350 atmospheres and this is obtained by means of hydraulic pumps through the intervention of a pressure accumulator. The pressure is applied in the usual way: it is allowed to increase but slowly and gradually, and made to reach its maximum only at the end of the pressing.

Besides these presses there are in use in Java others after the Anderson Patent known as oil wringers. The results obtained from the installations described above vary between 57-59% of the weight of copra.

The oil that comes out of the press still contains small flocular granules of coagulated protein. This is the substance that is generally known as the dross of the oil. In order to separate this, the oil is put into troughs to let it settle, while filtering follows as the last operation. From the settling troughs the oil is pumped into filter presses or into bag filters, both of which are used in Java.

After this the oil is got ready for transport. It is packed in vats or drums or pumped into storing tanks for later transport.

A very small portion of the Java oil is also refined, *i. e.*, clarified and deodorized. Clarifying is done with fullers earth, whilst the deodorizing is done by passing over heated steam of about 130C. through the oil. The oil thus refined is brought on the market under the common name of "butter oil."

APPENDIX 1.

Export of Coconut Oil.

Year	Copra Kilogrammes	Coconut Oil Litres
1913	79,155,000	66
1914	70,827,000	1,299,000
1915	51,557,000	5,475,000
1916	38,491,000	10,868,000
1917	24,922,000	26,727,000
1918	3,493,992	26,895,865
1919	103,794,066	76,890,563
1920	49,735,417	63,899,639
1921	94,013,684	30,311,583
1922	50,895,626	16,443
1923	53,260,938	1,442,641
1924	59,000,000	7,936,000

APPENDIX 3a.

Increase in Production of the Oil Factories Insulinde.

Year	Capacity in Piculs of Copra
1913	160,908
1914	224,765
1915	246,786
1916	377,399
1917	746,753
1918	949,823
1919	1,296,733
1920	1,093,603

APPENDIX 4.

Increase of the Acid Content of a Shipment of Oil.

No. of Tank.	Acid Content Per cent.	
	On Shipping	On arrival
1 Starboard	3·47	3·53
2 ,,	3·15	3·23
3 ,,	3·47	2·87
4 ,,	4·04	4·27
5 ,,	2·77	2·87
6 ,,	2·91	3·07
7 ,,	3·10	3·44
8 ,,	3·69	3·46
9 ,,	2·88	3·15
10 ,,	3·02	3·29
1 Larboard	3·50	3·75
2 ,,	3·10	2·97
3 ,,	3·35	3·56
4 ,,	4·14	4·27
5 ,,	2·80	2·70
6 ,,	2·91	3·19
7 ,,	3·19	3·44
8 ,,	2·92	3·29
9 ,,	2·85	3·44
10 ,,	2·77	3·75
Average of all tanks	3·20	3·37

APPENDIX 5.

Export of Coconut Oil

Destination.	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Holland ..	462	4,168	—	—	5723	42005	13255	9009	—	—	7742
Great Britain ..	811	197	800	127	170	1048	19678	7813	—	14104	70378
Belgium ..	—	—	—	—	—	2990	—	—	—	—	—
Denmark .	—	—	1457	—	—	1313	—	—	—	—	—
Norway ..	—	—	1697	2422	487	7268	772	—	—	—	—
Sweden ..		—	1508	—	575	5581	652	—	—	—	—
Germany ..	—	—	—	—	—	—	—	—	—	—	272
Italy ..	—	—	—	—	—	—	—	—	—	—	274
Other European Countries	—	654	126	—	—	1394	—	—	—	—	—
U.S. America ..	12	438	3793	22654	16130	13175	11640	10951	—	—	—
British India ..	—	—	—	—	—	—	—	—	—	189	9
Egypt ..	—	—	—	—	—	2116	17750	2424	—	—	234
Siam ..	—	—	22	—	—	—	—	—	—	—	279
Japan ..	11	—	1068	1225	3805	—	—	107	—	—	—
China ..	—	—	99	274	—	—	121	—	—	—	82
Other Countries . .	3	18	321	25	6	1	32	8	164	127	—