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ANNEX i

INDUSTRIAL DEVELOPMENT IN CHILE

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CHAPTER XXIII. CHILE

SECTION 1. PRODUCTION AND CONSUMPTION OF ENERGY

Energy plays a vitally important part in the development of every country, the level of production being closely related to local sources of energy.

Where energy is abundant and cheap, it is possible to mechanise activities and improve the standard of living.

Energy is a predonimant factor in the industrialisation process.

I. Consumption

The total consumption of energy in Chile shows a steady growth, with the exception of the period of crisis from 1930-33.

The corresponding curve is shown in Graph 1, reducing to KWH the consumption of coal (1 kilogramme = 1 kilowatt hour); petroleum (1 kilogramme = 1.4 kilowatt hour); gasoline (1 kilogramme = 2 kilowatt hours) and wood (1 kilogramme = 0.33 kilowatt hour), plus electric energy; an approximate estimate is given for wood.

During the period from 1925-1948, Appendix 1, the consumption of energy increased by 59.5 per cent, and in the period 1932-1948 by 126 per cent; the variations in average energy consumption, in each five year period, are:

Table 1. Consumption of Power

Year	Hydro-Electric	Coal	Wood	Petroleum	Gasoline	Total Energy
1930-34	22.5 %	- 4.7%	-	- 48 %	17%	- 11.7
1935-39	33 %	39 %	-	25 %	15.4%	24.2
1940-44	27.5 %	10.6%	-	44.5%	27 %	20.8
1945-48	36 %	- 2.7%		19 %	67 %	5.7

Sources: Dirección General de Servicios Eléctricos, Dirección General de Estadística and Empresa Nacional de Electricidad S.A. (ENDESA).

/The energy

The energy consumed is derived from two sources: one is domestic (electricity, coal, wood) and the other is based on imported fuels (petroleum, including Diesel oil and gasoline). The curves giving the values of these are shown on the same graph. In the period 1925-1948, energy from domestic sources increased by 63 per cent, while that on an imported basis increased by 51 per cent; nevertheless in 1925 and in 1948, domestic energy represented 68 and 71 per cent, respectively.

At this stage it is important to note that there are two large consumers of energy based on imported fuels. These are the nitrate and copper mines, which produce on an enormous scale and have a petroleum consumption out of all proportion to that of the remainder of the country's activities. Thus in 1925, copper and nitrate were responsible for 85 per cent of the total consumption of thermo-electric energy, while in 1948 these industries were responsible for 80 per cent.

Graph No. 2 shows the fluctuations of the consumption of imported liquid fuels. The profound depression which fuel oil consumption suffered in 1931-33 is immediately noticeable; this was a result of the crisis of that period, and following those years, a notable increase may be observed; gasoline and Diesel petroleum follow the same tendency, although to a lesser degree. The disproportion between the consumption of fuel oil and gasoline is noteworthy; in 1925 the ratio was 14 to 1, while in 1948 it was 4 to 1, ratios which are very important for the future supply of liquid fuels on the basis of locally refined domestic petroleum.

Referring to the period from 1910 to 1948, petroleum imports increased by 800 per cent and those of gasoline by 1,700 per cent.

Table 2. Per capita consumption of power

Year	Kilowatt hour Total energy	Kilowatt hour Electric energy (Hydro and thermo)
1910	778 (x)	-
1915	548 (x)	-
1920	570 (x)	-
1925	1,074	179
1930	861	218
1935	899	293

/1940

Year	Kilowatt hour Total energy	Kilowatt hour Electric energy (Hydro and thermo)
1940	1,011	359
1945	1,017	441
1948	1,182	516

(x) Excluding hydro-electric power and wood.

Sources: Dirección General de Servicios Eléctricos, Dirección General de Estadística and Empresa Nacional de Electricidad S.A.(ENDESA).

The consumption "per capita" of total energy has been increasing slowly, the crisis of 1930 having had a marked effect upon it. On the other hand, consumption of electric power shows a strong increase, amounting to 190 per cent in the period from 1925 to 1948.

The value of fuel imports in relation to total imports, is as follows:

Table 3. Value of imported fuels as a function of total imports

Year	Percentage of the value of imported fuels in relation to total imports
1925	7.2
1930	5.4
1935	7.8
1940	11.0
1945	7.9
1947	7.6

Source: Dirección General de Estadística.

In other words, fuel imports in 1925 and 1947 showed the same proportion in relation to total imports, with a drop during the 1930 crisis, and a rise in 1940, due to the fact that as a result of the war, general imports dropped considerably, but not the import of fuels, a large proportion of imported fuel being used, as already stated, in the production of nitrate and copper.

Coal, wood, imported petroleum, domestic petroleum and electricity are all used to meet the demand for energy. As no data is available, we shall not consider the suggestions made by some experts concerning the use for the generation of energy of the natural hot steam of "El Tatir" in the North of Chile, nor the underground rivers which flow from the Cordillera to the sea under the "pampas" or plains of the

/North.

North.

II. Petroleum

An important part of the energy consumed comes from petroleum and its derivatives which, until now, have been imported.

The Government, through the Corporación de Fomento de la Producción (Corporation for the Promotion of Production), has carried out petroleum exploration in the region of Magallanes, which have proved successful. Up to the present time 550 million Chilean pesos have been invested and 26 wells have been sunk in Manantiales, of which 16 are rich in liquid petroleum and the remainder in gas. An oleoduct extending 70 kilometres from Cerro Manantiales to Clarence Bay, the port of shipment, is already in operation together with the corresponding tanks. By December 1949 40,000 barrels had been stored; production at present is around 2,000 barrels per day, and it is hoped it will shortly reach from 10,000 to 12,000 barrels per day, this quantity being sufficient to supply current internal consumption.

Apart from the region of Cerro Manantiales, the petroleum deposits which are sufficient for Chile's consumption for more than 25 years, there are other petroleum deposits in the region.

A refinery is to be built at Concon, Valparaiso, which will be in operation by 1953, with a capacity for treating 12,000 barrels of crude oil per day.

Meanwhile, the crude oil is being sold and in 1950, these sales (which will be made to Uruguay) will amount to 2,000,000 dollars.

When the refinery is complete and the domestic petroleum fields can supply it, only fuel oil will have to be imported. Until this takes place, Chile will have to continue importing lubricants, paraffin paste, fuel oil and the difference between the crude oil obtained from the Magallanes fields and the amount required to supply the domestic refinery.

If we calculate that the requirements for petroleum derivatives will at current prices reach 45,000,000 dollars for 1955 while it is

/estimated that

estimated that 33,000,000 dollars will be needed to cover the import of fuel oil and the foreign currency costs of the Magallanes petroleum fields, the petroleum refinery, including the lubricants plant, and the service of the debt, there will be a net economy in foreign exchange of 12,000,000 dollars, if the refinery were to function only with domestic crude oils.

III. Coal

Coal is one of the most important sources of energy in Chile, having contributed 40 per cent of the total energy consumed in 1924 and 36 per cent in 1948.

Chile is the most important coal-producing country in Latin America, and may be said to be almost self-sufficient in this respect. There are large deposits, principally in the region of Concepción, which have been mined for many years; in Magallanes there are large deposits of light coal of low calory power and high ash content, which are not at present being mined.

It is estimated that the deposits already discovered comprise practically all the country's stocks, there being over 100,000,000 tons of surface coal, while reserves probably amount to 200,000,000 tons, so that coal supplies are ensured for many years. Nevertheless, the reserve is small in comparison with that of other countries, since Chile's total reserve is only 60 tons 'per capita', against Germany's pre-war reserve of 4,400 tons 'per capita', 23,300 tons 'per capita' in the United States and the world reserve of 2,500 tons 'per capita'.

It should be added that the working of coal in the most important Chilean mines is difficult, as there are very long galleries which run for several kilometres under the sea.

In the first quarter of this century, coal production was insufficient to meet the demand, and heavy imports had to be made, as shown in the following table:

/Table 4.

Table 4. Coal Imports for Selected Years

(in thousand tons)

Year	Gross production	Imports	Supply
1910	1,074	1,493	2,567
1915	1,171	461	1,632
1920	1,063	384	1,447
1925	1,453	264	1,717

Source: Dirección General de Estadística.

It should be mentioned that until 1925 not only coal but common coke was imported. Moreover, in 1910 national production represented 43 per cent of total requirements and in 1925, 85 per cent.

On the other hand, in the second quarter of the century the situation changed:

Table 5. Coal Imports for Selected Years

(in thousand tons)

Year	Production	Imports	Supply
1930	1,441	16	1,457
1935	1,909	0.9	1,909.9
1940	1,937	221	2,158
1945	2,049	0.6	2,049.6
1948	2,234	94	2,328

Source: Dirección General de Estadística.

Graph 3 shows the enormous importance of coal production in relation to supply during the second quarter of the century, as coal imports dropped continuously until they disappeared completely in 1931, a year in which exports began to increase. This situation suffered a severe blow in 1940, when a large demand for coal began as a result of the war, which brought in its train an increasein industrial production and a decrease in the imports of liquid fuels, the lack of electric power being one of the reasons for this increased demand. It should also be stated that in the years 1945-1946-1947, as a result of strikes in the coal mines, there was a drop in coal production, which was detrimental to the country's

/industrial production.

industrial production. At present, in order to present these difficulties, an under-water coal deposit is being completed near Santiago, with a capacity of 50,000 tons, and another in Valparaiso with a capacity of 15,000 tons.

The scarcity of coal resulted in rationing and the necessity to import, the imported coal being more expensive than the domestic product at the coal port:

Table 6. Price of domestic coal and import coal c.i.f.

Year	Imported $/Tons c.i.f.	Coal Port $ per ton	Santiago $ per ton
1940	348	135.05	252.14
1941	363	172.27	293.84
1944	695	257.64	482.16
1947	595	359.57	700.93
1948	715	507.11	880.76

Source: Dirección General de Estadística.

The principal characteristics of the coals are indicated below:

Table 7. Analysis of foreign and domestic coal

	Chilean coal			Imported coal
	Light	Heavy		
Calories	5,392	from 7,182	to 7,542	7,532
Ash	13,532%	" 9.6	" 5.8%	10.93%

Source: Comisión de Racionamiento de Carbón.

As regards the coal situation in 1949, there is a deficit of lump coal (above 1 inch) and an excess of slack (under 1 inch). This situation is aggravated, because the Compañía Acero del Pacífico (Pacific Steel Company) expects to consume over 200,000 tons of lump coal in 1950, this being an entirely new consumption.

In order to overcome these difficulties, the following steps will be taken: the washing and screening of slack; the use of 700,000 tons of small coal in the production of gas; the replacement of a part of the heavy coal consumption by washed and screened slack; the elimination, if possible, of coal exports, encouraging instead the export of slack; as well as the use of coals of lower calory power.

/Nevertheless, it

Nevertheless, it is foreseen that there will always be an excess of slack and a deficit of 100,000 tons or more of heavy coal; an attempt will be made to offset this by increasing production. The producers of heavy coal expect, with their own resources, to increase production by some 400 tons daily, and with the aid of a loan from the International Bank, by some 1,500 tons daily. In Appendix 2, the principal consumers of coal are show, from which it will be seen that the railways have always been the most important consumer, followed until 1918 by the nitrate fields (which changed from coal to petroleum during the First World War), with the manufacturing occupying second place since then, followed by gas and electricity. It must be borne in mind that in 1924 the railway from Santiago to Valparaiso was electrified, with a resultant saving in coal consumption of 100,000 tons per year.

As we shall see later on, the electrification of the railways would solve the coal situation.

IV. Electricity

Chile is a country which possesses vast hydraulic possibilities for the generation of power.

The country's hydroelectric resources permit the planning of the installation of power plants with a total capacity of up to 6,000,000 KW, without taking into account the potential from Puerto Montt to the South, which signifies another 1,500,000 KW; this would make it possible to construct hydroelectric plants close to the sea, which could then supply electro-metallurgic and electro-chemical industries, as is the practice in the United States, Canada and Norway.

The country's position in regard to hydroelectric reserves is very favourable both in regard to geographic location and to quantity; in fact, the following comparisons may be made:

Chile	1,300	watts per capita
United States	240	" "
Norway	4,150	" "
Sweden	460	" "
World Average	150	" "

/If we consider

If we consider that in 1949 the hydraulic capacity installed was, under favourable conditions, 340,000 KW, we can see that only 4,5 per cent of the country's potential is in use, so that the remaining margin for obtaining hydroelectric power is practically unlimited.

Appendices 3 and 4 show the installed electric capacity and the energy generated in the period from 1925 to 1948.

Graphs 4 and 5, based on these appendices, show the variations of both installed electric capacity and generated power.

These variations may be summarised as follows, in terms of the proportion of hydro and thermo electricity:

Table 8. Installed Power and Generated Power

Year	Installed capacity		Power Production	
	Hydraulic	Thermal	Hydraulic	Thermal
1925	40 %	6.0%	53%	47%
1948	47 %	53 %	50%	50%
1949	49 %	51 %	-	-

Source: Empresa Nacional de Electricidad S.A. (ENDESA).

Regarding increases from 1925 to 1948, we have the following:

Table 9. Percentual increase of generated power

	Installed capacity		Power Production	
	Hydraulic	Thermal	Hydraulic	Thermal
Percentages of increase	265%	177%	222%	340%

Source: Empresa Nacional de Electricidad, S.A. (ENDESA).

This suggests that:

a) There is an outstanding tendency towards the replacement of thermo-electricity by hydro-electricity, both in terms of capacity and production, an increase which is fundamentally due to the plants which the Government has installed through the Empresa Nacional de Electricidad (Endesa) (National Electricity Enterprise); in 1949, 38.5 per cent of the installed hydro-electric total was accounted for by Endesa.

b) The thermal plants have been used to better effect than the

/hydraulic ones,

hydraulic ones, since the increase of energy generated by them (1925-1948) is much greater than the increase, during the same period, of their installed capacity, this being due to the fact that the thermal plants, as a result of the scarcity of electric energy in the last few years, have worked intensively, independent of climatic conditions, while this is not the case with the hydro-electric plants.

V. Supply

We have already described the situation in regard to coal and petroleum; we will now deal with electricity.

1 - Present supply and future plans

Installed capacity, as we have seen, reached a total of 701,000 KW in 1949. In order to satisfy future demand, several projects are under way, which will be outlined below:

a - ENDESA

The Government of Chile, fully aware of the absolute necessity of increasing electricity production and realising that the private companies were not equipped to undertake vast projects, created the "Empresa Nacional de Electricidad S.A." (National Electricity Enterprise, S.A.) abbreviated to "Endesa", with a capital of 500 million pesos, now increased to a billion pesos, with the object of putting into effect plans for the electrification of the country.

Endesa's investments to date may be estimated at around 1,500 million pesos, of which 90 per cent represent contributions by the Corporación de Fomento de la Producción which has obtained credits from the Eximbank and the International Bank amounting to 25 million US dollars. About 250 million pesos of these investments have been used for purchases abroad. Investments during the period 1943-53 are estimated at 1,800 million pesos, of which 520 million will be obtained from foreign credits, 500 million from new contributions by the Corporación, and the balance from direct income from the electric system.

/In view of the

In view of the country's geographic contours and the river system, the plan envisages seven geographic regions, and in the first stage, which will last until about 1960, the principal aim will be to develop, the generative possibilities of each region separately. Once this stage is complete, the different regional systems will be interconnected, with the object of facilitating the transmission of surplus energy from one region to another. According to the plan, Endesa will have installed 293,500 KW by the end of 1953.

In the southern region of the country, which is supplied by the hydro-electric plant of Pilmaiquén, "rural electrification", or the distribution and delivery of low-volt power to farms has been carried out for the first time in Chile, in a planned and methodical manner. This distribution has been organised on the basis of "Cooperativas de Electrificación Rural" (Rural Electrification Cooperatives), formed by the interested parties themselves in collaboration with Endesa.

a) In operation: Endesa has the following networkds in operation:

Name	Installed Capacity KW	Future power KW	Region served
Pilmaiquén	13,500	35,500 (24,000 in 1951)	Valdivia to Puerto Montt
Abanico	43,000	129,000	Concepción
Sauzal	75,000	75,000	Santiago-Rancagua

b) Under construction:

Los Molles	16,000 KW in 1951	Province of Coquimbo	
Cipreses	100,000 KW in 1956	"	" Talca

c) Planned:

Mostazal, as an extension of Los Molles, Calafquén with 73,600 KW, in addition to Rafael and Tinguiririca.

Endesa's installed plants represented 132,100 KW. in 1949, that is, 19 per cent of the total hydraulic and thermal plants installed in the country.

/B - COMPAÑIA CHILENA DE

B - COMPAÑIA CHILENA DE ELECTRICIDAD LTDA.

(Chilean Electricity Company Ltd.)

This is a private company, a subsidiary of the Electrical Share and Bond Company of the United States. It is considering the construction of the Hydro-electric Plant of Tinoco, with an output of 50,000 KW, downstream from the present plant of Quelteheues, owned by the company, which supplies Santiago. The company also contemplates a thermal plant in the Santiago zone, of 30,000 KW., which could be located near the coalfields of Maipu or even as a third unit in Laguna Verde, Valparaiso.

Nevertheless, these plants are only under consideration, and there is no certainty regarding their immediate construction. The thermal plant is the most likely, as it would serve as an emergency plant and to cover load points in the winter.

The Company is awaiting the completion of Endesa's plant at Los Cipreses; it is estimated that together with Sauzal, it will solve the problem of energy deficit in the Santiago region.

In 1949, the Compañía Chilena de Electricidad's installed plants amounted to 168,570 KW, or 24 per cent of the total installed in the country.

C - COMPAÑIA GENERAL DE ELECTRICIDAD INDUSTRIAL

(General Company of Industrial Electricity)

This Company will complete shortly a new hydro-electric plant of 750 KW in Temuco. Its thermal plant of 10,000 KW. in Concepcion, is now out of service due to the utilisation of Endesa's Abanico Plant.

In general, this Company's plants are not being replaced, since the electrical energy of the zone supplied by them (between Buin and Los Angeles) will be supplied by the Endesa Plants, and the Compañía General de Electricidad Industrial will undertake only the distribution of this energy.

This Company has already taken over the distribution of electric energy from the Abanico and Sauzal Plants to Concepcion and Rengo respectively.

/In 1949,

In 1949, this Company's installed plants, of 22,917 KW, represented 3.2 per cent of the total installed in the country.

2 - Future Prospects

After the completion of the Cipreses Plant, which is expected to be functioning by 1954, it is estimated that Santiago's demand can be satisfied, since Cipreses and Sauzal will be interconnected and the surplus energy will pass to the Santiago zone, through the distributory system of the Compañía Chilena de Electricidad.

Thermo-electric plants are planned for the Santiago zone, on a coal basis like all the existing plants of the public services Companies, with the object of assuring a constant voltage and taking into account transmission under unfavourable climatic conditions, (frosts, etc.)

The hydro-electric plants not only help to satisfy the greater demand for electricity, but they can also release a acertain amount of coal and reduce the costs of energy.

Thus, for example, the thermo-electric plant of the city of Concepcion, with an installed capacity of 10,000 kilowatts, has been put out of service through the connection of the distribution network with the hydro-electric plant of Abanico, thus releasing some 26,000 tons per annum of small coal.

In the coal mines of this region, a thermal plant of 10,000 KW has also been replaced by energy from Abanico. This plant frees some 24,000 tons yearly of slack; on the other hand, if we consider that a KWH generated on a small coal basis costs 0.65 (0.50 for fuel) and energy bought from Abanico costs 0,40 pesos, there is an economy of 0.25 pesos per KWH, which on the basis of 23,000,000 KWH generaged, signifies an annual economy of 5,750,000 pesos in the plant indicated.

Electrification of the Railways. The electrification of some 900 kilometres of trunk lines and branch lines is being studied, in two stages, as follows:

First, the lines from Santiago to Cartagena; the branch from

/Paine to Talagante

Paine to Talagante (which transports copper ingots from Braden Copper); and Santiago to San Fernando; and second, the network from San Fernando to Chillan.

The sectors corresponding to the first stage could be put into service within three or four years, while the second stage would take approximately another two years.

Investments, including locomotives, substations, machine house, etc. would be:

	First stage	Second stage
Foreign	US$ 23,000,000	US$ 11,000,000
Domestic	160,000,000	160,000,000

As is know, Endesa's hydro-electric plant at Cipreses, planned for a future total power output of 120,000 KW, will have 60,000 installed by 1954.

If the electrification of the railways is to be carried out, the other two units of 30,000 KW each should be finished, thus giving the total of 120,000 KW, or perhaps it will be necessary to build one unit at Los Cipreses and the other downstream at a small additional cost; the preparatory work, as well as the electric system of transmission will have been carried out previously.

There would be several advantages in electrification; operational improvement and lower working costs; the necessary consumption of electric power would be distributed over the 24 hours of the day, thus permitting an improvement in the load factor at the hydro-electric plant and consequently, greater profitability. Moreover, the railways would cease to burn coal, which by 1955, on the basis of an annual traffic increase of 3.5 per cent, would amount to some 290,000 tons for the sector covered by the lines to be electrified; those tons of coal thus made available would practically solve the future scarcity of lump coal which is predicted, and would mean the elimination of a possible importation which, reduced to crued petroleum would amount to 3,900,000 dollars annually, based on the present price of this fuel.

VI. Consumption and

VI. Consumption and resources

Electric Energy. The future situation of electric energy will be analysed on the basis of the zone between Petorca and Linares, a zone which in 1942 produced 90 per cent of the electric energy generated in public servic installations, and which comprises the most important industrial regions of the country. On an average, consumption in this zone has shown a cumulative annual increase equal to or greater than 10 per cent; whereas the growth of electric energy (hydro and thermal) generated in the whole country, has shown an increase of 7.5 per cent.

Graph No. 6 shows the availability of power. Future consumption has been calculated assuming increases will be continued at the rate registered during the last few years. From this graph it may be seen that during 1950 and part of 1951, as well as in 1954, there will be no difficulties regarding the supply of electric energy, but that there will be in the other years; demand has been estimated by the natural continuation of the curve showing demand until the present time. in other words, the normal growth of this demand, and availability, is represented by the plants built or under construction.

According to experts and the plans of private companies and of Endesa, this situation would be remedied by the construction of a thermal unit of 30,000 or 40,000 KW; a hydro-electric unit of 50,000 KW; and of more hydro-electric units after 1958.

The graph which we are analysing shows us the forecast of average annual demands, a demand which naturally is not constant, reaching its peak in the winter months and its lowest points in other months. All this justifies the installation of a thermo-electric plant, which would have the advantage of consuming slack, which, as we have seen, is always produced in excess; it would serve as an emergency plant, and would cover the load points, assure a constant voltage and take into account transmission under unfavourable climatic conditions.

/The construction

The construction of a thermo-electric plant of 30,000 kilowatts would cost the equivalent of 6,750,000 US Dollars, of which some 4,500,000 US Dollars would correspond to material which would have to be imported; the construction of a hydro-electric plant in the central zone of some 50,000 KW would cost 19,300,000 US Dollars, of which 5,790,000 US Dollars would correspond to imported material.

If we accept the hypothesis that a power plant run on a basis of fuel oil is as valuable as a coal plant, and assume that the imported material is obtained through a foreign loan at 9 per cent (interest plus amortization), and that the price of fuel oil is 14.5 US Dollars per ton c.i.f. (1949 average), then the following calculation can be made:

A. With respect to the plants

Item	Coal plant	Hydro-electric plant	Fuel oil plant
Kilowatt power	30,000	50,000	30,000
Kilowatt hours generated per year	123,000,000	205,000,000	123,000,000
Total cost of the plant (dollars)	6,750,000	19,300,000	6,750,000
Cost of imported materials (dollars)	4,325,000	5,790,000	4,525,000

B. With respect to the saving of foreign exchange:

Item	Coal plant	Hydro-electric plant	Fuel oil plant
Amortization and interests per kilowatt hour	0.332 cents dol.	0.255 cents dol.	0.332 cents dol.
Imported fuel per kilowatt hour	-	-	1,035 "
Service of debt plus imported fuel per kilowatt hour	0.332 "	0.255 "	1,367 "
Saving of foreign exchange in regard to generation with imported fuels per kilowatt hour	1,015 "	1,112 "	0.0 "
Annual saving of exhange	1,248,000 dol.	2,279,000 dol.	0.0 dol.

/In these calculations,

In these calculations, we have supposed that the costs in foreign exchange corresponding to repairs and spares are the same in the three cases considered, even though in fact they are less for the hydro-electric plant.

The preceding calculation shows that the coal plant would mean a saving of foreign exchange, which in five and a half years would equal its total cost, including both foreign and domestic expenditure; while the amount saved by the hydro-electric plant would only equel its total cost in eight and a half years.

The experts believe that, in general, hydro-electric plants are the most suitable for the country; that as the thermal plants on a coal basis show a lower saving in exhcange and as their cost of production is greater (three times) than that of the hydro-electric plants, their installation is justified only in very special cases, as in that of the 30,000 KW plant which we mentioned before, or for certain industries which use steam in their manufacturing processes; that thermo-electric plants on the basis of imported fuel should not be installed, except in special cases where neither of the other two solutions is feasible. An exception should be made, for example, in the case of the power plants for copper and nitrate in the North, where there are no waterfalls nearby, and where coal production would not be sufficient, apart from the fact that the coal plant's production costs would be greater, which is important, since copper and nitrate are fundamental export products which compete in the international market.

Balance of energy. By 1955, estimating that the projected electrification of the first section of the railways will have been carried out as indicated, that electric current will be supplied separately for this by means of a special plant, that the normal increase in total consumption of energy will be in the nature of 100,000,000 KWH per year, and that the petroleum refinery will refine

/12,000 barrels

12,000 barrels daily of domestic crude oil, we would have the following balance of total energy:

Estimated demand, millions of KWH:

Normal demand	7,520	
Increased through electrification of railways	45	
Huachipato consumption	270	
Total demand		7,565

Possible supplies, millions of KWH

Coal	2,200	
Hydro-electric power	1,950	
Wood	1,000	
National petroleum	1,350	
Coal saved by the electrification of the railways	95	
Coke and gas produced by Huachipato	100	
Total supplies		6,695
Deficit		870

If a coal plant of 30,000 kilowatts had been constructed, as mentioned, with a production of 123,000,000 kilowatt hours, this situation would not vary since the fuel it consumed would be deducted from the coal available, that is, its construction would only cause a variation in the form of using the energy, and not in total consumption.

The deficit of 870,000,000 KWH on the basis of imported fuel, is equivalent to 9,000,000 dollars.

Nevertheless, it should be borne in mind that the copper and nitrate industries are obliged to use fuel oil, as already explained and, except under very special circumstances, they will continue to consume it; if we suppose that by 1955 the country's total consumption of fuel oil would be 900,000 tons, of which 40,000 would be supplied by the petroleum refinery, it would still be necessary to import 860,000 tons, signifying 1,200,000 KWH.

As a result, the balance of energy, due to the necessary import of fuel oil for copper and nitrate (since there is no probability of the country's petroleum refinery being able to work for these industries, even supposing that it had the necessary crude oil) would

/be balanced

be balanced, and there would even be a surplus of 330 million KWH. As in this estimate we have been taking as demand that which would be normal in 1955, according to that existing up to the present time, under circumstances which due to the repercussions of present industrialisation will show the appearance of new subsidiary consumptions, this possible surplus will be available to meet these demands and any possible contingencies in the supply of energy.

Apparently, then, there would be no saving of exchange with the plans now under way in regard to energy. Actually there will be, since all increases and new consumptions are absorbed, as well as the replacement of imported fuels by national fuelds. By 1955 in relation to 1948, there would be the following figures for increases and replacements as for savings:

	Million Kilowatt Hours	Savings in dollar Exchange
Hydro-electric power	493	5,500,000
National Petroleum	1,350	12,000,000
Coal released by the railways	95	2,000,000
Coke and Huachipato gas	100	
	2,038	19,500,000

VII. Conclusions

1. Consumption of energy, in its different forms, has increased considerably in the last few years.

2. In regard to coal, the country may be considered practically self-sufficient, having reserves of a certain size.

3. The petroleum discovered in the south will, it is forecast, meet of the country's needs for liquid fuel, excepting the fuel needs of the great extractive industries of copper and nitrate.

4. As regards electric energy, the country has suffered from a shortage having had to accept rationing during the last four years, principally in the central zone, with the consequent loss and diminution of industrial production.

/There is a marked

There is a marked tendency towards the increase of hydro-electric energy over thermal energy, principally due to the great plants of Endesa.

Reserves of hydro-electric energy are very great and allow for a notable increase in their use.

If the progress made in the provision of electric energy is well known, the situation has not yet been totally resolved, as it is foreseen that future demand will be somewhat greater than supplies.

5. In regard to total energy, the country will require to continue importing fuel oil (due to the particular needs of the copper and nitrate industries), which will bring about a balance of energy.

6. Even considering this import, the progress made in regard to the provision of energy, will mean an important saving of foreign exchange for the country.

Appendix I.

Total Consumption of Energy

(in millions of kilowatt hours)

Year	Hydro-electric energy	Coal	Fuel Wood a/	Petroleum	Motor Spirit	Total
1925	368	1,453	1,000	1,182	100	4,103
1926	405	1,490	1,000	1,115	100	4,100
1927	448	1,482	1,000	835	100	3,865
1928	452	1,376	1,000	1,073	102	4,003
1929	473	1,508	1,000	1,388	184	4,553
Average 25/29	429	1,462	1,000	1,119	117	4,127
1930	473	1,441	1,000	1,208	203	4,325
1931	529	1,100	1,000	663	188	3,480
1932	443	1,080	1,000	280	90	2,893
1933	538	1,538	1,000	297	106	3,479
1934	646	1,808	1,000	494	99	4,047
Average 30/34	526	1,393	1,000	588	137	3,644
1935	631	1,909	1,000	532	144	4,216
1936	647	1,876	1,000	537	132	4,192
1937	747	1,989	1,000	993	151	4,880
1938	740	2,044	1,000	862	179	4,825
1939	755	1,850	1,000	750	186	4,541
Average 35/39	704	1,953	1,000	735	158	4,530
1940	765	1,937	1,000	933	210	4,845
1941	846	2,048	1,000	1,028	240	5,162
1942	847	2,151	1,000	1,040	202	5,240
1943	985	2,276	1,000	1,228	180	5,669
1944	1,048	2,276	1,000	1,074	171	5,569
Average 40/44	898	2,137	1,000	1,061	201	5,297
1945	1,164	2,049	1,000	1,052	195	5,460
1946	1,090	1,954	1,000	1,310	319	5,673
1947	1,202	2,080	1,000	1,263	378	5,923
1948	1,378	2,234	1,000	1,480	451	6,543
Average 45/48	1,208	2,079	1,000	1,276	336	5,899

a/ Estimated.

Sources: Dirección General de Servicios Eléctricos.
Dirección General de Estadística.
Empresa Nacional de Electricidad S.A. (Endesa).

Appendix 2

Chief Consumers of Solid Fuels in Chile

(in thousands of tons)

Years	Total Coal	Railways		Nitrate plants	Mining and Metallurgy	Manufac-turing	Electri-city	Gas
		Private owned	State owned					
1913	2,870	208	802	488	177	116		180
1918	1,902	113	547	319	126	145		101
1923	1,371	15	418	53	81	327		109
1931	1,200	11	292	21	23	110	144	
1935	1,899	60	388	146	40	303	185	
1940	2,159	47	493	49	64	392	361	
1943	2,281	36	508	39	73	422	342	

Sources: Dirección General de Estadística and Comisión de Racionamiento de Carbón.

Appendix 3.

Installed Capacity

(kilowatts)

Years	Hydro-electric	Thermo-electric	Total	Increase of Five yearly averages
1925	79,590	121,465	201,055	
1926	79,760	123,327	203,087	
1927	84,130	137,472	221,602	
1928	126,650	147,247	273,897	
1929	126,660	153,291	279,951	
Average 25/29	99,358	136,560	235,918	
1930	134,240	169,029	303,269	
11931	134,240	188,629	322,869	
1932	134,240	193,799	328,039	
1933	134,240	195,419	329,659	
1934	136,590	195,879	332,469	
Average 30/34	134,710	188,551	323,261	37 %
1935	137,980	225,079	363,059	
1936	138,100	233,669	371,769	
1937	138,500	238,794	377,294	
1938	147,280	240,760	388,040	
1939	147,388	265,006	412,386	
Average 35/39	141,848	240,661	382,509	18 %
1940	147,705	267,156	414,861	
1941	147,805	289,966	437,771	
1942	147,805	292,961	440,766	
1943	169,155	297,316	466,421	
1944	202,810	298,250	501,060	
Average 40/44	163,046	289,130	452,176	18 %
1945	208,510	297,644	506,154	
1946	211,640	298,774	510,414	
1947	212,040	314,409	526,449	
1948	291,340	335,789	627,129	
Average 45/48	230,882	311,654	542,536	20 %

Sources: Dirección General de Servicios Eléctricos and Empresa Nacional de Electricidad S.A. (Endesa).

Appendix 4

Generated Energy

(in millions of kilowatt hours)

Years	Hydro-electric	Thermo-electric	Total	Five yearly average increases
1925	373.2	330.3	703.5	
1926	404.2	378.5	782.7	
1927	448.4	392	840.4	
1928	451.3	412	863.3	
1929	472.5	431.5	904	-
Average 25/29	429.9	388.9	818.8	
1930	472.4	465.1	937.5	
1931	528.4	511.6	1,040	
1932	442.1	549.6	991.7	
1933	537.4	589.1	1,126.5	
1934	645.8	636.9	1,282.7	
Average 30/34	525.2	550.5	1,075.7	31 %
1935	630.2	690.9	1,321.1	
1936	647.1	735.6	1,382.7	
1937	746.9	814.2	1,561.1	
1938	740	891.3	1,631.3	
1939	754.9	957.9	1,712.8	
Average 35/39	703.8	818.0	1,521.8	41 %
1940	765.3	1,024.7	1,790.0	
1941	844.5	1,090.4	1,934.9	
1942	845.7	1,161.9	2,007.6	
1943	984.7	1,129.3	2,114	
1944	1,052.9	1,185.9	2,238.8	
Average 40/44	898.6	1,118.4	2,017.0	32 %
1945	1,163.7	1,195.5	2,360.2	
1946	1,089	1,303.9	2,392.9	
1947	1,201	1,400	2,601	
1948	1,457.6	1,447.8	2,905.4	
Average 45/48	1,227.8	1,337.0	2,564.8	27 %

Sources: Dirección General de Servicios Eléctricos and Empresa Nacional de Electricidad, S.A. (ENDESA)

Appendix 5.

Consumption of fuels and electric power for all industries

(as percentage of the production cost).

Years	Fuels	Electric Power
1940	2.5	1.0
1941	2.6	1.3
1942	2.8	1.2
1943	3.1	1.1
1944	2.9	1.2
1945	3.2	1.1
1946	2.9	1.1

Source: Dirección General de Estadística

Appendix 6

Fuel consumption in all industries

As percentages of total value

Years	Petroleum	Motor spirits	Coal	Coke	Charcoal	Fuel Wood	Others	Total
1940	5.9	4.0	66.8	4.0	3.3	8.7	7.3	100.0
1941	5.1	6.2	63.3	5.4	3.9	6.9	9.2	100.0
1942	6.8	5.1	60.5	5.4	5.3	7.3	9.6	100.0
1943	6.9	4.9	62.5	4.3	5.9	7.1	8.4	100.0
1944	8.6	4.5	60.9	5.3	5.4	8.0	7.3	100.0
1945	8.9	5.5	57.4	6.3	6.0	8.5	7.4	100.0
1946	8.9	4.9	58.7	2.8	3.5	8.3	12.9	100.0

Source: Dirección General de Estadística

Appendix 7

Consumption of Fuel and Electric Power in selected Industrial Groups

As percentages of production cost

Groups	Years	Fuels	Electric Power
Food Products	1940	2.1	0.6
	1943	2.1	0.3
	1946	2.0	0.4
Textiles	1940	1.8	1.5
	1943	2.2	1.5
	1946	1.4	0.9
Chemical Industry	1940	2.1	0.9
	1943	3.3	1.6
	1946	3.1	1.6
Metallurgy	1940	4.0	1.8
	1943	6.9	2.1
	1946	4.7	1.5

Source: Dirección General de Estadística.

Appendix 8

Fuel consumption in selected industrial groups

(As percentages of total value)

Items	Years	Petroleum	Motor spirit	Coal	Coke	Char-coal	Fuel Wood	Others	Total
Food products	1940	5.4	5.5	59.9	1.6	2.4	21.1	4.1	100.0
	1943	1.8	5.3	61.3	1.7	4.2	20.1	5.6	100.0
	1946	1.5	6.2	57.8	1.6	1.4	21.4	10.1	100.0
Textiles	1940	0.8	2.3	83.8	1.3	0.1	00.3	11.4	100.0
	1943	2.7	5.1	69.1	0.9	0.5	1.6	20.1	100.0
	1946	19.0	3.8	60.3	0.7	0.1	1.5	14.5	100.0
Chemical Industry	1940	2.1	3.7	61.1	9.1	0.5	6.1	17.6	100.0
	1943	4.7	7.4	65.9	4.9	5.6	6.1	5.4	100.0
	1946	7.0	5.5	56.7	7.8	3.0	4.7	15.3	100.0
Metallurgy	1940	11.3	3.9	35.7	16.5	16.8	7.4	8.4	100.0
	1943	16.5	3.5	23.9	17.2	24.2	0.6	14.1	100.0
	1946	16.6	2.8	23.2	8.5	19.0	4.6	25.3	100.0

Source: Dirección General de Estadística.

SECTION 2. IRON AND STEEL

I. Natural Resources

Chile possesses large iron-ore deposits, such as El Tofo, exploited by the Bethlehem Chile Iron Mines Company, which supplies Huachipato and Corral, and Algorrobo and Romeral, all of which lie in the Norte Chico Region.

The reserves of the principal deposits can be estimated as follows: known reserves: 60 million tons; probable reserves: 120 million tons. Chilean ores generally have a fine metal content of 60 per cent and contain few impurities.

El Tofo normally produces about 1,600,000 tons per annum of very pure ore, free of sulphur and traces of phosphorus and containing 59 per cent metal.

Ore-loading in El Tofo is performed on a mechanical basis, at the rate of 22,000 tons in 40 minutes.

Other deposits contain ores possessing a fine metal content of 61 to 63 per cent of iron.

The exploitation of the "El Romeral" mines is expected to begin in due course, and it is hoped they will supply the blast furnaces of Huachipato.

In the steel mills, scrap plays an important role. Until the present time, there has been no difficulty in obtaining this raw material, since the dismantling of a large number of nitrate plants - replaced by three mechanised plants - has left available a considerable amount of scrap iron.

This kind of scrap will be used in Huachipato, as it is intended to make use of that produced during the different stages of processing.

As regards fuel, both the blast furnaces now working are using charcoal, and the blast furnace now being finished will use Chilean coke, mixed with 10 - 20 per cent of imported coal.

/II. Producing

II. Producing plants and machinery

In Chile there are five establishments producing rolled materials. Of these, two possess blast-furnaces. In addition there is another enterprise, Huachipato, also possessing a blast-furnace on the point of being finished.

The six enterprises can be described as follows:

1) Compañía Electro-Siderúrgica e Industrial de Valdivia.

It owns the iron and steel factory at Corral in the province of Valdivia. Until now, it has been the only complete one, producing iron ingots in blast furnace, and rolled material.

The Corral factory - installed at the beginning of the century - was the first of its kind in Chile. It was planned to use wood for the blast furnace, but due to difficulties arising out of this method, charcoal was later introduced. The factory was erected in Corral, since it was situated in a wooded area, on the coast.

The blast furnaces in Corral have been little used. High costs have not allowed economic production.

The installations are partly obsolete and partly acquired in Germany in 1935. They consist of two blast furnaces, one is the original reconstructed, and the other was intended for use with charcoal. Only one of them is in operation, and has a yearly maximum capacity of 20,000 tons of foundry ingots, (60 tons daily). The factory also possesses two Siemens-Martin coal furnaces for steel, with a capacity of 20 and 30 tons respectively. One of them runs while the lining of the other is being changed; together they can produce daily up to three taps. Finally, the factory possesses three rolling mills, of 450,320 and 260 millimetres, with a maximum annual capacity of 14,000 tons, altogether production has only reached 11,000 tons.

Production so far has been as follows:

/ Table 1.

Table 1. Iron and Steel Production at Corral

Years	Blast furnaces ingots tons	Steel Mills billets tons	Rolling Tons
1936	1,722	-	-
1937	10,562	-	1,579
1938	2,583	-	6,005
1939	5,848	-	8,379
1940	7,040	8,347	8,518
1941	12,410	7,967	6,190
1942	14,547	13,867	10,739
1943	10,099	11,503	7,244
1944	12,644	9,941	9,422
1945	13,473	13,726	10,121
1946	13,558	9,323	7,315
1947	11,395	11,389	9,427
1948	14,433	13,252	10,536
1949	13,000	10,575	8,775

Sources: Departamento de Industrias Fabriles.
Corporación de Fomento de la Producción.

The factory at Corral uses, as raw material, iron ore brought by sea from El Tofo. For fuel and as a reducing agent, it uses charcoal produced in the district. It employs 790 workmen and 122 employees. Its capital is formed as follows:

State	1,200,000 shares
Private-owned	300,000 "
Production Development Corporation	1,200,000 "

Its present paid-up capital amounts to 108 million pesos and the total capital, including reserves, totals 11,470,000 pesos. Assets amounts to 140 million pesos, of which 48 million correspond to machinery and installations (33 per cent) and 14,900,000 (10.6 per cent) to grounds and buildings.

The product made at Corral is of good quality, since the blast furnace employs charcoal and uses fairly pure ores; the cost of production, however, is high. The necessary charcoal is produced in

/rather a

rather a primitive way, thus contributing to a high cost. Due to difficulties in the supply of coal, it is not convenient to work blast furnaces at the same time. This naturally leads to an increase in production costs.

The installations are generally out-dated, and the various processes lack complete mechanisation; they consequently require an excess of labour, which results in higher costs. The layout of the plant is considered inadequate, because it hinders the work of the various sections and makes the logical distribution of work more expensive. The factory lacks sufficient space (it is situated in a sort of ravine), so that any enlargement would be awkward and would require a considerable amount of money.

The actual position of the factory does not seem very suitable either. The ocean floor at the port of Corral is of shifting sand and thus no docks for the mooring of large ships can be built. Without these docks, the transport of minerals will always remain an expensive factor. Finally the factory possesses no direct outlet by railway and this increases freight costs.

All these facts conclusively prove that there is little scope for Corral to increase production. When Huachipato is well under way the Corral factory will have to be limited to special products, such as ingots, the purity of which ensures future demand.

At the same time there is a plan under consideration to transform the Corral factory into a producer of centrifugalized cast-iron piping. Corral also produces steel for tools and automobile springs, and also rolling stock for railways.

2) Compañía Siderúrgica Larifún, Sociedad Anónima

This company - whose factory lies in Santiago - specialises in producing ordinary steel bars, round, square and flat, for construction work and industrial use, and also rolled products. It owns a petrol driven Siemens-Martin furnace with an annual capacity of 15,700 tons of billets, and a rolling mill possessing an annual maximum capacity of 13,200 tons.

/The production

The production of rolled steel has been as follows:

Table 2: Production of Lamufin Steel

Years	Tons
1939	5,885
1940	6,117
1941	5,717
1942	5,890
1943	5,997
1944	-
1945	-
1946	8,643
1947	11,368
1948	11,615

Sources: Departamento de Industrias Fabriles. Dirección General de Estadística. Corporación de Fomento de la Producción.

The ingot iron required for the blast-furnace comes mostly from Corral. Lamifún employs 390 workmen. Its paid-up capital amounts to 27 million pesos, and its assets to 94,740,000 pesos, of which 34,500,000 (36 per cent) correspond to machinery and installations, and 8,500,000 pesos (9 per cent) to grounds and buildings.

3) Establecimientos Metalúrgicos Indac, Sociedad Anónima

They are also situated in Santiago, and specialize in the production of round bars and flat and rolled steel. They make packaged iron and possess an electric furnace capable of producing 12,000 tons of steel billets per annum, and a rolling mill with a maximum annual capacity of 16,000 tons. They employ 450 workmen, and production during recent years has been as follows:

Table 3. Production of Indac Steel

1943/44	5,220 tons
1944/45	7,650 "
1945/46	8,170 "
1946/47	8,578 "
1947/48	10,814 "

Sources: Departamento de Industrias Fabriles. Dirección General de Estadística. Corporación de Fomento de la Producción.

/Total paid-up

Total paid-up capital is 15 million pesos and the real capital itself amounts to 78,568,000 pesos.

4) Fábricas y Maestranzas del Ejército

They specialize in covering the demands of the armed forces and sell their surplus production to the public.

5) Siderúrgica de Talca (Sidetal)

This is a company with a capital of 18,500,000 pesos, partly owned by the Maestranzas del Ejército and the rest private-owned. The factory lies in the province of Talca at a distance of 85 kilometres from the city and 55 kilometres away from the railway loading from Talca to Mariposas. The high tension wires from the power station at Los Cipreses pass very close to the factory. It possesses a blast furnace with a maximum capacity of 30 tons of ingots. It uses its own ores, with a fine metal content of 60 per cent. Its ore deposits - with a known existence of 200,000 tons and a probable existence of 1,400,000 tons more - are situated at 25 kilometres from the factory. The factory uses charcoal as fuel as a reducing agent, which it obtains from neighbouring woods.

The construction of the blast-furnace was begun during the war, but regular production did not start before January 1950. Pig-iron is transported by truck to Santiago (360 kilometres).

6) Compañía de Acero del Pacífico

On the basis of studies made by a special commission in 1942, the Government decided to build a large iron and steel plant. A company was formed with private capital and contributions from the Government, through the Production Development Corporation and the Amortization Institute. The factory will employ coke blast furnaces. It is situated in the bay of San Vicente at Talcahuano. It will begin to produce on a large scale in the last half of 1950. The sections corresponding to rolling, welded piping and galvanized iron sheets using imported raw material, began work in January 1950. Thus it is hoped that these sections will have reached a normal rate of production by the time the blast furnace is in operation.

/During the

During the first stage, the Huachipato plant will have one blast furnace, with an annual capacity of 250,000 tons of ingot iron. It will use coke as fuel and as a reducing agent; as by-products, it will form blast furnace gases, which will be used as fuel in the factory itself, and slag, to be used in the production of cement.

Until a few years ago, experiments using Chilean coal in the making of foundry coke had not been particularly successful. Recent experiments in the United States, however, made in laboratories as well as on an industrial scale, have already given favourable results. A large part of the success expected from the Huachipato enterprise - as far as the saving of foreign exchange is concerned - depends on the possibility of using domestic coal in the coking plant.

Huachipato possesses a battery of 57 furnaces, with a distilling capacity of 1,000 tons of coal daily, for the production of coke. At first, a mixture of selected Lota and Schwager coal will be used. Delivery will be made by rail (80 kilometres). To this coal, 10-20 per cent of imported highly coking coal (Northamerican coal from Pocahontas) will be added. As initial obstacles are overcome, the proportion of imported coal will be gradually reduced.

It is also intended to build a washing plant for screened coal under 1 inch, so as to make use of small-sized coal in the coking process. The gas remaining from this process will be used as fuel in local industries.

Limestone proceeding from the Madre de Dios island will be used as fluxes. The ore will come from El Tofo. These resources are at a distance of 750 and 1,600 kilometres respectively, and transport in both cases will be made by sea.

The steel plant will have two Siemens-Martin refining furnaces, of 75 tons load each. They will use blast furnace gas as fuel. The steel plant will also possess a 15 ton Bessemer converter. The rolled products workshop will consist at the beginning of 3 rolling mills (ore blooming mill, for bars and light structures, and one for plates, sheets and tinplate). Each will be equipped with reheating furnaces, tables, saws,

/etc. It is

etc. It is planned to add a rolling mill for rails and heavy structures, once sufficient experience in rolling has been acquired.

The factory already possesses a plant for producing welded steel piping, up to a diameter of 20 inches, that can be used for gas, water and petroleum. It also has a plant for producing galvanized iron and tin-plate. The electric energy required will come from the hydro-electric plant at El Abanico. The factory also possesses installations for producing sulphuric acid, and repair shops and boiler rooms, etc. The steel plant will have no need to obtain scrap-iron from outside, since the Siemens-Martin furnaces will make use of the scrap-iron produced in the factory itself.

In the first year of production, it is hoped that the following will be obtained:

	Tons	
a) Plates, sheets and tin-plate:		
Black plates rolled while hot and cold, for enamelling and zinc-covers (galvanized)	14,400	
Medium-sized plates	7,700	
Tin plate and black sheets	10,000	33,100 tons
b) Bars and light structures:		
Thick wire	20,000	
Flat bars and straps	3,200	
Angle-irons of equal legs	2,000	
Round bars of commercial calibre, square, rolled and for concrete	22,400	
Iron hoops and straps	6,000	53,600 tons
c) Semi-finished products:		
Billets	10,000	
Ingots	8,000	18,000 tons
d) Manufactured products:		
Welded steel piping from 12 inches to 6.5/8 inches external diameter	1,500	
Galvanized pipes for drains	500	2,000 tons
TOTAL:		106,700 tons

/Later on,

Later on, but still within the first stage, it is hoped to reach the following:

Plates and tin plate	55,000 tons
Thick wire, iron hoops, bare	90,000 "
Steel piping	5,000 "
Ingots	11,000 "
TOTAL:	161,000 tons

In general, production will include: round bars for reinforced concrete, for drawing wire, for hammer forging, etc.,[1] light structures (T beam, double T beam, angles, channels, etc.); square bars, flat-rolled steel, flat iron, iron hooks for piping, straps, bars for bolts and units, etc.; thick and thin plates, sheets, tin-plate, iron ingots and steel billets. By-products will be: coke gas for industrial and local use; benzol and light oils; creosote and ammonia; foundry coke and coke for domestic use; blast furnace slag, in sufficient quantity to produce 120,000 tons of cement per annum.

During this first stage, 50,000 tons of exportable products are expected, and it is hoped to begin the export of these goods for an approximate value of 3 million dollars per annum.

The installations have been estimated as large enough for two or three times the initial production.[2] Investments are as follows:

1/ As regards bars and light structures, the maximum dimensions to be finally reached are as follows:

Angular light structures:	80 millimetres	width of leg
Round bars:	50 "	diameter
Flat iron:	120 "	wide and
	20 "	thick.

2/ The United States specialist firms, H.A. Brassert Co. and Coppers Co. have taken part in the planning and construction of the plant.

/Foreign

Foreign	60,600,000	dollars
Domestic	26,600,000	"
	87,200,000	dollars

They are financed as follows:

Capital	15,000,000	dollars
Loan from Eximbank	48,000,000	"
Credit granted by suppliers of equipment	3,000,000	"
Loan from Central Bank, Amortization Institute, Production Development Corporation	21,200,000	"
Total:	87,200,000	dollars

It is hoped that the production of Huachipato will signify a considerable saving of foreign exchange. This has been estimated as follows:

Value of new production	20,000,000	dollars
Expenses in foreign currency	7,300,000	"
Annual saving of foreign exchange	12,700,000	dollars

This is without taking into account the amount of foreign exchange proceeding from possible exports.

As regards costs of production, it must be remembered that Huachipato will receive mineral ores from the large and highly mechanized deposits which the Bethlehem Chile Iron Mines possess in Coquimbo at cost price. Taking other factors into account and on the basis of an exchange rate of 60 pesos to the dollar, the cost of necessary raw materials is practically the same in Chile as in the United States, while the cost of labour is less. In Chile the average investment in an enterprise is 18,850 pesos per ton-year, while in the United States the required investment to set up a new factory amounts to between 15 and 18,000 pesos for larger-sized factories. Again it must be remembered

/that factories

that factories in the United States were built at a low cost and have been working for some time, and also that the amount paid out has been largely amortized. It would therefore be fairer to take the figures given by the United States Steel Corporation, which establishes an average investment of 67 dollars, i.e. 4,020 pesos in 1948. The comparison is made in the following table:

Items	United States Steel	Huachipato
Average investment per ton-year, capacity	$ 4,020	$ 18,850
Difference	-	$ 14,830
Interest and amortizations (11 per cent) on the difference		$ 1,632
Per kilogramme		$ 1.63
Per kilogramme finished goods		$ 2.00

In other words at the beginning in Huachipato the financial cost is greater by 2.00 pesos per kilogramme. This would be compensated by the lesser cost of labour and transport (1.26 pesos) and of tax duties on the imported product (1.24 pesos of principal cost per kilogramme of bars). All this should result in sale prices comparable to those of the imported product, and should diminish as production increases.

The factory lies near fuel deposits, and will have fresh coal for the coking process, which, considering the type of coal to be used is a highly important factor. It also owns a mechanized pier and the loading and transport of materials is carried out promptly.

Law No. 7896 of 1944 exempts all enterprises which aim to produce iron and rolled steel from domestic ores from all Government taxes over a period of 20 years. It also exempts from all kinds of taxes - except the additional income tax of the individual shareholders - all dividends paid by these enterprises, up to 8 per cent per annum on the capital, and all payments of interest whether in Chile or abroad. In addition, all interest proceeding from bonds issued by these companies will be exempt from the additional tax. The Compañía de Acero del Pacífico is entitled to all these facilities, and, in addition, is

/exempt from

exempt from all customs duties on articles which it imports, always on the assumption that it is neither possible nor advantageous to obtain the articles within the country.

Once Huachipato is finished and working normally, it is hoped to promote the following secondary activities:

a) Factory producing carbide and ferro-alloys. The firm "Carburo y Metalurgia S.A.", which has a factory producing carbide and ferro-alloys in Nos, near Santiago, plans to transfer its installations gradually to San Vicente (Huachipato). There it will specialize in the production of carbide, ferro-manganese and ferro-alloys, with the ultimate aim of supplying all domestic needs and being able to export up to 3 million dollars' worth of these products.

b) Wire factory. The company called "Industrias Chilenas de Alambre Inchalam", has come to an agreement with the Belgian firm "Leon Bécard" to form a company with a capital of a hundred million pesos. It is planned to instal a factory producing wire and its multiple variations in San Vicente, which would include the necessary installations for drawing and galvanizing wire, making barbed and black wire, nails, staples and wire mats. Annual production 0 it is estimated - will be about 25,000 tons.

c) Malleable cast-iron factory. The firm called "Mecánica Industrial S.A.", which has a factory in Santiago, is planning to build another in San Vicente. In its first stage it will include a foundry for making piping accessories and similar products.

d) Iron and Steel Foundry. The "Compañía Acero del Pacífico" has bought the necessary machinery to smelt about 7,000 tons annually of heavy iron and steel parts which the factory will use for its own needs. This machinery, to which additions can easily be made, would allow the foundry to produce a further 6,000 tons of iron and steel parts for railway material, agricultural, industrial and mining machinery, central-heating installations, etc.

e) Dockyards. It is planned to install later some dockyards for small ships of medium tonnage; negotiations between Dutch capitalists and Chilean firms are at present under discussion.

/f) Metallic

f) Metallic structures and boiler-making. The firm called "Socometal" has drawn up a plan which includes transplanting all installations to San Vicente, as well as the purchase of new machinery capable of producing annually between 6,500 and 7,000 tons of steel products, including considerable quantities of railway material, which is at present imported.

g) Industry of Organic Chemical Products. From the carbonization process, it is possible to obtain light oils (phenol, benzol, tolnene, xylol), and tar and its derivatives. In order to make the fullest use of these products, the "Sociedad Química Nacional" and the "Laboratorio Sanitas" together with Huachipato, are making a study of the installations required for distilling raw creosote and oils of medium density, refining naphtalene, the production of formaldehyde, bakelite and phenolic resins and for making dyes.

h) Industry of Inorganic Chemical Products. The production of sulphuric acid in Huachipato is also under study, as well as the following: an electrolytic plant for making caustic soda; other plants for making hydrochloric acid; precipitated phosphates by means of excess of chlorine, nitric acid; ammonium nitrate from ammonia, a by-product of the carbonization process.

i) Factory of refractory bricks. The installation of a factory producing refractory bricks is also being studied. It is hoped thereby to save nearly a million dollars per annum in foreign exchange.

III. Production and consumption

Iron and steel imports, in ingots as well as rolled products, have varied considerably during recent years. Domestic production of rolled articles began in 1933 and reached a peak in 1935. Exports of iron and steel have not been of much importance. During the Second World War, there was a considerable increase of exports of blast-furnace ingots, mostly to Argentina: from 5 tons in 1937, they reached a maximum of 3,500 tons in 1947 and dropped to 354 tons in 1948. The annual average over this twelve-year period was a thousand tons. This item is no longer exported.

/Table 1 gives

Table 1 gives the figures for production, consumption and export. All these figures form Chart 1. The table as well as the Chart show the decisive influence of the great economic depression of the thirties, the slowness of the recovery of iron and steel industry and how it has since gradually increased its contribution in supplying domestic needs until in 1948 it reached 27 per cent of domestic consumption.

In 1948, the per capita consumption was 26 kilogrammes. If the amount produced by home foundries be added, including those of the large mining industry, a total of 34 kilos per annum is obtained. During the thirties, there was a considerable decrease in per capita consumption down to the present level, which has remained the same during the last 13 years, and which is far lower than that in countries such as Argentina, United States, and the European countries.

This very low "per capita" consumption is due largely to the difficulty of ensuring stable imports - for lack of foreign exchange - as well as to the high costs of the comparatively small domestic production.

The consumption of iron and steel in Chile increased at an annual rate of 3 per cent, i.e. at a much lower rate than that of the consumption of other products like cement, coal, electric energy, railway freight, all of which possess an annual increase rate of about 8.5 per cent. In Europe and the United States, there is a strong parallel between the per capita consumption of steel and cement. The ratio between them is about 2:1 in favour of steel. In Chile the "per capita" consumption of iron and cement is as follows:

/Table 4.

Table 4. Iron and Steel Production and Consumption

(tons)

	Year	Production a/	Imports b/	Consumption	Five-yearly increase (percentage)	Consumption "per capita"
						Kilogrammes
	1925	-	161,109	161,109		41.0
	1926	-	144,172	144,172		36.2
	1927	-	132,495	132,495		32.8
	1928	-	149,592	149,592		36.3
	1929	-	196,640	196,640		46.8
Average	1925/29	-	156,802	156,802	-	38.6
	1930	-	220,459	220,459		51.4
	1931	-	91,262	91,262		21.1
	1932	-	77,748	77,748		17.7
	1933	-	38,579	38,579		8.7
	1934	-	60,096	60,096		13.5
Average	1930/34	-	97,629	97,629	- 33	22.5
	1935	10,000	101,020	111,020		24.7
	1936	12,000	109,997	121,997		26.9
	1937	14,500	113,641	128,141		28.0
	1938	18,000	101,348	119,848		25.9
	1939	22,000	88,408	110,408		23.8
Average	1935/39	15,300	102,983	118,283	+ 21	25.8
	1940	23,000	111,530	134,530		26.8
	1941	22,000	80,251	102,251		20.1
	1942	26,116	54,788	80,904		15.8
	1943	21,483	65,355	86,838		16.6
	1944	24,734	85,107	109,841		20.8
Average	1940/44	23,467	79,406	102,873	- 13	20.0
	1945	27,666	100,023	127,689		23.9
	1946	32,553	98,272	130,825		24.1
	1947	35,976	109,014	144,990		26.2
	1948	39,624	107,372	147,496		26.2
Average	1945/48	33,955	103,795	137,750	+ 34	25.1

a/ The case of some factories, whose data refer to periods computed between the 1st July till the 30the June of the following year, production has been calculated on a natural year basis, adding half one year's production to half the next year's.

b/ Imports have been calculated on the basis of products imported according to the following sections of the customs tariff: 11-1189-1190-1191-1191A-1192-1193-1194-1194A-1194B-1194C-1195-1196-1197-1211-1212-1213-1255-1255A-1255B-1256-1428-1432. Other sections, often assumed to correspond to processed goods, have not been taken into account since they do in fact refer to manufactured goods.

Sources: Dirección General de Estadística
Departamento de Industrias Fabriles

/Table 5.

Table 5. Per capita Consumption of Iron and Cement

Years	Iron	Cement (kilogrammes)	Years	Iron	Cement (kilogrammes)
1925	41	37	1940	27	80
1930	51	97	1945	24	86
1935	24	66	1948	26	96

Source: Departamento de Industrias Fabriles.

The "per capita" consumption of cement in Chile has increased and and is now three and half times greater than that of iron.

The relation between price indices and indices for per capita consumption (bases 1937 = 100) is the following:

Table 6. Prices and per capita consumption of Iron and Cement

Years	Flat iron		Cement	
	Price (pesos)	Consumption "per capita" (kilogrammes)	Price (pesos)	Consumption "per capita" (kilogrammes)
1930	24.2	191	102.3	142.2
1935	69.5	87.5	95.3	97.5
1940	118.2	99.7	121	117.2
1945	260.7	89	287.7	126
1948	433.9	97.5	359.5	141.2

Source: Dirección General de Estadística.

The relation between the price and consumption indices, of each of these products is as follows:

Table 7. Ratio of prices to per capita consumption of Iron and Cement

Years	Relation: Price index / Index of per capita Consumption	
	Iron	Cement
1930	0.12	0.72
1935	0.78	0.92
1940	1.18	1.03
1945	2.92	2.30
1948	4.1	2.55

Source: Dirección General de Estadística.

/The final

The final balance, as can be seen, is greatly in favour of cement.

In 1948, imports (iron and steel in bars) reached a price c.i.f. of 147 dollars per ton. At that ime the wholesale cost of domestic flat iron size 1.1/2 inches by 3/8 inch was 12,260 pesos per ton, i.e. 405 dollars (1 dollar was worth 31.10 pesos). Imported iron was being sold at 10,140 pesos per ton. Domestic production in 1948, which amounted to 39,624 tons of rolled products, signified a saving of 5,800,000 dollars.

The iron and steel industry, confronted by offers of rolled products from abroad and a decrease in building, has evened up production during recent years, as can be gathered from the following data, which refer to Siemens-Martin steel and steel produced by electric furnaces, and also to rolled products:

	1946/47	1947/48
Annual tons per workman	23.7	26.8
KWH per ton	445	428

IV. Conclusions

1) The consumption of iron and rolled steel is very low in Chile.

2) Once the Huachipato factory is working normally, it will be possible to satisfy the greater part of domestic needs, a considerable saving of foreign exchange will be obtained and it is hoped there will be large increase in per capita consumption.

3) Fair-sized quantities of rolled products will shortly be available for exporting. This has already begun on a small scale.

4) The iron and steel industry is assured of supplies of ore and scrap-iron, and can produce more ferro-manganese and ferro-silicon than is necessary.

5) Until now, domestic production has been small and expensive, but it is hoped that once Huachipato is operating, production will increase considerably, and costs will diminish.

6) The iron and steel industry will shortly produce a considerable saving of foreign exchange, when costs become comparable with those of the imported article.

SECTION 3. PROCESSED COPPER

I. General aspects

The production of refined copper in ingots in Chile represents the high "per capita" production figure of 80 kilogrammes against 5.3 for the United Stated and 0.95 for the world.

In spite of these very promising figures, until 1942 copper was not available to the manufacturing industry of the country as it was all exported in ingot form; imports were necessary to satisfy the needs of the country with regard to tubes, bars, sheets, wire, etc., also copper alloys such as brass and bronze.

Law No. 7160 of December 1941 provided under Article No. 60 that "in all cases the enterprises exploiting copper mines shall reserve for the internal consumption needs of domestic industry, the metal in electrolytic bars, standard and blister, that it requires. To determine the price referred to in this previous clause, transportation expenses incurred outside the national territory will not be taken into consideration".

A number of small concerns immediately started, using rudimentary and improvised installations to produce sheets and wire. The steel rolling plants used part of their capacity to produce copper ingots, which they delivered as heavy plates and copper wire to other establishments, which further elaborated them. The army workshops did likewise, allocating part of this primary production to their own needs.

Decree number 3885, November 10, 1943, of the Ministry of Finance, specifies that the payment of copper purchased for elaboration in the country, shall be made in dollars, and Decree No. 1134, of December 1946, promulgated by the Ministry of Economy, determined that the payment of copper should be made taking as a basic price the average weekly quotation for electrolytic copper in the Engineering and Mining Journal, Metal and Mineral Markets, of New York, United States, published on the Thursday preceeding the data on which the Ministry receives the application for purchase made by the industrialist.

The above indicates the system by which copper produced in Chile is acquired for factories of the country.

/Contrary to

Contrary to what might be expected, the elaboration of copper in the country, in spite of the progress made, is not very important compared to the production and exportation of copper in ingots, as will be seen.

The processing of copper shows clearly the difficulties encountered by the countries of South America which would prefer to export processed material, than the raw material.

II. Processing

A large number of the processing plants which existed in 1942-1944 have suspended operations, and only a few remain, production being concentrated practically in two; FAMAE (Army Arsenal) which manufactures bars, tubes, and sheets; and MADECO (Copper Manufactures Corporation, with capital contributed by the Production Development Corporation) manufacturing sheets, bars, tubes, bare and covered wire, electric cords, etc., both establishments possessing shaping presses as part of their basic equipment.

FAMAE's plants are used principally to supply the Army's needs, although some articles are produced for sale and export.

MADECO, a company with an authorized capital of 200,000,000 pesos and a paid-up capital of 140,000,000 pesos, was organized in February 1944 to supply the needs of the electrification plan and the export market and is the most important processing plant. The section for sheet-rolling which also produces tubes, bars, and profiles, possesses modern and efficient machinery, in a good state of preservation. The section producing conductors of electricity is not as well equipped; its machinery is antiquated, but in good condition.

Considering that in view of its large capacity, the MADECO plant was destined principally as a producer for export, some experts are of the opinion that it should have been located in Antofagasta, near the raw material, as the freight charges to and from Santiago outweigh the advantages of its location in the capital.

III. New plants

On the outskirts of Santiago, opposite Los Cerrillos Airport, the installation of a new copper processing plant is nearing completion, as an annex to a factory for rubber articles. The articles which will be manufactured, and the yearly capacity of production, working a 40 hour

week are as follows:

Wire for construction purposes and outside wiring	27,000,000 metres
Electric cords	4,000,000 metres

In general, the machinery is modern and efficient. This industry, which does not as yet possess equipment for sheet-rolling nor shaping presses, will have to purchase the wire bars which it will use to start its processing.

IV. Production and exports

Production capacity naturally depends on the type of product to be processed and the finishing given, but along general lines may be classified as follows: 1/

Tubes, bars, profiles, cables, sheets, bare wire, enamelled wire, billets, approximately	50,000 tons
N.G.A. wire, electric cord, electric conductors	48,000,000 metres
which once the plant is installed and is in operation, will increase to a total of	79,000,000 metres

If we take into consideration that internal requirements are estimated at about 5,000 tons a year in sheets, tubes, cables, etc., and less than 20,000,000 metres in wires, cords, etc., it is evident that the capacity of production is not fully used, and that ample margin remains for export.

The following table shows production and exports (including small amounts of brass and bronze):

Table 1. Production and Exports of Processed Copper

Year	Billets, sheets and tubes, in tons		Wires, cables, and cords in metres	
	Production	Exports	Production	Exports
1945	11,847	10,011	- - - -	- - - -
1946	9,246	5,305	4,221,481	- - - -
1947	20,257	11,028	10,419,747	1,362,055
1948	18,524	15,020	11,412,165	178,542
1949	- - -	14,975	- - - -	- - - -

Source: Departamento de Industrias Fabriles.

1/ Departamento de Industrias Fabriles.

/In 1948

In 1948 and 1949 exports of elaborated copper totalled 8,000,000 and 8,400,000 U.S. dollars, representing 2.4 per cent and 2.8 per cent respectively of total exports.

Argentine, Italy, Holland, Switzerland and Belgium are the principal countries to which exports were made.

As regards the quality of wires and cables destined to electrical uses, they must comply, whether locally produced or imported, with the quality specifications established by Decree 382 of 1948, issued by the Ministry of Economy and Commerce, and controlled by the Laboratory of Material Resistance Tests of the University of Chile.

The average prices of exports (amongst which predominate billets, that is, a semi-ingot type), and the price paid for the raw material ex-factory are as follows:

Table 2. Export Prices of Processed Copper

Year	Dollar value per ton	Raw material (copper ingots) Dollar Cost per ton
1944	572	250
1945	424	250
1946	380	287
1947	503	408
1948	538	463
1949	516	430

Source: Departamento de Industrias Fabriles.

V. Labour and Power

The following are representative figures:

Table 3. Average Wages, Labour and Power consumed

	1945	1946	1947	1948
Average wages (pesos per hour)	4.80	7.15	8.15	10.60
Index number of workmen	100	118	190	220
Index KWH consumed	100	165	258	500
KWH per year per labourer	5,150	7,000	6,820	11,000

Source: Departamento de Industrias Fabriles.

There are no special difficulties regarding the supply of labour as the wages are amonst the highest paid.

VI. Problems

The natural tendency is to make the most profitable use of natural resources and export them when processed.

/In Chile

In Chile, this aspect is clearly apparent, in the case of copper, with the argument that the lamination stage yields the most profits amongst the different phases of the complete processing of copper, i.e., extraction of the mineral, concentration, smelting, refining and transformation into finished products.

As a matter of fact, as regards the United States, for example, the difference between the prices of electrolytic copper and certain processed products are considerable and have increased; for Chile these differences are important insofar as the prices of the internal market are concerned; also these differences are much greater, as is shown by the following figures:

Table 4. Relationship Between Prices of Processed Copper and Raw Materials.

Products	United States 1935-1938	Chile 1949
Wire	34%	132%
Copper Sheets	76%	227%
Bronze Sheets	57%	278%

Source: Sociedad Nacional de Minería and Departamento de Industrias Fabriles.

The large copper enterprises of the United States have for some time made use of this situation, and the Anaconda Mining Company, Kennecott Copper Corporation and Phelps Dodge Corporation, which produce more than 80 per cent of the United States copper, have for more than 20 years followed the policy of buying the copper factories established throughout the country.

In Chile on the other hand, the processing of copper, in comparison with the production of ingots, is insignificant; exports of processed copper in 1948, did not reach 3.5 per cent of the exports of copper ingots, though exports of processed copper included 2.5 per cent corresponding to billets, a product requiring very little processing.

The fundamental problem lies in the restricted production of the plants, which signifies a high cost of production, often impeding sales on the foreign market.

/The majority

The majority of the countries which could purchase processed copper from Chile in appreciable quantities (Argentine, Brazil, Italy, Belgium, Holland, Switzerland, etc.) have their own processing plants and therefore try to obtain copper with the least degree of processing when they cannot secure ingots. These countries purchase copper products processed in Chile but payments are not made in dollars.

The countries which are prepared to buy Chilean processed copper are not able to pay in dollars, and since dollars are the scarce currency, it is preferable for Chile to export ingots, even though at a lower price, in order to obtain dollars.

VII. Conclusions

The processing of copper products is a sound industry in Chile, which produces an article of good quality that must comply with certain specifications before it can be sold.

The capacity of production is very much greater than the needs of the country, and could amply supply the requirements of Latin America and even other countries.

Exports have increased, particularly due to the demand for partly processed products.

When countries are able to obtain copper ingots freely (without) exchange problems) the situation of processed copper in Chile (sheets, tubes, wires, etc.) will be strongly and adversely affected, as the habitual consumers, though they have no copper within their territory, possess processing plants and will take protective measures.

SECTION 4. CEMENT

I. Production

A. Established factories

The cement industry in Chile dates from the year 1906, when the Sociedad "Fábrica de Cemento el Melón" installed a plant with a productive capacity of 40,000 tons in Calera, principally in order to meet requirements in the reconstruction of Valparaiso, destroyed by an earthquake.

The 1931 crisis obliged the Government to protect this industry.

The 1939 earthquake and the difficulty in importing cement during the war pointed to the necessity for increasing production, which in 1940 rose to 385,000 tons.

The consumption of cement in Chile is centred mainly in Santiago, which absorbs 50 per cent, and is distributed as follows:

Northern zone:		4.7%
Central zone:		
Aconcagua and Valparaiso	17%	
Santiago	49.5%	66.5%
South central zone: (O'Higgins to Concepcion)		18.3%
Southern zone: (To Llanquihue)		10.5%
		100.0%

Since cement should be a low-priced commodity, easily and conveniently acquired, its transportation should not be complicated, nor should it cover long distances; therefore cement factories should be so placed that each one serves a district where consumption is limited. The existence of factories with a large productive capacity is justified if they supply by rail small but densely populated areas, or regions in the neighbourhood of maritime or rive routes. Generally speaking, however, a large number of small factories is preferable. Thus the average productive capacity per factory is as follows:

/Table 1.

Table 1: Average Productive Capacity per Factory.

United States	258,000	tons	per	year
Canada	159,000	"	"	"
Argentina	191,000	"	"	"
Brazil	138,000	"	"	"
Uruguay	120,000	"	"	"
Mexico	76,000	"	"	"
Ecuador	36,000	"	"	"

Source: Mineral Yearbook, American Cement Directory.

On the other hand, in Chile, the annual productive capacity of the above-mentioned factory is, as we have seen, 400,000 tons, and it has frequently been working up to 97 per cent of this capacity.

As a result of the shortage of cement, recourse was had to importations free of customs duties, although even under these conditions the price of imported cement was higher than that of the national article; the bulk of the cement imported came from the United States, and some from Great Britain and the Argentine.

In order to meet the growing demand the "Fábrica de Cemento El Melón" extended its plant, attaining in 1945 a production of 500,000 tons. During the years 1948 and 1949 this same company effected improvements in order to produce a new type of cement in its factory at Calera, which would increase its production, as from 1950, by 125,000 tons a year. The "Fábrica de Cemento El Melón S.A." has a capital of 252 million pesos, its assets amounting to 941 million. The financial situation of this concern has always been excellent.

Towards the end of 1945 the factory constructed by the "Sociedad de Cemento Juan Soldado S.A." began operations. It was situated by the sea, near the port of Coquimbo, 600 kilometres from the "El Melón" plant. The above-mentioned company was financed by the Production Development Corporation (Corporación de Fomento de la Producción) and its main object was to fill the requirements of the Northern zone and to export to Bolivia. The planned production was 200,000 tons a year; deposits of raw materials are to be found on the same site, and the wet and flotation process is employed in order to eliminate the impurities contained in the limestone. The machinery has been reconditioned, having been purchased

/in the United States

in the United States by the Corporation.

The Juan Soldado plant was not a financial success, mainly owing to difficulties of a technical nature. The concern was faced with the necessity of purchasing raw material from deposits situated at a distance of 30 kilometres, of which the price was lower than that of their own raw material. "El Melón" sold its cement in La Serena, 9 kilometres from the Juan Soldado factory, whilst the latter could not do so without loss.

This plant has now been taken over by "El Melón", who, pending certain technical and administrative reforms, will work it partly for the production of phosphate fertilizers and partly for the annual production of 100,000 tons of cement. The Juan Soldado plant has a capital of 85 million pesos, with assets amounting to 235 million.

B. Factories in the course of construction

In 1944 a survey was begun for the construction of a cement factory 40 kilometres from Santiago, 2 kilometres from the Pan-American highway and 6.5 kilometres from the Polpaico railway station. At the same time the construction and exploitation of a lime and agricultural carbonate factory was undertaken.

The Polpaico plant will have a production of 200,000 tons and will employ the wet and flotation process. The lime deposits close by have a positive reserve of 32 million tons and a potential reserve exceeding 100 million. The machinery is new and up-to-date. "Cemento Cerro Blanco de Polpaico S.A." has a capital of 250 million pesos. The factory will go into production in January 1950 and the cement will be transported by land to Santiago.

C. Proposed factories

a) Plans are well under way for the installation of a cement factory with an annual production of 150,000 tons close to the Tinguiririca railway station, which is on the line from Santiago to the South and 150 kilometres from this city; and also for a factory for the production of ground carbonate for fertilizers, with a capacity exceeding 1,000 tons and equipped with new and up-to-date machinery.

/They will

They will utilize the deposits of El Flaco, 77 kilometres away, the content of which has been estimated at 30 million tons at first sight, but may actually consist of 300 million; the average grade of these materials consists of 82.5 per cent of calcium carbonate, together with exceedingly small quantities of magnesium and sulphur.

The wet process will be employed and the raw material, after being ground at the mine, will be diluted in the proportion of 1.6 to a semi-solid form and conveyed by aqueduc to the factory, a new process which has not yet been adopted by any cement plant.

The "Calcáreos Tinguiririca C.M." Company has concluded its survey and is endeavouring to raise a capital of 300 million pesos, plus 4 million dollars. It hopesto be able to begin construction in 1951, and production in 1955.

b) The "Compañía de Acero del Pacífico" is considering the production of blast furnace cement, adjacent to its establishment at Huachipato, by crushing slag from the blast furnaces together with "Portland" clinker. At first clinker from Juan Soldado will be used; later it intendsto produce clinker on site. Should this project materialize, the new plant could produce some 120,000 tons by 1955. The capital expenditure involved is estimated at 50 million pesos.

II. Raw Materials

The factories utilize raw materials from their own mines. The "El Melón" factory ownstwo mines, a low-grade one at a distance of 2 kilometres, and a high-grade one at a distance of 15 kilometres. All these raw materials are suitable for the production of a high quality "Portland" cement. The raw materials from the deposits of "El Melón" and Tinguiririca are mined; the Juan Soldado and Polpaico raw materials are quarried. It is hoped that the raw material at Polpaico can be extracted at a lower cost in view of the peculiar characteristics of these deposits.

III. Power

The "El Melón" factory consumes pulverized coal in its furnaces; the Polpaico and the proposed Tinguiririca plants will operate on the same fuel basis. National coal is utilized; this is partly of the heavy

/type and

type and partly of the light type (Lirquén), both of which are produced in the district of Concepción. The electric power used by "El Melón" comes mainly from its own 15,000 kilowatt hydroelectric plant at Los Quilos. The Polpaico factory obtains electricity from the 8,000 kilowatt hydroelectric plant at La Carena. The Tinguiririca factory proposesto construct their own hydroelectric plant of 9,500 kilowatts.

IV. Prices

Prices of imported cement have been much higher than those of the national commodity, due principally to the depreciation of the Chilean peso and the high cost of transportation. Below are some comparative figures:

Table 2: Price of 1 ton of cement

Years	National (In Calera)	Imported (c.i.f.)
	Pesos	
1940	240	487
1945	612	766
1947	748	2,163
1948	864	2,018
1949	1,020	2,900

Source: Dirección General de Estadística, (Statistical Department).

Nevertheless, the prices fixed by the Comisariato General de Subsistencias y Precios (Department for the Control of Prices and Supply), for national cement are high, since production per worker is low and cost considerable. In practice, no internal competition has existed to date, and the need to import more expensive cement has caused a surtax to be placed on the national article in order to bring the prices into line. The customs duties on cement are at present 903.96 pesos per ton.

V. Productivity

Partly owing to the difficulties encountered in exploiting deposits, the annual production per worker is low and has decreased in inverse

/proportion to

proportion to wages, as will be seen in tables 4 and 5, which are condensed below:

Table 3: Productivity and average daily wages

Years	Tons per year per worker (factory and mine)	Average daily wages (pesos)
1935	261.4	15.35
1940	206.0	29.45
1945	188.1	69.35
1948	196.4	116.47

Source: Departamento de Industrias Fabriles - (Manufacturing Industries Department).

The increase in production per worker in 1948 is due to the expansion of the "El Melón" plant and to the production of Juan Soldado; the workings are now more mechanized.

VI. Supply and demand

Up to 1928 the country was supplied to an equal extent by national production and by imports. During the 1928-31 period the part played by imports was higher. Since 1932 national production has supplied practically the entire country, with the exception of occasional imports between the years 1940 and 1946. There were times during this latter period when cement was rationed.

The normal increase in the domestic consumption of cement averages 8.5 per cent per year. Imports of cement have not amounted to an appreciable percentage of the total imports of the country, since in 1946 when cement imports were at their peak their value only amounted to 0.6 per cent of the country's total imports.

On the other hand, the materials used in the production of cement being of domestic origin, with the exception of certain types of hard-wearing spares, and its price being lower than that of the imported article, the cement industry constitutes a very valuable contribution to the economic

/development of

development of the country. The importation of the 500,000 tons of cement produced in 1949, based on a c.i.f. price of 2,000 pesos per ton, would have represented an outlay of exchange amounting to 30 million dollars.

Exports of cement up to the present time have been insignificant, the maximum amounts being 5,000 tons in 1925, 4,000 in 1946, 2,833 in 1947 and 3,250 in 1940. Exports to neighbouring countries, principally Argentina, are anticipated; and these are estimated at some thousands of tons.

The supply and demand of cement per capita over a period of years is indicated in table 1.

It is interesting to note the trend in per capita consumption, rising between the years 1925 and 1947 to 195 per cent. The demand for cement reflects the economic situation of the country, with its periods of prosperity and its depressions, except during the period 1940 to 1945 when, owing to the shortage of cement, (insufficient production and difficulties in importation), demand was greater than supply.

The fluctuations in the production and consumption of cement from 1925 to 1948 inclusive are shown in Graph 1. Between 1925 and 1947 production increased by 625 per cent, and consumption by 310 per cent.

The demand for cement bears a close relationship to building. Graphs 2 and 3 indicate the trend of figures between 1940 and 1948. Especially remarkable are the increases in the figures representing prices and in those showing the relationship between production and consumption: 1 in 1940, rising to 1.17 in 1948. This indicates that a small reserve has been set aside in order to meet possible contingencies: stoppages, strikes, etc.

Finally, in 1951 production will be in the region of 925,000 tons, and in accordance with the graphs showing the normal increase the theoretical consumption will amount to some 900,000 tons. Should the Tinguiririca and Huachipato projects materialize, by 1955 production would rise to 1,200,000 tons, and the theoretical consumption to a similar figure.

From 1948 onwards the demand falls off as a result of internal economic troubles. Notwithstanding this, the figures predicted for the coming years

/continue in

Table 4: Production and Consumption of Cement

Years	Production	Imports tons	Apparent consumption tons	Per capita consumption kilos
1925	83,000	67,332	145,332	36.9
1926	82,000	94,934	176,934	44.4
1927	95,853	120,246	216,099	53.5
1928	110.721	96,840	207,561	50.4
1929	143,234	241,965	385,199	91.7
Average 25/29	102,961	124,263	226,225	55.4
1930	163,609	252,073	415,682	96.9
1931	102,310	41,577	143,887	33.2
1932	112,441	11,068	123,509	28.1
1933	139,058	390	139,448	31.2
1934	203,057	854	203,911	44.9
Average 30/34	144,095	61,192	205,287	46.9
1935	283,385	17,018	300,403	65.2
1936	248,424	1,710	250,134	53.4
1937	313,140	1,828	314,968	66.2
1938	363,974	1,676	365,650	75.6
1939	340,786	1,462	342,248	69.7
Average 35/39	309,942	4,739	314,681	66.0
1940	385,091	13,741	398,832	79.4
1941	359,720	30,931	390,651	77.2
1942	364,584	15,632	380,216	74.1
1943	374,747	9,308	384,055	73.8
1944	362,877	33,872	396,749	75,2
Average 40/44	369,404	20,697	390,101	75.9
1945	411,088	47,376	458,464	85.7
1946	579,906	9,003	588,909	108.0
1947	602,299	1,186	603,485	109.3
1948	539,789	2,200	541,989	96.4
Average 45/48	533,270	14,941	548,212	50.9

Source: Dirección General de Estadística and Departamento de Industrias Fabriles.

continue in force, in view of the fiscal and semi-fiscal projects for those years involving the consumption of approximately 30 to 35 per cent of the present total consumption.

VII. Conclusions

1. The situation of the cement industry is, on the whole, good, except for transitory crises.

2. The machinery is up-to-date and the factories are highly mechanized, especially after the recent expansion and installations.

3. Labour has presented no difficulties; wages are relatively high and are adjusted periodically.

4. The exploitation of deposits is, in some cases, difficult, with a consequent low productivity. The raw materials, after the necessary treatment, are suitable for the production of high quality "Portland" cement.

5. The quality of the cement produced is constantly tested by the Government, as is also that of the imported article; these qualities should conform to official specifications.

6. It is anticipated that it will be possible to export considerable quantities of cement for several years to come.

Table 5: Labour and Daily Wages

Years	Number of workers	Average daily wage (pesos)
1931	677	9.70
1932	611	7.50
1933	859	9.30
1934	834	12.35
1935	1,084	15.35
1936	1,120	15.95
1937	1,398	18.20
1938	1,557	21.84
1939	1,680	25.00
1940	1,869	29.45
1941	1,916	35.81
1942	1,882	42.06
1943	1,939	52.90
1944	2,054	61.18
1945	2,185	69.35
1946	2,586	75.84
1947	3,364	94.11
1948	2,748	116.47

Source: Dirección General de Estadística.

SECTION 5. PLATE GLASS

Amongst the different forms in which glass is used, plate-glass has a predominant place, since it is an essential element in all types of constructions; its fluctuations serve to give us an idea of the change in the economic situation of a country.

In Chile, up to 1937, the consumption of plate-glass was supplied by imports as domestic production did not appear on the internal market until 1938.

I. Producing Plants and Machinery

Plate-glass is made in only one factory, located at Lirquen, on the coast of the province of Concepción; it belongs to the National Plate-Glass Factory Incorporated, working under the Fourcault system of vertical lamination.

The original machinery and installations came from Germany, with one furnace and two machines (1.80 and 1.50 metres width of usable glass, respectively), and with a daily capacity of 3,000 square metres with a thickness of 2 millimetres.

Amplifications were begun during the war with the installation of one North American furnace and three machines (2 of 1.80 and 1 of 1.50, usable width of glass) which started to produce in 1946 and in which some changes were introduced, their daily capacity equalling 5,000 square metres of 2 millimetres thick.

The furnaces are heated with producer gas made from coal, principally from the Lirquen mines located close to the factory, of which they consume about 27 tons daily. Preparations are being made to use gas from the coke section of Huachipato (steel blast furnaces some 30 kilometres away).

Improvements are actually being made in the handling of raw materials and in the mixing section.

They propose to install a special section for the production of cathedral glass and another for polishing glass with the object of being able to cover the consumption of cathedral and crystal plate-glass in

/the country,

the country, this being estimated at about 200,000 square metres per year.

II. Raw material

The material employed, about 22 tons daily, is found in the region, as is the coal; dolomite and borate of lime come from the north, and most of the soda ash is produced in the country.

III. Production and Labour

As we have seen, the factory began commercial production in 1938; in January of 1939 it was damaged by the earthquake; the furnace had to be repaired, and production started again the last quarter of that year. In 1948 the two furnaces worked during 7 months, reaching the maximum figure of plate-glass so far produced.

The types of plate-glass produced correspond to the following distribution:

Table 1. Plate-glass Classification

Type	Thickness (millimetres)	Percentage of Production
Single	2-3	55
Double	3-4	25
Triple	4-5	10
Quadruple	5-6	5
-	6-7	5
	Total:	100

Source: Departamento de Industrias Fabriles

The average sales price of domestic production as compared with the price of the imported article, is as follows:

Domestic Production (Pesos per kilo)	Imports (CIF) (Pesos per kilo)
22.-	10.-

The Customs duties for 1950, for glass up to a thickness of 4 millimetres, amounts to 2.28 pesos per gross kilo.

/ In spite

In spite of the lower price of the imported article, exchange for its importation is granted only in special cases, because on one hand production is sufficient to meet consumption in most cases, and on the other hand there has been a great scarcity of foreign exchange.

The high cost of locally produced glass is due to the relatively small production and to the deficient functioning of the second furnace.

The plate-glass produced in 1948 has prevented an outlay of foreign exchange equivalent to 2,000,000 dollars.

The workmen employed, average salaries received, total production, output per labourer per year and energy consumed per ton, are shown below:

Table 2. Labour and Production in Plate-glass Industry

Year	Number of workmen	Pesos per day	Production (in tons)	Output per Labourer per year (in tons)	Kilowatt hour per ton
1938	208	11.94	3,536	17	40.5
1939	219	14.15	926	-	-
1940	250	18.38	4.715	19	40.0
1941	263	22.42	3.983	15	51.5
1942	287	27.89	4.823	17	39.0
1943	272	35.99	3.406	13	45.5
1944	248	47.64	3.888	16	64.0
1945	227	53.41	3.125	13	61.5
1946	212	62.94	4.156	20	108.0
1947	313	79.82	3.994	13	157.0
1948	362	100.78	7.819	22	122.0

Source: Departamento de Industrias Fabriles.

The lower output per labourer in some years was due to the unavoidable seasonal stoppages in order to change the refractory bricks; the drop in 1947 was due to defects encountered in the second furnace which had just been put into operation and worked badly in the beginning, turning out an appreciable quantity that had to be re-smelted.

The increased mechanization of the furnace and installation

/introduced in

introduced in 1946, and their bad functioning in 1947, may be deduced from the consumption of energy.

The electric energy is purchased from the Empresa Nacional de Electricidad, Sociedad Anónima, and is supplied from its plant at Abanico.

IV. Consumption and Supply

Up to 1937 domestic consumption was supplied by imports; domestic production started in 1938 and imports decreased very noticeably, although they still exist to supply the types not manufactured in the country and to compensate the difficulties encountered in domestic production.

Consumption corresponds to production and imports, exports being negligible. (See Table 1).

Chart 1 shows supply and consumption, and the important contribution of domestic production.

V. Conclusions

1. The plate-glass industry, although relatively recent, has made considerable progress, its production capacity now being greater than the requirements of the country.

2. The industry is able to export 5,000 tons a year.

3. The prices of the domestic product are twice as high as the prices CIF of the imported article, of which large quantities are available, especially from Belgium.

Table 3. Supply and Consumption of Plate Glass

Year	Production	Imports	Apparent Consumption	Consumption per capita, kilos
1925	..	3,349	3,349	0.85
1926	..	4,910	4,910	1.25
1927	..	3,928	3,928	0.97

/Year Production

Table 3 (Continued)

Year	Production	Imports	Apparent Consumption	Consumption per capita, kilos
1928	..	4,299	4,299	1.04
1929	..	6,635	6,635	1.58
Average 1925/1929	..	4,624	4,624	1.14
1930	..	4,802	4,802	1.12
1931	..	3,082	3,082	0.21
1932	..	1,653	1,653	0.38
1933	..	1,296	1,296	0.29
1934	..	3,165	3,165	0.70
Average 1930/34	..	4,799	4,799	0.64
1935	..	3,889	3,889	0.84
1936	..	3,699	3,699	0.79
1937	..	4,607	4,667	0.98
1938	3,536	1,330	4,866	1.01
1939	926	1,475	2,401	0.49
Average 1935/39	2,231	3,000	3,904	0.82
1940	4,715	1,879	6,594	1.31
1941	3,983	1,675	5,658	1.12
1942	4,823	2,267	7,090	1.38
1943	3,406	1,275	4,681	0.90
1944	3,888	1,724	5,612	1.06
Average 1940/44	4,163	1,764	5,927	1.15
1945	3,123	1,235	4,358	0.81
1946	4,156	812	4,968	0.92
1947	3,994	2,902	6,896	1.25
1948	7,819	1,450	9,269	1.65
Average 1945/48	4,773	1,600	6,373	1.16

Source: Departamento de Industrias Fabriles

SECTION 6. PLYWOOD

I. General Aspects

Chile possesses important timber resources, amounting to 16 million hectares of forest land, which represents 22 per cent of its continental area. This is equivalent to 2.9 hectares per capita against 1.85 for the United States and 1.5 for the world. In terms of commercial plantations the proportion per capita is: 1 hectare for Chile, 1.3 for the United States and 1.2 for the world.

It is interesting to note that Russia possesses the greatest extension of forests (21.1 per cent of the total area of the world), followed by England and its colonies and protectorates with 14 per cent; then comes Brazil with 13.4 per cent and next the United States, 9.1 per cent; in South America 3.5 per cent correspond to the Argentine, 3 per cent to Peru and 0.4 per cent to Chile.

Nevertheless it should be mentioned that the greater part of the forests of certain countries consists of species of little commercial value and that great extensions in countries such as Russia and Canada are not, in fact, economically exploitable.

In Chile the commercially exploitable area is appreciable, the species being of high quality consisting for the most part of hard woods of temperate climates, which are scarce amongst the world volume of forests. Despite the fact that the greatest amount of lumber used comes from conifers, that is, evergreens, the hard woods of Chile acquire great importance because of their accessibility, and constitute one of the few reserves of hard wood in the temperate zones of the world. Chilean forests consist of trees from 6 to 25 and even 35 metres high, and with a diameter up to 2 metre and over. The Tamarack and the Araucanian pine reach extraordinary dimensions. There are many species found in the forested area, but it is important to note that two to five predominate, which does not occur in the hard wood forests of other countries. Thus the coigue, teak wood, elm and tenio, represent 73 per cent of the volume suitable for sawing. Naturally

/forests exist

forests exist containing only one specie, principally coniferous, as is the case of the Tamarack and Araucanian pine.

The Chilean forests are distributed through 28 degrees of latitude, varying from the small trees and shrubs found in the North to the heavy forests of the South.

There are 143,000 hectares planted for commercial purposes which include species such as tall pine 58 per cent, eucalyptus 31 per cent, poplar 4 per cent and the remainder corresponding to cypress and acacia.

The total volume of usable timber available in Chile amounts to 1,840 millions of cubic metres: of this 48 per cent is found distributed between Arauco and Llanquihue; 36 per cent in Chiloé and Aysén and the rest in the remainder of the Country.

The annual increase of timber is estimated at 20 million cubic metres, i.e., 1.1 per cent of the total volume of standing timber; of this increase 85 per cent corresponds to natural forests. The decrease is estimated as follows:

Felled timber	5.5	million	cubic	metres
Destroyed by fires	19.0	"	"	"
Wind storms	13.0	"	"	"
Total	37.5	"	"	"

Of the volume lost, 98 per cent corresponds to natural forests, the losses in the planted forests being insignificant.

As the decrease in the forested area is greater than its annual increase, experts, including the United States Forestry Commission which studied the timber problem in Chile, have recommended an effective control of forest fires, a change in the present system of cutting or felling, and systems of second growth and reforestation. The Chilean Government is taking the necessary measures to preserve the forests and increase their contribution to the National economy.

Natural forests provide 82 per cent of the cut timber and the rest comes from forest plantations.

/An estimation

An estimation of the uses of felled or cut timber is given in the following tables:

Table 1. Utilization of Timber

USE	Percentage	Species
Fuel	55.5	Oak, eucalyptus, lingue, coigue, tall pine, ulmo and rauli.
Saw-mill Timber	27.5	Oak, laurel, rauli, coigue, tall pine.
Railway sleepers	6.6	Oak
Pit props	5.5	Eucalyptus
Posts, fences	2.9	All species.
Veneer and plywoods	1.4	Araucanian pine, teak and coigue.
Wood pulp	0.5	Tall pine
Poles for communication and power lines	0.1	Cedar, cypress and oak.

Source: Corporación de Fomento de la Producción.

Two fundamental problems arise concerning wood generally: the fact that it is not put to rational uses and the preservation of forests in order to avoid their destruction, especially by fire, second growth and reforestation being necessary.

Plywood is one of the most important uses for wood as is analyzed below:

II. Plywood Factories

There are three factories located in the Southern part of Chile, (Curacautin, Neltume, Puyehue) and a fourth is being installed.

The plywood industry is relatively new. It started in 1940-42 and grew notably during the last years of the war, owing to a large

/demand and

demand and the export trade, since Chilean costs enabled it to compete on the international market.

III. Machinery and Installations

The machinery and installations are modern, efficient rotary lathes and hydraulic presses being employed; the manufacture of plywood is one of the better organized wood industries. Of the paid-up capital, 18 per cent corresponds to investments in machinery and installations and 16.5 per cent in lands and buildings.

IV. Additions and New Plants

The industries which are installed plan to make extensions, in order to process pressed woods, using for this purpose all the waste, bark and trees not suitable for plywood. Dryers, fixers and gluers will also be added in the future. It is also planned to complete the use of the wood in one of the factories, by means of the equipment necessary to fabricate barrels and for the distillation of wood.

In Magallanes a plywood factory is being installed, for which all the new and modern machinery has been purchased from Denmark, as a Danish capital investment. This factory will use wood from a region which so far has not been exploited industrially, particularly the Magellan oak, annual productive capacity of 3,000 cubic metres. The plywood is intended for export, principally to Denmark. The conditions will be favourable since the forests will be leased advantageously and the necessary merchandise and machinery can be imported duty free in that region.

V. Raw Materials and Products

The plywoods are made from various woods, the majority from wild forests and approximately in the following proportion:

Table 2. Categories of Plywood

Araucanian Pine	55 per cent
Teak Wood	23 " "
Coigue	13 " "
Rauli	4 " "
Ulmo	5 " "
	100 " "

Source: Departamento de Industrias Fabriles.

/The basic

The basic dimensions of the sheets are:

2.20 x 1,525 metres and 1,525 x 1,525 metres

and sheets may be obtained within any combination of these dimensions. The thicknesses vary from 3 millimetres up to 24 millimetres, the most common being 3, 4, 5 and 6 millimetres

The Chilean plywoods are of very good quality, especially the Araucanian pine, and are easily placed on foreign markets.

VI. Production and Supply

When domestic production began, imports ceased, and as the capacity of the installed production was more than 20,000 cubic metres per year and superior to domestic consumption (estimated at between 4,500 and 5,500 cubic metres), exports were made from the beginning in order to maintain production at an acceptable level. The corresponding figures are shown in the following table:

Table 3. Production and available balance of Plywood.

Year	Production (In cubic metres)	Exports	Remainder not Exported
1943	6,554	3,500	3,045
1944	6,551	4,624	1,927
1945	9,010	3,335	5,675
1946	8,428	5,868	2,560
1947	12,078	4,183	7,895
1948	12,464	2,900	9,564
1949	11,529	5,463	6,066
Yearly Average	9,516	4,269	5,247

Source: Departamento de Industrias Fabriles.

The principal destination of exports has been the Argentine, England and a small amount to Bolivia. The value of exports in 1949 totalled an equivalent of 1,790,000 dollars.

VII. Importance of the Industry

Its importance can be appreciated from the following details. Paid capital of the plywood industry reached 147,000,000 dollars.

/The number

The number of workmen employed amounted to:

Year	Number
1947	1,297
1948	1,479
1949	1,486

The following figures though they do not correspond to the total are representative of this industry.

Table 4 Consumption, Production and Wages for Plywood

Year	Electric Energy Consumed KwH Cubic Metres	Index of Production	Production per man per year (In Cubic Metres)	Average Annual Salary (In pesos)
1945	214	100	7.2	7,820
1946	275	84	-	12,250
1947	242	124	10	9,200
1948	250	129	8.3	11,140
1949	330	108	6.8	13,350

Source: Departamento de Industrias Fabriles.

Despite greater mechanization in some of the sections (larger consumption of electricity), the workmen produce less, a fact which is observed in various industries. The production of 1949 represents a value of 3,760,000 dollars, of which an equivalent of 1,790,000 dollars was exported.

VIII. Problems

The per capita consumption of plywood in Chile is small, as is deduced from the following comparative figures:

Country	Cubic Decimetres
England	7
Argentine	2.5
Chile	1
Peru	0.5

There is therefore an important potential market in the country. The main importer has been Argentina, whose demand has been

/sufficient to

sufficient to cover production. After 1947, Argentina closed its market to foreign plywood, as it had its own factories. The Chilean industry found itself with no market for its production and at the end of 1949 began to accumulate an important stock for which it had no outlet.

The Argentine market being closed, the Chilean industrialists tried to sell their production in England, a market in which prices have lately fallen, constituting a further obstacle in the way of exports from Chile. The low price reached by plywood is due to the fact that many countries, including Russia, have protected their industries and also because in European countries reforested forests are used industrially; this means that in a forest there will only be one type of tree, and that it will be cut at the proper age to be able to fabricate a good plywood, thus simplifying and standardizing the process of fabrication.

The influence of the different factors in the costs can be seen from the following figures:

Wood and Wood Cutting	28 per cent
Transportation	28 " "
Processing	22 " "
Electric and Steam Power	10 " "
General Expenses	12 " "
Total	100 " "

Some of these items may be reduced. For instance, in the felling of the trees, instead of employing mainly the cross-cut saw and wedge system, a more economical method, such as the circular saw, could be applied.

If tractors were used instead of oxen and carts for the transportation of the logs to the mill, costs could be reduced with a lower capital investment.

However, owing to the lack of foreign exchange it has been impossible to make these improvements.

The actual processing has been carried on under favourable conditions.

This industry has had no difficulty in securing labour since the industry is located in zones or districts of little industrialization.

IX. Conclusions

1. The plywood industry is in good condition and produces more than is needed to supply the internal consumption, so that it is necessary to export. The quality of the product is well accepted in foreign markets, but its prices have not lately permitted an increase of exportation.

2. There is a possibility of lowering costs by means of mechanization of the felling and transportation of the trunks, but this has not been possible up to the present time due to the general scarcity of foreign exchange.

3. It is expected that the new rates of exchange of 60 pesos per dollar, will favour exportation, thereby contributing to the placing of Chilean plywood in foreign markets.

SECTION 7. WOOL

The wool industry is the oldest in Chile; as early as 1541, the Indians wove the wools of the guanaco and vicuña, dyed with vegetable dyes. The Spaniards introduced the use of sheep's wool.

The regions of Calera, Talagante, Bucalemu, and Chillan have been famous textile centres which in the eighteenth century reached an approximate annual production of 100,000 metres of Chillan type flannel, which was sold for high prices in Lima and Buenos Aires.

In the nineteenth century the first establishments for the production of wool appeared. The patriotic Army of Independence which fought in the first years of the past century was dressed in the product of the fulling mills which had been established in Santiago from colonial times, first of all in the extreme western districts, and shortly afterwards on sites now occupied by the Compañia Nacional de Tejidos El Salto, an important textile factory.

The principal cloth factories of today date from the past 30 years.

In 1942, the factories engaged in the manufacture of wool reached 155, of which 40 were checked by the Dirección General de Estadística; this number went up to 44 in 1943. The total number of establishments at present engaged in manufacturing wool can be estimated at over 200.

As for the total number of workers employed, the 1942 census gives the figure of 6,044; the present number is estimated at over 10,000.

The wool industry is chiefly engaged in the manufacture of woolen cloth, yarn for selling purposes, knitting wool and knitted fabrics.

I. Location and size of factories.

According to the census of 1930, 24.8 per cent of the factories of the wool industry were located in Concepción, 21.10 per cent in Valparaíso, and 20.4 per cent in Santiago; the Concepción factories employed 62 per cent of all the workmen engaged in the manufacture of wool.

In 1946-1947, 91.5 per cent of the factories for yarn and woolen fabrics were located in Santiago, 4.5 per cent in Concepción,

/ 3.5 per cent

3.5 per cent in Valparaiso, and 0.5 per cent in Antofagasta, the most important factories being situated in the province of Concepción.

In 1949, where woven cloth and woollen goods only are concerned, 70 per cent of the production came from Concepción, 5 per cent from Valparaíso, and 25 per cent from Santiago.

The total number of cloth factories amounts to 46, 10 of them producing 60 per cent (5,650,000 metres) of the total; there are 4 producing over 500,000 metres each, one of which reached an annual output of 1,000,000 metres in 1949.

The woollen cloth factories taken together, have a rotating capital of more than 1,700,000,000 pesos. The proportion of the amount invested in land and buildings as compared with the investment in machinery and installations is 1.1 for 1948 and 0.75 for 1947; during 1950 this ratio will increase owing to investments in new machinery and installations made during 1949.

II. Production and raw material

The production of woven cloth woollen goods and woollen yarn for weaving, and the raw material consumed has been as follows:

Table 1. Production of woollen cloth and consumption of wool

Year	Production		Wool consumed		
	Metres of cloth	Kilogrammes of wool	Unwashed wool National	Washed wool National	Washed wool Imported
1929	1,751,000	193,254	-	-	-
1930	1,770,000	238,767	-	-	-
1931	1,214,000	354,105	-	-	-
1932	1,694,000	553,246	-	-	-
1933	2,281,000	485,896	-	-	-
1934	2,794,000	504,662	-	-	-
1935	3,915,000	568,738	-	-	-
1936	4,210,000	532,706	-	-	-
1937	3,809,000	505,072	-	-	-
1938	3,377,000	611,836	3,205,000	430,000	302,000

Year	Production		Wool consumed		
	Metres of cloth	Kilogrammes of wool	Unwashed wool National	Washed wool National	Imported
1939	3,538,831	685,658	3,205,000	541,000	182,000
1940	4,040,445	823,493	5,081,000	695,000	73,000
1941	4,465,969	673,108	4,649,000	758,000	57,000
1942	5,315,777	1,004,593	3,912,000	2,184,000	47,000
1943	5,241,735	1,259,757	4,222,000	1,684,000	9,000
1944	5,773,195	1,267,148	3,938,000	2,159,000	105,000
1945	6,224,276	1,329,809	3,160,000	2,304,000	472,000
1946	6,664,602	1,340,787	4,474,000	2,653,000	681 000
1947	7,353,085	1,999,321	-	-	-
1948	8,500,000	1,500,000	-	6,600 000	985 000
1949	9,355,816	1,550,000	-	8,330,000	564,000

Source: Departamento de Industrias Fabriles - Sociedad de Fomento Fabril.

Attention may be called to the increased production of woollen goods during the 1929/1946 period, in which output increased up to 140 per cent; this increase has continued, reached 120 per cent during the 1936/1949 period. It may be seen that, except in a few instances, production was stepped up from 1932 onwards, due to the protective measures of this period and to the shortage of foreign exchange which automatically restricts imports.

With regard to raw material, an increase may be observed in the consumption of unwashed wool, which increased by 40 per cent between 1938 and 1946, reaching its maximum in 1940; the increase in the consumption of national washed wool is particularly noticeable, increasing during the same period by 51.5 per cent, and reaching its maximum in 1942. With regard to imported wool, there was a decrease from 1938 to 1943; a sustained increase was however observed from 1944 onwards, owing to the tendency of consumers to prefer worsted to woollen, a tendency which had its effect on production.

If we accept shrinkage of 45 per cent in the washing of unclean wool, we obtain the following percentages for the consumption of imported wool in regard to the total (washed and unwashed wool, the latter being

/converted to

converted to washed wool).

Year	1938	1939	1940	1941	1942	1943	1944	1945	1946	1948	1949
Percentage imported	12.2	7.3	2.	1.7	1.	0.	2.3	10.5	11.8	12.7	6.3

The largest proportion of the wool produced in Chile is of the intermediate and low-grade type, and only a very small proportion is fine or extra fine.

The bulk of the output comes from Magallanes; fine woven cloth cannot be obtained from this wool, owing to the fact that its fineness is from 46s to 58s, so that it is not suitable for the profitable spinning of yarn with an average count higher than 30; it is besides a springy wool which is not easily felted, as is merino wool, and although it is true that it is very suitable for yarn used for making underwear etc., it cannot be recommended for the manufacture of woven cloth. Further the feel of these wools is not up to the standard the public demands in a fine quality.

The annual production of unwashed wool from Magallanes amounts today to about 11,000 tons, and its average composition is as follows:

9 per cent of 58s (4 per cent of this quality is of 60s)
53 per cent of 56s
17 per cent of 50s
14 per cent of 46s
19.6 per cent of 40s and "pieces" ("lana de ojo", belly wool, locks, etc.)

In Aysen the annual production of washed wool amounts to 1,000 tons , of which 300 tons consist of merino wool with a fineness of 56s to 58s.

The central zone of Chile produces approximately 3,000 tons of a fineness of 50s to 58s, and 350 tons of washed merino wool of a fineness of 60s to 64s.

/The quantity

The quantity of merino wool available in the country amounts annually to approximately 650 tons.

As we have seen, the national industry has at its disposal 45,000 spindles for worsted which could produce annually 36 grade, about 3,000,000 kilogrammes of worsted of an average count of 36. If we estimate that, of this output, the country can consume 400,000 kilogrammes in underwear, etc., or knitted goods, and 100,000 kilogrammes of wool mixed with staple rayon, approximately 2,500,000 kilogrammes of yarn would be left for woven cloth or worsteds; this yarn would allow of the manufacture of approximately 5,000,000 metres of cloth; so that if we consider that in 1949 the consumption of worsted amounted to nearly 3,000,000 metres, then the installations have a capacity sufficient to cover for some time at least (bearing in mind that, as we have seen, the tendency to use worsteds is on the increase) the demand for this type of worsteds and woolens.

With the new installations, after 1950 it will not be necessary to import wool tops, which on some occasions have accounted for nearly 150,000 dollars yearly.

The manufacturers prefer the merino wool of the central zone for the production of fine worsteds. The supply of this wool is however insufficient to cover the demand, and it has therefore been necessary to import wool, the bulk of which comes from the Argentine and some from Australia; the industrialists and experts are therefore pointing out the necessity of developing the production of merino wool in Chile, starting with the importation of suitable breed-stock, as there will in the future be a substantial demand for this type of wool.

With regard to raw material in general, a tendency may be observed towards an increase in the consumption of wool on the part of the wool industry of the country, and also a tendency towards a decrease in the exportation of wool, without any noticeable relation between the two tendencies being evident, as may be deduced from Graph 1; which can be obtained from Chart 1.

/III. Machinery

III. Machinery

The large wool factories are fitted with complete equipment for spinning and weaving. The spinning mills devote themselves to supplying the smaller cloth factories.

A large part of the equipment is old, it being estimated that in 1945, 50 per cent of the machinery used by the spinning mills had been inuse for 20 years or longer.

From 1945 onwards there has been a great tendency to use worsted, owing to the improved economic situation of the population. On the other hand, the situation created by the war and by the shortage of foreign exchange acted as a powerful incentive to the expansion of the cloth industry.

Thus in 1946 there were 65,000 spindles in operation nearly all in woollen, and 1,208 looms; it is estimated that in 1950 there will be 81,200 spindles for woollen, 45,600 for worsted and 1,870 looms, of which 15 per cent will be automatic; and the possibility of converting a large number of the present looms (110 picks) to semi-automatic ones, in accordance with the trend in Europe, is under consideration.

The latest enlargements, as well as the new installations, are based on new machinery which is mainly Italian, French and English.

The cloth industry, which in 1929 produced 1,750,000 metres, reached the figure of 9,355,000 metres in 1949, and it is estimated that in 1950 with the new installations, a total of 12,000,000 metres can be produced, of which 5,000,000 will be worsted and the rest woollen. If we reckon that 3 metres per inhabitant are necessary in order to clothe the population adequately the maximum annual consumption of worsteds and woolens should amount to 17,000,000 metres; this accordingly signifies that the consistently low figure for production is purely theoretical.

IV. Labour and energy

The woollen and worsted factories, which in 1938 occupied 4,120 workers of which 47 per cent were women, in 1949 occupied 7,000, of which 45 per cent were women. The table below gives these percentages

/for the various

for the various years, as well as the consumption of energy and the annual production per worker (taking an average of 0.4 kilograms per metre of cloth):

Table 2 Consumption of Labour and Power in the Production of Woollen Cloth.

Year	Percentage of Women in the total number of workers.	Annual production kilograms per worker	K.W.H. consumed annually per worker
1938	47	477	1,440
1939	45	475	1,620
1940	47	510	1,660
1941	46	494	1,600
1942	46	598	1,470
1943	44	648	1,730
1944	45	655	1,770
1945	45	696	1,800
1946	47	760	1,840
1947	-	-	-
1948	45	413	1,830
1949	44	426	1,980

Source: Departamento de Industrias Fabriles.

In 1946 the annual production per worker increased in 67% in comparison with 1938; and from 1942 onwards there are on the whole appreciable increases in production per worker in comparison with the preceding year; these increases are due in great part to the production of woollen yarn and heavier cloth, of which the installations are giving higher yield.

In 1948 and 1949 the production in kilogrammes per worker decreased, due to the greater importance attached to the manufacture of worsteds and woollens lighter in comparison with those produced in preceding years.

A growing tendency towards mechanization is observable in the annual K.W.H. consumption per worker which amounted to 1,440 in 1938 and to 1,980 in 1949.

With regard to the training of labour, much of this is obtained in

/the factories

the factories themselves, where the worker starts as an apprentice. Two mechanical training schools exist in the district of Tomé, a centre for the production of woollen cloth; they specialize in spinning, weaving, and dyeing, with courses which last two years; there is also an Industrial School in Concepción, where a 3-year course entitles one to the degree of craftsman in the branches of spinning, weaving, sizing and dyeing. The difficulty consists rather in securing good technicians.

V. Costs.

The influence of prices on the various items of expenditure are as follows:

Table 3. Production Costs for Woollen Cloth

	1938	1946	1948
Raw Material and other materials			
Domestic	36.9%	39.2%	23.5%
Imported	14.7	10.7	18.1
Combustible	2.5	2	1.8
Electrical Energy	1.6	1.8	1.6
Wages	11.2	16.8	20.3
Salaries	4.1	5.2	4.4
Rates and taxes	4.3	5.8	7.7
Social Laws		3.2	3.9
General Expenses	24.7	15.3	18.7
Totals	100.0%	100.0%	100.0%

Source: Dirección General de Estadística. Departamento de Industrias Fabriles.

The changes in expenditure are evident, showing an increase in the importance of raw materials and particularly of domestic raw materials, and a decrease in that of imports in 1946, rising again in 1948 owing to the increased prices of the latter: in like manner, the importance of wages increased owing to the higher rates that were paid. General expenses decreased appreciably in 1946, and increased in 1948.

If the rise in the cost of production is compared with the rise in the cost of living, over a period of years, the former has been less than the latter; or rather, the real cost of woollen goods has shown a

/proportional

Table 4. Production, importation and consumption of woollen yarn and woollen cloth

Tons

Year	Production	Importation	Consumption	Consumption % average increase for 5 year period
1936	2,217	725	2,942	
1937	2,029	787	2,815	
1938	1,963	726	2,688	
1939	2,101	717	2,819	
Average 1936-39	2,077	739	2,816	
1940	2,440	849	3,289	
1941	2,459	600	3,059	
1942	3,131	592	3,723	
1943	3,356	552	3,908	
1944	3,576	269	3,845	
Average 1940-44	2,992	572	3,564	27.1
1945	3,820	192	4,011	
1946	4,507	208	4,714	
1947	4,941	363	5,304	
1948	4,900	426	5,226	
1949	5,290	283	5,573	
Average 1945-49	4,692	294	4,966	39

Sources: Asociación de Fabricantes de Paños de Lana.
Dirección General de Estadística.

Table 5. Production, importation and consumption of woollen cloth

Tons

Year	Production	Importation	Consumption	Consumption % average increase for 5 year period
1929	700	1,264	1,964	
1930	708	1,287	1,995	
1931	486	632	1,118	
1932	678	149	827	
1933	912	58	980	
1934	1,118	184	1,301	
Average 1930-34	780	462	1,244	-
1935	1,566	504	2,070	
1936	1,684	715	2,399	
1937	1,524	773	2,297	
1938	1,351	708	2,058	
1939	1,416	697	2,112	
Average 1935-40	1,508	679	2,187	74
1940	1,616	837	2,453	
1941	1,786	591	2,376	
1942	2,126	591	2,417	
1943	2,097	547	2,644	
Average 1940-44	1,687	565	2,491	14
1945	2,490	189	2,678	
1946	2,666	204	2,970	
1947	2,941	345	3,286	
1948	3,400	420	3,820	
1949	3,740	283	4,023	
Average 1945-49	3,047	288	3,3555	35

Source: Departamento de Industrias Fabriles. Sociedad de Fomento Fabril.

proportional decrease, and the increase in the figures is the result of the inflation prevailing in the country.

The cost of production is high, due to the relatively low capacity of the factories; to the output of the Chilean workman which is inferior to that of the European or North American, and is not offset by the lower wages he receives; the excessive personnel, which at present has an average of 5.6 workmen for each loom, a figure which in 1943 was 6.2; in Mexico, on the other hand, the average is 3.5 workmen per loom. On the average, each loom in Chile is managed by one workman, which is also a low figure.

VI. Supply and Consumption.

In order to determine the consumption, (Table No.1), let us consider imports and production, since exports have no significance in view of those figures (20,356 kilogrammes in 1945 and 41,390 kilogrammes in 1947).

We will consider imports as a whole, where cloth and woollen yarn are concerned; in 1925 these imports amounted to 1,553,000 kilogrammes, the value of which represents 3.6% of the total imports of the country; in 1949 the imports amounted to 203,200 kilogrammes, representing 1.4% of the total value of the imports of the country.

The greater part of the imports consists of woollen cloth, which represented about 95% of the total in 1925, and 99.9% in 1949.

When domestic production is concerned, the average weight of 0.4 kilogrammes per metre has been taken as a basis for the conversion of metres of cloth into kilogrammes; this has been used in Table 2; from this we have prepared Chart 2, which clearly demonstrates the tendency of Chile towards self-sufficiency, because production figures are approximating more and more closely to those for consumption, while imports are steadily decreasing; it will however always be necessary to take imports into consideration since, in view of the situation where foreign trade is concerned, Chile is obliged to import woven cloth from certain countries.

Chart 3, obtained from Table 3, indicates the tendency in reference to woollens and worsteds. It may be observed that from 1929 to 1940, imports followed the tendency shown by consumption, beginning to decrease from that date, while production and consumption continued

/to increase;

to increase; imports of worsteds, which in 1929 reached 1,265,000 kilogrammes, fell to 363,000 kilogrammes in 1947, i.e. by 71%, while consumption rose by 69% in the same period. Consequently, if imports could have maintained this increase of 69%, they would have amounted to 2,140,000 kilogrammes in 1947; but as they only amounted to 363,000 kilogrammes, actual imports have only come to 17% of that theoretical figure.

The per capita consumption of woollen goods has increased by 28% from 1930 to 1947, as may be inferred from the following figures, in which, by way of illustration, the prices have been given for domestic and imported products, in so far as they were available.

Table 6: "Per capita" consumption and prices of woollen cloth.

Year	1930	1935	1940	1945	1946	1947	1949
Consumption "per capita" kilos	0.465	0.437	0.493	0.501	0.528	0.594	0.650
Medium grade woven cloth for men, $/metre	...	...	...	54.44	76.12	96.44	156.90
High grade woven cloth for men, $/metre	...	...	...	134.67	159	154.50	338.33
High grade woven cloth for women, $/metre ..	...	...	...	76.67	82.22	100	182.25
Imported woven cloth $/metre c.i.f.	...	...	...	310.75	370	409.90	..

Sources: Departamento de Industrias Fabriles. Sociedad de Fomento Fabril.

The approximate customs dues on woven cloth are 1% of their c.i.f. value, which in 1950 will amount to $ 124 pesos per kilogramme. Setting aside considerations of quality, the total imports of the production of cloth which in 1949 amounted to about 9,300,000 metres (i.e. 3,720,000 kilogrammes) would have meant an outlay of foreign exchange equivalent to 53,000,000 dollars.

It should be mentioned that the quality of Chilean fabrics has improved considerably, but is not yet equal to high-grade imports, although there are well-founded hopes of this in the near future.

The price of cloth is regulated by the "Comisariato General de Subsistencies y Precios".

/The c.i.f.

The c.i.f. price of high-grade imported woven cloth is lower than the price of the best Chilean variety, but on account of exchange restrictions and protective measures, its importation is reduced to a minimum.

VII. Conclusions

1) The situation of the cloth, yarn and knitting wool industry, has improved during the past few years, production almost equalling consumption. The quality of the cloth has improved, with an obvious tendency towards an increase in the production of worsted; this branch of production can rely on modern and automatic machinery; most of which has been made since 1947; mucho of it is Italian.

2) The industry consumes a large proportion of national raw material, but it will always be necessary to import fine merino wool, together with some types of heavy lincoln, as well as small quantities of camel and mohair, which are used in the manufacture of shawls or "ponchos" used by country people.

3) Where raw material is concerned, the fundamental problem is that of increasing the production of fine merino wool in the central zone.

4) The industry has not had to face special problems as regards labour; it has made periodic readjustments in wages, which are accordingly high. Schools for the training of textile workers exist, but the attendance is low.

5) The financial situation of the industry is good, and has enabled expansion and modernization on an important scale to be carried out in the past few years.

SECTION 8 RAYON

I General Aspects

Chile needs large quantities of textiles and this has brought about the creation of important industries which today supply almost entirely the country's requirements of this material. Among these industries, rayon, which today is of considerable importance, deserves special mention.

II Factories and machinery

The rayon industry is fairly recent in Chile, as its production started in 1941 with the plant owned by SAID S.A., in Quillota, a few kilometres from the railway station of the same name, on the line from Santiago to Valparaiso.

Originally, the equipment had been ordered from Germany, but owing to the war it was necessary to resort to other markets to complete the installation.

The capacity of production is 6000 kilos of cellulose in 24 hours, using the glutinous process; 20 spinning machines of 200 positions each are in use. There are twisting machines (of 160 to 250 twists per metre), retwisters or winders (2000 twists), reels, spools, hanks, coil-winding machines, etc. the installation being completed with equipment for washing, drying, bleaching, dyeing, etc.

A plant also exists for the manufacture of sulphuric acid, with a capacity of 12.5 tons daily; and one for the manufacture of carbon sulphide with a daily capacity of 1.3 tons.

The defect in these installations is that groups of machines performing the same work are, for the reasons expressed above, of different types and origin, part of them also having been acquired, second-hand, or reconditioned which affects the quality and greater cost of the product.

Various changes are actually being considered, in order to modernize and improve the installation and make use of the waste and the poor quality thread, thus reducing the losses.

/A new

A new plant has recently entered into operation, located in San Juan, Llolleo, near the port of San Antonio and belonging to the Fábrica Victoria de Puente Alto corporation.

The San Juan plant, intended for the production of rayon (brilliant, opaque, chain, crepe) will also use the glutinous process, thread size will be 100,150 Denier and finer, while as regards short fibre they will produce 1'9/16" long by 1 1/2 denier, and also a special type to mix with wool of 4" long by 3 denier.

The new and modern machinery counts with 12 spinning machines of 100 positions each.

A plant for sulphuric acid will be installed and in the future another for carbon sulphide. A spinning-mill with 5000 spindles will also be installed to produce spun rayon with a capacity of 800 kilograms of cut fibre in 8 hours.

The installations have been made by the Oscar Kohorn Co., U.S.A.

III. Production

Rayon production in Chile, according to readjusted and amplified data (World Fibre Survey FAO 1947) is given below:

Table 1 Production of Rayon

Year	Quantity (Kilograms)	Year	Quantity (Kilograms)
1941	50,150	1946	1,107,500
1942	173,200	1947	1,348,200
1943	404,860	1948	1,494,600
1944	560,000	1949	1,609,000
1945	709,400		

Source: World Fibre Survey FAO, 1949

The production of rayon from 1941 to 1949 totals 7,406 tons, and the importation of pulp for rayon during the same period amounted to 8,750 tons, or 1.18 tons of pulp per ton of rayon, a figure in agreement with the accepted averages of 1.20.

In 1949 the production of rayon in the country signified a saving in foreign exchange of approximately 2,000,000 dollars, which amount should be reduced by approximately 400,000 dollars for the importation of wood pulp for the fabrication of the rayon.

/The theoretical

The theoretical capacity of plants installed is 2,300,000 kilograms of yarn and 1,700,000 kilograms of short fibre, that is a total of 400,000,000 kilograms of rayon.

IV. Supply and Consumption

In table 1 production has been shown with imports of rayon yarn, thereby obtaining consumption (since exports are negligible). The decisive influence of domestic production is immediately evident, as well as its constant increase. Imports have decreased since production began, until 1946, at which time they rose again, owing principally to the demand for acetate rayon, the opaque type, and a few other special types.

Annual consumption "per capita" was as follows:

Table 2 Per capita Consumption of Rayon

Year	Kilograms	Year	Kilograms
1930	0.10	1945	0.23
1935	0.20	1947	0.41
1940	0.33	1948	0.34

Source: World Fibre Survey, FAO, 1949

which compares with other countries as follows:

Table 3 Per capita Consumption of Rayon in selected countries

Country	1938	1948
Belgium	0.59	1.10
Denmark	0.55	0.68
Germany	3.30	1.59
Italy	1.54	0.55
Great Britain	0.95	1.55
United States	1.09	3.40
Argentine	0.27	0.45
Brazil	0.14	0.27
Colombia	0.23	0.36
Cuba	0.32	1.00
Ecuador	0.50	0.59
Mexico	0.27	0.59
Peru	0.09	0.05
Uruguay	0.27	0.45
Japan	2.59	0.32
Egypt	0.18	0.18
Latin America	0.27	0.49
World	0.41	0.50

Sour : World Fibre Survey, FAO, 1949

/Table 4

Table 4. Production, Imports and Consumption of Rayon

(Tons)

Year	Production	Imports	Consumption	% increase per five averages of consumption
1925	-	84	84	
1926	-	144	144	
1927	-	211	211	
1928	-	323	323	
1929	-	435	435	
Average 1925/29	-	239	239	-
1930	-	404	404	
1931	-	326	326	
1932	-	354	354	
1933	-	304	304	
1934	-	586	586	
Average 1930/34	-	395	395	0.5
1935	-	900	900	
1936	-	1,189	1,189	
1937	-	1,148	1,148	
1938	-	1,212	1,212	
1939	-	1,237	1,237	
Average 1935/39	-	1,137	1,137	18.7
1940	-	1,655	1,655	
1941	50	1,154	1,204	
1942	173	684	857	
1943	405	508	913	
1944	560	527	1,087	
Average 1941/44	297	906	1,143	0.5
1945	709	518	1,227	
1946	1,107	521	1,629	
1947	1,348	922	2,270	
1948	1,495	385	1,880	
1949	1,609	122	1,731	
Average 1945/49	1,254	494	1,748	5,3

Source: World Fibre Survey, FAO, 1949, and "Dirección General de Estadística.

/It is interesting

It is interesting to compare the per capita consumption of the most important fibres:

Table 5 Per capita consumption of selected fibres

Country	Cotton	Wool	Rayon
Chile	2.3	0.90	0.34
Latin America	2.8	0.41	0.41
World	3	0.50	0.41

Source: Departamento de Industrias.Fabriles.

V. Types, qualities and prices

As regards the types of yarns produced, these correspond fundamentally to the brilliant type, the opaque type being first produced in 1949; 83 per cent of the production corresponds to the chain type and the rest to crepe; 82 per cent of the manufactures has been of 100 and 150 denier class (a unit which signifies the number of grams that 9000 metres of the thread weigh), the remainder in grades of 200, 300 and 450 experiments starting to be made in the production of grade 75. Some special threads are also obtained such as "frissotine" and "cordonette", which represent 2.5 per cent of the total.

The quality of domestic rayon has improved in the last years, some thread imported from Brazil and Italy on a few occasions was inferior in quality to Chilean thread.

An analysis made in the Rayonier laboratories, in the United States regarding tenacity, stretching and microscopic examination, showed that the Chilean rayon fibre compared favourably with the North American standard.

The wholesale prices of the domestic product fluctuated between 3 and 3.30 dollars per kilogram (100 to 150 denier) in comparison with the imported product which during the middle of 1949 varied from 1.60 to 2 dollars, at a rate of 43.10 to the dollar, for the brilliant type in standard skeins.

The tariff duties per kilo were the equivalent of 0.69 dollars, but owing to the scarcity of foreign exchange imports have been restricted to those types not manufactured in the country, acetate especially. The high cost of the domestic product is due largely to the lack of standardization in the installation of one of the plants, and its relatively small production.

/The influence

The influence of different items in the costs, and their variation are indicated as follows:

Table 6. Production costs of rayon

Item	1942	1948
Raw materials		
domestic	7.2%	4.0%
imported	44.0	17.6
power	7.3	6.5
wages	17.2	21.4
amortization	3.3	13.8
contributions and G.G.	21.0	36.7
	100.0%	100.0%

Sources: Departamento de Industrias Fabriles; Dirección General de Estadística

It can be seen that the influence of the value of the raw material and electric energy has diminished, and that the increased cost is due to higher wages and fundamentally to amortization, taxes and general expenses, whose participation in costs has risen from 41.5 per cent in 1942 to 71.9 per cent in 1948.

VI. Labour

Formerly there was difficulty in securing labour, but now this is comparatively easy (although a certain amount of special training is necessary) as the salaries paid are high compared with other industries.

The following table gives details of labour:

Table 7. Labour employed in production of rayon

Year	Index workers employed	Per cent Women	Average yearly salary (pesos)	Kilograms of rayon per year per worker
1941	100	48.5	2,900	113
1942	110	45	6,520	354
1943	135	39	7,900	675
1944	-	-	-	-
1945	194	38.4	11,700	820
1946	272	39.7	14,300	915
1947	266	37.7	21,800	1,135
1948	278	36.4	23,200	1,200
1949	283	37.8	24,400	1,290

Source: Departamento de Industrias Fabriles. Dirección General de Estadística.

/Two stages

Two stages can be distinguished, the first, 1941/43, in which production per worker was low until the plant began to function normally, and the second, in which the importation and commencement of the installation of a new plant signified an adjustment in production methods together with an improvement in quality, as has been previously mentioned.

In Brazil, in 1944 the average of five factories was 1,470 kilograms per worker per year, with a total production of 8,717 tons; there was therefore an excess of labour in the Chilean plant.

VII. Raw Material

The basic raw material needed for the production of rayon, for thread as well as for short fibres is wood pulp. In Chile, until now, all the cellulose for rayon has been imported, as well as a large part of the cellulose for paper and other uses.

The Production Development Corporation together with the Paper and Cardboard Manufacturing Company of Puente Alto are studying the installation of a cellulose factory to supply the needs of the country, as experiments have shown that species of trees exist in Chile suitable for this purpose, the plant will have a daily capacity of 100 tons of cellulose, will be located in the province of Concepción and will use the tall pine. A credit from the International Bank will be used and the investment will amount to 5,000,000 dollars plus 200,000,000 pesos. In a second stage it is intended to go as far as the processing of cellulose to be used for rayon, by means of a plant for the purification of part of the cellulose obtained for paper, or else by means of a separate plant.

In 1949 the importation of mechanical paste and chemical paste amounted to 21,000 tons, and that of wood pulp for rayon to 2,200 tons; the domestic production of mechanical paste and cellulose is around 18,000 tons; the mechanical paste is for newspaper paper and the cellulose principally for writing paper.

VIII. General situation and problems

The rayon industry has expanded more especially due to the war, which restricted imports of foreign thread.

/At the same time

At the same time, the silk industry has increased extraordinarily owing to the scarcity of imported fabrics, as a result of the war and the scarcity of foreign exchange.

The principal problems of the rayon factories, as of many industries, are the high cost of production, the limited domestic market, and the difficulty of securing raw material and imported spare parts, owing to the scarcity of dollars.

IX. Conclusions

1. The industry of glutinous rayon is new in the country, and has recently succeeded in producing a thread which compares favourably with the United States standards.

2. The capacity of production, once the new plant functions normally, will be more than enough for the necessities of the country, thus leaving a surplus for export.

3. It will still be necessary to import certain grades of thread, as well as certain kinds of rayon.

4. Prices are higher than the imported articles, but they are expected to fall due to the better use and operation of the producing plants, and to competition.

5. At present raw material is imported, but the possibility of its production in the country is foreseen.

SECTION 9. SHOE INDUSTRY

I. General Aspects

The shoe industry in Chile is quite old; the exact date of the first factory is not known, but as far back as 1853 there was one in Valdivia.

According to the industrial census of 1937, there were 156 shoe factories distributed throughout the country, of which 66 per cent were located in the province of Santiago. In 1948 the 174 establishments registered in the Department of Manufacturing Industries were geographically distributed as follows:

Table 1. Location of the Shoe Factories

	Number of Factories	Percentages
Santiago	153	87.96
Valparaiso	4	2.30
Talca	4	2.30
Concepción	5	2.81
Malleco	1	0.57
Valdivia	3	1.72
Tarapacá	1	0.57
Osorno	1	0.57
Llanquihue	1	0.57
Magallanes	1	0.57
Total	174	100.00

Source: Departamento de Industrias Fabriles.

This table shows the concentration of factories in Santiago and a distribution in the rest of the country which bears an approximate proportion with the consumption of each region. There is a striking lack of factories in the northern part of the country which comprises 10 per cent of the population and where there are industrial centres such as nitrate and copper plants, which are important consumers of shoes. As regards the size of the factories, the following figures correspond to the year 1948:

	Number of Factories	Percentages
Employing less than 10 workmen	49	28.16
" " " 50 "	66	37.93
50 or more workmen	59	33.91
Total	174	100.00

Source: Departamento de Industrias Fabriles

/ These sizes

These sizes, which are small, can be appreciated by the following data:

Year	Number of Factories	Annual Production (pairs per factory)	Labour (workmen per factory).
1943	141	35,300	65
1944	131	39,100	73
1945	139	38,100	70
1946	135	41,300	74
1947	128	44,000	76
1948	174	32,600	58

Source: Departamento de Industrias Fabriles

II. Machinery

The shoe industry operates with machinery, most of which is leased from the United Shoe Company, at a fee for each pair produced, varying according to the type of machinery. The machinery although in general found to be in a good condition of preservation, in the majority of cases has been in use for more than 10 years and in some cases 20 years. In the process of fabrication some parts are made by hand; in certain styles of women's shoes the work is done entirely by hand.

III. Raw Materials

Most of the raw material is produced in the country. The amount of material consumed was as follows:

Materials	1935	1940	1945	1948
Leathers (square feet)	4,470,000	7,413 000	7,812,000	9,079,000
Sole leather (Kgs.)	2,124,000	3,556.000	3,803,000	4,233,000
Bindings (metres)	---	---	2,229,000	2,884,000

Sources: Dirección General de Estadística and Departamento de Industrias Fabriles.

The importation of leather (uppers) and sole leather for shoes has been occasional. In the second six months of 1949, the rationing of leather was established, and importation from the Argentine was begun, up to a volume equal to 10 per cent of consumption.

IV. Production and Supply

Imports and exports of shoes are insignificant. Production

/practically equals

practically equals consumption.

The production can be classified in three groups: shoes for men, for women and for children. Each group includes various types according to the different methods of fabrication.

The production of 1948, which reached 5,665,000 pairs, was distributed as follows:

Men's shoes	28 per cent
Women's shoes	35.7 per cent
Children's shoes	36.3 per cent
Total	100.0 per cent

Production has risen as follows:

Year	Pairs	Year	Pairs
1935	3,587,000	1945	5,292,000
1940	5,146,000	1948	5,665,000

Production and per capita consumption curves are shown in Chart 1. Production has increased 58 per cent during the past 13 years and per capita consumption 26 per cent during the same period. Since 1939 consumption has remained stationary.

V. Labour and Energy

In 1948, the number of workmen employed in the 174 factories registered in the shoe industry reached 10,288. The percentages of men were:

Year	Men	Year	Men
1935	63 per cent	1946	59.6 per cent
1940	59.5 per cent	1947	56.5 per cent
1945	59.8 per cent	1948	58.5 per cent

The average wages were as follows:

Year	Wages (pesos)	
1935	8.60	per day
1940	17.59	per day

/1945

Year	Wages (pesos)
1945	5.82 per hour
1946	6.48 per hour
1947	7.83 per hour
1948	8.19 per hour

Chart 2 shows the curves representing the pairs of shoes produced per workman per year, and the pairs per worker in 1000 working hours. Production per worker per year decreased after 1940; production per 1000 hours per worker is irregular, and fell 25 per cent in 1948 as compared with 1947. Productivity of labour is therefore declining.

Chart 3 shows the energy consumed per worker and per 1000 pairs of shoes produced. The consumption in both cases has increased because production has been concentrated in the better and more mechanized factories. The results of mechanization were nevertheless reduced owing to the lower productivity of the workmen.

VI. Prices

The prices of "box calf" type of shoes and the sole-leather used, and the relation between both, are given below:

Table 2. Consumption of Materials

Year	Retail price per pair	Wholesale price (Kgs. of Sole Leather)	Relation
	(pesos)	(pesos)	
1935	45.50	10.23	4.4
1940	90	15.74	5.7
1945	234	25.36	9.2
1947	278	26.53	10.5
1948	305.33	33.70	9.0

Sources: Dirección General de Estadística y Departamento de Industrias Fabriles.

During the period of 1939-1948 the price of shoes increased by 575 per cent, while sole-leather rose only by 249 per cent; the relation between both prices increased progressively until 1947,

/since when

since when it has tended to decrease.

VII. Conclusions

1. The shoe industry is fairly well developed in Chile and supplies the needs of the country.

2. Up to the middle of 1949 the industry had been able to depend on domestic raw material. From this date it has had to import 10 per cent of the consumption.

3. In general the machinery is in good condition but old.

4. Production has increased, but the consumption per capita has remained stationary.

5. The quality of the shoes has always been good, but the prices have increased notably in recent years.

SECTION 10. CHEMICAL INDUSTRIES

I. Sulphuric Acid

The manufacture of sulphuric acid was begun in Chile in 1918, at a factory in Santiago which employed the lead chamber process.

1. Factories

At present there are 4 factories in operation. One is situated at Calama, and is run by the Compañia Sud Americana de Explosivos; there is another at Quillota, owned by Said Hermanos, who are rayon manufacturers; a third is located in Santiago, that of Gellona Hermanos, Limitada and lastly there is one at Sewell, Rancagua, belonging to the Braden Copper Company. The latter produces exclusively for the consumption of that company in the flotation of ores. These four factories together have an annual productive capacity of 37 thousand tons.

The setting up of a contact plant has been practically completed at the rayon and cut fibre factory owned by the Fabrica Victoria de Puente Alto, in San Juan, Llolleo, with a productive capacity of 3,600 tons per annum. Financial difficulties have held up the building of a factory in Santiago, in which it was intended to employ a modification of the lead chamber process, the productive capacity of which would have been 9,000 tons annually of acid at 60° Baumé. It was expected to begin production about the middle of 1950.

The machinery and equipment in all these factories is relatively modern with the exception of the one operating in Santiago.

As raw material, they all use sulphur obtained from the deposits in Northern Chile and turn out acid from 66° to 60° Baumé.

2. Production and consumption

During the past ten years, consumption has been supplied by domestic production, of which the remainder has been exported to Bolivia. Nevertheless, during this period, a few tons of acid in containers were imported, principally by the mining establishments in the north.

/Production, imports

Production, imports, exports and consumption in 1948 were as follows:-

Production	25,916
Imports	14
Exports	423
Consumption	25,507

During the year 1948, 18 per cent of production was manufactured in the contact plants. The industry is working at 70 per cent of its total capacity.

Since 1939, domestic production has been increasing steadily, with the exception of 1946, when it dropped practically to the level of the aforesaid year. This upward trend of home production has enabled it to supply consumption fully.

Per capita consumption has been as follows:

Years	Kilograms
1939	3,32
1940	2.74
1945	3.78
1946	2.98
1947	4.6
1948	4.5

In Mexico, for instance, per capita consumption was 1.26 kilos in 1948.

Prices of the imported product in containers, and of the domestic article are shown below, in Chilean pesos per kilo:

Table 1. Price of imported and domestic Sulphuric acid

Year	Imported Product	Domestic Product	
	C.I.F.	Contact plant	Lead Chamber
1945	7.43	2.45	1.77
1946	8.49	2.76	1.94
1947	9.09	3.26	1.85
1948	11.70	4.45	2.45

Source: Departamento de Industrias Fabriles & Dirección General de Estadísticas.

Customs [illegible] on the importation of sulphuric acid in containers is 12.80 chilean pesos per kilo, and for the unspecified product 2.56 pesos per kilo.

/3. Various problems

3. Various problems of the industry

The fundamental problems of the industry arise from the raw material employed and the irregularity in the operation of some of the factories. The raw material required is sulphur, which is expensive in Chile. Laboratory experiments are being made with a view to using sulphides instead of sulphur. Moreover, the factories producing sulphuric acid for sale do not maintain stable production. For instance, one factory is turning out 30 per cent of its production in the form of 60° Baumé acid and the remaining 70 per cent as a 66° Baumé solution. (See Table 2)

Table 2. Production, consumption of power and prices at the factory

Years	Production: Indices	Production: Annual tons of acid per labourer	Consumption of power KWH per ton of acid	Prices at the factory Chilean pesos per kilo
1942	100	161	9	0,93
1943	68.5	120	15.4	2.
1944	75	141	15.4	2.077
1945	82.5	116	17.7	1.77
1946	50	95	31.6	1.94
1947	63.5	131	11.3	1.85
1948	60.5	171	12	2.45

Source:- Departamento de Industrias Fabriles

Such irregularities are partly due to the fluctuations of demand, and partly to the deficient state of equipment.

II. Soda Ash

1. Factories

There are eight soda ash factories in Chile, of which six are located in Santiago and a further two in the Province of Valparaiso. The equipment in all of them is very primitive and furthermore the processes adopted are uneconomic, based chiefly on the use of nitrates. The factories are small and do not seek to recover the sub-products. Two of them use the soda ash for the manufacture of washing materials.

2. Production

The factories are working at 50 per cent of capacity. Production is irregular, depending on conditions on the domestic market and the

/availability of

availability of soda ash imports. The majority of these factories also produce other goods.

No accurate data are available concerning production, but some estimates have been made. Herewith the available statistics:

Table 3. Production, Imports, and consumption of soda ash

Years	Production (Crystallised Soda) Tons	Imports (Soda ash) Tons	Consumption Tons
1942	2,364	6,364	8,728
1943	6,873	4,302	7,484
1944	1,730	3,278	5,008
1945	1,044	4,741	5,785
1946	785	3,532	4,317
1947	2,509	1,041	3,550
1948	4,023	2,675	6,698

Source:- Departamento de Industrias Fabriles &
Dirección General de Estadística.

During the period 1942 - 1948 no exports were made except in 1943, when some Chilean soda ash left the country, notably 3,691 tons for Brazil.

In 1949, a new factory was set up in the province of Valparaiso producing 3,500 tons of soda ash, from which other products are also manufactured in the same establishment.

The following table shows the prices, in Chilean pesos per kilo, for both the domestic and imported product and the Customs Duties levied on the latter.

Table 4. Soda Ash Prices

Years	Domestic Product Factory prices	Imported Product C.I.F. price	Customs Duties levied
	(In Chilean Pesos per Kilo)		
1946	3.06	1.33	0.478
1947	4.55	2.37	0.478
1948	5.05	3.09	0.478

Source:- Departamento de Industrias Fabriles

/3. Problems and

3. Problems and Conclusions

Soda ash production in Chile is still in its initial phase. The process usually employed throughout the world, i.e. the Solway system, has not been adopted in Chile. Schemes to build a factory of this type have come to nothing, principally because of the small demand.

The method of production is based on the employment of nitrate, burned in small ovens, and mixed with coke or charcoal. Nitrous gases are produced by this combustion, but they are not recovered. One of the factories intends to make use of these gases in order to produce nitric acid and calcium nitrate.

However, the problem of the manufacture of crystallised or calcinated soda ash cannot be solved until a Solway system factory has been built which at the same time would manufacture caustic soda and bicarbonate of soda.

III. Caustic Soda

The production of caustic soda is associated with that of soda ash. In Chile, stable production is carried on by the process of electrolytic in the factories belonging to the "Cia. Manufacturera de Papeles y Cartones S.A." and the "Farmoquímica del Pacifico". The former, located at Puente Alto, sells the surplus production not consumed in its own manufacturing operations. The other, which manufactures chemical and pharmaceutical products, is in Santiago. The caustic soda is generally put up in 98° Baumé solutions.

Further to the factories mentioned, there are other undertakings occasionally manufacturing caustic soda by the caustification process.

The filament and spun rayon factories import the pure caustic soda they require. The following production and import figures for caustic soda are available:-

Table 5. Production, imports and consumption of caustic soda.

Years	Production (Tons)	Imports (Tons)	Consumption (Tons)	Per capita Consumption (Kilos)
1940	[illegible]	3,789	2,734	0.55
1945	1,[illegible]58	4,731	6,181	1.16
1948	2,355	4,293	6,648	1,18

Source:- Departamento de Industrias Fabriles

/There has

There has been an increase of domestic production during the past few years but it is still far from being able to supply total consumption, demand still existing for large imports of this product. In 1948, imports supplied 64 per cent of consumption. It should be pointed out that in 1942 and 1948, two new rayon factories began operations, both consuming imported caustic soda.

The principal forms of caustic soda imported are the flakes used in the manufacture of anhydrous soap, and the special caustic soda used in the manufacture of filament and spun rayon. Other industries which require caustic soda (soap manufacturers, dyers, and cleaners, oil factories, food processing, etc) use the domestic product.

The rayon manufacturers intend to set up an electrolytic factory but at present are hampered by exchange difficulties and the problem of disposal of the chlorine, which is produced simultaneously. Experiments are being carried out to investigate the possibility of using the chlorine in the manufacture of plastics and synthetic resins and the manufacture of phosphated fertilizers.

The following table shows prices in Chilean currency:-

Table 6. Caustic soda prices

Years	Domestic production	Imports C.I.F.	Customs Duties
	(Pesos per kilo)		
1943	3.34	2.60	0.480
1945	3.58	2.17	0.480
1946	5.10	2.10	0.480
1948	5.93	4.50	0.667

Source:- Departamento de Industrias Fabriles.