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REPORT OF THE SEMINAR ON THE DEVELOPMENT OF THE  
CHEMICAL INDUSTRY IN LATIN AMERICA



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## Part One

## ATTENDANCE AND ORGANIZATION OF WORK

The Seminar on the Development of the Chemical Industry in Latin America jointly convened by the Economic Commission for Latin America and the United Nations Bureau of Technical Assistance Operations, with the co-operation of the Central Co-ordination and Planning Office (CORDIPLAN) and the Association of Manufacturers of Chemical Products of Venezuela, took place at Caracas, Venezuela from 7 to 12 December, 1964.

It was not the purpose of the Seminar to adopt conclusions or formal recommendations, or to discuss and adopt the report covering its work. Accordingly the present report, prepared by ECLA in Santiago after the Seminar, is intended as a document by the technical secretariat, setting forth the impressions it had gained from the Seminar's debates and incorporating the different ideas expressed, information contained in documents and debates, without identifying the speaker.

The Seminar was attended by fifty participants (from ten countries of the region) ninety five observers (half from Venezuela and the rest divided equally among the other Latin American countries and the United States) four consultants, and eight United Nations' representatives (two from Headquarters and six from ECLA).<sup>1/</sup>

The debates were presided over by a Chairman, Mr. Antonio Ledesma Lans, Director General of the Venezuelan Petrochemical Institute, invited by the United Nations; a director, Mr. Nuno F. de Figueiredo, Director of the Joint ECLA/INST/IDB Programme for the Integration of Industrial Development, representing the United Nations at the Seminar, and a Secretary-General, Mr. Ricardo Pinés, President of the Venezuelan Association of Manufacturers of Chemical Products (Asociación de Fabricantes de Productos Químicos de Venezuela).

In addition, with a view to guiding the debates from a technical standpoint, the officers of the Seminar included a group of technical experts, engineers and economists from ECLA and United Nations Headquarters and a small number of consultants.

The Seminar was convened in accordance with ECLA Resolution 234(X) in which the secretariat's programmes are directed towards studies intended to provide Governments with the necessary criteria for the setting up of regional type industries, whose production is mainly designed to supply the Latin American market; problems of industrial development are considered from the standpoint of increasing regional co-operation, so as to obtain

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<sup>1/</sup> See below, Annex 1.

greater benefits from the available resources by dividing the work among the Latin American countries; and emphasis is placed on the practical nature of the research undertaken, so as to make it possible for Governments and the private sector to put their results to immediate use in speeding up industrial development.

Regarding the chemical industry, ECLA published at the end of 1963 La industria química en América Latina (E/CN.12/628/Rev.1) the basic document for the work being carried out in this industrial sector under the terms of resolution 234(X) previously mentioned. In the light of its conclusions, the secretariat deemed it advisable to include in its work programme a Seminar on the Development of the Chemical Industry in Latin America in order that experts from governmental agencies and the private sector might consider jointly the present situation of the chemical industry in each Latin American country as well as the programmes and development projects prepared for this sector and the possibilities of achieving a regionally co-ordinated development within the framework of Latin American economic integration.

This general proposition was expressed in terms of the following specific objectives, set out in the order of the agenda items concerned.<sup>2/</sup>

(a) to complete and bring up to date the statistical information relating to new projects and developments, available in ECLA, and reproduced in Evolución de las industrias químicas en América Latina en el período 1959-62 (ST/ECLA/Conf.15/L.4) (agenda item 1.A).

(b) to discuss the setting up in Latin America of a small permanent unit that would periodically and systematically compile statistical and project data using for this purpose the national agencies responsible for the planning of the chemical sector and/or the associations of chemical manufacturers (agenda item 1.B).

(c) to discuss certain problems relating to programming and the development policy of the chemical sector, as well as such problems as internal and external financing, the absorption of foreign technical know-how concerning products and processes, and the various procedures connected with the use of patents and royalty payments (agenda item 2).

(d) to consider the practical possibilities (regarding product lines) and operational methods whereby the chemical sector can be gradually included in a common market system (agenda items 3 and 4).

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<sup>2/</sup> See below, Annex II.

In view of the lines along which the secretariat endeavoured to proceed at the Seminar by limiting the debates to the physical aspects of integration, i.e. to clarify the possibilities of channelling the development of the future production of each major product in accordance with a scheme of regional specialization based on the growth of demand, market sizes, economies of scale and other circumstances peculiar to each product and to the industrial structure of each country, the last two items of the agenda were discussed on the assumption that all the problems relating to trade negotiations (such as tariff reductions and foreign exchange and payments systems, etc.) would be solved in due course through the measures taken by the bodies specifically concerned with such questions, e.g., ALALC and the Central American common market.

With this end in view, these factors were examined separately for each main branch of the chemical industry, under item 3 of the agenda. The analysis of suitable procedures and machinery was left to item 4, so that progress could be made in the systematic consideration of specific plans for the regionally co-ordinated development of the chemical industry, and a summary evaluation made of the possibilities that emerged in that respect from the discussions of specific products and the difficulties of attaining such development.

In order to achieve these aims, a wide variety of documents were presented for the participants' consideration. Some discussion papers were prepared by ECLA, and information documents were presented by national development and planning agencies, national associations of chemical manufacturers, industrial enterprises (Latin American or international) and individual experts.<sup>3/</sup>

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<sup>3/</sup> See below, Annex III.

Part Two

ACCOUNT OF PROCEEDINGS

A. PRESENT SITUATION OF THE CHEMICAL INDUSTRY  
IN LATIN AMERICA

1. Supply and demand in each country and in the region as a whole 4/

One of the main objectives of the Seminar was an exchange of information on the chemical sector. The information presented by the participants, in thirty eight information documents and in oral statements, was ample and valuable and has made it possible to complete and improve the preliminary report submitted by the secretariat (ST/ECLA/Conf.15/L.4) and to produce certain general information about 1963, especially that pertaining to production and new projects.

The exchange of information once again highlighted the need for constant personal contact in order to keep basic information up to date as well as the need to establish permanent machinery responsible for the periodic collection of these data, making possible the preparation of future studies directed towards the formulation of specific integration plans.

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4/ Secretariat documents

ST/ECLA/CONF.15/L.3 (E/CN.12/628/Rev.1) La industria química en América Latina.

ST/ECLA/Conf.15/L.4/Rev.1 Evolución de las industrias químicas de América Latina en el periodo 1959-62.

Information documents

Nº 7 Programa de desarrollo de la industria química chilena.  
P. Castro B., Corporación de Fomento de la Producción.

Nº 21 Panorama de la industria química en Colombia, G. Torres,  
Instituto de Investigaciones Tecnológicas.

Nº 30 Consumo aparente de productos químicos en Chile. P. Sepúlveda,  
Comisión Nacional Consultiva para ALALC.

Nº 35 A Indústria Química no Brasil, Petróleo Brasileiro S.A.  
(PETROBRAS).

Nº 36 Plano de desenvolvimento das Indústrias Químicas no Brasil.  
M. da Silva Pinto, Industrial consultant and Professor of  
Metallurgy, Universidad do Brasil

(In this item of the agenda reference will only be made to those information documents that analyse the chemical sector in a general sense, excluding those that only deal with specific items - alkalis, fibres, etc. - which are included in the items of the agenda referring in detail to these aspects).

/The statements

The statements made by the participants contributed not only to increased knowledge of the sector, but provided a fairly complete picture of the preparatory stages of each country's development programmes for the chemical industry. The over-all figures for the chemical sector presented by ECLA as an introduction to these working sessions were not basically changed, as in the majority of cases they were confirmed by the experts from the various countries who attended the Seminar (e.g. the figures for the chemical sector in Argentina, Brazil, Mexico, and Colombia); in certain countries where the information compiled by ECLA only afforded an initial estimation of the size of the sector, the participants' statements made it possible to complete the over-all evaluation and to modify ECLA's study, as in the case of the chemical sectors in Peru, Chile, and Venezuela.

A summary of the main conclusions is given below on the basis of secretariat document ST/ECLA/Conf.15/L.4/Rev.1 which introduced the topic Situación actual de la industria química en la región, and the most significant contributions to the knowledge of the sector made both in the information documents and the oral statements are also reviewed.

(a) Summary of the figures submitted by the secretariat

The development of the Latin American chemical industry during the period 1959-62 does not, except for Mexico, show a substantial increase over that of the industrial sector in general, whereas in more developed countries the growth rate of the chemical sector is, on an average, 50 per cent higher than that of the entire manufacturing industry. This is the result of the generally unfavourable situation of the Latin American chemical industry as regards technical standards, utilization of investments, and costs, which consequently limits the industry's ability to meet increased demand.

To appreciate the general position of Latin American production and consumption of chemical products, one must refer to the per capita consumption and production levels reached in certain industrialized countries of Western Europe and the United States as compared with those of Latin America in 1959 and 1962. Chemical products in general, i.e. including traditional manufacturing lines such as soap, toilet articles, matches and fireworks, pharmaceutical industries and other activities being formed, constitute a market in Latin America which amounted to 3,715 million dollars in 1962. This sum represented a per capita average of 18 dollars and showed a cumulative annual increase of 8.7 per cent over 1959. The size of the probable future development of this market can be seen if the per capita figure of 18 dollars is compared with that of 126 dollars recorded in 1957 in the United States; and 60 dollars for an important group of European countries.

/Although the

Although the production of the Latin American countries increased considerably between 1959 and 1962 - from 1,865 to 2,470 million dollars <sup>5/</sup> the region's imports of chemical products increased in value from 1,052 million dollars in 1962 to an estimated 1,300 million in 1965.

It is estimated that in 1962 the region met 72 per cent of its demand from domestic production, compared with 70 per cent in 1959. These very general figures conceal a relatively marked weakness in Latin America's capacity to supply demand for specific groups of products, like sodium alkalis, chemical products for agriculture, synthetic rubber and plastics, imports of which were equal or superior to 40 per cent of the demand.

Of the total production recorded for 1962, equivalent to 2,470 million dollars, an appreciable portion corresponds to the three countries with the largest domestic market: Brazil (40.5 per cent) Mexico (21.7 per cent) and Argentina (18.8 per cent). This means that these three contributed 81 per cent of Latin American production although they only have 64 per cent of the region's population. Moreover, a spontaneous tendency can be seen in these countries towards a greater development of chemical production since their share in 1959 alone reached 79.9 per cent. As regards per capita production figures the general average of 12 dollars in 1962 can be compared with 21 dollars in Argentina, 14 dollars in Mexico and 13 dollars in Brazil.

In 1959 two-thirds of Latin American chemical production was accounted for by the so-called light chemical industry, producer of consumer goods and articles described as "parachemicals",\* the remaining third being basic and intermediate goods. This situation had already improved by 1962, as a result of the appearance of new chemical products in the field of fertilizers, and of petrochemical products (carbon black, synthetic rubber, etc.).

In spite of the progress of the Latin American chemical industry, it only reached the eleventh part of that of the United States in 1962, less than half of that of the German Federal Republic and the United Kingdom, nor did it come up to the industries' proportions in France, Italy and Japan.

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<sup>5/</sup> The production figures mentioned correspond wherever possible to an estimate of North American or European f.o.b. prices as this was the only way to eliminate the distortions caused by the different price structures in the countries, as well as the uncertainty regarding exchange rates for converting domestic prices into dollars. There may therefore be a certain amount of discrepancy between these figures and local estimates of chemical production in each country.

\* The name given by ECLA to chemical products whose processing does not involve any change in molecular structure, such as cosmetic and toilet preparations, paints, detergents, etc.

(b) Summary of the information documents and participants' statements

(i) Argentina. Information documents providing an over-all analysis of the chemical sector of Argentina were not available. The preliminary analysis presented by ECLA (based on a product sampling that represented around 55 per cent of the total) was completed and amplified by the statements of Argentina's participants in the Seminar.

Although the over-all chemical production figures submitted do not tally with those prepared by ECLA, largely for methodological reasons, each one does reflect the declining tendency noted in 1962, caused by Argentina's economic crisis of the same year.<sup>6/</sup> Judging by the figures presented, the effects of the depression lasted until the first half of 1963; in the second half, there was a significant recovery, which continued through the first few months of 1964. This recovery of the chemical sector can be measured by its effects on the production levels and idle capacity in the traditional chemical industry. This is calculated at 60 per cent in 1962, but dropped to 40-35 per cent at the end of 1963 and to an even lower figure in May/June 1964. Moreover, production began in a series of petrochemical plants (methanol 10,000 tons/year; polyethylene 24,000; benzene 47,000; toluene 40,000, etc.) so that the share of the petrochemical industry in the total gross value of the chemical industry, although still of slight significance, rose from 1.15 per cent in 1960 to 3.55 per cent in 1963, giving it a production value of 13.7 million dollars for that year.

On the other hand, the flow of investment into the chemical industry had been fairly sizable before 1961 but diminished shortly after. In 1964, the series of projects submitted and the swift completion and installation of many of them shows that the amount of investment that year exceeded even the figure for 1961. (Estimated investment in projects already approved is about 330 million dollars.)

Regarding production for 1963 and 1964, significant increases can be seen in products such as PVC (50 per cent) polyethylene (45 per cent) polystyrene (80 per cent); in addition some products such as carbon black, polyesters, polyethylene, began to be exported and sales showed signs of increase over the short term, thereby leading to a sharp expansion in the production capacity of carbon black.

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<sup>6/</sup> As has been said previously, to calculate the gross production value in dollars, ECLA estimated domestic production at North American and European prices in force in 1960: on the other hand, the figures submitted reflect the internal structure of prices beginning with an evaluation in local currency converted to dollars at the exchange rate for each year as given by the Central Bank of Argentina.

During this period equipment was replaced and the national plants of PVC, acetic acid, methanol, formaldehyde, DDT, were enlarged. At the same time, the manufacturing processes of products such as methanol, phenol, benzene, toluene have developed towards petrochemistry. These factors have had a favourable effect on the quality of products and on production costs.

Regarding the projections contained in the National Development Plan, it is estimated that the gross value of the entire chemical sector will increase during the period 1965-69 at a cumulative annual rate of 13.7 per cent; for the same period the rate for the petrochemical industry will be 45 per cent, this branch thus representing more than 25.8 per cent of the total, with an approximate value of 370 million dollars in 1969 (estimated at domestic prices). In the same year the gross production value of the chemical industry as a whole would be equivalent to 1,400 million dollars. During the period about forty projects will be completed; ranging from new plants to extensions, which means an increase in production capacity of 467,000 tons, taking into account only those projects which have actually been approved. Investments will be mainly in basic products.

Judging by the information submitted, the chemical industry of Argentina will in five years time be able to integrate its processes, substituting imports and supplying the greater part of its demand for basic chemical products. Moreover, it will be able to export, at least to the region, on a competitive basis as regards quality and costs.

(ii) Brazil. The information gathered at the Seminar testifies to Brazil's real desire to develop its petrochemical industry, since the size of the present internal market justifies the installation of plants of economic capacity.

Information document N° 35 A Indústria petroquímica no Brasil, gives some idea of the present state of development of the petrochemical industry and its future prospects. The existing petrochemical plants, those in course of expansion, those being built and those planned by PETROBRAS are described in detail.

Among the expanded facilities are ethylene (100 tons/day), propane (60 tons/day) and ammonia (140 tons/day). Among the plants under construction are butadiene plant with a capacity for 33,000 tons/year, one ammonia unit (200 tons/day) and benzene (100 tons/day). Projected plants whose construction should be completed between the middle of 1966 and the end of 1967, include facilities for the production of ethylbenzene (23,000 tons/year), styrene (20,000 tons/year), 1-dodecene, dodecylbenzene (10,000 tons/year) urea (250 tons/day) and tetraethyl lead (11,500 tons/year) whose location has yet to be determined.

Information document N° 36, Plano de desenvolvimento das industrias químicas no Brasil, was also submitted to the Seminar. It includes, in an attached list a group of chemical industries that could begin production within not more than four years. For these industries the internal demand already justifies certain economies of scale and the country possesses the basic inputs. The list gives a preliminary selection of industries prepared by the Brazilian Ministry of Planning, and does not mean that any other industrial effort is excluded.

The list includes twenty-four chemical products, imports of which exceeded 64 million dollars in 1963 and whose investment requirements amount to about 235 million dollars, which would yield an estimated production value of 193 million dollars. Among the main projects, in accordance with the magnitude of the investment required, the following can be mentioned:

Product	Production in 1963	Production capacity to be installed	Invest- ment required	Estimated production value
	(Thousands of tons/year)		(Million dollars)	
Ammonia and derivatives	14.0	200	50.0	20.0
Caustic soda (sodium hydroxide)	86.5	150	33.2	9.6
Polyethylene	11.6	40	18.0	18.6
Benzene	6.6	80	17.0	7.8
Titanium di oxide	1.6	20	14.0	9.9
Butadiene	-	33	13.0	9.7
Soda ash (sodium carbonate)	76.2	108	12.2	10.8
Styrene	14.5	20	12.0	6.1
Ethylene	5.3	60	12.0	9.2
Urea	-	150	10.0	13.7

/(iii) Colombia.

(iii) Colombia. In view of the ample statistical data that ECLA possesses on Colombia's chemical sector, the additional information compiled during the Seminar does not necessitate the introduction of changes in the figures and conclusions reached. The series of information documents and oral statements by Colombia's participants makes it possible to complete and elaborate those aspects of the industry that are already well advanced.

At present Colombia's chemical industry is the fourth largest in Latin America, contributing 60 per cent of the region's total production. Its great importance consists not only in its contribution to economic production, but in its provision of raw materials that are indispensable for many industries, through which it is closely linked to the development of the manufacturing sector as a whole. Recent progress is noted in the large plants of alkaline products, fertilizers, agrochemical products and nitrogenous products for industrial use; the petrochemical industry can be described as one of Colombia's most promising industries.

In the last three or four years the growth of Colombia's chemical industry has not kept up with the goals set in the ten-year plan. This lag can be attributed largely to the high proportion of traditional slow growth (soaps, paints and matches), with a small proportion of basic and intermediate chemical products (industrial reactors, fertilizers, organic chemicals, etc.). However, it is hoped that this last group will show a considerable increment in the future, for the more or less permanent, and in some cases unusual, growth of the internal demand for some chemical products, ensures a market that would foster the rapid progress of the industry.

A considerable number of large new chemical plants are already planned or under construction. A recent study of ANDI shows that among the forty-one major projects under way, twenty-one concern basic chemicals, petro-derivatives, artificial fibres and miscellaneous chemicals, with an investment valued at over 1,700 million pesos. An important project is the construction of an ethylene plant with a capacity of 17.5 million pounds a year which will start production at the end of 1965; production will also begin of calcium carbide and polyvinyl chloride. An important innovation for petrochemical derivatives will be the manufacture of PVC, polyethylene, polystyrene, carbon black, acetylene, urea-melamine resins and compressed industrial gases. A plant is being constructed to manufacture organic acids (citric and acetic), making use of the residual melasses of the Cali sugar refineries; it will also produce acetone, acetic anhydride, vinyl acetate, ethyl acetate and butyl acetate. In addition the production of sodium hydrosulphite, sodium sulphate, sodium bisulphate and zinc oxide in Manizales, has emerged as a new basic chemical industry.

A study prepared in 1961 outlined the possibility of producing a wide variety of new items in Colombia, perhaps on a lesser scale than those mentioned. These will include many polymers on the basis of imported monomers, (alkyd resins, polyesters, polyurethanes, urea resins and plasticizers for vinyl resins). But the study pointed out that the market for other basic organic chemicals for plastics, like butadiene, phenol, styrene, and caprolactam, would remain inadequate for several years.

/Among projects

Among projects under way, five new ones will manufacture artificial fibres (nylon and polyesters) for a total investment of 125 million dollars, making it possible to substitute imports, which cost 45 million dollars a year. These plants are located in Medellin, Cali, and Barranquilla. Other projects under way include the production of organic mineral fertilizers, paraffin, lubricants, ammonia, nitrogenous fertilizers, maize products, water proofing materials, herbicides, fungicides, glycerol, dynamite, ferric chloride and essential oils.

Regarding the established items the production of sulphuric acid will soon be substantially expanded to meet the increased demand. It is most probable that the four existing plants will take part in this development and some of them will increase their present production of fertilizers, superphosphates and aluminium sulphate. In the field of pharmaceutical products, there are very few possibilities envisaged for new projects, other than that of initiating basic fermentation processes for antibiotic production. This would be possible as soon as a Latin American market exists. Among the chemical processing industries those producing animal and vegetable fats for industrial uses and tanning materials, should considerably increase production in the next few years. Similarly with the traditional industries of long standing, such as soap manufacturing, there is ample opportunity for the expansion of both production and consumption.

(iv) Chile. ECLA possessed such inadequate statistical information regarding the evolution of Chile's chemical industry from 1960-1962, that it was impossible to include a detailed account on this subject in the preparation of the basic document (ST/ECLA/Conf.15/L.4/Rev.1).

This shortcoming was amply compensated by the presentation in the Seminar of the information document Consumo aparente de productos quimicos en Chile a report based on a classification adopted by ECLA that gives comprehensive and valuable statistical data covering an estimated 90 per cent of the industry as a whole. The information document Programa de desarrollo de la industria quimica chilena describes the programmes and steps to be taken towards the development of the sector and envisages three courses of simultaneous action: (i) substitution of the most important imports; (ii) the development of certain basic items; (iii) agreements for market distribution or sectoral integration in Latin America.

The development programme for the immediate future is based upon the following items: petrochemical products, phosphate fertilizers and sulphuric acid, the industries that not only sell their finished products at a low price but also those that they used as raw materials and others that become or are turned into surplus or by-products.

Some of these production items have already been started and others are in advanced stages of study; the latter include polyvinyl chloride, polyethylene, and polyester chips. These are products whose domestic manufacture is justified by the internal market, and whose annual production capacities should reach 11,400, 8,000 and 5,000 tons respectively.

/Moreover, studies

Moreover, studies carried out by the Corporación de Fomento show the advantage of local production of phosphate fertilizers which are required in increasing quantities by agriculture in order to maintain and raise its productivity (the consumption of phosphoric anhydride should increase from 70,000 tons in 1963 to 200,000 in 1973); it is estimated that the installed capacity of phosphoric anhydride will be about 60,000 tons annually, with a probable location in the Concepción area. This plant will supply phosphoric acid to the domestic market and/or technical phosphates at prices comparable to those in force in highly industrialized countries.

Lastly, a network of plants belonging to a branch of CORFO will supply the country with sulphuric acid.

This programme has already begun and will be completed within the next few years. The plants which will form part of this network are: one in Arica, with a daily capacity of 15 tons of 98 per cent acid, scheduled to start production in the middle of 1966; the Antofagasta plant, whose capacity is now being doubled as a result of the installation of a new plant producing 30 tons daily of 98 per cent acid; another in Vallenar, with a daily capacity of 30 tons, whose construction is due to begin in July 1965 so as to be functioning by January 1967. Lastly, studies are being made for a plant in Coquimbo Sur, which will have a daily production capacity of 20 tons.

The establishment of these basic production units will make the following items available at low prices to Chile's industry: chlorine, caustic soda, hydrochloric acid, ethylene, benzene, toluene, ortho-xylene, meta-xylene, para-xylene, phthalic anhydride, terephthalic acid, ethylene glycol, acetic anhydride, acetic acid, sulphuric acid, and phosphoric acid.

(v) Mexico. Information documents analysing the Mexican chemical sector as a whole were not available. The preliminary analysis presented by ECLA was completed and amplified by the oral statements of the participants, particularly with regard to developments in recent years.

The additional information made available shows that the sector's annual growth rate for 1963 and 1964 exceeded 15 per cent as a result of the particularly favourable conditions for economic development at that time. During these years important projects got under way, ranging from new plants to expansion of existing capacity.

The production of acids is among the most important: hydrochloric, hydrofluoric, acetic and citric; insecticides: DDT, BHC and toxaphene; resins: phenolic, melamine, alkyd, acrylate and polyester; synthetic fibres: nylon 6; fertilizers: urea, nitrate and ammonium sulphate and superphosphates; lastly, other products like phthalic anhydride, carbon black, active carbon and acetaldehyde derivatives.

/As regards

As regards the basic petrochemical industry, an important factor will be the functioning of a group of plants for the production of aromatics and the expansion of ammonia's capacity. The production of tetraethyl lead, begun successfully three months ago, is most important.

In nearly all these products Mexico has succeeded in eliminating or reducing its imports from third countries. However, the value of Mexico's imports has continued to increase. According to statistical data, the value of imports during the first nine months of 1964 was equal to that recorded during the whole of 1963 which, in turn, was above the figure for 1962. This is explained by the need for raw materials and for semi-finished and finished products, whose production is required by some of the items listed above.

The development goals of the Mexican economy for the next few years set an annual minimum growth rate of 6 per cent for the gross domestic product. Although quantitative goals have not been determined for the chemical industry, they are not likely to be less than the ratio between the growth of this industry and the future economic activity as a whole. The projects for which material and equipment are already being purchased, and those under construction, would appear to support this view.

Of these, the most important should be noted: Reynosa, Tamaulipas: a petrochemical complex producing ethylene, ethylene oxide, amines and glycols and polyethylene. In Coatzacoalcos, Veracruz: a large petrochemical complex based on the production of ethylene and sodium chloride and includes the tetraethyl lead plant previously mentioned, plants for the production of chlorine derivatives: ethylene dichloride, ethyl chloride, vinyl chloride, acetaldehyde chloride, caustic soda, chlorine and soda ash. In the Monterrey area, Nueva Laredo: production of soda ash, polyester fibres and expansion of nylon capacity. In Tampico, Tamaulipas: styrene, polystyrene, synthetic rubber and dodecylbenzene. In Chihuahua: ammonia and urea. In Ocotlan: cellulose acetate. In Salamanca: caprolactam; and around Mexico City: anilines and dyes, phenol, methanol, chloroacetic acid, phthalic anhydride, propylene glycol, pentachlorophenol. The production capacity of most of the projects mentioned is based on the estimated potential of the domestic market, although Mexico will always consider the possibility of exporting those items for which it finds itself in a favourable competitive position.

(vi) Peru. There were no information documents on Peru's chemical industry; the ECLA statistics covered only 15 per cent of the sector, making it impossible to analyse its development during the period. The information gathered during the Seminar from oral statements and data submitted by the Peruvian participant, made a more detailed analysis of the sector possible and provided an indication of the future lines along which national action might be taken in this branch of industry.

Although the Peruvian chemical industry is relatively new, it has already co-operated significantly in the country's economic development by supplying basic raw materials to the transforming industries.

/The production

The production of basic chemical, pharmaceutical and paint items substantially increased in 1962, while there was a moderate improvement in the production of artificial fibres. Consumer and paracheimical products constituted almost two thirds of the domestic chemical industry up to only a few years ago; by 1957 this situation was already improving with the production of superphosphates, and more rapidly so at the beginning of 1960, when nitric acid, ammonia, ammonium nitrate, etc., were being produced.

Peru produces three inorganic basic acids: sulphuric, nitric, hydrochloric. Sulphuric acid, with a daily capacity of 232 tons, at present supplies 99.7 per cent of domestic consumption, its prospects of growth are good, largely owing to the increased production of fertilizers.

As regards the sodium alkali sector - the production of caustic soda reached 7,872 tons in 1962, covering 29 per cent of internal consumption; this low proportion of self supply was compensated by the installation of a new plant in Callao that began functioning in the middle of 1963. With this plant it is estimated that the domestic supply of caustic soda will be able to meet 50 per cent of consumption.

Ammonia began to be produced from the end of 1959, when a large complex in Callao entered into operation with an annual capacity 16,500 tons. Capacity began to expand - by 20 per cent in 1962 - and the installation will be completely operative by 1965.

Peru produces fertilizers in the form of island guano, nitrate and ammonium sulphate. Throughout the period the consumption of nitrogenous fertilizers derived from guano has tended to decrease (supplies 25 per cent of domestic demand) but this was offset by the increased consumption of chemical nitrogenous fertilizers; at present nitrogen consumption is estimated at 50,000 tons. Superphosphates (capacity 18,809 tons/year) and compound fertilizers (25,000 tons/year) are also produced.

In 1962, the output of artificial fibres increased 15.3 per cent over the previous year as a result of the substantial expansion of nylon output, a fibre which began to be produced in the middle of 1961.

In 1962, the domestic production of paints reached 10,044 tons, its growth rate exceeding that of consumption. The product's quality improved as a result of a massive modernization of installations and equipment, making it possible to diversify the domestic industry's production and to reduce imports, 80 per cent of which are made up by special water paints for hides, enamels, pyroxylin-based paints and anti-scaling compounds. In 1962 production began of lacquer for motor-cars and nitrocellulose paints.

The National Institute of Industrial Promotion, (Instituto Nacional de Promoción Industrial) has carried out a study on the sector as part of its programme 7/ with a view to detecting the negative forces influencing the chemical industry's development and to recommend substitution of certain imports and possible export outlets. Based on the 1962 import statistics, a selection was made of six sectors of the industry:

- (a) Plastic resins
  - (i) polyvinyl chloride
  - (ii) polyethylene
  - (iii) polystyrene
- (b) Paint resins
- (c) Synthetic fibres
- (d) Phosphate detergents
- (e) Chemicals for mineral flotation
- (f) Inorganic insecticides

The study's conclusions on the whole point out that certain factors, e.g. high costs of inputs, inadequacy of market, etc., are impeding the growth of this industry in Peru and these cannot be rectified overnight.

However, the work has produced useful information for the evaluation of the present state of the industry, showing the availability of raw materials and their prices, and sets forth the problems relating to investment costs as well as an over-all picture of the incentives offered to investors in Peru.

(vii) Venezuela. Information documents on Venezuela's chemical sector as a whole were not available but the relevant figures presented to the Seminar by ECLA were amplified and corrected by the information documents submitted at the meeting and the oral statements made by the participants. 8/ Among the information documents, the one submitted by the Venezuelan Institute of Petrochemistry should be mentioned; it analyses the development of the country's petrochemical industry and in Chapter V sets down its plans for future development. (Information document N° 5 "La industria petroquímica y su desarrollo en Venezuela").

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7/ The National Institute for Industrial Promotion (Instituto Nacional de Promoción Industrial) and the Industrial Bank of Peru (Banco Industrial del Perú), series, Estudios de la industria en el Perú:

"Informe N° 1 - Seis sectores de la industria química", June 1964.

8/ Corrections are included in Secretariat document ST/ECLA/Conf.15/L.4/Rev.1.

During the period Venezuela's chemical industry increased its production largely as a result of new manufactures in the field of fertilizers and other petrochemical products. According to the information document the sales made by the Venezuelan Institute of Petrochemistry between 1960-1964, increased at an annual cumulative rate of 10.1 per cent, showing the penetration into the consumer market of both fertilizer and industrial products, as a result of the active policy of promoting and advising on the use of such products.

At present the Venezuelan petrochemical industry supplies virtually all the domestic demand for industrial products as well as having contributed substantially to the process of export diversification. The development programmes for Venezuela's petrochemical industry provide for three clearly defined stages: (a) a short-term plan of action or rationalization of the industry; (b) a medium-term plan providing for consolidation, moderate expansion and research; and (c) a long-term plan or dynamic expansion to carry out structural changes.

The short-term plan envisages elimination of the 1965 operational deficits and financial self-sufficiency in the production plants by 1966.

The medium-term plan covering 1965 to 1969 includes a series of projects that will cost approximately 633.5 million bolivares. The following should be mentioned:

- (a) Complex of explosives for civilian use, scheduled to start partial production in 1965 and to reach full capacity in 1966;
- (b) Complexes of synthetic rubber, detergents and plastics; this projects is new under study and production is expected to begin in early 1968;
- (c) Expansion of the fertilizer complex to 500,000 tons/year;
- (d) Enlargement of the soda chlorine plant in the long-term plan to be carried out from 1965-1970 whose rapid growth rate will tend to diversify Venezuela's exports and make possible a considerable degree of import substitution.

(viii) Ecuador. Ecuador has no basic chemical industry, a fact confirmed by the data submitted in the Seminar. The sector consists mainly of the production of soaps, certain oils and fats and the preparation of pharmaceutical end-products.

Possible items of manufacture are chemical products derived from agriculture (alcohol, organic solvents, acetone), production of insecticides and biodegradable detergents.

/(ix) Uruguay.

(ix) Uruguay. The figures submitted are for 1960 and do not add information to that presented by ECLA. Among the projects envisaged in Uruguay is the production of polyvinyl chloride from acetylene, and superphosphates.

There was no opportunity to collect fresh data on the state of the chemical industry in the rest of the Latin American countries and therefore the over-all production figure must be taken as a mere indication of size and accepted with appropriate reservations.

## 2. Centralization of information and bringing it up to date

The problems involved in the development of the chemical industry, the role played by this important branch of the manufacturing sector in the process of forming a Latin American common market and the relation of this development to the criterion of regional complementarity, call for detailed research based on periodic statistical information that must be both adequate and accurate. This data should cover the many chemical products that constitute the complex structure of this branch of industry and give a general picture of the sector in each country.

ECLA's experience gained in its recent studies underlines the inadequacies and difficulties confronting most Latin American countries when they compile information on the production, regional trade and consumption of chemical products as well as on the specific projects and development programmes prepared.

In view of the urgent nature of the problem, the secretariat submitted to the participants 9/ for discussion the setting up in Latin America of a system of periodic and systematic collection of statistical data and information regarding projects, in which the basic tasks of collection and tabulation would be the responsibility of each country, and suggested alternatives for the choice of the responsible bodies. It was suggested that this task should be centralized at the regional level in some agency with previous experience in the subject, so that methods and criteria could be unified, and reports be issued periodically based on information gathered on the sector.

The secretariat's idea gained broad acceptance among the participants and there was agreement that ECLA, in view of its experience in the field, should be the agency responsible for the co-ordination and preparation of a homogenous methodology of work with standard guidelines and bases. At the national level it was considered that the agencies that could most effectively take charge of the collection and primary tabulation would be those responsible for planning of the chemical sector and associations of chemical industrialists.

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9/ Document ST/ECLA/Conf.15/L.9, was used as a guide.

Among the national agencies that could take this responsibility in each country the following were referred to:

- Argentina: Consejo Nacional de Desarrollo (CONADE)  
Cámara Gremial de la industria química (affiliated to Argentina's industrial association)  
Secretario de Estado de Industria y Minería (Dirección Nacional de Industria)
- Brazil: Grupo ejecutivo de la industria química (GEIQUIM)
- Colombia: Dirección nacional de planeación  
Instituto de Investigaciones Tecnológicas  
Departamento Administrativo Nacional de Estadística (DANE)
- Chile: Corporación de Fomento de la Producción (CORFO)  
Asociación de Industriales Químicos (ASEQUIM)
- Mexico: Cámara Nacional de las Industrias de Transformación  
Consejo Nacional de Industrias Químicas  
Banco de Mexico (Departamento de estudios)  
Nacional Financiera
- Peru: Instituto Nacional de Promoción Industrial (INPI)
- Venezuela: Oficina Central de Coordinación y Planificación (CORDIPLAN)  
Instituto Venezolano de Petroquímica (IVP)  
Asociación de Fabricantes de Productos Químicos de Venezuela

It was essential that a methodology of work, which it would be ECLA's responsibility to prepare, should not differ from that employed by other international agencies, so that the studies carried out by these bodies could be regarded as comparable. For this purpose it was deemed advisable that ECLA should contact these agencies to standardize the working methods. It was considered desirable that chemical products should be identified by the code now used by other bodies and which is already in widespread use in the sector.

The following were included among the most urgent tasks that ECLA would have to deal with:

- (a) Preparation of a detailed classification of chemical products.
- (b) Preparation of a model work survey enumerating in detail the information to be collected, with precise definitions of each item. Secretariat document ST/ECLA/Conf.15/L.9, gives an example of this questionnaire, making many suggestions regarding its scope and the advantage of including data on the use of capital, manpower, input costs, etc. The first revision of the model recommended can be seen in Appendix I.
- (c) The preparation of a list of products about which information would be required (Appendix II). The recommendations made show the usefulness of including other products like dynamite, ferric chloride, sodium cyanide.

/Regarding the

Regarding the report to be issued by ECLA on the basis of information thus compiled, there was unanimous acceptance of the secretariat's view that an annual statistical report should be prepared, in which only information pertaining to the list of principal chemical products would be included. The report would be supplemented every three or four years with a study similar to Evolución de la industria química latinoamericana en el período 1959-1962 (ST/ECLA/Conf.15/L.4) in which the chemical sector is considered as a whole, together with the important changes that have taken place during the period. It was suggested that this general report might well include the projected demand for products, as in document E/CN.12/628, amplified and corrected in the light of new information collected in the period. Such projections will make it possible to have up-to-date knowledge of the possibilities of the region with regard to the future market and thus help to guide new investments.

ECLA would issue the first annual statistical report at the end of 1965, which would contain the 1963 and 1964 figures relating to the list of products in Appendix II. Provision would be made in future working plans for the publication of a report in 1966 or 1967 covering the sector as a whole.

### Appendix I

The following would be the minimum information to be collected:

- (1) Name of product
- (2) Definition of the quality or type of product (degree of concentration, purity, etc.)
- (3) Price of product (at producer's level in national currency)
- (4) Installed production capacity (tons/year)
- (5) Number of existing and proposed plants
- (6) Actual production (quantity and value at producer's prices)
- (7) Imports - quantity and value c.i.f.
- (8) Exports - quantity and value f.o.b.
- (9) Trade with countries of the region
- (10) Total investments (national currency)
- (11) Projects for the expansion of installed capacity (indicating probable year of operation)
- (12) New production projects (indicating probable year of operation)

## Appendix II

## PROVISIONAL LIST OF THE MAJOR CHEMICAL PRODUCTS

Group and productGroup I: Basic inorganic chemical products

1. Sulphuric acid
2. Hydrochloric acid
3. Phosphoric acid
4. Nitric acid
5. Hydrofluoric acid
6. Ammonia
7. Caustic soda
8. Soda ash
9. Sodium bicarbonate
10. Caustic potash
11. Sodium sulphate
12. Chlorine
13. Calcium carbide
14. Hydrogen peroxide
15. Carbon sulphide

Group II: Major organic chemical products

16. Benzene
17. Toluene
18. Xylene
19. Naphthalene
20. Ethyl benzene
21. Methanol
22. Ethyl alcohol
23. Formaldehyde
24. Isopropyl alcohol
25. Acetaldehyde
26. Glycerol
27. Ethylene
28. Propylene
29. Acetylene
30. Ethylene dichloride
31. Butadiene
32. Tetrapropylene
33. Phenol
34. Cresol
35. Ethylene glycols
36. Propylene glycols
37. Acetic anhydride
38. Acetic acid
39. Cyclohexane

/Group III

Group III: Chemical products for agriculture

40. Ammonium sulphate
41. Ammonium nitrate
42. Urea
43. Simple superphosphate
44. Triple superphosphate
45. Dibasic calcium phosphate
46. Compound fertilizers
47. DDT
48. BHC
49. Copper sulphate

Group IV: Plastic materials and synthetic resins

50. Vinyl chloride
51. Vinyl acetate
52. Polyvinyl chloride
53. Polyvinyl acetate
54. Phenol-formaldehyde resins
55. Melamine-formaldehyde resins
56. Urea-formaldehyde resins
57. Styrene
58. Polystyrene
59. Polyethylene
60. Polypropylene
61. Acrylate resins
62. Polyester resins
63. Alkyd resins
64. Cellophane
65. Phthalic anhydride
66. Maleic anhydride

Group V: Man-made fibres and their raw materials

67. Cellulose acetate
68. Nylon 66
69. Nylon 6
70. Rilsan
71. Polyamide fibres
72. Caprolactam
73. Dimethyl terephthalate
74. Adiponitrile
75. Hexamethylenediamine
76. Adipic acid

Group VI: Synthetic rubber and related products, including carbon black

- 77. Styrene-butadiene rubber (SB-R)
- 78. Cispolybutadiene rubber
- 79. Other stereo-isomer rubbers
- 80. Carbon black

Group VII: Painting, dyeing, tanning and colouring materials

- 81. Titanium dioxide
- 82. Zinc oxide
- 83. Artificial ferric oxides
- 84. Sodium dichromate and sodium chromate

Group VIII: Surface-active agents and bleaches

- 85. Toilet soaps
- 86. Washing soaps
- 87. Dodecylbenzene
- 88. Detergent preparations
- 89. Sodium phosphates

Group IX: Products for explosives, matches and fireworks

- 90. Potassium chlorate
- 91. Dynamite

Group X: Industrial gases

- 92. Freon gases
- 93. Oxygen

Group XII: Products for other specific uses

- 94. Ethyl chloride
- 95. Silicon carbide
- 96. Tetraethyl lead
- 97. Aluminium sulphate
- 98. Casein

Group XIII: Tars, pitches and similar by-products

- 99. Paraffin wax

/Group XIV

Group XIV: Salts, oxides and other chemical products, minerals of miscellaneous uses, not included in Group I

- 100. Sodium silicate
- 101. Ethylene bromide
- 102. Bromine
- 103. Iodine
- 104. Ferric chloride
- 105. Sodium cyanide

Group XV: Organic compounds of miscellaneous uses, not include in Group II

- 106. Solvent esters
- 107. Octanol
- 108. Butanol
- 109. Acetone
- 110. Citric acid
- 111. Tartaric acid
- 112. Carbon tetrachloride
- 113. Trichloroethylene

MINERAL RAW MATERIALS

- Sulphur
- Phosphate rock
- Common salt
- Limestone

## B. ANALYSIS OF CERTAIN PROBLEMS RELATING TO THE CHEMICAL SECTOR

By definition item 2 of the agenda contained a wide variety of topics which could be discussed. The secretariat, in its introductory statement, selected the most interesting of these that dealt with four aspects of the institutional framework within which the chemical industry is developed and around which the Seminar's debates revolved. Thus the discussions dealt consecutively with the problems related to: (a) the transfer of technical know-how from abroad, technological research and local manufacture of the equipment required by the chemical industry; (b) the size of the plants in the Latin American chemical industry, the minimum economic size and industrial policy in so far as it affects plant size; (c) the methods of development planning in the chemical sector, the advances achieved by their application in Latin America and the drawing up of investment projects and (d) the role of the public and private sectors in the development of the chemical industry, the problems concerning the co-existence of both sectors and the definition of the area of action of each.

The problems of technical know-how and research are multiple and complex. The Seminar did not try to embark upon an exhaustive analysis of these but confined itself to a careful study of some aspects of particular interest in the present stage of Latin America's development. After recalling that very often the production techniques developed in the more advanced industrial centres cannot be adapted to Latin American economic conditions, and the general awareness of the need to broaden the applied technological research being carried out in the region as part of a long-term solution to this problem, a few questions were raised in the Seminar regarding the possibility of defining the problems that might be successfully investigated. In view of the vast human and financial resources that would be required for a long term investigation into the chemical industry and the close relationship between applied research and the advance of pure science in this field, the question raised is of an essentially practical nature and endeavours to make a guideline available to the Latin American technological institutes, which would help them to avoid duplication of work and conserve their scant resources. Is the tendency towards large plants and the increasing capital-intensity an exclusive or principal result of the characteristics of the countries where the new methods are being developed, or is it implicit in scientific and technical progress and hence, difficult to counteract by means of a technology especially devised for the specific requirements of the less developed world?

The new processes and their corresponding equipment are developed and devised, on the whole, in research laboratories and engineering companies that inevitably draw on their previous experience as a starting point in all the new projects. By what means can such laboratories and companies be enabled to explore new fields of technological development, so that modern productive techniques can be placed within the reach of the countries with small markets, scarcity of capital and abundant and invariably redundant manpower? Is it merely fortuitous that there have recently been, a few cases

/of adaptation

of adaptation of the traditional processes of the chemical heavy industry - for example petroleum refining and the manufacture of ammonia - to manufacture on a much smaller scale than usual without an undue increase in investment per unit of product or is it, on the contrary, an example of the great extent to which techniques can be adapted by means of more applied research by the less developed countries, together with international co-operation, to allow a few of the more experienced companies specializing in this field to explore the subject more deeply?

While the Seminar did not purport to answer such difficult questions, it was inclined to agree with certain points of view, briefly summarized as follows:

(i) Problems concerning applied technological research can be divided into two broad, distinct categories: (1) the basic processes of the chemical industry required to produce raw materials and the intermediary products of the heavy chemical industry; (2) the non-basic or derivative processes that are used to obtain finished products.

(ii) Research into the basic processes is largely beyond the scope of the less developed countries because of the resources and experience that it requires. However, this does not apply to research into finished products, in view of their closer dependence on local raw materials, on the characteristics and requirements of the local markets they must serve, etc.

(iii) On the other hand, there is nothing to prevent access to know-how concerning the basic processes developed in the large centres from being obtained through licensing arrangements. This can rarely be done in the case of the manufacturing processes of finished products because the problems are, in the main, peculiar to each country.

(iv) The importing, through licensing arrangements, of know-how concerning certain processes and their local development in respect of others is perfectly compatible, as can be seen from the experience of Japan, which recently developed a petrochemical industry based on German and United States processes. This has not prevented it from acquiring its own know-how and even from starting to export it.

(v) Regarding the professional capacity needed to devise processes and plant projects, the recent experience of Argentina, Brazil and Mexico, shows that Latin American chemical engineers possess the training required although it has also been observed that the training needed for this type of work is not the usual background required of a chemical engineer but rather, calls for a wide experience in the many facets of industrial techniques.

(vi) Thus, local development of an industrial chemical technology is obstructed not by a lack of technical personnel, but rather by the inadequate allocation of material resources to research institutions. This must be attributed to a lack of awareness of its importance in economic and social development, seeing that the authorities responsible for over-all industrial planning and for that of the chemical industry, in particular, have not formulated a definite policy in this respect.

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In the matter of the licensing arrangements and the problems of their better adaptation to the requirements of the development of the Latin American chemical industry, the Seminar concentrated on two principal aspects: the high cost of these arrangements and the possibility of more comprehensive operational guarantees offered to countries in the early stages of development which base their industrialization upon these arrangements. In the matter of cost, it was pointed out at the Seminar that in the recent United Nations inter-regional conference on the development of the petrochemical industries in the developing countries (Teheran, November, 1964) it had been suggested that in order to reduce licensing costs, the developed countries should exempt the licensing companies from paying tax - or reduce the rate of taxation - on income derived from licences granted to developing countries.

With the same purpose it was also recommended in Teheran that the United Nations carry out a study on the main licensing practices and costs involved in the granting of licences to the petrochemical industry, placing special emphasis on nitrogenous fertilizers since these are of great interest for developing countries.

The Seminar agreed with both recommendations. It was also mentioned, in connexion with the engineering sector, that the purchase of plans and designs for the local manufacture of equipment would, in many cases, make it possible to reduce the cost of the licence agreements. These would be limited to knowledge of the process which, in some cases, might even be dispensed with. Further, with regard to the high cost of licensing agreements in countries with limited markets, it was suggested that in some cases it would be advisable for a regional body specializing in industrial development to acquire abroad the right to utilize certain processes, with authority to transfer that right to the Latin American companies. This would not only allow substantial saving to be effected where the licence agreement consists of a fixed sum plus royalties in proportion to output, but would also be a form of facilitating - and even subsidizing - the transfer of advanced technologies for the benefit of the less industrially developed Latin American countries.

As regards the problem of the transfer to the developing countries of know-how on the installation of modern chemical industries based on modern technological processes, a participant pointed out that although technical assistance from foreign firms represented a great expense to the Latin American industrialist, it had the great advantage of ensuring the proper functioning of the industrial installations, which is not always the case when such assistance is not used.

In view of this statement, the secretariat took the opportunity of inquiring among the persons present about their experiences regarding contracts for technical assistance and the transfer of know-how through licences for patented processes, with particular reference to the guarantee that the installations function properly. It is customary for technical assistance contracts to provide for payment, to the firm that grants the

/licence, of

licence, of the remunerations specified in the contract, net of such income tax as may be levied in each country at the time said payments are remitted abroad. In these circumstances the cost to the Latin American industrialist of a licence of this kind is approximately 30 per cent greater than it would be for an industrialist in the same country as the licensing firm.

Depending upon the scope and conditions of the guarantees that the licensing firm may be disposed to offer in the contract for the normal functioning of the industrial installations, it might happen, - and has happened on several occasions - that the installations do not function according to plan and that the respective contracts do not secure the licensee against the losses thus incurred. Thus, the "operational guarantees" are closely linked to the advantages provided by the licence contracts under the conditions in which they have been entered into up till now in Latin America.

A participant who was particularly informed concerning this type of problem explained that the fee that an engineering firm receives for the services rendered in the preparation of projects for a large industrial installation is not sufficient to allow the firm to assume responsibility for the costs of any alterations that might have to be made to ensure the normal functioning of the installation; nor could the firm be responsible if the industrialist fails to make a profit during the initial phase of operations. The only possible guarantee, according to this participant, lies in the selection, in each specific case, of a firm of technical repute and solid tradition.

Another participant declared that the procedures in this respect vary among firms that normally grant licences for the use of processes and provide technical assistance. He cited the case of one of these firms which is an organization specializing exclusively in the development of new processes and their licensing. Its model contracts include a provision establishing limited responsibility up to a fixed amount. A substantial portion of the fee it receives, goes to cover the costs that must be incurred until the installations are in full operation in accordance with the terms of the contract.

The problem of transferring technology is closely linked to the local manufacture of industrial equipment, and the Seminar gave considerable attention to this subject. Although it recognized the achievements made, especially in Argentina, Brazil and to a lesser extent, Mexico, it concluded that more intensive action should be taken in favour of the local production of heavy equipment for processing industries since the possibility of increased investment in the chemical industry's development and, over the longer term, of achieving production costs, in respect of many important items, similar to international costs, depends on greater advances made in this direction. Briefly, such action would have to be taken along the following lines:

/(i) An

(i) An incentive policy encouraging the gradual creation of local engineering ability as regards both processes and mechanical construction, by giving preference to industrial projects that can be carried out locally or with knowledge of local manufacturing possibilities. There is much still to be done in this field even in the three countries with the most possibilities - Argentina, Brazil and Mexico - although pressure of circumstances and the facilities offered by an increasingly more healthy industrial climate - rather than a considered and coherent policy - are slowly leading to the desired objective.

(ii) A well defined policy designed to protect the local manufacture of processing equipment, together with the promotion of specific and technically effective programmes to encourage such manufacturing; this objective, which has already been realized to a considerable extent in Brazil, still calls for fresh and determined measures of industrial policy in Argentina and Mexico.

(iii) A policy of active co-operation between the manufacturers of heavy equipment or, rather, between the metal-transforming plants with the necessary experience and with adequate working facilities for this production. Such a policy would be aimed at mutual assistance in solving technical problems and making use, through sub-contracts, of the limited number of larger pieces of equipment; it would also enable the authorities to formulate gradually all the indispensable economic policy measures (import control of equipment similar to that produced in the country, whether separately covering the integration of complete installations which receive external credits, the financing of local production, a policy of local purchases in the country on the part of the major state agencies, etc.); Brazil has advanced considerably in these aspects;

(iv) A regional policy of preferences (not only in the form of tariffs) for the purchase of equipment, combined with pragmatic and flexible procedures of co-operation between manufacturers of the principal producing countries in order to facilitate the joint use of their capacity, the transfer of orders from one country to another in the region, in cases where demand may have accumulated excessively in one and capacity be unused in others, and lastly, the acquisition of designs and projects to be used indiscriminately by the manufacturers of any one country (by means of the regional industrial promotion agency that would be established in the future); the conditions required in order to reach this goal have not yet all been established but possibly the most urgent would be for the manufacturers (present and future) of processing equipment in Mexico and Argentina to form an organization and adopt the co-operation measures put into practice in Brazil by the Associação Brasileira para o Desenvolvimento das Indústrias de Base (ABDIB).

The Seminar then considered the problem of the size of factories in the Latin American chemical industry in relation to the practice followed in this respect by other countries and areas and the minimum dimensions in each case. It was pointed out (ST/ECLA/Conf.15/L.8) that there are many examples in the region of under-utilization of installed capacity as a result of slow growing, small and isolated national markets, or the co-existence of two or more plants supplying a very limited market.

/There is

There is also the case of manufacturing establishments with insufficient capacity to meet increased demand, which consequently resort to imports in order to supply a portion of the market.

In an attempt to answer the query about which factors have been decisive in this fragmentation of the market and in the restriction of the sizes of the chemical installations, one factor appears to be the logical tendency to limit the risks that could be incurred when new competitors appear in the market in respect of the installations whose size had been planned according to the expected maximum size of the market; again, a plant whose capacity is adjusted to the requirements of the existing domestic market might well fear the pressure of specific price regulatory policies or tax modifications that might affect it economically. Moreover, it often happens that some countries lack adequate legal instruments with which to prevent the installation of plants that are very small compared with the immediate market demand and there may even be a desire to promote the establishment of more than one enterprise producing the same line of items in order to avoid monopolistic conditions. These factors could be modified if plants were installed with a capacity which would not be below a specific economic scale compatible with the industrial structure of the country, and provided a variety of solutions were employed to eliminate the drawbacks of a monopolistic situation; obviously one of these would be the gradual application of tariff reductions tending to replace the competition between small local enterprises by a regional competition between plants with a larger production scale. The integrated development of the corresponding production line would complement this action by means of the successive installation of plants at intervals in line with the increased demand of the area and to the technically and economically viable plant sizes.

Other points regarding the size of chemical plants and the influence of economies of scale were discussed in item 4 of the agenda of "The possibilities of a regionally integrated development of the chemical industry" and are included in this report because they are closely related to the theme of regional integration.

In considering the planning techniques for the chemical sector's development the general lines followed by certain Latin American countries were described. For example, administrative structures have been established recently in various countries to co-ordinate the over-all planning work of the public sector with sectoral planning which includes both public and private sectors. This is done in some cases through mixed working groups and in others, through national advisory councils. At the same time it was pointed out that sectoral planning, especially in so far as the chemical industry is concerned, should be closely linked to over-all planning. Several statements were made about the advisability of extending the planning to the formulation of specific projects, for key points in industrial development and feasibility studies generally, as well as for the establishment of priorities for the granting of financial benefits and incentives.

/Several comments

Several comments were made on the direct participation of the public sector in chemical production, especially in the petrochemical line, and in some cases in its by-products. This participation is on the whole called for by reason of the large investments required, the close technological link between petroleum refinery operations - which are usually the responsibility of national enterprises - and the obtaining of basic petrochemical products, and finally because of the concentration imposed by production scales that are high compared with the requirements of most domestic markets.

Special emphasis was laid on the necessity of clearly defining the area in which the national enterprises' development programmes should be applied, in view of the fact that even when there are no technical or economic factors with which to determine the field of action of the public and private sector, the element of insecurity hampering the characteristic dynamism of the chemical industry, particularly in the private sector, must be removed. Thus a timely definition has enabled several Latin American countries to establish mixed enterprises and to maintain understanding and co-ordination between both sectors.

Moreover it is advisable that the studies carried out by national planning bodies should be complemented by the drawing up of specific draft projects, thus enabling private investors to decide to embark upon new production lines.

Included under this item were the information documents dealing with the problems of planning methodology and promotion policy for the chemical industry; that is to say, the problems closely linked with the institutional framework within which the industry is developed rather than with the supply and demand position. While it was not possible for the ECLA secretariat to prepare any specific document on this type of methodological or industrial policy problem, it was deemed advisable that the Seminar should avail itself of the opportunity to hear information from the participants about the main obstacles impeding development of the chemical industry in their respective countries as well as the measures adopted in recent years for the rational planning of that development.

In connexion with the different facets of the broad range of problems covered by this subject, the Seminar received an important number of documents:

- Nos. 2 - Programación de un plan de inversiones petroquímicas en Argentina (Yacimientos Petrolíferos Fiscales);
- 4 - Abastecimiento regional de equipos básicos para las industrias químicas - conveniencia de su coordinación y racionalización en América Latina (Ing. B. Rikles);

- 9 - Licencias para utilizar procedimientos industriales estadounidenses en América Latina (Dr. E.W. Schnabel y J. Estrugo);
- 10 - Mesas redondas pro-industrialización en provincia del Instituto Mexicano de Ingenieros Químicos (Ing. O. Hentschel C.);
- 14 - Aspectos institucionales de la industria química en América Latina - participación del Estado en el desarrollo de la industria química (Dr. R.F. Beltramino);
- 15 - Filosofías mexicanas sobre el desarrollo industrial de un país (Ing. C.O. Baptista);
- 22 - La planeación del sector químico en Colombia (Ing. J.W. Delaplaine y Dr. G. Londoño);
- 28 - Planning of the Chemical Industries at the National Level (Dr. Th. Vietorisz);
- 31 - Problemas que enfrenta una empresa química en América Latina (Ing. J.C. Fuentealba).

In addition, other information documents on different subjects, including comments or questions relating to this section of the agenda, were also received. The secretariat's report "Las industrias químicas y la integración económica regional",<sup>10/</sup> although not specifically intended to consider this type of problem, does refer to certain aspects of the size of plants and economies of scale that are closely linked to the policy of promoting the chemical industry.

The gist of each of the documents listed is summarized briefly below:

Information document N° 2 gives the main outlines of the policy it intends to pursue in the planning and promotion of the petrochemical industry, describing too the methodology being applied there for the formulation of a specific and rational programme for new plants.

YPF does not at present manufacture petrochemical products, confining itself to the sale of raw materials at low prices to other public or private enterprises - producers of plastics, synthetic rubber, explosives, solvents, etc. -, but considers that being the national institution responsible for all that relates to the production, industrialization and sales of hydrocarbons, it should also plan and promote the petrochemical industry. In this way

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<sup>10/</sup> ST/ECLA/Conf.15/L.8.

YPF is aiming towards "the installation and operation of its own plants in the basic petrochemical sector". State participation is considered necessary in this field for two reasons: "price regulation and the promotion of the domestic chemical industry, as well as for the fulfillment of the primary requisite of all enterprises: to make profits guaranteeing its future development". YPF's action in this respect would consist of placing in the market "an increasing supply of basic and intermediate petrochemical products to facilitate the formation of chemical enterprises in Argentina which will be able to develop in a market free from monopolistic pressures, thus achieving an effective equilibrium between supply and demand".

The methods being applied to formulate a programme for the development of the petrochemical industry, which would preferably include State-owned enterprises, are those being employed in operations research and, by means of these methods, YPF proposes to define investment objectives for the petrochemical industry along the following lines:

1. On the basis of the YPF programme for the present and future production of petrochemical raw materials and taking into account the existing chemical industries and the projected demand for intermediate products, a list will be prepared of the items obtainable from the raw materials previously referred to, "whose direct consumption by the processing industry, both present and future, may have sufficient economic weight", and grouping the manufacturing plants in industrial complexes;

2. The most suitable size and location will be determined for each of the possible projects so defined;

3. Bearing in mind the foregoing and considering also the capital available, "the project or projects offering the largest return would be chosen by application of the linear programming methods";

4. In order to achieve this, it will be assumed that no project will be duplicated, i.e. that only one installation of a specific type will be established in only one location of the country.

Lastly it is recognised that less profitable plants should be included among those of high priority for reasons of public interest and not of an economic nature, for instance in order "to encourage other activities of the country, such as installing fertilizer plants for agriculture which though they may not be the most profitable of industries would nevertheless benefit the economy as a whole".

Information document N° 4 contends that it would be advisable to have a growing supply of domestically manufactured equipment in order to expand the chemical and petroleum industries' expansion and suggests that there is need for regional co-ordination among manufacturers of this equipment. "Although in some cases equipment has been manufactured which is comparable in quality and characteristics to those made in workshops of highly

/industrialized countries,

industrialized countries, prices are not as yet competitive". Moreover, it often happens that existing workshops manufacturing basic equipment use only a small part of their capacity, thus raising production costs even further; this has a most unfavourable repercussion on the industry for which the equipment is intended (chemical and petroleum). Costs must be kept low both because of the effect they have on the cost of other manufactures and for reasons of foreign competition. With special reference to the present situation in Argentina and to the conclusions of a previous ECLA report (E/CN.12/628/Rev.1), the document states that "it is a logical and natural aspiration on the part of the planner and investor to acquire the installations of a chemical plant at the lowest possible cost" and that this "justifies the tendency of many investors to acquire their installations in highly industrialized countries like the United States, Germany, Great Britain and France, where, in addition to lower prices, credit is offered on easier terms than by the Latin American manufacturers or banks". This policy however "tends to solve an immediate problem", but overlooks the longer-range objectives required for the chemical industry's sustained and even development in future years, which require that domestic manufacturing of equipment should be established and consolidated upon a broad base. If local industry is not increasingly given the chance to manufacture the basic equipment for the chemical industry, difficulties of varying degrees will arise in connexion with: the training of employees and workers; meeting future expansion needs and unforeseen and urgent modifications of the original projects; the acquisition of spare parts for the maintenance of installations, thus avoiding relatively long work stoppages, a factor which is especially important for plants that have to replace parts or complete installations by reason of wear and tear, corrosion, explosion or fire, and for the gradual modernization of existing installations.

The present cost position is unsatisfactory. But "it can be concluded from an analysis of the international prices that Argentina's metallurgical workshops equipped with modern machinery, trained technicians and skilled workmen, can produce processing storage and transport equipment, at competitive prices provided they have an adequate volume of work and are favoured by promotion measures (elimination of customs surcharges, granting of tax exemptions) and bank credits at low rates of interest (in line with those being charged in Europe and the United States)".

Some Latin American countries (Argentina, Brazil and Mexico) are proceeding with the manufacture of equipment for the chemical and petroleum industries. The document recommends a study of the existing facilities and of a suitable co-operation "to co-ordinate their efforts so that the basic industries that are already established in the region may work at full capacity", thus introducing "a healthy competitiveness that will make equipment available to the chemical industry at reasonable prices".

Information document No 9 describes the experience gained in the granting of licences for the use of its manufacturing processes in Latin America by an important United States company specializing exclusively in devising, designing and patenting processes for the refinery of petroleum and for the

/petrochemical industry.

petrochemical industry. This company has in recent years granted more licences for the use of its processes outside the United States than it has in that country, a disparity that reflects the extraordinarily rapid expansion of the petrochemical industry in the developing countries which are very much dependent from a technological stand point, and the important part played by licence agreements in this development.

This document lists the principal conditions of a typical licence agreement, three of which are outlined below. In the first place, a licence agreement in the chemical industry generally signifies far more than the mere authorization to use a patented process. Because of the nature of the patent laws in many countries, it is often pointless, if not impossible, to obtain adequate protection for a patent for "important details of the modern refinery processes and for the petrochemical industry, to which much time, energy and money has been devoted... At present it is recognized that these considerations bear considerable weight in the conceding of licences". Secondly, the patent rights consist, on the one hand, of a specific sum calculated on the basis of the estimated capacity of the patented unit "which is normally paid in cash when both parties sign the licence concession" and on the other hand, a sum payable annually, proportionate to the sales value of the product manufactured by the licenced process. Lastly, the licence concession generally only grants the right to use the process in its original form and does not permit the adaptation of this process to the peculiar conditions of the country or of the individual manufacturer who is the recipient of the process. Such adaptation when necessary and feasible can only be effected by means of special agreements for the granting of technical services.

Information document N° 10 describes a method for the promotion of small and medium enterprises that the Instituto Mexicano de Ingenieros Químicos has successfully applied in the interior of Mexico. It consists of organizing round table seminars in the provincial capitals where entrepreneurial and governmental representatives assemble to discuss specific subjects related to the industrial utilization of the region's natural resources and the governmental initiatives required for its implementation. The views of the experts who are appointed by the sponsor of the meetings, Instituto Mexicano de Ingenieros Químicos, are made available to the authorities, "and are later complemented by the publication of a general report on the Seminar which usually also includes additional information or replies to inquiries that could not be dealt with immediately". Several of these round table discussions have been organized in recent years and their results appear to be promising.

Information document N° 14 analyses the principal aspects that must be considered on the formulation of a policy for the development of the chemical sector, drawing special attention to the different criteria concerning State participation in this development. Some of the criteria set forth are resumed as follows: activities and experience of other areas must be utilized and their transfer to Latin America facilitated by making local capital available to those who have the know-how. Access should also be had to foreign capital by giving it fair treatment "that does not imply

/discriminatory or

discriminatory or detrimental policies but provides the necessary safeguards and ensures respect for contractual obligations. Under these conditions considerable benefits can be derived from foreign investments in the developing countries". Regarding the role of the State, while recognizing that it is relatively less effective than private enterprise, "governmental participation is justified and to a greater extent than in the countries of automatic growth"; it is concluded that "the only criterion to bear in mind for the allocation of tasks between the public and private sector would be the extent to which each sector can efficiently carry out and adapt itself to its tasks"; however, indirect measures of intervention should preferably (but not exclusively) be used in order to "maintain the basic functions of the price system in guiding production factors".

Specifically, regarding the role of state enterprises it is suggested that "excluding the regions that are relatively less developed, where private enterprise activity is virtually non-existent, and the Government therefore has to undertake an active promotional role in almost every field", governmental investment should generally be concentrated in the establishment and consolidation of the economic and social infrastructure. Only exceptionally should it concern itself with projects related to direct production when, for instance, large production units have to be established that call for investments beyond the means of private enterprise, or when the period of maturity of projects is too long for them to be financed by private capital, or when the formation of monopolies has to be prevented, and when new processes have to be put to use, and when there is need to foresee increased demand and open the promotion of new areas, and finally to correct adverse factors in the structural sectors of certain industries".

The document mentions also the manner in which Governments must act in the matter of direct profits. "In such cases once the initial phase of operations is completed, they should transfer the companies to private enterprise, thus recovering funds for new projects; avoid competing directly with private enterprise and the granting of special privileges to their companies; seek the formation of mixed enterprises wherever advisable; adopt the method of organization, administration and control characteristic of private enterprises; prevent enterprises from gradually coming under political influence; see that investments are not inflationary (taxes, domestic and foreign loans)".

Information document N° 15, after setting forth some of the fundamental criteria that have guided Mexico's industrialization policy, makes certain observations of direct relevance to the development policy of the chemical sector. In the first place, it affirms that in Mexico investment in the form of joint domestic and foreign capital has produced results far superior to investment using only foreign capital. Secondly, it suggests that on the whole the possibility of producing an article locally should be looked into when the size of the domestic market approximates the output of a small plant which functions successfully in an industrialized country. "The industrial cost for these initial activities will be higher than the average foreign cost, and certainly higher than the prevailing 'dumping' price. This need not be a barrier to industrialization, for a price has to be paid to industrialize a country".

The third point of interest concerns the tendency to underestimate the size of the plants to be established. "For many years the procedure used in Mexico to determine the size of a possible industry was by means of extrapolating the growth of the market so that after two years of operation the plant might meet the extrapolated demand. This implied the extrapolation of the market to four or five years, bearing in mind that promotion and construction would take some two to two years and a half which, added to a similar interval before the plant can operate normally, would enable it to operate at full capacity at the end of this period when the market would, at the same time, be able fully to absorb its production. This line of thought has proved clearly shortsighted, and has encouraged the installation of unduly small plants", with the ensuing result that unit costs tend to remain high indefinitely. "Today nearly all the industrial installations in Mexico are being enlarged because they were too small when originally built". This includes plants that began operating during the last eighteen years. Now the size of plants is planned so that at the end of the second year of operations a balance will have been reached which would leave a considerable margin to enable the plant to meet the growth of the next few years and to have an exportable surplus. This new policy is leading to the construction of much larger plants operating more efficiently, and at much lower unit costs". If the export market does not materialize, the natural growth of the domestic market will within a reasonable time, be able to absorb the surplus capacity originally provided for.

Another point related to the foregoing is the unsuitable practice of constructing several plants to manufacture the same product, thus further reducing already insufficient markets. "The concept of free competition becomes extraordinarily anti-economic in these cases", it being preferable to establish - albeit temporarily - regulatory mechanisms that would limit the installation of plants of an economically reasonable dimension to the minimum required to supply the whole market. "This will inevitably create temporary monopolies, together with all the problems to which monopolies give rise, but the government's powers of economic supervision will control such situations".

Lastly, the document deals with the local manufacture of equipment for industry, which is considered indispensable "certain though it is that the early output of a specific production line will be nearly always of poorer quality and rougher finish than the imported equivalent. However, if encouragement is not given to the initial production of this equipment, it will never be of superior quality". As regards the granting of international export loans which are an obstacle to local manufacturing, the document supports "an inflexible policy prohibiting the importing of equipment that within acceptable specifications is manufactured domestically. The policy should deal with the problem in a manner likely to make it easier to obtain loans to finance the purchase of equipment locally. "This method is hard and difficult, but sometimes indispensable, for only thus can the important equipment manufacturing industry be established". The problem of domestic

/engineering skill

engineering skill a basic requirement for such manufacturing, may be solved gradually "by promoting the establishment of domestic engineering firms able to carry out small and simple projects; and with due caution and understanding gradually to entrust them with more complex and broader projects". It would be worthwhile in this respect to make use of associations with foreign enterprises as well as various advisory services, while constantly endeavouring to train competent domestic personnel.

Information document N° 22 points out the role that practical planning can play in a free enterprise economy and refers more particularly to the relationship between the planning of the chemical sector and over-all planning. The principal guideline is Colombia's Four-Year Development Plan (1965-68), which will include integrated programmes for the chemical sector, the industrial sector as a whole and for other sectors of the economy, as well as an analysis of the relationships between the various sectors. The main focus will be on sectoral planning which is closely linked to the specific projects and to technical assistance, as well as on the studies required to determine new investment. At the same time the foregoing is co-ordinated with the macro-economic projections. A basic plan is expected to be established for technical assistance and sectoral and regional studies, and for projects that link investment requirements with the sources of financing (international or national institutions). An inventory is being prepared of the projects and programmes of both private and public institutions, which is based on comprehensive questionnaires covering all the essential aspects of continued planning so that the four year plan can be adjusted every year.

The joint working groups (Government and private sectors) will play the principal role in this continuous process of planning. These groups are co-ordinated through the Economic Planning Advisory Group, which was established in January, 1964 on the re-organization of the Administrative Department on Planning, and the Industrial Planning Advisory Council, which depends on the Advisory Group.

Some of the most important functions of the Advisory Group for the Chemical Sector will be the following: establishment of targets; periodic surveys of the sector's enterprises; establishment of priorities for studies, projects and sub-branches; studies on the domestic supply of capital goods; promotion of the export sector; regional planning and studies on location; studies on skilled manpower requirements; studies to determine a strategy for integration and to analyse the short-term and long-term financing requirements. With respect to this last task, it is expected that a current account of funds and a four-year assessment of the requirements and availability of credit will be established.

Information document N° 28 is a concise manual for the planning of the chemical industry and illustrates several aspects of the methodology accompanied by information on the structural characteristics of the chemical sector in countries at different levels of economic development and on the

main links between the chemical sector and the rest of the economy. The document's main conclusions relate to the methodology of planning, to the importance of economies of scale and to the establishment of chemical industries in countries with limited domestic markets.

Regarding the methodology of planning, the establishment of rough priorities when studying the expansion of the chemical sector as a whole or upon initiation of large-scale chemical projects is considered both necessary and feasible. These priorities relate to the allocation of investment funds and to the formulation of policies on import substitution and, possibly, the promotion of new exports. These priorities are determined mainly by the construction of models for the economy as a whole through the use of linear programming and its extensions. The use of linear programming models in economic planning is still in the experimental stage, but since there is rapid progress in this field, good results have been obtained in various cases.

Referring again to the methodology of planning and to the structure and location of chemical activities at a lower level of aggregation, the document concludes that considerable empirical data is available which is included in the text. In particular, the technical "co-efficients that characterize this sector are far more abundant than those in most of the other sectors of the economy and make it possible to formulate feasibility studies based on the most important components of production cost, including market and shadow prices. Such studies furnish answers to questions about the comparative advantage of a process in a given area; about the number and location of plants that can most efficiently supply a market", etc.

A further aspect of this document is its conclusion about the "predominant importance of economies of scale and the disadvantages of limited markets. The chemical industry, especially in its principal branches, requires sub-regional markets to operate efficiently. The drawback of small-scale production leads to the loss of capital productivity, particularly that of the capital invested in machinery and equipment. In the measure that this capital represents an imported element the result will be not only a deterioration in the capital/product ratio (and, for that reason, of the growth potential) of the economy in question, but also a setback in the balance of external payments and thus an adverse factor in import substitution".

Lastly, the document draws some striking conclusions about the basic alternatives before the countries with inadequate markets in their decisions for establishing chemical industries. The question - what has the establishment of a chemical industry to offer these countries? - is formulated in the cases where these countries wish to promote some sort of industry as part of an integrated industrial structure.

The two decisive factors in this respect are, on the one hand, the economies of scale, and on the other the fact that the final uses of chemical products are most varied. Economies of scale call for the maximum production possible; the second factor largely prevents this objective from being achieved by means of greater emphasis of the growth certain sectors.

Not all the branches of the chemical industry share this dilemma to the same extent. The "simple" chemical products (soap, cosmetics, etc.) are practically not subject to economies of scale at the national level and can be established in minimum conditions of market size. Vegetable oils and fats, as well as paints, varnishes, and similar products, also show the same tendencies of this group. As regards these chemical sub-branches, import substitution presents obvious advantages, but these branches are not usually included in the requirements of an "industrial base".

The dilemma becomes crucial in the branches that contribute to the creation of this industrial base, that is to say, the heavy chemical products, including the intermediate organic products. These products show strong economies of scale and their demand is spread throughout the chemical sector and often through other non-chemical sectors as well. If the manufacturing of these products is established on small scales it will be affected by the anti-economic use of capital and foreign exchange. However, the demand or apparent consumption of these products will not easily be, increased by means of a selective promotion of final uses as this often is in conflict with the over-all objectives of economic development. For a given production structure, the needs for chemical products are to a considerable extent determined, and in a process of normal development, the additional requirements depend more on the growth of the economy as a whole than on that of specific sectors. For this reason, the only way to generate additional demand is by emphasizing final consumer uses. This leads to two distortions: one in favour of consumption and against investment; the other favouring the consumption of complex products (synthetic fibres, plastics, rubber tyres for vehicles, detergents) and against the products of popular consumption. Avoidance of such distortions would limit the possibilities of developing the basic chemical products (the fertilizers are a possible exception to this).

A possible solution to this dilemma would be to import the heavy chemical products and establish certain lines of chemical end-products that require more processing and which can more justifiably be considered as part of the "industrial base" of a country: synthetic fibres, plastics, rubber, detergents, dyes and pharmaceutical products. These products - possibly with the exception of synthetic rubber - will be affected much less by the economies of scale and, in spite of this, their manufacture is characterized by the same advanced technology and complex organization that is involved in basic industrial progress.

/However, such

However, such strategy also presents certain new risks owing to the fluctuation of foreign exchange income characteristic of most of the less developed countries. The need for intermediate goods in the manufacture of finished products creates a strong demand for foreign currency, which cannot be curtailed without cutting down the manufacture of these final goods; this would entail unemployment, under-utilization of capital resources and a reduction of the supplies intended to meet the requirements of other sectors.

The best choice depends in each case on the particular circumstances of the country concerned, always bearing in mind, inter alia, the aforementioned factors.

Information document N° 31 describes the main problems of a Latin American chemical enterprise that has had some twenty-five years in business and supplies the market with basic intermediate products like methanol, caustic soda, and others of varied industrial application. The problems mentioned are obviously specifically those of this particular enterprise and of the country in which it operates (Argentina). Broadly speaking, however, they may very well be characteristic of conditions in Latin America as a whole. Among the many problems mentioned, two should be emphasized: the instability of demand and the larger investment required for a specific production. Regarding the first point, the document states that a phenol plant which was planned in 1957-1958 to produce 10,000 tons a year with an investment of 6 million dollars, in accordance with market estimates considered reasonable at that time, was working at the end of 1964 at 40 per cent of this capacity. The unsteadiness of demand caused by economic conditions in general, and especially by the vulnerability of the economy to the ups and downs of the external payment situation, is aggravated by extremely keen foreign competition, not only because of the effects of certain dumping practices, but also because of the initial disadvantage of local companies in competing with foreign concerns.

The foreign manufacturers of chemical products work in conditions quite different from those prevailing in Latin America: "They have enormous installations with minimum operating costs, placing their surplus at very low prices in the international market where competition is intense". Low production costs, together with dumping, often permit foreign products to enter the market "at below domestic prices, in spite of the considerable import surcharges". The caustic soda industry appears to be a good example of this situation, which is described in the document, which also provides data.

The higher initial cost of the installations is the result not only of a higher cost of capital (for example, the capital needed for one installation financed entirely through capital loans would cost 13 per cent more than if it were obtained abroad), but also because the equipment is more expensive - both in the case of imported (because of freight, insurance, customs costs etc.), and local equipment.

/"There are

"There are good workshops that specialize in the construction of simple chemical apparatus which cost about the same as those manufactured in the United States, but there is still much to be done in the manufacture of lined vessels, chemical ceramics, special alloys, etc. There is a scarcity or lack of measuring instruments, pumps and acid resistant propellers, motor operated valves, etc. In other cases some items could be manufactured locally but the cost would be so high because of the small demand that they must be imported. This is the case of certain types of rotating filters, centrifugals, mills, and driers, etc. The price of these imported elements could be raised - by as little as 10 per cent if there is some special reason to place them in a privileged position, or as much as 100-150 per cent if normal customs duties and surcharges are applied. As far as installation and assembly costs are concerned, these are generally lower than in the United States or Europe. In brief, considering all these factors and depending upon the proportion of domestic or imported equipment included in an industrial plant, it can be estimated that the final installation cost in our country will be from 20 to 50 per cent higher than in the United States or Europe. This signifies an equivalent increase in amortization costs and in their influence on production costs".

#### C. PROSPECTS FOR A REGIONALLY INTEGRATED DEVELOPMENT OF THE PRINCIPAL SECTORS OF THE CHEMICAL INDUSTRY

It was intended, under this item of the agenda, to analyse the prospects that Latin American economic integration offers to speed up the development of the chemical industry. For this reason various documents relating to specific items in the chemical industry and prepared by ECLA and experts and institutions from Latin America and elsewhere, were presented to the participants. In the reports the possibilities are analysed of accomplishing the regional co-ordination and complementarity of investments in the light of projected demand, information on economies of scale and other technical and economic data, in some cases on Latin America as a whole, and in others on individual countries.

As a result of the direction that the ECLA secretariat gave to the Seminar, the discussions were confined to the physical aspect of integration, that is, to the study of the possibilities of adjusting the development of future production of each principal product to a scheme of regional specialization based on the growth of demand, market size, economies of scale and other circumstances peculiar to each product and to the industrial structure of each country. For this, it was necessary to assume that all trade negotiation problems (like tariff reductions, foreign exchange and payments systems, etc.) would be resolved in time through the action of competent bodies, such as ALALC and the Central American Common Market.

The discussions revolved around the following sub-branches of the chemical industry:

/(1) fertilizers

- (1) fertilizers and pesticides
- (2) synthetic resins and plastics plasticizers
- (3) man-made fibres
- (4) synthetic elastomers and carbon black
- (5) alkalis and chlorine derivatives
- (6) Dyes and pigments
- (7) Synthetic detergents and other chemical products

1. Fertilizers and pesticides

The documents presented to the Seminar on chemical products for agriculture included the following:

- Nº 5 "Mercado Brasileiro de fertilizantes" (BNDE) (Banco Nacional do Desenvolvimento Economico)
- Nº 12 "Los plaguicidas en América Latina" (Shell International, London)
- Nº 17 "Realization of Fertilizer Production in a developing country: The case of Bolivia" (YPB & Kellog Co.)
- Nº 20 "La producción de un fungicida para las necesidades del mercado latinoamericano" (California Chemical Co.)
- Nº 23 "Situación del sector de fertilizantes en México" (Nacional Financiera S.A.)
- Nº 27 "The Latin American Fertilizer Industry" (J.W. Bradley and E.J. Wygard)
- Nº 29 Fertilizer development for South America (USA representative: ICAP, Oct. 1964)
- Nº 37 "La industria de Parasiticidas y Fertilizantes en cifras" (M. Soberanes, Cámara Nacional de la Industria de Transformación, México)

Document ST/ECLA/Conf.15/L.7 "La industria de fertilizantes en América Latina" was also presented and contains preliminary figures on the consumption level up to 1963 as well as a general examination of production prospects in the region. Another section of this document mentions the probable demand for fertilizers up to 1970 and 1975, estimated on the assumption that the rate of expansion recorded until 1963 will continue.

/Briefly reviewing

Briefly reviewing the recent growth of fertilizer consumption in the seven countries that represented 87 per cent of the total demand it was pointed out that in 1963 the consumption of nutrients (N,P and K) reached some 926,000 tons compared to 533,000 tons in 1959. For the whole of Latin America in 1963, the consumption of nitrogen, phosphorus and potassium was more than one million tons.

Regarding the future growth of demand, the foregoing Latin American consumption may, on the basis of the above studies, be estimated at 1,770,000 tons (NPK) in 1970 and 2,440,000 in 1975, broken down as follows, (in thousands of tons):

Year	Nitrogen	Phosphorus	Potassium	Total
1970	840	650	280	1,770
1975	1,160	900	380	2,440

These demand projections are relatively conservative since a study of the region's need for fertilizers to cope with the shortage of foodstuffs and the rapidly growing population might produce far higher figures (information document N° 29). The recent increase in nitrogen demand in Mexico and Argentina confirms that the use of fertilizers may be increased provided that action is taken to promote it, either through a policy of low prices and discrimination of modern techniques among the farmers, - as in Mexico - or by revising fertilizer import regulations, as was done in Argentina whose nitrogen consumption rose to 22,116 tons in 1963-64 after long remaining virtually at a standstill at 6 to 8 thousand tons. Because of this it is difficult to forecast demand on the basis of the trends recorded in recent years; and thus it becomes far better to analyse the measures that can be applied to increase fertilizer consumption which would be justified by the necessity of rapidly increasing the region's agricultural output.

Following this line of thought, attention was drawn to the work done by the Joint ECLA/FAO Agriculture Division, beginning with a study, financed by IDB, on the inputs of the agricultural sector. These studies, the preliminary results of which will be known at the end of April 1965, would make it possible to determine the desired levels of fertilization as well as those already reached, the effect of exchange and tariff regulations applied to fertilizer imports, the source of supply, production structure, research situation, development of the agricultural extension services and technical assistance, credit, marketing and present legislation.

A factor that could have a negative effect on adequate market growth would be the maintenance of protectionist barriers established to support domestic industries whose production costs are high.

With regard to the supply of nitrogenous fertilizers, emphasis was laid on the increased production of ammonia, especially in Mexico, Argentina and Venezuela, as a result of the new plants some of which are still being constructed. These increases would mean that various nitrogenous fertilizers amounting to some 71.5,000 tons of nitrogen would be available for the region towards 1970; this is less than the minimum projections of consumption (840,000 tons) and represents a deficit of some 100,000 tons of nitrogen (or 122,000 tons of ammonia). By 1975 this deficit would be at least 410,000 tons of nitrogen, which justifies the new projects for ammonia production which, on the basis of the present known projects, would be some 500,000 tons annually, above the capacity forecast for 1966/67.

Regarding the other fertilizer elements - phosphorus and potassium - the document mentions their close dependence on the mineral resources and the advantages of developing regional sources of supply. This would be feasible in the case of phosphate raw materials, especially if the expected economic exploitation of Peru's Sechura deposits materializes.

One of the characteristic features of the region's production of ammonia and nitrogenous fertilizer derivatives (urea, nitrates and ammonium sulphates) is that the plants in the different countries vary in size. Thus, while some countries have medium or small size plants built to satisfy a portion of domestic demand (13 to 25 thousand tons of nitrogen annually), others show a trend towards much larger plants on sites where raw materials are available - especially natural gas - under favourable conditions the annual production capacity of the large plants fluctuates between 55,000 and 120,000 tons of nitrogen and the plants were installed either to supply an expanding domestic market, sustained and promoted through adequate policies for agricultural development, credits, and the sale of fertilizers at prices near or below cost (Mexico), or in the interests of export programmes (Colombia and, to a lesser extent, Venezuela). This situation would make it difficult to apply a criterion for the regional liberalization of fertilizers, because it would lead to variations in production costs which would necessitate the maintenance of a tariff protectionist system for large producers. It would therefore be advisable that the new plants, to be installed during 1966-70 and onward, are planned in such a way that in so far as location and scale of output are concerned, the only consideration is that these should permit them to compete in the world market. This should not lead to excessive pressure on the neighbouring regional markets which are supplied by domestic production in less favourable conditions and thus would require a greater protection than that afforded by transport costs.

The gradual transition towards a more satisfactory structure of the Latin American nitrogen industry would thus remain assured and the region, with its vast resources of natural gas and energy, would become a nitrogen exporter.

/In connexion

In connexion with these aspects reference was made to the programmes being carried out in Colombia as a result of which the country at present has a considerable production capacity 11/ and exports a proportion of this to Costa Rica in the form of ammonia to be used as a raw material in the country's fertilizer complex (FERTICA).12/ Mention was also made of the domestic promotion activities by Colombian producer enterprises, and of the additional projects under study for the supply of phosphoric acid used in the production of compound fertilizers and which is at present imported; lastly attention is drawn to a project, still in its preliminary stages, intended to install a third ammonia plant in Barranquilla whose daily output of 700 tons would be exported.

Regarding the influence of manufacturing capacity on the costs of ammonia it was pointed out that the recent installation of partially pre-assembled plants would permit economic operations at capacities from 30 to 120 tons daily; at the same time European plants (Australia and Denmark) were cited whose capacities would be much lower than those usually considered as "economic minimums"; some aspects were also discussed regarding the share of the production costs of ammonia in the items "raw materials" and "capital expenditure"; the influence of the latter is such that the advantages deriving from the use of a low-cost raw material would be reduced and more than offset by transport costs. Thus, the advantage of concentrating production in regional plants situated according to the location of the best raw materials is open to question. These aspects however, demand detailed studies both on the costs of the various possible solutions as well as on the proportion of freight costs; the preparation of the basic information needed for such studies would require the collaboration of national agencies responsible for the development programmes.

The experience of Mexico shows how a national economy can benefit from the greater agricultural output obtained through the increased use of fertilizers. In this respect the economic and social benefits amply justify the financial efforts and the sales price promotion policy that has been followed in that country, which resulted in an increased consumption of nitrogenous fertilizers at an annual rate of 15.4 per cent, having increased from 69,541 tons in 1956 to 190,428 tons in 1963. Moreover, it is estimated that towards 1970 Mexico will be using some 547,000 tons of nitrogen.13/

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11/ Entering into production in 1963, the two existing plants have a total capacity of 110,000 tons of ammonia (270 tons/day in Cartagena and 50 tons/day in Barranca Bermeja); 250 tons/day and 30 tons/day of urea, respectively; 450 tons/day of compound fertilizers in Cartagena; 100 tons/day of ammonium nitrate in Barranca Bermeja (see information document N° 21).

12/ The Fertica plant in Puntarenas also receives some ammonia from Aruba.

13/ Information document N° 23.

Although Brazil offers an important potential market for fertilizers (25 to 28 million cultivated hectares) demand is only growing sluggishly and it would not exceed 2 per cent annually without the different types of foreign currency subsidies that have been granted in previous years. This is the result of several factors one being the technological standstill in the agricultural field, another the unfavourable terms of trade, etc. In this respect, it was recalled that domestic transport costs constituted a burden which unduly increased the price paid by farmers. Mention was also made of the necessity of offering a relatively wide selection of nitrogenous fertilizers to agriculture.

Other participants pointed out the advantage of limiting as far as possible the variety of nitrogenous fertilizers available in the region today. This would be an additional means of facilitating trade and the gradual integration of this sector. It would be advisable too that the technological and feasibility studies should be directed towards the selection of the most adequate types of nitrogenous fertilizers. These studies, which would have to be financed by the Governments of the countries concerned, would include not only a review of the new manufactures to be established, but also the size and location of the new plants to be constructed.

In this connexion, the view was expressed that, as a practical step towards regional integration enterprises with capital from more than one nation shall be established. Countries interested in acquiring their production would contribute to their capital in proportion to each country's demand and the enterprises would be established in the best locations determined by joint studies. This would assure an adequate share in the profits of the operation and would make it possible to establish provide the industry with the best possible structure from an economic standpoint.

These ideas, discussed separately in broad outline, were received favourably, emphasis being laid inter alia upon the necessity of considering the problem of regional location from a geo-economic, rather than a political standpoint.

The salient features of the documents on fertilizers submitted to the Seminar are summarized below.

Brazil's fertilizer market is described in information document N° 5, submitted by BNDE (Banco Nacional do Desenvolvimento Economico). It gives detailed information about imports and production in 1950 and 1957-63, showing an apparent demand for nutrients (NPK) of 88,556 tons in 1950; 164,800 tons in 1957, 226,215 tons in 1959 and 307,196 tons in 1963. On the basis of fertilization tests carried out in various areas of the country it is estimated that the desirable average ratio between nitrogen, phosphorus and potassium would be 1:3:1. Lastly the document states that with a 15 per cent annual increase in demand in the next four years (1964-68) consumption

/by 1968

by 1968 - adjusting the basic figures according to the incidence of certain industrial consumption (potassium) - would reach 513,000 tons of N,P,K, including 307,725 tons of phosphorus ( $P_2O_5$ ). The domestic industry should be self-sufficient in nitrogen towards 1969 with the completion of the plans now being studied for new plants in Bahia and Volta Redonda.

This cannot be said of phosphate fertilizers, however, in respect of which there will be a deficit estimated at 165,000 tons of  $P_2O_5$ . Because of a lack of natural resources, most of the potassic fertilizers required will have to be imported.

Document N° 17 gives an example of the research carried out in Bolivia in connexion with the establishment of a fertilizer plant. It provides general data on conditions in Latin America with respect to agriculture, climate, the yields obtained from the main crops, raw materials available for the preparation of fertilizers, the transport situation, etc. It examined Bolivia's fertilizer requirements as estimated by various authorities, and concludes that it would be feasible to begin production of 30,000 tons of nitrogen and 15,000 tons of phosphates, importing the required amount of potassium.

Document N° 23 submitted by Nacional Financiera de Mexico (NAFIN), contains the preliminary conclusions of the studies carried out by that institution. According to these conclusions it is anticipated that during 1964-70 the demand for N,P and K, will increase at an annual rate of 15.4 per cent, similar to that of nitrogenous and potassic fertilizers recorded between 1956 and 1963. The previous growth and that projected up to 1970 is summarized in the following figures:

MEXICO: FERTILIZER CONSUMPTION, APPARENT AND PROJECTED TO 1970

Year	N	P	K	Total
	(thousands of tons)			
1956	69.5	28.6	7.3	105.4
1960	118.1	43.6	19.7	181.4
1963	190.4	60.1	22.4	272.9
1965	252.4	76.3	29.6	358.3
1970	547.4	160.8	59.4	767.6

The nitrogen-phosphorus ratio would go from the present 1:0.29 to 1:0.50, a proportion considered rather more suitable for Mexico's agriculture. The present development plans would satisfy the recorded phosphate demand; however, nitrogenous fertilizers would have to be imported in view of the supply projected for 1964-70 and the expected deficit of approximately 100,000 tons in 1964-68, rising to 300,000 tons in 1970. Plans are already

/under way

under way to build new ammonia plants and thus reduce the deficit, with production beginning in early 1966. A domestic supply of potassic fertilizers is not foreseen.

The document presented by the United States participants to the second meeting of the Inter-American Committee on the Alliance for Progress (ICAP) (Washington, October, 1964), was among those dealing with the general aspects of the problem. It points out the persistent decline in the indexes for Latin American agricultural production,<sup>14/</sup> from 107 in 1959-60 to 101 in 1962-63, and more particularly in the case of per capita grain production which dropped from 254 kg in 1934-38 to the present figure of 214 kg. After stating that little progress is being made in the expansion of the agricultural sector and in the improvement of the level of agricultural technology as a whole, the authors referred to the short-term results that could be obtained through the intensive use of chemical fertilizers which would raise agricultural yields by up to 50 per cent. Following a summary of the development of the area's fertilizer production and consumption, the ability of Latin America's raw materials resources to support a far larger fertilizer industry than exists at present is examined. Lastly, emphasis is laid on the urgent need to concentrate efforts on the exploration and development of allied mineral resources, such as potassium and phosphates.

Information document N° 27, besides giving information, examined the fertilizer situation in Latin America from the point of view of present capacity as well as resources available; the latter would be sufficient to meet the requirements for nitrogenous fertilizers. It was pointed out however, that only in some areas are there large reserves of natural gas capable of sustaining economically viable, large-scale nitrogen industries. Among these are Mexico, Venezuela and Tierra del Fuego but only in Mexico is there a large domestic market to absorb the available supply of hydrocarbons. Hydrocarbons are available in some of the other countries in one form or another - including refinery products - but domestic consumption alone cannot justify production scales large enough to obtain maximum savings. Thus one of the possible means of utilizing this supply of gas resources would be to install large production complexes in areas like Venezuela or Tierra del Fuego, whence bulk shipments of anhydrous ammonia in tankers, as well as nitrogenous solids, would be distributed to the centres where demand is greatest. Through the integrated development of the region these plants would attract a flow of joint investments from the consumer countries or conversely, to encourage in these countries investments intended to finance plants for the conversion, mixture and distribution of fertilizers.

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<sup>14/</sup> According to the United States Department of Agriculture, Economic Review Service, The 1963 world agricultural situation.

The discussions on pesticides as a whole dealt with certain aspects of the familiar difficulties caused by the variety of products and their application. It is clear that the role of research is decisive both in the development of new products and in the study of the diseases that afflict plants. In this respect, what is required is, on the one hand, accurate information on the markets which, by definition, are variable and split up and, on the other, research facilities to keep up with the constant change and improvement of the chemical products available for this market. For these reasons, this group of products is one case in which there is urgent need for regional co-operation and integration as the only way to avoid duplication of effort leading to the establishment of plants which, as a rule, apart from being relatively small, must cope with unstable domestic markets and are naturally affected by the constant supply of new preparations and products. Such co-operation would lead to a substantial trade in "active substances" - which would then be prepared in local plants - and a certain stability in the demand for a specific type of product, since its replacement in a given area would be compensated by its increased use in another field of application. It was agreed that more accurate knowledge of the regional demand for each one of the principal pesticides was absolutely indispensable.

Information document N° 20 illustrates the need for fungicides for the protection of fruit, potatoes and other produce, and summarizes the basic requirements for the installation of regional plants producing "Difolatan" with an annual capacity of 1,000 to 4,000 tons.

Information document N° 12 points out that pesticides are not themselves consumer goods but "corrective substances for the agricultural productive processes". Thus their short commercial life causes the high research costs peculiar to this industry and the risk that each new production line faces when introduced into the market. Apart from this negative aspect the document does illustrate the positive advantages of local preparation of formulas. In fact, this frequently adds to the preparation a value in excess of the total cost of the active material, signifies less immobilization of capital as regards the large amount of investments required to obtain the active elements, makes it possible to offer the market, for immediate use, preparations which would not remain in good condition if they have to be imported from distant countries - because of the delay sometimes involved in transport and customs handling. Lastly, local preparation would add to technological know-how with respect to these products and would establish bases for the gradual supply of active materials produced in regional plants.

The document similarly drew the participants attention to the problems of toxicity and the risks which inadequately uncontrolled use of these products would entail for animal and vegetable life.

Document N° 12 includes an over-all appraisal of the specific situation in Latin America according to which the region consumes annually some 80 million dollars of pesticide products, with consumption likely to increase at an annual rate of 10.5 per cent, somewhat higher than the over-all world market growth rate. Pointing out the high degree of specialization which would be required for continued development, of the insecticide industry, the document states: "Except for insecticides, such as DDT and BHC, which have been used for some time, other pesticides have tended to be manufactured only in one or two highly industrialized countries. There are several reasons for this:

- (a) The availability of raw materials which, in many cases, are chemical products of the more complex type, produced on a small industrial scale, and themselves requiring new production techniques;
- (b) The high cost of most of the pesticide plants, compared with the tonnage produced;
- (c) The fact that the potential market of any single country is on the whole insufficient to justify, from an economic standpoint, production for the domestic market alone; hence the plant would have to depend on exports in order to keep production up to its estimated capacity."

After the discussions on this item of the agenda, a broad summary was made of the opinions and conclusions regarding the working programmes to be proposed with a view to clarifying the regional possibilities of developing the sector of "chemical products for agriculture", in particular, fertilizers. These would lead specifically to the formation of a mixed working group (ECLA/FAO/ICAP, with the participation of other agencies both inter-American and national) whose responsibility would be to collect complete information on supply and demand, make contacts with the sectors concerned in each country, prepare a preliminary outline of regionally integrated development of the fertilizer industry while taking into consideration demand as a function of intermediate and long-term promotional plans for agricultural development, as well as the supply in relation to natural resources, transport costs, and the complementary development of the chemical industry in each country, etc. On the basis of this outline recommendations would be made to ICAP and countries of the region, so that measures required for its application may be adopted including, inter alia, the carrying out of studies and the preparation of specific projects by consultants and specialist firms as well as making available the funds with which to put these projects into effect.

The outline of work met one of the needs mentioned by the participants in their statements and, on the whole, received favourable comments.

## 2. Synthetic resins and plastics, plasticizers

The scant information that could be collected on the present situation in the region and the prospects for developing the market in respect of the various types of synthetic resins and plastics unfortunately prevented the secretariat from preparing, for submission to the Seminar, a special study on this important production line of the chemical industry, which would have included the main aspects of present conditions in each country.

The documents submitted to the Seminar with comments on the industries concerned, and therefore of interest to the discussions of this item of the agenda, were the following:

### (a) Secretariat documents:

La industria química en América Latina (ST/ECLA/Conf.15/L.3)

Evolución de las industrias químicas de América Latina en el período 1959-1962 (ST/ECLA/Conf.15/L.4)

La industria petroquímica en América Latina (ST/ECLA/Conf.15/L.6)

### (b) Information documents:

Nº 1 - La industria petroquímica en la República Argentina  
(Instituto Argentino de Petróleos) (Comisión de  
Productos Petroquímicos)

Nº 7 - Programa de desarrollo de la industria química chilena  
(Patricio Castro)

Nº 8 - Mercado brasileiro de plastificantes (BNDE)

Nº 25 - La industria petroquímica y su desarrollo en Venezuela  
(Instituto Venezolano de Petroquímica)

Nº 32 - Installation of a Petrochemical Industry in a Developing  
Country (Institut Francais de Petrole)

Nº 35 - A Industria Petroquímica no Brasil (PETROBRAS)

Nº 38 - Plan de la Industria Petroquímica de la Empresa Colombiana  
de Petróleos (ECOPEPETROL)

Synthetic resins and plastics form a group of chemical products that depend to a very large extent on the advance of modern technology; the growth of their markets is dynamic and at times unpredictable, not only because of the gradual substitution of traditional materials in the industries producing consumer goods, in construction and in industrial uses, but also because of the replacement of one type of plastic or resin by another more recent material of better quality and/or lower cost.

This being so, the way in which the market is formed and grows has always made it difficult to project consumption of these products, and thus there is little knowledge in Latin America of the information available and studies carried out in each country. On the whole, these studies are undertaken independently by the main industrial and commercial enterprises in the sector for their exclusive use, and because these companies consider such information to be confidential, their content is very rarely divulged.

Because specific information on this sector is scarce, the documentation submitted to the Seminar included firstly, the study on the chemical industry,<sup>15/</sup> with its statistical data brought up to 1962 by the information contained in the document Evolución de las industrias químicas de América Latina en el período 1959-62 (ST/ECLA/Conf.15/L.4).

According to this document the recent trend development of production in the synthetic resin and plastics industries, as measured by the dollar value of their annual output, shows that the annual growth rate of 22.5 per cent in 1959-62 was one of the highest in the seven countries, and was exceeded only by the growth in the rubber and related products group. Thus, while in 1959 the production value in seven countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela) had been 65 million dollars, in 1962 it rose to 120 million dollars. However, in relation to the total production value of the chemical industry, the synthetic resin and plastics industries in these seven countries represented only 3.7 per cent of the total production in 1959, and 5.1 per cent in 1962, a proportion that may become larger, judging by the experience of the United States where it was already 8.8 per cent in 1957.

In 1959 Latin America's imports of plastics and synthetic resins amounted to 74 million dollars, rising to 93 million in 1962. These figures represented 8.4 per cent of the total value of chemical product imports for the entire region in 1959 and 8.9 per cent in 1962, showing a cumulative annual growth rate of 8.3 per cent.

With respect to the apparent consumption of synthetic resins and plastics in the seven countries, the document indicates that it was 139 million dollars in 1959, reaching 217 million dollars in 1962, for an annual growth rate of 16 per cent. It can be seen, in turn, that the percentage of plastics and resins in the total consumption of chemical products had been 5.3 per cent in 1959, rising to 6.4 per cent in 1962.

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<sup>15/</sup> Document ST/ECLA/Conf.15/L.3.

The document points out that in 1959 import substitution in respect of these products amounted to 53 per cent in the seven countries mentioned above, and that by 1962 Latin America's self-sufficiency in this field reached 62 per cent.

In addition to the above document, which describes in broad terms the position of these industries in the chemical sector in Latin America, the ECLA secretariat, realizing that the synthetic resin and plastics industries constitute a branch of the "petrochemical industry", prepared the document "La industria petroquímica en América Latina" (ST/ECLA/Conf.15/L.6) which contained comments of relevance to the discussion of this agenda item.

The nature and scope of the information documents received by the secretariat for presentation to the Seminar are further evidence of the obstacles - already mentioned - to the collection of specific information on the resin and plastics industries. Except for information document N° 8 on Brazil's plasticizer market, the rest are more concerned with the situation and problems of the petrochemical industry's development in the country concerned.

Since the aim of the Seminar was to study the chemical industries as a whole, whether or not they were based on raw materials of petrochemical origin, it appeared more satisfactory, from the point of view of organizing the work, that the discussions should concentrate on analysing the problems of the resin and plastics industries, regardless of their origin.

This was done to give the participants an opportunity to supplement the information already available with other specific considerations on the possibility of developing the synthetic resin and plastics industries in the region.

As a rule, the installation of the synthetic resin and plastics industries in the Latin American countries begins with finished goods, proceeding next to the most important intermediate products, in so far as the domestic demand for them justifies the installation of the corresponding plants. For this reason, in the three countries with larger domestic markets (Brazil, Mexico and Argentina) and gradually in the others (Colombia, Chile, Venezuela, Peru, etc.), the more the vertical integration of these industries is promoted the more interest will be shown in the development of the basic petrochemical industry and on defining in each country the terms that Governments are prepared to offer for this development.

On the basis of the projected demand for some of the principal types of plastic raw materials, as indicated in document ST/ECLA/Conf.15/L.6 on the Latin American petrochemical industry, the secretariat gave the Seminar an approximate indication of the probable distribution of the demand for these products in the various countries. The figures given for each country on finished polystyrene or polyethylene products are the result of detailed studies carried out previously by the secretariat on factors that are likely to affect consumption growth of these products in the seven countries during the decade 1960-1970.

/In this

In this respect, an examination was made, for each one of the countries of present conditions and the future prospects for expanding the domestic processing industry, the state of the equipment in this industry and its projects for expansion, the problems of the domestic supply of resins, the incidence of domestic prices on the development of demand, the substitution of traditional by synthetic materials and the competition between various types of resins. Since 1960, when these studies were carried out, the changes which have taken place in the different factors in each country are bound to have modified the projections indicated in this document.

As regards primary and intermediate products, however, the estimates presented are rather less accurate, the feasibility of various industrial projects in each country with respect to these products being still somewhat uncertain in 1960.

Likewise, chapter 5 of the document on Latin America's petrochemical industry attempts to give a general description of present petrochemical installations and those under construction in the region (see table 10, document ST/ECLA/Conf.15/L.6). This table depicts the situation of the region's petrochemical industry pointing out the principal petrochemical basic raw materials already used there, their origin, and the other manufactures to which they are or will be applied.

It was pointed out in the Seminar that many of the region's petrochemical plants, in operation or being constructed, were planned with a capacity below the minimum economic capacity usually set for of these industries, bearing in mind the investment required to cover production costs, in spite of the fact that in various cases, the total demand of the country concerned exceeded the minimum economic limit. Moreover, there are a number of examples in Latin America of the market being split up as a result of the construction of plants with a combined capacity below what would be considered the minimum economic capacity in the light of the data available on economies of scale.

Adhering to the principles of the economies of scale and the minimum economic capacities set out in the study on the region's chemical industry,<sup>16/</sup> the aforementioned document (ST/ECLA/Conf.15/L.6) endeavoured to describe the position of the petrochemical plants, both in operation and under construction, from the point of view of the probable savings in investment that could have been effected had the plants been established on the basis of a minimum economic capacity.

For this purpose, a selection was made of nine major petrochemical products which usually account for most of the Latin American investments in this sector, and which include polyethylene, a product regarded as representative of synthetic resins and plastics.

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<sup>16/</sup> Op. cit.

With respect to this product, only the plant being constructed in Mexico could offer reasonable prospects in terms of the investment made and its projected capacity. On the other hand, the polyethylene plants operating in Argentina represented a relatively large volume of investment in relation to capacity, particularly if this includes investment in ethylene plants whose capacity is also low. In spite of possible unfavourable economic conditions, Colombia is also endeavouring to install a small ethylene plant producing 16,000 tons annually, 60 per cent of which will be produced by the cracking of ethane. The ethylene will be supplied to a low density polyethylene plant with an annual capacity of 10,000 tons. Venezuela is also considering the installation of a polyethylene plant with an annual capacity of 10,000 tons. This would form part of a large petrochemical complex that would result from the expansion of the present group of plants in Moron through the use of the ethylene obtained in a central unit that produces many of the basic petrochemical raw materials. Chile too, albeit in a rather more preliminary form, is considering the installation of a polyethylene plant producing 8,000 tons annually (see information document N° 7).

As regards the region's new projects or plans for the construction of polyethylene plants of low capacity, it can be seen that because of the lack of a regional integration scheme for the chemical industry, the pressures of domestic demand and the difficulties encountered by various countries in their balance of payments lead to the installation of small plants even though their operating conditions may be relatively uneconomical.

The possibility of developing some petrochemical industries in the region was also analysed 17/ and the installation of plants with at least minimum economic capacity considered, regardless of the size of the domestic markets, but bearing in mind the objectives of the regional integration of these markets.

Thus for the two plastic materials, polyethylene and styrene, the total demand estimated for the markets in Venezuela, Colombia, Peru and Chile would justify the installation of only one plant capable of operating economically. In 1970, in turn, the demand for these products in Brazil would approximately equal what is estimated to be the minimum economic capacity for plants producing these plastic materials. By 1970 the installation of a third polyethylene plant producing at economic capacity might be justified. Its location has not yet been decided, but its output would help to meet the demand of more than one country.

Among the information documents submitted to the Seminar, mention should be made of Document N° 21, presented by Colombia's Instituto de Investigaciones Tecnológicas, a technological research institute. It provides a brief account of the country's chemical industry and the present situation of industrial activities there, concluding with an estimate of what Colombia

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17/ See Secretariat document ST/ECLA/Conf.15/L.6, Chapter VII.

would have to offer in an integration scheme. It also defines some specific lines of possible trade, not only by indicating certain products that Colombia would be in a position to supply to markets of other countries, but also its possible participation in regional programmes.

In the case of plastics, Colombia proposes to introduced into the common market polyethylene, polyvinyl chloride, polystyrene, urea-formaldehyde, phenol-formaldehyde, and melamine-formaldehyde resins, glycerol, phthalic anhydride, DOP and DPB plasticizers and cellophane. At the same time the country would be interested in participating in regional programmes for the manufacture of ethylene glycols, melamine, methanol, methyl methacrylate, nitrocellulose, isocyanate, polyols, maleic anhydride, isooctane, dibutyl maleate, dibutyl fumarate, ethylhexyl acrylate, high density polyethylene and polypropylene.

It was pointed out in a document 18/ that Chile's market would already justify the local production of polyvinyl chloride, polyethylene, and polyester chips, products that would be obtained at a price similar to the c.i.f. value of similar imported products. Regarding the polyesters it is stated too that Chile would be particularly keen to share in any equitable division of the Latin American market or to participate in any specific production of chemicals if such participation proved advantageous to the country, subject to a prior study of each specific case and of the compensation that Chile would either receive or grant as the case may be.

Document N° 25 points out the favourable conditions that Venezuela offers for the development of the petrochemical industry.

Venezuela's present development plant for the petrochemical industry consists of three programmes covering different periods: (1) a short-term plan (1965-66) for the rationalization of the present industry; (2) a medium-term plant (1965-69) of consolidation and moderate expansion; (3) a long-term plant (1965-80) for the dynamic expansion of the industry in order to carry out structural changes in the country's economy.

In order to develop Venezuela's chemical and petrochemical industries efforts are being made to establish the National Council of the Chemical Industry (Consejo Nacional de la Industria Química - CONIQ), an agency which would specialize in rendering advisory services to public and private bodies in this branch of industry and also for studying the policy and procedures which would make such industrial development possible in Venezuela.

Taking into consideration the limited extent to which Venezuela's market is able to absorb the production of economic plants, the document concluded that multilateral agreements should be entered into in Latin America relating to the branches of activity in which each country would engage within the framework of Latin American integration, bearing in mind

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18/ See Information document N° 7.

the comparative advantages to be derived from each. In order to determine these fields of action, the Venezuelan report recommends that the Latin American countries should promote a greater exchange of information within the region, and that ECLA should act as the focal point through which such information would be channelled, distributing it in the form of periodic statistical bulletins, so that the countries may be informed of the development of the region's chemical and petrochemical industries.

Document N° 38, submitted by ECOPETROL, points out in relation to present plans in Colombia, that the plan for the expansion of the ECOPETROL refinery emerged from the study of the markets of various semi-finished products manufactured from such petroleum derivatives as polyethylene, styrene, polyester resins, ethylene dichloride, acrylonitrile, acetone, isopropyl alcohol, polypropylene, etc.

Thus, considering the availability of ethylene and in the light of an analysis of the polyethylene market, bids were requested from various foreign firms in Colombia for establishing a polymerization plant for the joint production of polymers, as a result of which Colombia's State petroleum company formed a partnership with an international firm engaged in this branch of activity to produce low density polyethylene. Each party contributed 50 per cent of the capital. The new company will buy ethylene from ECOPETROL at a price which will depend on the polyethylene sales price. According to estimates made this price should be approximately 5 dollars cents a pound.

The Seminar was also informed, with regard to the development of the petrochemical industry, that Colombia has stipulated that the State company will co-operate fully in the development of this industry in the country, while confining its action to the production of basic raw materials; and should private enterprise be unable to carry out the part of the work relating to synthesis, the state enterprise would assume responsibility for it. ECOPETROL seeks financial and technical co-operation for the manufacture of synthetic products on the basis of partnerships in which most of the capital is held by domestic private interests. If the domestic sector is unable or reluctant to participate, foreign capital would be accepted, on the understanding that its share could be purchased outright after a reasonable period, of time had elapsed, sufficient to guarantee fully the amortization of, and a return on, the investment made. Colombian interests should own at least 51 per cent of the shares in these joint partnerships.

With respect to the situation in Argentina's petrochemical industry, including the manufacture of synthetic resins and plastics, it was reported to the Seminar that at the end of 1964 the country had begun a determined development of this industry as a result of the entry into production of large modern plants, that are petrochemical complexes of considerable size. Only in 1964 did production begin in the following: a joint ethylene-polyethylene plant with an annual capacity of 14,000 tons, a phenol plant, (by chlorination) with an annual capacity of 8,000 tons and a modern installation for naphtha catalytic reforming which is part of a large industrial complex.

/The increasing

The increasing importance of the petrochemical industry within Argentina's chemical industry as a whole can be gauged from its share in the total gross production value of the latter. Actually this share was only 0.22 per cent in 1953, 0.84 in 1958 and a mere 3.55 per cent in 1963. It should be pointed out that only in 1960-63 did it rise from a little more than 1 per cent to 3.55 per cent, showing that the ratio has only recently begun to increase. Nonetheless, the petrochemical industry showed a more dynamic trend in 1953-63 (rate: 39.8 per cent) as compared to the chemical industry as a whole (rate: 5.3 per cent). Thus the outlook is such that the annual sectoral growth rate of 13.7 per cent estimated by the National Development Council (Consejo Nacional de Desarrollo) can be reached in 1965-69 with the help of the petrochemical industry, whose growth rate would be 44.5 per cent.

The considerable supply of raw materials in Argentina ensures a broad area of future growth, which will make it possible to supply not only domestic markets but also those outside the country. It is worth pointing out that the main result of this industrial expansion will be import substitution and the vertical integration of existing industries. At the same time it should be remembered that most of the investment to be made comes from the private sector - domestic or foreign - even though State-owned agencies intend to carry out important petrochemical projects.

With regard to investment in the petrochemical industry it appears from the studies of Argentina's National Development Council (Consejo Nacional de Desarrollo) that a total investment of 185 million dollars will be made within a five-year period, which would lead to import substitution in respect of basic and intermediate products to a value in excess of 160 million dollars in 1969. The total investment required by the projects for petrochemical plants which should be in operation by 1969 amount to almost 265 million dollars, based on the investment figure given by each enterprise when submitting its plans to the National Department of Industrial Promotion (Dirección Nacional de Promoción Industrial).

With regard to Peru the Seminar was informed that plastics was the manufacturing industry which had the highest growth rate in recent years. The demand for polyvinyl chloride, which is supplied entirely by imports, reached approximately 3,400 tons in 1963 representing an increase of 33.1 per cent over 1962. Polystyrene, another plastic used in Peru, is also imported, and consumption amounted to some 1,800 metric tons in 1963, an increase of about 50 per cent over the previous year. In turn, the consumption of polyethylene, which Peru uses for the manufacturing of pipes, lead wiring insulations, household utensils, etc., amounts to approximately 4,600 tons and is also entirely imported. With regard to industrial projects, it is intended to build a polyvinyl chloride plant with an annual capacity of 25,000 tons, some of which would be exported. This project will be carried out by an international company. The projected annual demand in 1967 for the three principal types of plastics would be 9,500 tons of PVC, 7,200 tons of polyethylene and 4,500 tons of polystyrene.

/Regarding the

Regarding the plastics industry in Brazil it was pointed out in the Seminar that lack of capital and of the necessary raw materials is the main reason why the country is unable to meet the domestic demand for plastics. The daily demand for ethylene in 1970-75 is estimated at 500 tons. It was also noted that in spite of the fact that the prices of plastics and resins are relatively high in Brazil, the domestic plastics industry is nevertheless making considerable headway, by reason of the very rapid development of the Brazilian economy as a whole. Since the growth rate of the domestic market is relatively high, little effect has been made to export plastics. Moreover, export prospects are slight in Brazil not only because of existing export regulations, but also because domestic plastics prices are not competitive enough for the international market. A statement was made to the effect that: Brazil should be following the example of Italy, which has adopted a policy of developing this sector of the chemical industry whatever the cost, in view of the potential market for these products.

With respect to the economic integration of the chemical industry, Information document N° 32, Installation of a Petrochemical Industry in a Developing Country, by the French Petroleum Institute (Institut Français du Pétrole) was presented to the Seminar. The French Government had previously submitted this document to the Second Symposium on the Development of the Petroleum Resources in Asia and the Far East.<sup>19/</sup>

Based on the concept of minimum economic capacity the document points out that in the majority of cases domestic demand is still below this capacity, and analyses some hypothetical conditions in which plants could be established with capacities in excess of domestic demand to facilitate trade in products between two countries to the benefit of both.

Among the criteria that would determine the feasibility of projects, the document recommends that, in the early stage of development countries, should limit themselves to the installation of the most profitable projects and should develop their own market through regional trade. This would avoid expenditure of foreign currency on importing products which, although necessary, cannot be manufactured locally under economic conditions. Moreover, it is assumed that in order for a project to be feasible the production cost must in no case be more than 130 per cent of the world price.

Before a programme of this nature can be carried out each country must prepare its own industrial development plan which should cover: (a) the cost of producing a specific product locally if it were decided not to import it, and (b) the price that must be fixed if it is going to be exported. Once the countries know these, they can negotiate with one another on specific

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<sup>19/</sup> Mineral Resources Development Series, N° 18 (Vol. II), United Nations Publication, Sales N° 63.II.F.9.

topics, and this should result in mutual agreements to exchange products by means of intra-regional trade. If industrial development plans are not prepared the discussions are likely to be conducted in somewhat of a vacuum, the advantages to be derived from trade might not be properly understood, and the conclusion of these complementarity agreements might be seriously jeopardized.

The views expressed by the participants and observers in the Seminar coincided with the conclusions reached in the aforementioned document, on the need to evaluate the prospects in each country by means of direct comparison of the domestic plans for the development of the chemical industry.

One participant, commenting on this topic, pointed out that an obstacle to the integration of the chemical industries, would be the failure of most countries to provide a political guarantee in respect of a single project designed to supply a specific product to various countries. For this reason the foreign investor is inclined, on the whole, to set up small plants in each country, rather than build large installations with a view to exporting to other countries in the area.

With respect to plasticizers, information document N° 8 analyses Brazil's market for phthalate ester plasticizers; according to this study, it is estimated that consumption of these products will amount to 30,604 tons in 1968, which would enable Brazil to install a new plant with an annual capacity of 20,000 tons. This would also increase the domestic capacity to produce isoctyl alcohol.

### 3. Man-made fibres

Although the secretariat did not have any specific contribution on plastic materials and synthetic resins for this Seminar it did, on the other hand, receive three reports on the raw materials industry for the manufacture of man-made fibres, which were submitted for the consideration of the participants. These were: La industria de las fibras textiles sintéticas y artificiales en América Latina, by John C. Tallman - E.I. du Pont de Nemours & Company Inc. (information document N° 3), Industria de las fibras textiles, celulósicas y sintéticas en la Argentina, presented by Ducilo S.A.I.C. (information document N° 19) and La industria de fibras químicas en México, by Oskar Hentschel, Celanese Mexicana (information document N° 34).

According to the data compiled in the secretariat document ST/ECLA/Conf.15/L.4) which was submitted to the Seminar, and with respect to recent trends in man-made fibre production in Latin America, estimated on the basis of the annual production value in dollars in 1959-62, the annual growth rate was nearly 15.2 per cent in the group of seven countries mentioned in the document (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela). In 1959 the production value was 152 million dollars, or 8.6 per cent of the total value of the chemical industry's output in the seven countries. In 1962 the figure rose to 233 million dollars.

/Regarding import

Regarding imports of man-made fibres in Latin America as a whole, almost 33 million dollars worth were imported in 1959, i.e. 3.8 per cent of the region's imports of chemical products, while in 1962 these imports reached 59 million dollars, or 5.6 per cent of the total imports of chemical products. Thus man-made fibre imports increased at an annual rate of 21.0 per cent.

With respect to the apparent consumption of man-made fibres in the seven countries, the aforementioned report points out that in 1959 it amounted to 197 million dollars, (7.5 per cent of the total consumption of chemical products), rising to 307 million dollars (9 per cent of total consumption) in 1962 for an annual growth rate of 15.8 per cent.

According to this document import substitution of these fibres has already reached a rate of approximately 85 per cent in the seven countries.

In view of the diversity of synthetic fibres manufactured at present and the keen competition between such fibres and the artificial fibres made of cellulose, and considering also that the market for most of these fibres is still being formed, it is very difficult to project the demand for some of the products in this branch of industry.

The study on the chemical industry in Latin America,<sup>20/</sup> which was prepared by ECLA in 1960-61, has a chapter on consumption projections for Latin America by types of products, in which an attempt is made to estimate the probable demand for the main synthetic fibres, bearing in mind the expectations of producers in the countries concerned, the growth of consumption in recent years and the income-elasticity characteristic of this type of product, as registered in each country. These ECLA projections were compared with others carried out by Dupont de Nemours in 1964 (see information document N° 3). Taking the actual consumption for 1963, the Dupont projections are on the whole more conservative than those of ECLA and the differences nearly always relate to Argentina and Brazil, since ECLA's estimates were worked out before certain developments (political crises, inflation, etc.), produced a delay in the execution of the plans for expanding the industry in these countries.

From the impressions gathered in the Seminar on this branch of industry, Latin America's cellulosic fibre industry seems to have reached a state of maturity. Only a slight increase is expected in consumption and it was pointed out that the construction of new plants appears to have been suspended. The principal consumer countries of the region are essentially self-sufficient, and imports have dropped.

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<sup>20/</sup> See document E/CN.12/628/Rev.1, United Nations publication, Sales N°: 64.II.G.7.

On the other hand, the region's consumption of non-cellulosic synthetic fibres is increasing rapidly, specially in the countries that produce them. The typical curve of consumption growth in non-cellulosic synthetic fibres shows an increase as soon as domestic production is started. Although data on the installation of new plants in the region is lacking, it is estimated that, compared with 1962, the consumption of polyamide fibre will be 55 per cent greater in 1965 and three times higher in 1970.

Polyester fibres are developing rapidly, and by the end of 1965 there should be production plants in five more countries, besides Brazil and Argentina which have been producing since 1963. Almost all Latin America's polyester consumption will be of staple fibre, principally to be blended with cotton, viscose, or wool. The use of polyester fibres to improve the quality of these natural fibres will increase in Argentina, Brazil and Mexico.

The lack of regional production of polyacrylic fibres has made the consumption of this fibre increase far more slowly than that of the polyamide or polyester fibres. Its production has not yet begun because the technology of dry spinning does not permit economic production of polyacrylic fibres in small scale plants. The minimum economic capacity of a polyacrylic fibre plant is around 5,000 tons yearly.

Latin America's basic requirements of synthetic fibres was satisfied by imports from the United States, Europe and Japan, which caused keen competition between foreign suppliers. Domestic manufacture began with rayon and acetate, and then included polyamide and polyester fibres. Most of these plants were using foreign technology and many were partially or entirely owned by foreign companies. Although the domestic installations were generally small and their production costs therefore high, they were able to replace most imports through different types of governmental protection. In some cases, tariff charges as high as 150 per cent of the value of the merchandise allowed the domestic producers to monopolize the market in their own countries, although their prices were considerably higher than those on the world market. On the whole, such restrictions were applicable also to all the synthetic fibres from Latin America. For this reason regional trade in domestically produced synthetic fibres developed very little.

As regional trade in chemical products increases, it is assumed that trade in man-made fibres will be more and more in the hands of producers best equipped to resist competition. On the whole, these are the large companies with the lowest production cost, which enable them to offer a broad range of fibres and packagings, to produce better quality fibres and to provide clients with competent technical services.

/It was

It was pointed out in the Seminar that production scales would be the most important variable for fibre producers in establishing a competitive position. Gradually the small fibre producers whose production costs are high will be in danger of losing their domestic markets to the more efficient producers from other Latin American countries. In 1965 the average annual capacity of the region's fibre plants will be only 5,400 tons for rayon and acetate, 2,300 tons for polyamides and 1,600 tons for polyesters. A few large installations (5,000 to 10,000 tons a year) raise these averages. There are some plants in the region producing polyamide fibres and polyesters whose annual production capacity is less than 1,000 tons. These small scale operations, according to the information presented at the Seminar, will be severely affected by the fact that at least 1,500 dollars must be invested in the production of each ton of fibre, and also because their production costs exceed by no less than 300 dollars per ton the costs of plants operating at greater capacity and efficiency.

It was also pointed out that as intra-regional trade is carried on, the small fibre plants will have to choose one of the following courses: expansion towards a more economic size, association with other fibre producers, merger with consumers of finished product or possibly the diversified production of special fibres in limited volume and at high prices.

In certain countries of the region some of the raw materials for the intermediate chemical products required in the production of synthetic fibres can now be obtained locally. Some of the large Latin American chemical companies already have the economic resources and technical know-how necessary for the installation of these plants. The plants producing intermediate products would have to be sufficiently large to allow their products to compete against imports, without needing excessive tariff protection. As an example of integrated industries it was pointed out in relation to nylon salt 66 that the manufacture of adipic acid might be envisaged in Argentina and hexamethylenediamine in Brazil in plants of economic sizes. This would generate trade in these intermediate products between the two countries.

The Seminar was informed that since the last three months of 1964 Brazil has been producing nylon salt 66, based on adipic acid obtained from the domestic production of phenol and imported cyclohexanol; the hexamethylenediamine is made from adipic acid, ammonia and nitric acid which are also of domestic production. It was pointed out regarding nylon 6, that at the beginning of 1965 caprolactam would be polymerized in Brazil where nylon 11 (rilsan) has been produced for many years.

Reference was made to the studies that Colombia is carrying out on the production for regional export of certain types of synthetic fibres in plants of economic scale.

/Lastly in

Lastly in the discussions on this branch of industry, it was pointed out that to improve the economic conditions of the existing fibre plants - as far as economies of scale is concerned - measures might be adopted along the following general lines:

(a) Cellulosic fibres

On the whole the shortage will be felt throughout the region, and will apply as much to acetate as to viscose. This deficit should be met by the expansion of existing plants, especially the smaller ones, which would improve their competitive position, unless, by reason of their location, efficiency and influence on the price levels of certain areas, etc., it might be more advisable to enlarge a few plants that have better operational facilities.

(b) Polyamide fibres

The 40,000 ton deficit represents two-thirds of the production capacity foreseen for 1970. Here too the main attempt must be to enlarge existing installations.

(c) Polyester fibres

In view of the small capacity of the plants, efforts should be initially concentrated on enlarging existing units and later, depending on demand and bearing in mind the probable deficit, consideration should be given to the installation of new plants in carefully selected locations.

(d) Polyacrylic fibres

A consumption of 22,000 tons is foreseen in 1970 and only Mexico has a project for the installation of a plant. The production of this fibre should be studied within the framework of a regional market, which would make it possible to establish conveniently-located plants of economic (5,000 tons capacity).

(e) Raw materials

As regards the raw materials required for the manufacture of these fibres it appears that in 1970 Mexico will be able to produce the requisite materials, except for alpha-cellulose (pulp for dissolving) which would have to be imported, possibly from the region, to the extent of 20,000 to 25,000 tons approximately. On the whole it seems that it would be possible to obtain complementarity in the supply of raw materials on the regional level.

Since it is of great interest to attain a healthy regional development of the artificial fibre industry, it was suggested to the Seminar that:

/(i) artificial

- (i) artificial fibres should be considered among the products worthy of detailed study by reason of their significance and potential in the regional integration of the chemical industry;
- (ii) this study should include a revision of the current estimates of probable future consumption and should define the characteristics of present projects for manufacturing artificial fibres;
- (iii) consideration should be given to the possibility of taking advantage of increased consumption in order, first of all, to install new units of adequate size and convenient location;
- (iv) this study should include workable recommendations about raw material trade for fibre production, including alpha-cellulose;
- (v) trade in certain types of fibres should be promoted through a possible specialization of production, and the advantages deriving from the economic integration of this branch of industry should be pointed out.

#### 4. Synthetic elastomers and carbon black

Unfortunately there were no information documents submitted to the Seminar specifically concerned with the production of and market for synthetic rubber in Latin America. The discussions revolved around the concepts expressed in the documents on the development of the region's petrochemical industry.

Natural or synthetic rubber is mainly used in the production of rubber tyres and inner tubes; its proportion in the consumption of raw materials in this industry varies from country to country, but on an average it ranges from a minimum of 70 per cent to a maximum of 92 per cent. There was hardly any synthetic rubber produced in the region in 1959 but production has already begun of carbon black (the oil black type) in Brazil. The region's production of synthetic rubber of the SB-R type was begun by a State enterprise in Brazil only in 1962 in a plant with an annual capacity of 40,000 tons.

Since then, various other projects for the manufacture of carbon black have entered into production in Argentina, Mexico and Venezuela, and at present new synthetic rubber plants are being constructed in the first two countries. In Brazil a second stereo-isomer (cis-polybutadiene) plant is being constructed utilizing the surplus from the production of sugar cane alcohol.

The production value of synthetic rubber, carbon black and allied products in the seven countries, which was only 2.4 million dollars in 1959, rose to 19.4 million dollars in 1962 when the SB-R plant in Brazil and the various installations for carbon black in the other countries entered into production; this increase corresponds to 0.8 per cent of the total production value of the chemical industry in these countries. (In 1959 the production value of this group was only 0.1 per cent of the total production.)

/Imports for

Imports for the region as a whole reached an approximate value of 45.2 million dollars in 1959, rising to 63.7 million dollars in 1962 which corresponded to an annual cumulative growth rate of only 12.2 per cent.

With respect to the consumption of these products in the seven countries mentioned earlier, while the apparent consumption was 41.9 million dollars in 1959, this figure was doubled in 1962, reaching 83.2 million dollars, which corresponds to an annual growth rate of 26 per cent. The import substitution position of the seven countries has changed. While in 1959 production managed to meet only 6 per cent of the consumption of these products, by 1962 this figure had gone up to 26 per cent. It is worthwhile to underline the situation in Brazil where in 1959 25 per cent of the imports of this item had already been substituted by domestic production. In 1962 this reached 58 per cent.

With respect to this branch of industry, the ECLA study on La Industria quimica en América Latina 21/ has endeavoured to project the demand for the principal types of rubber for 1965 and 1970 in the various countries, bearing in mind the projected growth in the motor vehicle inventory of each country. In recent years consumption of synthetic rubber for uses other than manufacturing tyres and liner tubes has increased more rapidly than demand in the motor-vehicle industry and it is estimated that in the next years the growth rate of rubber consumption, apart from the tyre industry, will tend to decrease because of the competition of the various synthetic resins.

For this reason, it was considered that the projections made previously by ECLA were still valid when the Seminar came to examine the situation of this branch of industry.

In order to project the demand for synthetic rubber, as has been done in the aforementioned study, it was first necessary to project the over-all consumption of this raw material - natural or synthetic - and then to consider its division into the various types of rubber. The forecasts for future distribution were based mainly on the situation recorded in more developed countries and on studies carried out in these countries on the future trends of rubber consumption. The properties of the SB-R rubber (styrenebutadiene) make its use preferable to natural rubber in 40 per cent of its applications. In the 30 or 35 per cent of its other uses, the choice between one or another type of rubber would depend on the price, on the lay-outs and the equipment of the tyre-producing industry and the availability of tyres at a given moment. In the 30 to 40 per cent of its remaining uses SB-R synthetic rubber cannot satisfactorily take the place of natural rubber.

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21/ See document E/CN.12/628/Rev.1, United Nations Publication, Sales No 64.II.G.7.

As the aforementioned ECLA document made clear, it can be foreseen that the region's natural rubber import substitution by locally made synthetic elastomer, which is necessary to obtain substantial savings in foreign exchange, will encourage the consumption of a larger proportion of domestically made synthetic rubber.

The recent technological advances as regards the manufacture of the types of stereo-isomer synthetic rubber (cis-polybutadiene) and polyisoprene, with the consequent reduction in their prices and their improved competitive position in relation to natural rubber, suggest that the region's demand for these products will also increase, albeit at the expense of the long established co-polymer styrene-butadiene. (SB-R)

For this reason, some countries like Mexico and Argentina are constructing SB-R rubber plants while at the same time Brazil is installing a cis-polybutadiene plant and Venezuela is planning one for polyisoprene.

The Seminar was informed that the plant being constructed in Mexico will have an annual capacity of 40,000 tons of SB-R and that the choice of this type of rubber was preceded by painstaking studies on Mexico's market, which indicated an annual requirement of 30,000 tons of SB-R in 1966. Some 80 per cent of the materials and equipment has already been acquired for this plant, and it will include the styrene but not the butadiene unit and is scheduled to enter production by the middle of 1966.

It was remarked that Argentina's total consumption of rubber will exceed 55,000 tons in 1964; of these, 45 per cent will be of the various types of synthetic rubber and the remaining proportion of SB-R rubber. Based on the projections carried out in Argentina it is estimated that the demand in 1969 will be from 70,000 to 71,000 tons, 54 per cent of which will be synthetic rubber. The San Lorenzo SB-R plant should begin producing in 1965. The styrene required will have to be imported. With respect to the cis-polybutadiene project in terms of the evolution of demand, it was decided that it would probably be more advisable to produce butyl rubber with a capacity not yet determined. It was recognized that the SB-R plant being constructed in Argentina would have a surplus to export to the Latin American market up to 1969.

With respect to the production of carbon black in Argentina, the Seminar was informed that the proposed plant for the petrochemical complex in San Lorenzo would produce styrene with an initial capacity adequate to meet domestic demand.

The present correlation in Argentina between the demand for rubber and carbon black led to the deduction that when the production of carbon black was doubled, the country would be able to have surplus of this product available for export, and this has already been occurring since 1964.

The Seminar was informed that the SB-R plant operating in Brazil has a nominal annual capacity of 40,000 tons, but that its working capacity is 4,000 tons monthly. Styrene and butadiene are imported at present. This will continue until the butadiene plant is constructed and a decision is taken on the technological process to be adopted for the production of ethylbenzene for the manufacture of styrene.

At the same time the production of styrene-butadiene latex is being considered as well as that of acrylonitrile rubber for special uses in the motor vehicle industry.

The Seminar was also informed that Mexico is already manufacturing styrene-butadiene latex at an annual rate of approximately 3,000 tons which will rise to 6,000 tons in 1970. The present annual demand in Mexico for butyl rubber is 6,000 tons, with an estimated demand for 18,000 tons in 1970 which is still below the capacities economically advisable for the manufacture of this type of rubber.

The Seminar was informed with regard to Colombia that the present annual demand for rubber is 17,000 tons and that in general Colombia offers an attractive market for future production from other countries of the region. The consumption of synthetic rubber in Colombia is distributed as follows: more than 50 per cent in the tyre industry, somewhat more than 18 per cent in the rubber footwear industry and 31 per cent in miscellaneous consumption.

#### 5. Alkalis and chlorine derivatives

The studies on the sodium alkaly group that were submitted to the Seminar covered the following subjects: Los álcalis sódicos, H. Duran-Chastel (Sosa Texcoco) (Information document N° 11), Cloro y derivados clorados, B. Argáandar (I.Q. Pennsalt S.A.) (Information document N° 13), Situación del sector de álcalis en México, (Nacional Financiera S.A.) (Information document N° 24), Informe sobre la industria de álcalis en Colombia, C. Gómez Z. (Colombiana de Soda) (Information document N° 33).

In addition, the secretariat document Desarrollo de la industria de álcalis sódicos en América Latina (ST/ECLA/Conf.15/L.5) examined the situation in the region as regards the production, import, projected capacity and the development that is required in the next ten years and studied the possibility of directing the required expansion of this industry towards large plants each intended to meet an important portion of the region's demand.

The situation in this sector, which is described in the aforementioned document, can be broadly summarized in the following figures:

Table 1

LATIN AMERICA: TOTAL CONSUMPTION OF SODIUM ALKALIS, 1958-63

(Thousands of tons)

1958	738	1961	930
1959	851	1962	1 002
1960	810	1963	1 090

/The consumption

The consumption recorded for 1963 is a preliminary estimate based on partial figures presented in some of the aforementioned documents.

There is still considerable need for the region to import products. Thus, the region's production of caustic soda was only between 50 and 52 per cent of its consumption (1960-64) in spite of the fact that the installed production capacity was close to 350,000 tons by 1963 compared with an estimated consumption of 555,000 tons and a production of only 280,000 to 290,000 tons. While some countries like Mexico showed a strong trend towards self-sufficiency, others on the contrary increased their imports as a result of a substantial increment in demand. Brazil and Colombia are cases in point.

An analogous situation can be seen in the case of soda ash, more than 55 per cent of its consumption being imported (74 per cent in 1959). However, between 1959 and 1963 imports were relatively lower and production doubled.

Although the plans and projects being implemented signify an appreciable increase in production capacity of alkalis which should total approximately 1.1 million tons towards 1966-67, it would still be advisable to speed up this industry's development at a regional level in order to satisfy an over-all demand estimated at 1.66 million tons in 1970. The deficit shown by these two figures may perhaps be really larger, since presumably the existing plants and those to be installed would not use, at least at this date, more than 80 to 85 per cent of their nominal capacity. If the intention is to programme the subsequent development stages of this industry with an optimum criterion, consideration would have to be given in the projects to be prepared in the next decade to the advantages the region is expected to derive from the increase in unit capacity. An attempt to weigh these advantages, which derived as much from the lower volume of investments as from lower costs, is presented in the final chapter of the aforementioned document, with the technical reservations advocated in the Seminar during the debates on this branch of the chemical industry. These are: the necessity of basing the development of electrolytic soda on the increased demand for chlorine; the possibility that medium-size plants may supply soda in solutions to a domestic market in order to save on the costs incurred by the concentration of the product, which is indispensable in plants whose output is to be exported to the Latin American market.

The information documents on the situation in Mexico presented a detailed picture that included medium-term projections for the expansion and development of the consumption up to 1974 (Information document N° 24, Situación del sector de álcalis en México); the characteristics of the alkali industry and especially of the soda ash industry were analysed in Information document N° 11, Los álcalis sódicos, while information document N° 13 made a special study of the present and future development of the chlorine industry and of its derivatives. This document set forth, in broad terms, the problems presented by the new investment projects in the region, and pointed out the need to plan the concessions granted within the framework of ALALC.

Information document N° 33, Informe sobre la industria de álcalis en Colombia, examined the situation in Colombia, making a detailed analysis of the development of domestic demand up to 1968, and the export possibilities offered by the new plants now being planned. By 1968 30,000 tons of surplus soda ash would be available annually in Colombia for export; its production capacity of caustic soda would still leave a deficit of approximately 19,000 tons. The project of the Solvay plant in Cartagena, which will have a total daily capacity of 320 tons towards 1968, will be supplemented by an electrolytic plant with a daily capacity of at least 50 tons, which would have new markets for the by-product, chlorine, related to the projects for the production of vinyl chloride and other derivatives. Lastly, a review was made of the favourable conditions for the supply of raw materials (salt, limestone, natural gas) thanks to which Colombia will become an exporter within the region at competitive prices.

Information document N° 24, prepared by Nacional Financiera, examined the development of Mexico's alkali industry which, as in Colombia, aims to transform the country into exporter of soda ash beginning in 1967-68, based on surplus capacity of 110,000 tons in 1969 and 29,000 tons in 1974 over and above domestic demand. The country should, on the other hand, either expand its production capacity of caustic soda or resort to imports if it is to supply some 20,000 tons annually in 1970 and some 86,000 tons annually by 1974. However, these figures are based on the assumption that from the beginning of 1968, the production of electrolytic caustic soda would be limited to 86,000 tons by the real demand for chlorine, despite the fact that nominal production capacity will be larger. The study also endeavours to compare the sodium alkali sector in Mexico with that of the other Latin American countries, emphasizing the sales prospects for soda ash in the region. When the known new projects are weighed against the estimated development of demand, it will be seen that regional capacity will show a deficit of 257,000 tons in 1969 and approximately 600,000 tons in 1974.

Both figures agree, on the whole with the conclusions reached in the document submitted by the ECLA secretariat,<sup>22/</sup> which estimates that the regional deficit of soda ash will be 280,000 tons in 1970 and 515,000 tons in 1975. As estimated in this study demand by 1974-1975 will be below the figures given in the Mexican study, especially in Argentina, Brazil, Chile and Colombia, for which demand is estimated at 1,030,000 tons compared with 1,278,000 for the seven countries with the most demand. The comparative costs established in the aforementioned document (Information document N° 24, diagram 20) indicate that a location in Mexico would be most advantageous from the point of view of costs. However, these estimates must be considered merely as approximate since their manpower cost and capital return assumptions are based on the criteria followed in previous ECLA studies <sup>23/</sup>which show differences valid in 1959-60 but obviously not entirely applicable today.

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<sup>22/</sup> ST/ECLA/Conf.15/L.5, op. cit.

<sup>23/</sup> La industria química en América Latina, op. cit.

Information document N° 11, Los álcalis sódicos, submitted by Mr. H. Durand-Chastel, stresses the fact that the soda ash industry is sensitive to the economies of scale and the increasing share of natural trona salt deposits in world production, because its extraction requires less investment than the equipment used in Solvay manufacturing process based on salt and limestone. The author estimates <sup>24/</sup> that "other than in exceptional cases it will not be possible to export surplus production (in the large plants required by the economic characteristics of the process) due to the keen international competition for soda ash being waged by powerful companies who control the world market through plants whose daily capacity is some 2,500 tons or more; these plants are entirely amortized and their capital costs are less than those prevailing in Latin America". The analysis concludes by stating that large markets should be established and part of the soda ash obtained in large units should be used, at least initially, to produce chemical caustic soda, thus reducing the caustic soda deficit and making it possible to effect the economies of scale which are indispensable in soda ash plants.

Information document N° 13, Cloro y derivados clorados analyses the region's projections of demand for chlorine and its principal derivatives, and compares them with the past trend in the United States. Similarly, the concessions granted in respect of chlorine derivatives by ALALC up to its third session are studied, as well as the obstacles to the development of this industry created by the present system of concessions since on the whole these concessions are mainly solicited to protect existing production and are not the result of a general planning of the chemical industry geared towards a balanced regional development.

Statements made by participants in the Seminar provided a critical examination of the growth rates in alkali demand and it was agreed that the consumption of caustic soda is increasing more rapidly, at a rate in excess of 8 per cent annually, especially in Colombia, Mexico, and Venezuela.

The problem of the use of chlorine and the explosive growth of its market in the near future was referred to in several statements. In some, attention was drawn to the possibility of achieving a market situation that would justify the production in Latin America of soda ash based on the carbonization of electrolytic caustic soda, as is taking place in the United States. It was recognized, however, that this practice would not be applied in the near future since the demand for chlorine is still far below the amounts obtained from it in the present electrolytic industry, in spite of the fact that the total cannot even satisfy 50 per cent of the caustic soda demand.

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<sup>24/</sup> See Information document N° 11, page 18.

Similarly, some participants questioned the advisability of increasing the size of the electrolytic installations producing soda and chlorine since the high freight rates would raise the c.i.f. price of the products to be exported to the neighbouring countries in the region, in an amount in excess of the economies of scale obtainable through the concentration of the means of production.

In the case of soda ash, on the other hand, economies of scale play an unquestionably important role which, together with the low costs of raw materials (salt and limestone) in specific locations, would justify every attempt being made to concentrate production. In this respect, it was considered desirable that capital from the non-producer countries should be brought into the new enterprises to be established in the countries which have an available supply of raw materials. Such participation would be in proportion to the volume of these products imported by the associated country. Mention was made of the capacities that the new projects in Colombia and Mexico would reach in the production of soda ash and their position as exporters.

The organization of a steady trade in this product should be based on methodical studies to determine what would be the best structure, i.e. the various practical means by which the demand for caustic soda can be met, whether by electrolytic or chemical methods, etc., tariff modifications they entail, and the consistent development of the regional market.

Several participants mentioned some of the problems which had arisen in recent years. For example, they pointed to the difficult position of the electrolytic industry in Argentina which cannot make full use of its installations because of the small market for chlorine. It is estimated that this will no longer be the case by 1970-75, when new industries - plastics, etc. -, enter production and require a greater volume of chlorine. Several studies have been conducted on the installation of a plant producing soda ash in the south of the country, and plans to construct it, with an annual capacity of approximately 200,000 tons, have reached an advanced stage. In order to reduce the cost of the limestone that would be used, it is proposed to combine this plant with a cement factory that would exploit the limestone deposits in the selected area. Mention was also made of the excellent resources in Chile, which were analysed in studies carried out some years ago in connexion with the installation of a soda ash plant in the northern part of Chile. However, domestic demand in the country did not warrant production for the internal market alone, since investment would be prohibitively large for medium - or low - scale production, which would offset the initial advantages derived from the quality and volume of the available reserves of salt and limestone. Reference was made to the factors limiting the development of Brazil's production of soda ash. It was pointed out that a whole set of problems relating to the supply of the existing plants have resulted in the freezing of additional investment funds and in the weakening of this industry. Apparently this cannot be remedied simply by expanding existing production capacity and Brazil will have to consider the installation of another production plant or continue to import an increasing proportion of its soda ash requirements.

The cost of concentrating the solutions obtained through electrolysis is considered to be one of the more serious drawbacks as regards the intra-regional exports of caustic soda. Such concentration is not essential when the market to be supplied is within easy reach of the producers. Thus, this feature of the caustic soda industry, added to the export freight surcharges, would render illusory any attempt to centralize the industry with a view to establishing large regionally integrated plants. On the other hand, as the electrolytic process permits lower economies of scale than in other basic chemical industries, it is perfectly feasible for plants with an annual capacity of 10,000 tons or less to operate economically.

The close link between the recent development of the petrochemical products - many of which provide chlorine derivatives which are in increasing demand, such as plastics, pesticides, solvents, fibres and synthetic resins; etc. -, and the electrolytic industry producing the necessary chlorine, would justify every effort being made to exchange information. This would make it possible to correct the estimates made of the growth in the consumption of these products, data which are usually scant and hardly ever complete. An attempt should be made to achieve greater trade in chlorine products in order to achieve a rapid expansion of this market throughout the region.

#### 6. Dyes and pigments

The Seminar received only one information document on synthetic dyes, N° 16, El mercado de colorantes y su fabricación en América Latina, which was introduced by its author. The Seminar was informed that centuries before the scientific process for the manufacture of synthetic dyes was developed, Latin America had already been supplying Europe with such dyeing agents as woods, plants and insects. More than a century ago, when the production of synthetic dyes began, the Latin American countries which had previously been raw material producers became importers of dyes.

The synthetic dyes brought about a rapid and profound change in dyeing processes, at the same time that thousands of types of dye were being developed as well as 3,000 chemically distinct products. These thousands of dyes come under at least 10,000 commercial trademarks available on the market for different uses or in various concentrations.

The region's synthetic dyes industry began in Brazil shortly before the First World War. Later, other plants were installed in Argentina, Chile and Mexico. The existing plants in the four countries produce practically all types of dyes which are in large demand, including fast dyes of the Indanthrene type.

This industry is one of the most complex branches of the chemical industry and the one most dependent on initial technical know-how. At the same time it constantly requires technical assistance, not only for the production process itself but also in the application of its uses.

/The dyestuffs

The dyestuffs industry requires intermediate products as well as raw materials like sulphur and auxiliary products like acids, alkalis, etc. The indispensable condition for the manufacture of intermediate products is the existence either of a well developed steel industry producing large quantities of coke and making use of coal tar products (benzene, toluene, naphthalene, anthracene, etc.) or a developed petrochemical industry that can manufacture the same basic products of the aromatic variety for use in the manufacture of intermediate products.

Brazil is the only country which manufactures some of the principal intermediate products like benzidine, H acid, metalinic acid, ortho-tolidine, aminoanthraquinone and various others.

Although intermediate products are important for the manufacture of synthetic dyes it was pointed out in the Seminar that establishment of a dyestuffs industry would be warranted in a country even if it did not yet produce the corresponding intermediate products, which in certain cases are most valuable chemical products and fairly abundant on the world market.

The value of the synthetic dyes produced in the past few years in the four countries mentioned, i.e., Argentina, Brazil, Chile and Mexico was approximately 11 million dollars while consumption in these countries amounted to about 32 million dollars.

It is interesting to note the observation made in the Seminar on the region's per capita consumption of dyes in comparison with that of some European countries. Thus in Switzerland, for example, annual per capita consumption and value were about 1 kg and 2.70 dollars respectively, compared with only 71 grammes and 0.21 dollars in Latin America. The per capita consumption of Chile and Argentina, the highest in the region at 120 and 113 grammes respectively, carries considerable weight in this average.

Information document N° 6 was the only paper on pigments presented to the Seminar. It analyzed the situation of Brazil's market for titanium dioxide and the possibility of manufacturing this pigment in the country with a view to supplying the needs of the domestic market. Demand in 1970 is estimated at 18,660 tons, which will be substantially increased if titanium dioxide can be produced in the future on a competitive basis as regards prices and quality and therefore be in a position to take the place of other white pigments. Brazil will require 8.3 million dollars worth of titanium dioxide in 1970, i.e. 39.6 million dollars for the period 1964-70. The installation in Brazil of an integrated titanium dioxide plant producing 20,000 tons a year will require an investment of 15.5 million dollars, which proves that apart from being necessary, such an installation would be completely justifiable from an economic standpoint.

## 7. Synthetic detergents and other chemical products

In addition to the secretariat reports (documents L.3, L.4 and L.6) which analysed in broad outline the region's prospects for the development of the chemical industry producing synthetic detergents and other chemical products, only one information document, N° 18, was presented to the Seminar on the synthetic detergent industry in Latin America, which was prepared by the California Chemical Pan American Company.

The consumption of detergent preparations in the seven countries mentioned earlier was 13 per cent of the total volume of soaps and detergents at the end of the fifties, a rate of substitution similar to that of Europe a little before 1950 and the United States in 1947-48. The rapid substitution of soap by detergent preparations in the more developed countries can be attributed to the real technical and economic advantages accruing from the use of detergents in the products prepared for household and industrial washing. Some countries of the region already have a high percentage of substitution. For example, the level of substitution in Mexico and Venezuela is over 30 and 50 per cent, respectively.

In the other countries, the substitution process of soap by detergent preparations was begun in the last decade and has reached figures that vary between 12 and 16 per cent of the total of soaps and detergents (Colombia, Chile and Peru). The substitution level is similar to that of Europe in 1947-49 and points to the likelihood of a proportionate evolution in the next ten years.

On the other hand, the countries that have unavailable supply of fats on favourable terms, together with a well developed soap industry, only recently began to show interest in detergents, in many cases following the introduction of foreign capital and technology intended to promote its production.

According to the data compiled in the secretariat document (ST/ECLA/Conf.15/L.4) presented to the Seminar, it was noted with respect to the recent evolution of the synthetic detergent production in the region, evaluated in terms of the annual production expressed in dollars, that the annual growth rate in the seven countries was nearly 16 per cent in 1959-62. In 1959 the value of this production was 65 million dollars, which represents 3 per cent of the total production value of the chemical industry in the seven countries concerned, rising to 102 million dollars in 1962.

It was observed that while in 1959 the apparent consumption of synthetic detergents was 73 million dollars (2.8 per cent of the total consumption of chemical products), in 1962, it reached 126 million dollars (3.7 per cent of the total consumption) implying an annual growth rate of 19.9 per cent.

/According to

According to the aforementioned document the seven countries' import substitution of synthetic detergents amounts to approximately 90 per cent.

Regarding the other chemical products grouped in the Seminar under "Other products" no specific report was presented nor did the participants have much to say about them during the discussions.

#### D. EVALUATION OF THE POSSIBILITIES OF AN INTEGRATED REGIONAL DEVELOPMENT OF THE CHEMICAL INDUSTRY

In this item of the agenda endeavour has been made to review the arguments underlying the proposals for the inclusion of the chemical industry within a system of market integration, as well as to evaluate the possibilities in this respect, already mentioned in discussing the specific products and the difficulties of reaching the desired target.

The arguments in favour of adopting a regional integration approach to the development of the chemical industry have been presented in the secretariat document Las industrias químicas y la integración económica regional (ST/ECLA/Conf.15/L.8). The advantages to be obtained from the integration of the chemical industry can be summarized as follows:

1. Savings in production costs, resulting from:

- (a) Choice of site, that is the advantages of better location of production activities in terms of the cheapest sources of raw materials, energy, fuel and other inputs that make up much of the production costs;
- (b) Better use of capacity both in the existing plants and in those to be constructed;
- (c) Raising the level of operational efficiency in existing and future plants;
- (d) More economic scales of manufacture, in light of the relation between plant size and costs for individual production lines.

2. Investment savings resulting from:

- (a) Adoption of scales of manufacture at least equal to the minimum economic scale for each particular product and rising progressively to scales closer to the optimum economic scales found in the more industrialized countries;
- (b) Accumulation of external savings and utilization of the savings that may be derived from concentration of the chemical industry in multiple production "complexes".

/3. Increase

3. Increase in the available supply of foreign exchange, as a result of:
- (a) More rapid import substitution at the regional level, made possible by the increase in production generated by the dynamism deriving from the above-mentioned factors, especially in so far as it could be achieved with the same total investment, in view of the appreciable rise in the product/capital ratio linked to the more efficient utilization of the investment made in the region each year;
  - (b) Increased foreign exchange earnings resulting from a rise in exports to the rest of the world, in the wake of the greater efficiency and lower costs brought about by the structural changes in the industry.

The subsequent chapters of the aforementioned document analyse each factor mentioned, attempting to express in figures, with the help of illustrations, the economies of scale in the production costs and in investment. The topic of economies of scale, basic to the ECLA approach to the integration of the chemical industry was dealt with extensively in the ECLA report, La industria química en América Latina which was also submitted to the Seminar.

The significance of economies of scale in the development of the chemical industries and in the regional specialization resulting from trade liberalization was the subject of careful consideration in the Seminar when different but not necessarily conflicting opinions were expressed.

In fact, the influence of economies of scale in determining the location of chemical production activities depends on various circumstances, the effect of which is not always the same.

On the one hand, the influence of economies of scale on costs is much more marked in the heavy chemical products - basic raw materials and intermediate products - than in those falling more into the category of end goods. In the former, the capital charges usually represent 40 to 55 per cent of the costs, a proportion which is much lower in the latter. But these same heavy products have a relatively low value per ton, and consequently their price is much more sensitive to transport costs. The products of large-scale regional plants, which are intended to supply several countries or the whole region at once, will necessarily have to contend with long distances and high transport costs - the larger the plant and the more scattered the markets the higher the transport cost. For this reason, in extreme cases, the transport cost for integrated consumer markets may well offset the economies of scale obtainable in an ideally located large-scale regional plant. Although this undoubtedly applies only to extreme cases, the ECLA studies confirm its possibility with data on costs, scales and alternative locations. This was mentioned by a participant, when referring to a comparison of costs between an ammonia plant of 200 tons/day, located in Brazil and using expensive raw /materials, and

materials, and another located in Venezuela with cheaper raw material producing 400 tons/day. This calculation shows that the transport costs influence the product's value to such an extent that it is more economical for Brazil to produce ammonia domestically with high-cost raw materials in a smaller plant. However, it was pointed out that the same ECLA data show that transport costs do not have the effect of cancelling out the economies of scale in other situations relating to the same product and the same locations. This implies that integration in such cases must be based upon arguments other than those relating to costs and which should be acceptable for all the countries concerned. If not, it must be conceded that regional specialization of products of low unit value in an area where transport costs are high, would not hold out great possibilities.

What are these other arguments unrelated to comparative costs? This was hardly touched upon in the Seminar, but mention can be made here of the more detailed discussions contained in the documents ST/ECLA/Conf.15/L.3 and N° 28. Regional integration can be justified not only on the grounds of costs but also on those of maintaining a regional balance in investment distribution or in the promotion of trade, as part of an over-all approach to economic development and regional trade based on reciprocal concessions. A detailed consideration of these points was clearly beyond the scope of the Seminar.

On the other hand, as regards economies of scale, another point of view was given that will bear considerable weight when the countries concerned come to consider and negotiate specific integration schemes. According to this view, a comparative analysis of the production costs in alternative locations should include special emphasis on whether or not the equipment in question is produced in the country being considered as a possible location for the industry concerned. The fact - and this has not been seriously considered up till now - that some countries of the region (above all Brazil) manufacture a high proportion of the necessary equipment for the expansion of the chemical industry suggests a new approach to the discussion of comparative advantages. A comparison between two locations, in one of which nearly all the equipment is imported, while it is manufactured locally in the other, would be incomplete unless consideration was given, in the second case, to the effects on earnings and the broad incentives resulting from such domestic production. All these points are particularly important in the specific case of Latin America and especially in any comparison of locations in which Brazil is included. The limited supply of basic raw materials (hydrocarbons and their immediate derivatives) puts chemical production (and petrochemical especially) at a considerable comparative disadvantage in Brazil. The country's vast domestic market, is a consideration which would seem to outweigh the disadvantage referred to by permitting higher production scales in terms of any comparison based on domestic markets. In fact, however, it does not have the desired effect, since the supply of raw materials (refinery gas) limited as it is to the size of the existing refineries and scattered throughout the area, in many cases does not make

/this possible.

this possible. However, the disadvantage resulting from the foregoing is offset (to a greater or lesser extent, according to the specific cases dealt with) by two circumstances: the high incidence of transport costs from other locations to Brazil, which is most important in the sub-branch of basic products, and secondly, the high and rapidly increasing proportion of domestically manufactured equipment (which is 100 per cent in certain types of installations and equipment).

Accordingly, the question arises whether the chemical industry is the industrial sector for which a regional market can most easily be formed. One of the participants expressed doubts in this respect, pointing out that in his judgement the close interdependence between the various branches of this industry which provides an exchange of markets and by-products, would indicate the desirability of concentrating many branches of production in the same place, it being impractical to scatter them among various countries. Moreover, the main cost item in this industry is capital, not raw materials or manpower. Consequently, when a country with a small domestic market exports a chemical product, those who benefit most are the manufacturers of the equipment and the licensors of the process (in both cases, companies from outside the region) rather than the production factors in the country concerned. This handicap would apply to lesser extent to the finished products, in which there is a higher proportion of manpower and the participant therefore considered that integration in the chemical industry must begin with such manufactured end goods.

In summary, it can be said that during the discussions various concepts became clear which, though not new, proved to be of special importance for the future integration of the chemical industry.

(a) The formulation of domestic plans for the development of the chemical industry would appear to be the initial step to be taken prior to the drawing up of the regional integration programmes. It has become clear that the countries really interested in integration and more prepared to discuss the possibilities and specific schemes for specialization are precised, those that have completed their domestic plans for the development of the chemical sector, e.g. Argentina, Mexico, Colombia, and to a lesser extent, Venezuela. The others, which have not yet achieved the same stage in their plans for the expansion of the chemical sector, are considerably more reluctant to enter into a more specific discussion of market integration.

(b) Specific plans for the integration of the chemical industry are much more likely to result from action to achieve consistency and complementarity in the various national plans, than from an automatic system of tariff reductions based on comparative advantages. None of the participants supported the view that the choice of items to be developed in each country should result from automatic machinery to eliminate trade barriers, with a view to allowing the free play of the market forces and the comparative advantages in each country. It was openly recognized that the advantage

/a country

a country can derive from the development of a specific project or chemical product cannot be assessed solely in terms of a comparison of production costs based essentially on natural resources, production scales and transport costs, but must also be viewed in the light of the role that this project or production line can play in a general plan for industrial development, in so far as its connection with other projects, the creation of external economies and the establishment of a balanced industrial structure are concerned. These considerations, which have nothing to do with costs and economies of scale, can only be taken into account when a programme for the development of the chemical industry has been formulated as part of an over-all plan for industrial development, in the light of which they can then be evaluated.

(c) Consequently, the considerations on costs and economies of scale are relegated to second place. All the previous secretariat studies were based on the analysis of theoretical or hypothetical production cost in alternative locations and at different production scales. The preliminary analysis of the possibilities of integration prepared by ECLA for the main chemical production lines can therefore be qualified as schemes based on the logic of costs and scales, and do not take into account the position of each item or project in the country concerned within an integrated programme of chemical development prepared in that country. ECLA has not taken into account factors other than costs and scales as many countries have not formulated integrated plans for the development of the chemical industry and such an approach can only be adopted on the basis of a comparison of plans presented by the principal countries.

(d) The elimination of trade barriers for the main chemical products must be accompanied by schemes for increasing production facilities in the most favourable locations, on the basis of large-scale regional plans financed jointly by capital from the principal product consumer countries. The principle of letting in capital for the financing of the regional plants from countries importing the product to be "integrated" is perhaps one of the most original and constructive conclusions reached by the Seminar. In brief, it would be a matter of opening the markets for imports from other countries of the region, contingent upon the acceptance by those countries of multi-national companies, financed on an intra-regional basis for new large-scale production for the export market. The capital of the private sector (or the Government, according to the predominant factor in each country) would be roughly proportionate to the share of the plant's total production that the country would expect to absorb during the initial operational phase of the plant. In principle, the capital contribution of each country should be furnished by the respective resources of the country, whether they are public or private. In practice, it appears quite probable that the capital contribution of the countries which will import the product in the future might have to be financed by international credit. The experts of all the countries represented supported this formula which would in some countries of the region help governments to decide in favour of integration.

/The prospects

The prospects for the integration of the principal chemical items, details of which are mentioned in relation to the previous item of the agenda, can be summarized as follows:

(a) Integration possibilities for potassic and phosphate fertilizers are limited by reason of the region's scant resources. It would be possible to install a large plant of phosphate fertilizers in Peru to supply the region if the phosphate minerals recently discovered in Sechura, Peru, were sufficiently abundant and of a quality that would permit economic exploitation.

The possibilities of nitrogenous fertilizer plants on a regional scale are potentially greater, but not in the immediate future by reason of the fact that the resources (natural gas or by-products or petroleum refinery) are widely scattered throughout the region and because of the slight importance attached to costs and scales, as a result of which plants are being planned or put up in all parts of the region. The projects under way or known at this time are sufficient to cover almost the whole of the demand expected by 1970. Regional large-scale installations with low production costs will have to be planned for the period 1975-80, with a view not only to the Latin American market but also to exports for the world market. It would be probably necessary to find some formula whereby these regional large-scale plants (located in Venezuela, Mexico, and Colombia) might cover only a part of the requirements of other countries, so that they would not displace the smaller domestic plants whose costs are higher in the importing countries (Brazil, Argentina, Chile, Uruguay and Peru) which are justified either on the grounds of "domestic industrial balance", or else protected by high transport costs. Moreover, in order to obtain the agreement of the net importer countries an arrangement whereby they can participate in the financing of the regional plants may be a decisive step.

(b) Petrochemical products (plastic materials, man-made fibres, synthetic rubber or carbon black, detergents and dyes). Here the considerations for a "balanced industrial development" have been applied to the same or even greater extent than in the case of fertilizers, in view of the close interdependence of the branches of the petrochemical industry. Two opposing points of view were expressed in this respect, one in favour of beginning integration with basic raw materials and then turning to finished products in each production line and the other advocating the opposite.

The countries with abundant petroleum resources (mainly natural gas) whose domestic market is still insufficient for the installation of plants of economic capacity and whose chemical industry is relatively less advanced in the region would favour regional integration initially based on the raw materials of each item. On the other hand, the countries whose chemical industry is more developed, since they have promoted the domestic manufacture of a broad variety of items, regard the petrochemical industry merely as a possible means of producing, in economic conditions, certain raw materials for import substitution. Accordingly, the latter countries favour integration beginning with finished products, those that are not yet produced domestically, or whose production in the country is very costly.

/The discussions

The discussions have shown that integration of the chemical industry is indeed possible, but the prospects in each case would have to be identified by means of a direct comparison of domestic plans for the development of the chemical industry after all the countries concerned had prepared them. To facilitate the execution of an integration programme, these plans in turn would have to cover: (a) the cost of producing a specific product domestically, if it was decided not to import it and (b) the price if it is to be exported.

In the production lines referred to some of the major primary and intermediate chemical products could, at first glance, be considered specifically for the establishment of an integration plan, such as styrene, vinyl chloride and vinyl acetate, benzene, phenol, cyclohexane, acrylonitrile, ethylene glycols, isoalcohols and various others.

With respect to dyes, the possibilities would appear far more immediately promising, but the production and apparent consumption of this sector is insignificant in size compared to that of the other petrochemical items. Among the major intermediate products of the dye industry that would have to be considered in an integration plan would be aniline, H acid, cresols, beta-naphtol, 1, 2, 4 acid, benzidine, sulphonic acid, salicylic acid, ortho-toluidine, G acid, anthraquinone, dianisidini, and other organic products of considerable importance as raw materials in the manufacture of dyes.

(c) Sodium alkalis. This chemical item offers perhaps the most promising short-term possibilities, largely since the countries which are the region's major consumers have limited prospects of expanding production at low cost. The increasing consumption of sodium alkalis, especially soda ash in the next decade, may well be supplied more and more by large-scale regional plants, located in Colombia, Mexico and possibly another country.

On the other hand, the expansion of electrolytic caustic soda production is subject to the development of the market for chlorine derivatives. The market for these is still limited and this fact prevents Latin America from becoming self-sufficient in respect of electrolytic soda. Although the latter can, as an interim measure, be manufactured by alternative processes, it would be unquestionably advisable to increase regional trade in chlorine products as a means of speeding up the over-all growth of chlorine demand.

As a conclusion to this report, mention must be made of the studies deemed, in the light of the discussions, to be urgently needed. They are of two types. In the first place, ECLA has been recommended to continue compiling statistical information on production, capacity and foreign trade in the field of chemical products, in order to bring up to date the information provided in recent documents, and to centralize, standardize and analyse it, and circulate it once a year among all the countries. Furthermore, it was recommended that a more complete analysis of the

/evolution of

evolution of the chemical industry should be carried out every three or four years, along the lines of the one contained in document ST/ECLA/Conf.15/L.4. The annual statistical survey would cover a limited number of products and would be carried out with the co-operation of governmental agencies or the private sector of each country responsible for the programming of the chemical sector.

Secondly, ECLA would prepare reports delving more deeply into the present situation and the prospects of future development for a few selected chemical products.

The items for studies of this type, according to the priority set by the Seminar, are the following:

1. Nitrogenous fertilizers (including, at the same time, analysis of phosphate and potassic fertilizers, in spite of the relatively secondary importance of these from the point of view of integration);
2. Sodium alkalis (caustic soda and soda ash);
3. Plastic materials and synthetic resins (polyvinyl chloride, polyethylene, polystyrene, etc.);
4. Man-made fibres (cellulosic, polyamides, polyesters, polyacrylic and intermediate products).
5. Carbon black and synthetic rubber.

The aspects to be analysed in relation to each product or group of products are the following:

- (a) Revision of the existing projections for demand, in the light of the most recent economic situation and the expected evolution in the principal sectors making use of the product;
- (b) Bringing up to date the available information on the existing industry (capacity, real production and expansion plans);
- (c) Analysis of the present and foreseeable transport costs for raw materials and finished products and of the main locations selected for production and the consumer markets;
- (d) Analysis of the different alternatives for the location of future production within the context of domestic development plans, i.e. in relation to objectives for the development of certain areas of the country, for the formation of complexes and for the integration of balanced industrial structures;

/(e) Inclusion

- (e) Inclusion in location analyses of factors relating to domestic manufacture (as against imports) of production equipment;
- (f) Preparation, on the basis of the foregoing, of an "integration scheme" that would make possible the co-existence between large regional plants, to be created in optimum locations, and domestic plants in sub-optimum locations, which may already be in existence or whose establishment may be decided in the future on the basis of the criteria for domestic planning mentioned in paragraph (d).

In order to develop this programme with regard to fertilizers, the formation is envisaged of a working group of ECLA, FAO, and ICAP in consultation with other regional agencies (IDB, ALALC), as suggested in one of the secretariat documents. The tasks that would devolve upon this working group would include studying the raw material resources, the examination of optimum structures that the industry will have to achieve from the standpoint of regional integration and a series of specific propositions to carry out this expansion. Similarly, emphasis would be laid on the means and procedures to give dynamic impetus to the domestic plans aimed at promoting the use of fertilizers. This group would later convene a meeting of government experts to discuss and approve the proposed plan of action, which would then be submitted to the consideration of the inter-American agencies for execution.



## Annex I

## ATTENDANCE

## PARTICIPANTS

Argentina

Roberto A. Craig	Monsanto Argentina
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Oscar Moreno Valdez	Asociación Nacional de la Industria Química
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Juan José Anichini	Comité de Inversiones y Desarrollo Económico
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Venezuela

Antonio Ledesma Lanz	Director General del Instituto Venezolano de Petroquímica, Presidente del Seminario
Ricardo Pinés	Presidente de la Asociación de Fabricantes de Productos Químicos de Venezuela, Secretario General del Seminario
Juan E. Aigster	Corporación Venezolana de Fomento
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Kurt Politzer  
Karl Schulz

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Bayer do Brasil Indústrias Químicas S.A.

Colombia

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Luis Restrepo Osorio  
Bernardo Samper  
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Grace y Compañía Colombiana S.A.  
Abocol S.A.  
Abonos Colombianos, S.A.  
Petroquímica Colombiana S.A.

Mexico

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William G. Gormley

Shell International Chemical  
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Bernard Larner  
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Esso Research & Engineering Co.  
Universal Oil Product Co.,  
Des Plaines, Illinois  
U.S. State Department  
Esso Chemical Co., New York  
Allied Chemical Corp.  
California Chemical Pan American Co.  
Agency for International Development  
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The Lummus Co., New York  
Scientific Design Co.  
Agency for International Development  
Universal Oil Products Co.,  
Des Plaines, Illinois  
Scientific Design Co.  
California Chemical Pan American Co.  
California Chemical Pan American Co.

/Uruguay

Uruguay

Jorge Giucci Urta

ANCAP

Venezuela

Ligia Angulo M.

Banco Central de Venezuela

M.C. Arthur

Industrias Consolidadas S.A.

Ricardo Barreto

C.A. Nacional de Grasas Lubrificantes  
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José M. Bassim

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Meller y Essink S.A.

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Luis A. Olivares	Corporación Venezolana del Petróleo
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/Rafael H. Travieso

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Nuno F. de Figueiredo	Director ECLA/Institute/IDB Joint Programme for the Integration of Industrial Development
Rinaldo Schiffino	Regional Adviser on the Chemical Industry
Roberto Petitpas	ECLA/Institute/IDB Joint Programme for the Integration of the Chemical Industry
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Fernando Fuenzalida	Joint ECLA/FAO Agriculture Division
Abel Navarro	ECLA Mexico Office
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Simón Teitel	Research and Evaluation Division, Centre for Industrial Development, United Nations
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Annex II

AGENDA

1. Present situation in Latin America's chemical industry:
  - A. Supply and demand in each country and in the region as a whole.
  - B. Centralization of information and bringing it up to date.
2. Analysis of certain problems relating to the development of the chemical sector
3. Prospects of a regionally integrated development of the main sectors of the chemical industry:
  - A. Fertilizers and pesticides.
  - B. Synthetic resins and plastics, plasticizers.
  - C. Man-made fibres
  - D. Synthetic elastomers and carbon black.
  - E. Alkalis and chlorine derivatives.
  - F. Dyes and pigments.
  - G. Synthetic detergents and other chemical products.
4. Evaluation of the possibilities of an integrated regional development of the chemical industry.



Annex III

LIST OF DOCUMENTS

A. Secretariat documents

ST/ECLA/Conf.15/L.1	Annotated provisional agenda
ST/ECLA/Conf.15/L.2/Rev.2	List of documents
ST/ECLA/Conf.15/L.3 (E/CN.12/628/Rev.1)	"La industria química en América Latina"
ST/ECLA/Conf.15/L.4	"Evolución de las industrias químicas de América Latina en el período 1959-1962"
ST/ECLA/Conf.15/L.5	"Desarrollo de la industria de álcalis sódicos en América Latina"
ST/ECLA/Conf.15/L.6	"La industria petroquímica en América Latina"
ST/ECLA/Conf.15/L.7	"La industria de fertilizantes en América Latina"
ST/ECLA/Conf.15/L.8	"Las industrias químicas y la integración económica regional"
ST/ECLA/Conf.15/L.9	"Centralización y actualización de informaciones estadísticas sobre las industrias químicas en América Latina"
ST/ECLA/Conf.15/L.10/Rev.2	Attendance list

B. Information document

1. Comisión de Petroquímica del Instituto Argentino del Petróleo, "La industria petroquímica en la República Argentina"
2. Yacimientos Petrolíferos Fiscales, "Programación de un Plan de Inversiones Petroquímicas en Argentina"
3. John C. Tallman, E.I. du Pont de Nemours and Company Inc., "La industria de las fibras textiles sintéticas y artificiales en América Latina"
4. Bernardo Rikles, Instituto Argentino del Petróleo, "Abastecimiento regional de equipos básicos para las industrias químicas - conveniencia de su coordinación y racionalización en América Latina"
5. Banco Nacional do Desenvolvimento Econômico, "Mercado Brasileiro de Fertilizantes"

6. Banco Nacional do Desenvolvimento Econômico, "Mercado Brasileiro de di-óxido de titanio"
7. Patricio Castro B., Corporación de Fomento de la Producción, "Programa de desarrollo de la industria química chilena"
8. Banco Nacional do desenvolvimento Econômico, "Mercado Brasileiro de plastificantes ftálicos"
9. E.W. Schnabel y J. Estrugo, Universal Oil Products Company, "Licencias para utilizar procedimientos industriales estadounidenses en América Latina"
10. Oskar Hentschel C., Instituto Mexicano de Ingenieros Químicos, "Mesas redondas pro industrialización en provincia del Instituto Mexicano de Ingenieros Químicos"
11. Hubert Durant-Chastel, Sosa Texcoco, S.A. "Los álcalis sódicos"
12. Shell International of London, "Los plaguicidas en América Latina"
13. Bernardo Argandar K., Industrias Químicas Pensalt S.A. de C.V., "Cloros y derivados clorados, modelo de industrias químicas en desarrollo en América Latina"
14. Roberto F. Beltramino, "Aspectos institucionales de la industria química en América Latina: participación del Estado en el desarrollo de la industria química"
15. César O. Baptista, Petróleos Mexicanos, "Filosofías mexicanas sobre el desarrollo industrial de un país"
16. Bayer do Brasil, S.A. "El mercado de colorantes y su fabricación en América Latina"
17. Juan Ayllon V. y Jorge Otero R., Yacimientos Petrolíferos Fiscales Bolivianos y L.C. Axelrod y B.G. Mandelik, M.W. Kellogg Company, "Realization of Fertilizer Production in a Developing Country - The Case of Bolivia"
18. California Chemical Pan American Company, "La industria del detergente sintético en América Latina" (Latino-América)
19. Ducilo S.A.I.C., "Industria de las fibras textiles, celulósicas y sintéticas en la Argentina"
20. California Chemical Company, "La producción de un fungicida para las necesidades del mercado latinoamericano"
21. Germán Torres, Instituto de Investigaciones Tecnológicas, "Panorama de la industria química en Colombia"

/22. John Delaplaine,

22. John Delaplaine, "La planeación del sector químico en Colombia"
23. Nacional Financiera S.A., "Situación del sector de fertilizantes en México"
24. Nacional Financiera S.A., "Situación del sector del álcalis en México"
25. Instituto Venezolano de Petroquímica, "La industria petroquímica y su desarrollo en Venezuela"
26. Remigio D. Gabin y Ernesto Onette, Administración Nacional de Combustible, Alcohol y Portland Uruguay, "Uruguay y el Desarrollo de la Industria Química en América Latina"
27. Arthur D. Little, Inc., "The Latin American Fertilizer Industry"
28. Thomas Vietorisz, S.M., Ph. D. Research Staff Member, International Business Machines Corporation, "Planning of The Chemical Industries at the National Level"
29. Background document submitted by the United States Representative to the Second Meeting of CIAP, Oct. 26-31, 1964, "Fertilizer Development for South America"
30. Patricio Sepúlveda, Comisión Nacional Consultiva para ALALC, "Consumo aparente de productos químicos en Chile"
31. Julio César Gómez Fuentealba, ATANOR, Compañía Nacional para la industria química, "Problemas que enfrenta una empresa química en América Latina" (ATANOR S.A.)
32. Institut Francais du Pétrole, "Installation of a Petrochemical Industry in a Developing Country"
33. Carlos Gómez Zuleta, "Informe sobre la industria de álcalis en Colombia"
34. Oskar Hentschel, Celanese Mexicana, "La Industria de Fibras Químicas en México"
35. Petróleo Brasileiro S.A. (Petrobrás), "A Industria Química no Brasil"
36. Mario da Silva Pinto, Consultor Industrial e Profesor de Metalurgia da Universidade do Brasil, "Plano de Desenvolvimento das Industrias Químicas no Brasil"

37. Manuel Soberanes Moncada, Cámara Nacional de la Industria de Transformación, México, "La Industria de Parasitocidas y Fertilizantes en Cifras"
38. Empresa Colombiana de Petróleo, "Plan de Industria Petroquímica de la Empresa Colombiana de Petróleos"

Annex IV

OPENING SPEECH BY MR. LUIS HERNANDEZ SOLIS, MINISTER FOR  
DEVELOPMENT OF THE REPUBLIC OF VENEZUELA

The Government of Venezuela immediately welcomed the idea that a Seminar on "The Development of the Chemical Industry in Latin America" should be held in Venezuela. It gives me great pleasure today, at this inaugural session, to welcome on behalf of the Government and the people of Venezuela, the Latin American delegates and all those individuals and agencies present who are concerned with the development of this continent.

The purpose of this meeting is to analyze the problems raised by the development of the chemical and petrochemical industry in Latin America. We realize that it is difficult and technically complex to plan and develop this branch of industry, especially in countries with a limited economic growth like ours, whose socio-political problems are characteristic of communities in the process of change.

In these countries, where so much remains to be done, the main problems are the large volume of investments required for the development of the chemical industry and the anxiety created by the continuous technical progress, as a result of which investment in this sector can become quite out of date, if we do not continue our initial efforts at a rate comparable to the accelerated tempo of this science. In spite of these obstacles, the region's important production of manufactured chemicals clearly indicates that Latin America must seek an integrated development that would reduce such hazards and to allow maximum use to be made of economies of scale and the comparative advantages of each Latin American country.

Venezuela has enormous potentialities for the development of a chemical and especially a petrochemical industry. It is well known that our country is blessed with vast natural resources, which are as basic to the processes of the heavy inorganic chemical industry as to those derived from hydrocarbon

The phosphorite of Tachira and the phosphate of Falcon, the vast mineral reserves of iron, kaolin, gold, etc., of Guayana, the recently proven high-grade nickel of Aragua and Miranda, the sulphurous gases in the east of the country, asbestos in Cojedes, the possibilities of magnesium carbonate in Margarita among many other mineral resources, together with the huge potential of our petroleum and gas deposits and the volumes of energy in our rivers, all constitute a bright picture for the development of our chemical industry, and a logical complement of the favourable prospects for exploiting other mineral production lines in the different countries of the region.

/Prospects are

Prospects are bright not only in Venezuela. Conditions are equally favourable in many Latin American countries. Latin America, however, is still involved in the preliminary stages of chemical production.

It is enough merely to analyze the per capita production figures of this industry. While in the Western European countries the per capita value of chemical production reached 66 dollars, and 133 dollars in the United States, Latin America's per capita production amounted to barely 10 dollars.

The level of the chemical industry in Venezuela is equal to that of the average for the region; nevertheless, its relative share in the domestic gross product was only 0.8 per cent in 1959, as against 3.1 per cent for Argentina, 3.0 per cent for Brazil and 2.5 per cent for Latin America as a whole.

Since then, through the efforts of Venezuelan entrepreneurs during the last five years, some private chemical complexes have entered production and the country has benefited from the fertilizer production of the domestic petrochemical industry. Despite these new contributions, the percentage represented by the chemical industry in our value added is, still short of the Latin American average.

These figures show that the country is not making full use of its available resources for the benefit of the chemical industry; this applies in particular to the petroleum and natural gas resources, which correspond to a very high percentage of our gross domestic product, and are basic inputs for the chemical industry.

In addition to this under utilization of potential resources, natural gas from petroleum, which is, perhaps, the most important resource, is burnt off like so many flares that needlessly illuminate the paradoxical night skies of Latin America, compelled as our country is by force of circumstances to burn a caloric potential worth approximately 100,000 dollars a day, without deriving any benefit whatsoever.

Fortunately it appears that the flash of these flares no longer leaves us indifferent. Let us hope that this Seminar may give us a more accurate idea of what has been done and of the many tasks before us.

When we realize that the components of natural gas are raw materials for different products like methanol, ethylene and the long chain of petrochemical products derived from them, and that a lesser number of products, no less important, come from the same natural gas, we can conclude that Venezuela must be considered as one of the region's most promising areas for the production of intermediate petrochemicals, that can be used as a basis for the development of final products which other Latin American countries can manufacture.

/We believe

We believe that this situation offers the best prospects for Venezuela's adherence to the Latin American Free Trade Association, where the possibilities of economic complementarity must be studied from a practical standpoint so that, after all, our desire for economic and social integration may not remain a mere dream.

The excellent ECLA report prepared for this Seminar, in which are analysed the complex circumstances of the present and future development of Latin America's chemical industry, contains a comment which is most encouraging:

"Comparing the results obtained with international prices, there is reason to believe that the industries intended to supply the integrated regional market with most of the more dynamic and basic products will ensure, without having to resort to excessive tariff barriers vis-à-vis other areas, a profit margin sufficient to allow the region's chemical industry to develop rapidly."

Venezuela's wish to play an active part in the integrated development of the region's chemical industry alongside our fellow Latin American countries, is the thesis it presents for discussion and analysis in this Seminar and is its contribution to the solution of the problems of our peoples, and to the constitution of the united America of which our liberators dreamed.



Annex V

OPENING SPEECH BY MR. ANTONIO LEDEZMA LANZ, DIRECTOR GENERAL  
OF THE VENEZUELAN PETROCHEMICAL INSTITUTE AND  
CHAIRMAN OF THE SEMINAR ON THE CHEMICAL  
INDUSTRY IN LATIN AMERICA

The conclusion can certainly be made that this first Latin American Seminar on the Chemical Industry constitutes a new step forward by the Latin American countries in resolutely coming to grips with their future economic and social development.

Fortunately, the countries are already sufficiently advanced in the theory of economic and social development, especially as a result of the valuable efforts of ECLA and the various national agencies to analyse and study the region's problems.

We are all aware that we must take bold and decisive steps if we are to face the future successfully. It is absolutely clear to Latin America that we cannot remain contented as a source of supply of raw materials to be processed by the more developed countries when the prices of these raw materials are more and more subject to fluctuations and declines at a time when those of the goods we have to import are constantly rising. This has led to decapitalization and the slackening of the growth rate, which has barely exceeded, the rate of population growth. Consequently, inasmuch as Latin America has become integration conscious, the necessity of both economic transformation and industrialization is universally recognized.

The principal role that the basic industries must carry out within the field of industrial development is similarly recognized. Latin Americans already know that merely to satisfy domestic consumption through import substitution is no great achievement. We know that this only lasts for a short period at the end of which development possibilities come to a halt; it is for this reason that the region so keenly recognizes the necessity of approaching decisively the development of the major basic industries for the promotion of Latin American economic development. In this sense therefore a fundamental role falls to the chemical and petrochemical industries, on account of the huge catalytic effect that they can exercise on the economies of the countries in which they have developed; however, from the study of this industry, characterized by great capital intensity, limited labour requirements, large economies of scale and the complexity of technological processes, emerges the need for a regional approach by means of which we may be able to construct a chemical and petrochemical industry on a permanent basis in the Latin American continent. Otherwise we would have to content ourselves with doing the same in this industry as we have done up to now in the development of other sectors of manufacture and find that our desires for isolated development, limited to individual countries, would sooner rather than later lead not only to stagnation but to economic retrocession.

/This Seminar

This Seminar is a most appropriate continuation of a significant event that took place a few days ago in Teheran when the United Nations convened a world conference for the study of the development of the chemical and petrochemical industry in the developing countries. It would appear highly significant that Latin America is also making a progressive step just within a few days of the United Nations organizing such a conference where the possibilities of this industry were presented to the consideration of the developing countries. Latin America, within a week of this event, has already brought the countries of the region together here to consider the specific solutions to be found in this field. It is most heartening therefore to see that Latin America is taking the road towards a dynamic economy, which is the only way to achieve economic and social development.

The implications and characteristics inherent in the petrochemical industry call for a collective Latin American endeavour; this feeling of association and co-operation between our countries is, in all modesty, an inspiration especially for Venezuelans, for many decades ago at the beginning of the last century, our Liberator Simon Bolivar with his visionary outlook, recognized that political independence of our nations would remain a dream unless there existed collective action to consolidate this political independence, not only by military force, but with the economic and social co-operation of all our countries. For this reason, and because of the mutual understanding and common characteristics afforded by our culture, we consider that we can expect both specific and concrete results within a short period of time. We are confident that our countries will be able to forego some of their private interests and realize that we will gain nothing whatsoever by trying to obtain isolated advantages that can only be temporary; our aim must be to fulfill the possibilities of social and economic development and by so doing rescue the impoverished masses of Latin America and deliver them once and for all from their wretched plight.

This meeting which is essentially of a technical nature, will give an opportunity to discuss a full and interesting agenda and we hope that it will prove a significant contribution to the economic development of Latin America and the consolidation of its peoples.

Annex VI

ADDRESS OF WELCOME BY MR. RICARDO PINES PRESIDENT OF THE VENEZUELAN  
ASSOCIATION OF MANUFACTURERS OF CHEMICAL PRODUCTS

It is a great pleasure for me to address you in my capacity as President of the Venezuelan Association of Manufacturers of Chemical Products in this inaugural session of the Seminar on the Development of the Chemical Industry in Latin America.

Venezuela is going through the difficult stage of industrialization. Within our possibilities and our respective fields of action, we Venezuelans are united in our efforts to achieve economic independence and greater prosperity for our peoples.

The domestic manufacturing industry has made really significant advance and today we can proudly buy practically every consumer item in the country with the label marked "MADE IN VENEZUELA".

The chemical industry has also made considerable progress, above all in its light manufacturing or what we might call consumer products. Substantial advances were made in the field of primary or basic raw materials products. The Venezuelan Petrochemical Institute, under the direction of Mr. Antonio Ledezma, who has been carrying out a judicious policy in this Institute, is manufacturing various raw materials for industrial use and has significant short-term and medium-term projects for the manufacture of other basic raw materials that are indispensable for the full development of the chemical sector in this country.

The Executive has a liberal policy of granting credit facilities and protection to those industrial projects meriting such concessions.

In a general picture otherwise fairly encouraging, the main stumbling block is that the fields of action in the private and public sector of the chemical industry have not been clearly defined. The execution of various industrial projects is thus delayed. We are confident that the Government will in the near future fulfill its promise to define the area in which it is prepared to act. The President has promised us that the field of action of both the private and public sector will be defined in a national council of the chemical industry whose establishment is soon to be authorized and in which the private sector will be represented with the right to participate and vote.

/In view

In view of the great interest that all Venezuelans have at present in the development of this complex branch of the national economy, ECLA could not have chosen a more opportune moment to hold this Seminar, since the presence of such outstanding experts in this field will be invaluable to us.

On behalf of the Venezuelan Association of Manufacturers of Chemical Products, I have the pleasure to extend to you all a most cordial welcome and am confident that the work of the Seminar will be a complete success.

Annex VII

SPEECH AT THE INAUGURAL SESSION DELIVERED BY MR. NUNO F. DE FIGUEIREDO,  
DIRECTOR OF THE JOINT ECLA/INST/IDB PROGRAMME ON THE  
INTEGRATION OF INDUSTRIAL DEVELOPMENT

It is a great honour for me to welcome you on behalf of the United Nations agencies - ECLA and the Bureau of Technical Assistance Operations - that have taken the initiative in convening this Seminar.

I shall try in a few words to outline the aspects of Latin American industrial development that have led us in ECLA to convene this outstanding group of government experts and representatives of the private sector who are gathered here today.

In an over-all appreciation of the problems of the region's industrial development, the most outstanding and disquieting aspect is surely the amount of investment that must be carried out in the next years in order to increase industrial production, if the targets for economic and social development outlined by the Governments in recent inter-American meetings are to be reached. We have estimated such requirements, for items that represent about 50 per cent of the manufacturing sector, at a sum approximating 5,000 million dollars, in plant investment only - buildings and equipment - for the five year period 1965-70. This figure refers only to the most important branches of industry, taken individually, that is, the steel and chemical industries, the pulp and paper industry, the metal-transforming industry (covering here only the industrial basic equipment machine tools and motor vehicles) and the textile industry. Of this total, a little more than a third (1,600 million dollars) relates to the expansion of the steel industry, an almost equal amount (1,500 million) to the chemical industry, 590 million to pulp and paper production, 500 million to the aforementioned metal-transforming industry and 375 million to the textile industry.

In the light of present circumstances and the recent situation, these figures signify a very considerable investment effort and, furthermore, will involve the introduction of new techniques and processes that easily surpass the present technological level of Latin America. Investment and technology of such magnitude must be programmed carefully and rationally and channelled within a framework of increasing regional co-operation if it is to be borne and absorbed by our economies.

It would thus appear that we find ourselves on the threshold of a new stage in the region's industrial development, in which two major objectives should be borne in mind:

- (a) to determine the economic size of the new investment, as a function of the economies of scale obtainable in plant sizes equal or superior to a minimum definable for each major product; and

/(b) to

- (b) to distribute investment geographically according to the comparative advantages existing in each country.

These two requirements are especially important in the development of the chemical industry, as several ECLA documents have endeavoured to point out.

In a recent study it was estimated that to maintain annual imports of chemical products at the same absolute level in 1970, i.e. a little more than 1,200 million dollars, it would be necessary to raise the region's production from the present figure of nearly 3,300 million dollars, to some 6,600 million dollars in 1970. To achieve this, the annual investment required would be approximately 300 million dollars.

This estimate is based on the assumption that the development of the chemical industry in the next few years will continue to be governed, as regards plant size, by purely national considerations. As economies of scale play a very important role in this production line, a regional integration of the industry - at least in the new plants to be established - would make it possible to reduce investments by an estimated 25 per cent, that is, 75 million dollars annually or nearly 400 million dollars during the period 1965-70, if this programme is applied to the new projects to be established within this term.

On the basis of these considerations we have prepared the agenda which will be offered for your consideration this afternoon, in which the main emphasis is upon the integration of the Latin American chemical industry.

The three major objectives of the Seminar are:

- (a) to exchange factual information on the present state of the chemical industry throughout Latin America and on programmes for its development;
- (b) to consider the organization of a centralized system for the collection and preparation of, inter alia, statistical information on the chemical industry, by means of which the over-all picture of the chemical industry drawn up by ECLA in recent years can periodically be brought up to date;
- (c) to formulate certain preliminary ideas and opinions on the possibilities of co-ordinating the future development of the principal branches of the chemical industry from the standpoint of regional specialization.

And speaking of regional integration, I should clarify the relationship between approach which we have sought to impress upon the Seminar, and ALALC's sphere of responsibilities.

/The relationship

The relationship between them is of a complementary and co-operative nature. ALALC is the body responsible for trade aspects of integration. Such aspects as tariff reductions, exchange and payments systems and others, are obviously outside ECLA's jurisdiction and have not therefore been included in the agenda prepared for this Seminar. We must confine ourselves to the consideration of what we would call the physical aspects of regional economic integration, that is, to clarify the possibilities of guiding the development of the future production of each major item along the lines of a scheme for regional specialization based on the evolution of demand, market sizes, and economies of scale. For this we must start from the hypothesis that all the problems of trade negotiation will be solved in time by the action of ALALC or as a result of the studies now being undertaken by different Latin American groups to give more impetus to ALALC's activities.

Lastly, I must mention that we expect this meeting to provide some useful guidelines for ECLA's future work on the chemical industry.

