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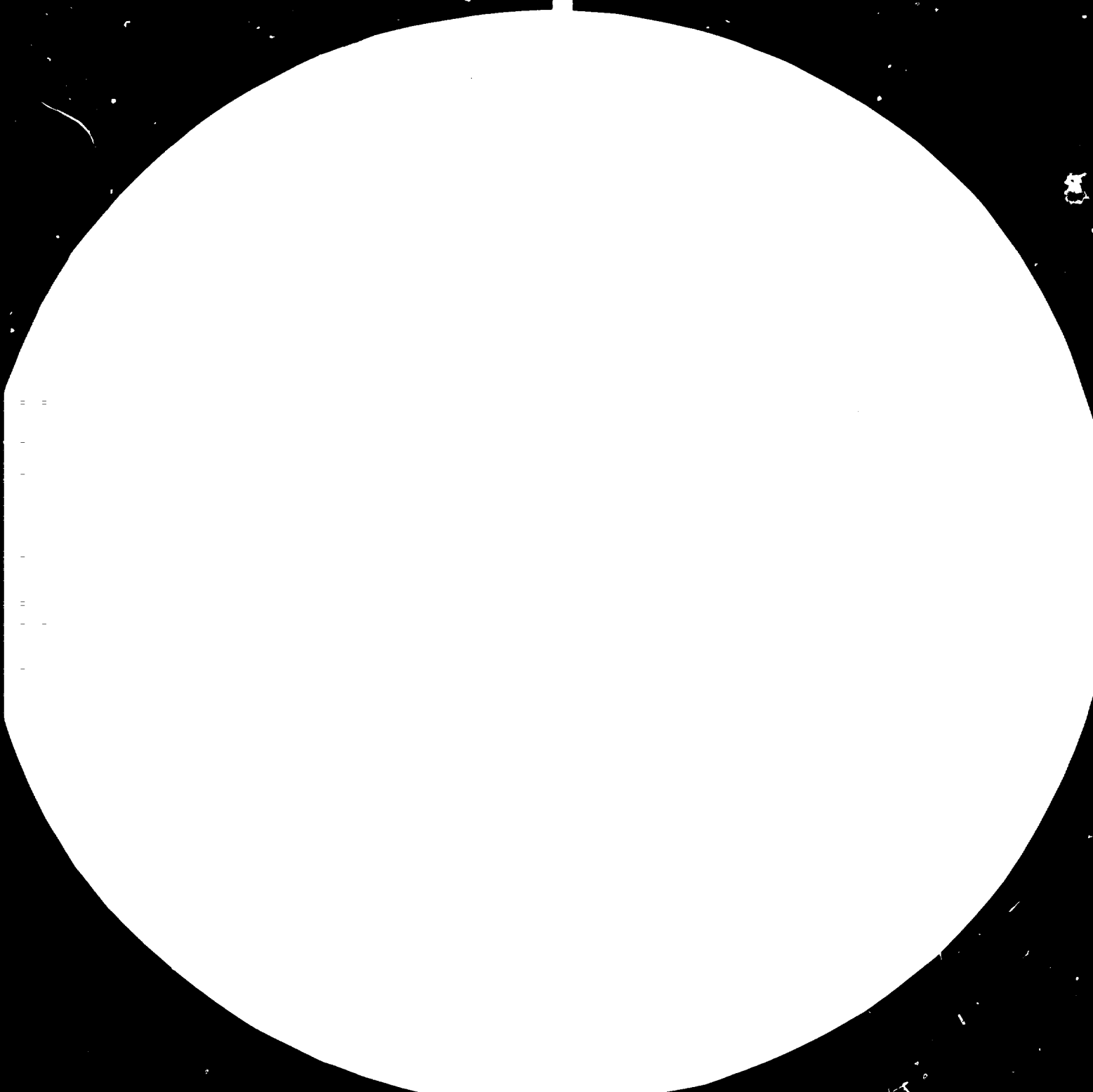
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PLAPIQUI: THE RESEARCH AND DEVELOPMENT CENTRE FOR THE BAHIA BLANCA,
ARGENTINA, PETROCHEMICAL COMPLEX

by

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PETROCHEMICAL COMPLEX OF BAHIA BLANCA

The Petrochemical Complex of Bahía Blanca is being built to utilize 270,000 tons/year of the ethane in natural gas that is pipelined from Tierra del Fuego and Neuquen to Bahía Blanca. It will satisfy the major fraction of Argentine polymer needs. The combined streams of natural gas will be fractionated to remove ethane and LPG, the LPG sold, and the CH₄ sent to Buenos Aires. The ethane will be cracked to ethylene and this polymerized to polyethylene. Low density polyethylene (LDPE) will be made both by high and by low pressure processes. The latter plant will be on a barge. High density polyethylene (HDPE) will also be produced. A sodium chloride electrolysis plant will produce caustic soda for sale and chlorine for feed to a vinyl chloride (VCM) plant. VCM will be converted to both emulsion and suspension polymers in two plants. All polymers will be sold, and no plans have yet been announced for polymer processors to locate at the complex. There will also be major streams of pure and impure hydrogen produced.

Figure 1 shows the various plants that have been proposed to constitute the complex. The black boxes are for those plants already built.

PIDCOP

The Research and Development Program for the Petrochemical Complex (PIDCOP) is an executive organization established by institutions concerned with the Complex. Its purpose is to establish a high level technological center to assist the functioning and future expansion of the Complex. The R&D Program is supervised by an executive committee and conduction of the Program is the responsibility of the elected Chief. The activities of the PIDCOP R&D Program proceed at the Planta Piloto de Ingenieria Quimica (PLAPIQUI), in its Division of Industrial Technology. All of the companies of the Petrochemical Complex are, since May 1980, affiliated with PIDCOP, whose membership as of this writing is:

Founding Institutions

- Petroquímica Bahía Blanca (PBB)
- Gas del Estado (GdE)
- Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET)
- Direccion General de Fabricaciones Cientificas y Tecnicas (DGFM)
- Universidad Nacional del Sur(UNS)

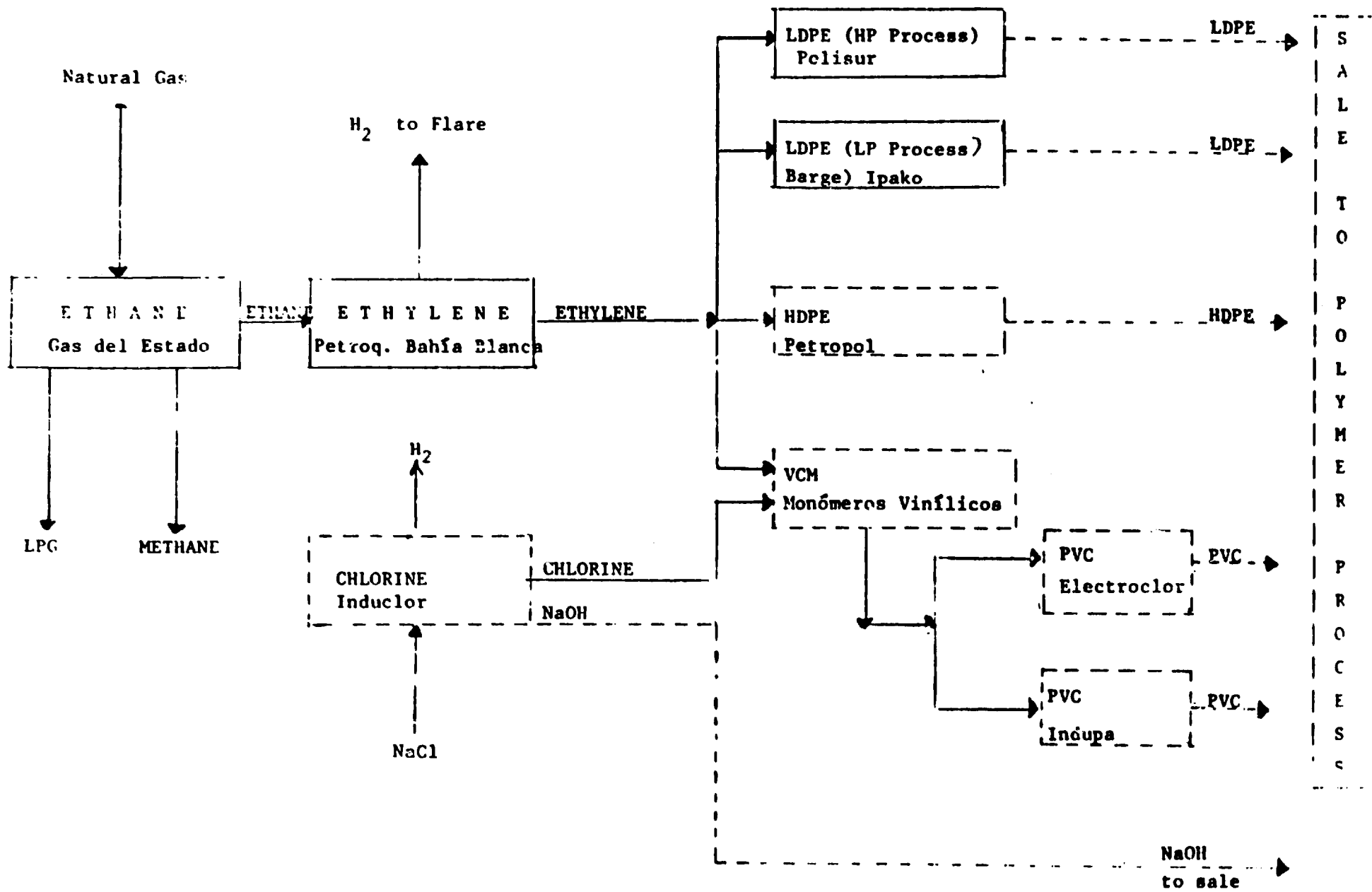


FIGURE 1

The Petrochemical Complex - September, 1980

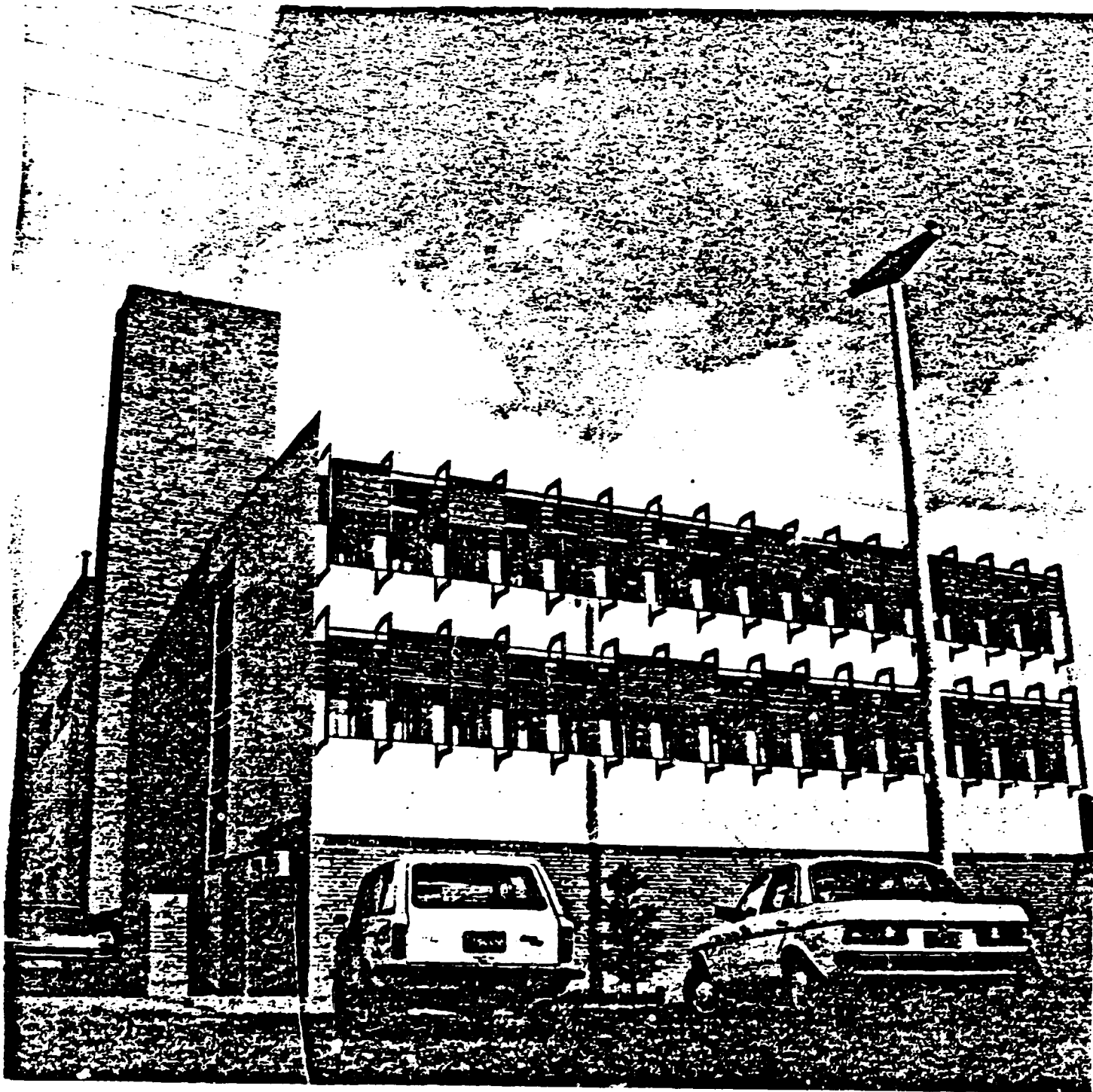


Figure 2: PLAPIQUI

Adjunct Companies

- Monomeros Vinilicos S.M.
- Indupa S.A.
- Petropol S.M.
- Polisor S.M.
- Induclor S.M.
- Electroclor S.M.

Other Argentine Companies not presently in the Complex have expressed their interest in joining PIDCOP, in order to take advantage of the technical capabilities. Ground has been broken in Bahia Blanca for a much larger University research center, CRIBABB, which will cover Mathematics, Life Sciences, Oceanography, and PLAPIQUI. At completion, the location of the PIDCOP R&D Project will shift to CRIBABB, and the present PLAPIQUI building, shown in Figure 2 will possibly no longer be used for PIDCOP.

UNDP/UNIDO PROJECT ARG/75/021

The United Nations have provided financial aid to the PIDCOP R&D Program through its "Project for Technical Assistance to the Bahia Blanca Petrochemical Complex."

On 1st February 1979, the Technical Cooperation Agreement, outlining the technical assistance to the Bahia Blanca Petrochemical Complex, was signed between United Nations Development Program (UNDP) and the Argentine Government.

The Project has at its disposal, a) experts and consultants, b) training, and c) equipment. On the other hand, the Argentine Government, with the supervision of PIDCOP and using the Planta Piloto de Ingenieria Quimica (PLAPIQUI) as the executive organization, provides personnel and establishes laboratories and special services: computation, polymer characterization, catalysis, etc. Included in the contributions of the UNDP are U\$S 464,669 for consultants, U\$S 376,040 for fellowships, and U\$S 769,988 for equipment.

The country will contribute a total of U\$S 4,489,000 in personnel, plant and operational expenses. Since the initiation of the Project, many international experts have visited (equipment maintenance, corrosion prevention, catalyst evaluation, polymerization reactors, petrochemical process engineering, optimization, etc.). They were selected by PLAPIQUI Administration.

Study trips for training for a total of sixty man-months have been carried out and equipment amounting to U\$S 153,924. has been received. The Initial Phase of the Project expired January 31, 1982, and a Second Phase then initiated.

PLAPIQUI

Planta Piloto de Ingenieria Quimica (PLAPIQUI), was established in 1963 as a teaching and research unit of the Universidad Nacional del Sur (UNS). In 1973, by an Agreement between UNS and CONICET (Consejo Nacional de Investigaciones Cientificas y Tecnicas), this group was converted into an Institute.

The main objectives of PLAPIQUI are:

- Chemical Engineering Undergraduate Teaching
- Chemical Engineering Graduate Teaching
- Research and Development
- Industrial Services

The activities of PLAPIQUI comprise two lines of technology:

- Petrochemical Technology
- Food Engineering

Personnel of PLAPIQUI

-- Researchers and Professors	13
-- On External Scholarship	12
- On Internal Scholarship	30
- Professional and Technical Staff	27
- Administrative and Service Staff	15
TOTAL	97

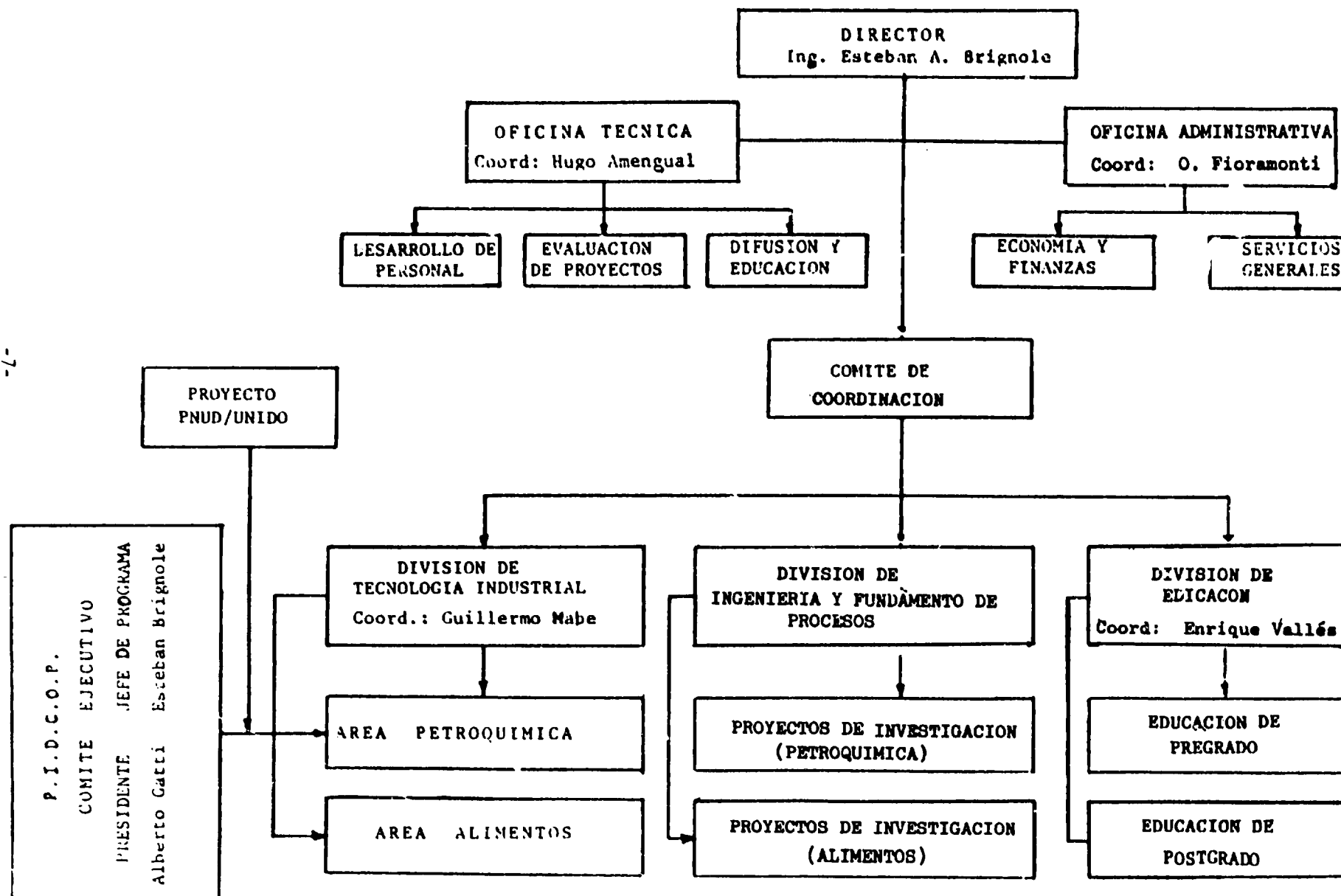
Note that the PLAPIQUI organization doubled from 27 in 1976 to 50 in 1979, to 100 in 1980 and will ultimately double to 190 personnel by 1985, if plans work out.

Organization of PLAPIQUI

Figure 3 is an organization chart showing the three Divisions of PLAPIQUI.

FIGURE 3

PLAPIQUI ORGANIZATION

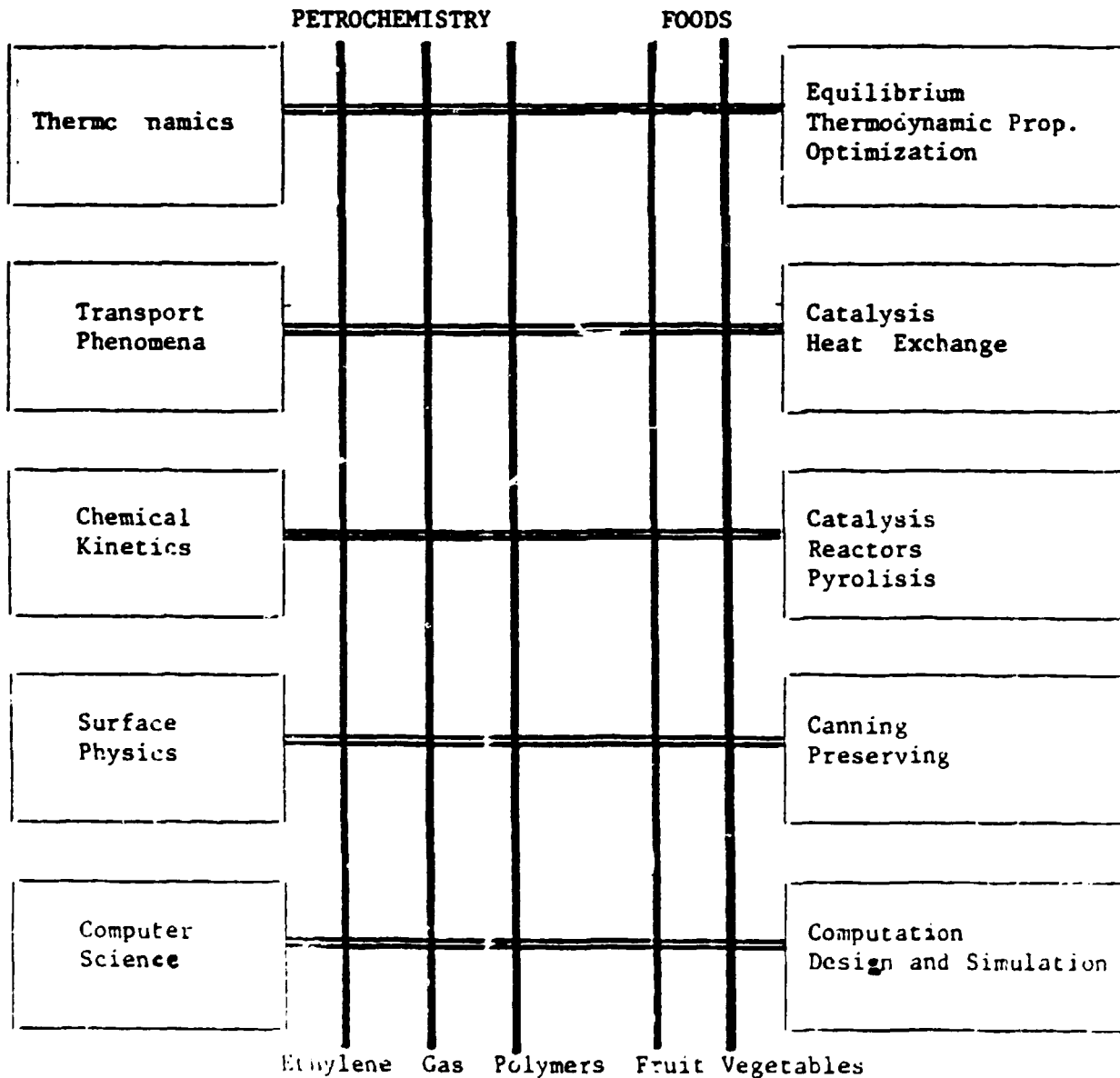


1. Division of Process Research and Engineering:

All research and Development activities are grouped together in this Division.

The organization of the technological-petrochemical effort is shown on Figure 4. The projects of PIDCOP and Food Technology are activities which frequently involve the three divisions of the Institute.

FIGURE 4



2. Educational Division

Undergraduate, postgraduate, review, specialization and training activities are provided by PLAPIQUI personnel and visiting experts. Instruction is given within the main lines of the institution: Petrochemistry and Foods.

The Graduate Program in Chemical Engineering at the Universidad Nacional del Sur is offered by the Planta Piloto de Ingeniería Química, under the supervision of the Graduate Department of the Universidad Nacional del Sur. The program offers graduate studies to obtain the Master's degree in Chemical Engineering. Twenty students are enrolled, and the Program was initiated in March, 1980. The Master's program involves the fulfillment of eight courses, a command of the English Language, and the completion of a graduate thesis frequently allied to problems of the Complex.

Intensive courses aimed at professionals of Industry are given; and their main purpose is to contribute to updating the engineering and techniques in special areas.

3. Industrial Technology Division

This Division is the link between the research and development groups and the services and projects carried out by PLAPIQUI on behalf of Industry. Figure 5 shows its organization.

The main objectives of this Division is the execution of the projects together with industry, and the transfer of results of research to industry. This is effected through the Programa de Investigación y Desarrollo del Complejo Petroquímico de Bahía Blanca.

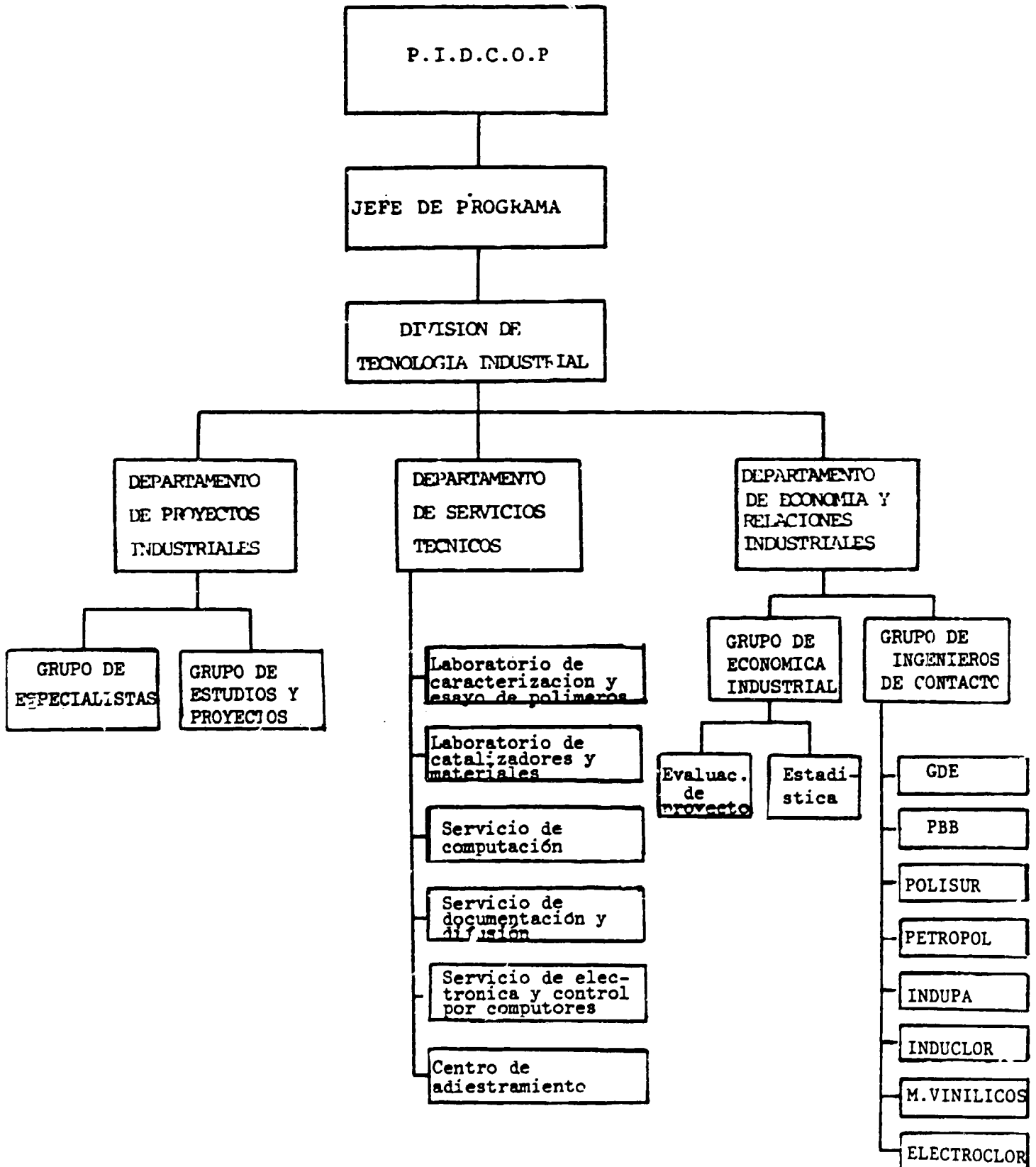
The Program aims to cooperate with the national petrochemical industry, especially with those companies which establish themselves in the Bahía Blanca Petrochemical Complex. The activities developed within the Program may be clasified as:

- 1) Personnel Training
- 2) Technical Services
- 3) Execution of industrial research or engineering projects.

FIGURE 5

DIVISION DE TECNOLOGIA INDUSTRIAL

ORGANIGRAMA FUNCIONAL



The specific activities carried out and/or coordinated by means of the Industrial Technology Division of the Planta Piloto de Ingenieria Quimica are:

a) Training

The training for personnel of the Petrochemical Complex Companies, as well as for the executing organization, is provided for by means of a program of fellowships and experts under the auspices of the United Nations Development Program. In the first phase of UNIDO funding, professionals of Gas del Estado and of Petroquimica Bahia Blanca participated actively in this program.

A training center for operators and technicians of the plants of the Complex is planned. It will use a process trainer-simulator, which will allow quick and efficient personnel training in process operation.

b) Technical Services to Industry

The characterization, testing and evaluation of polymeric materials laboratory is equipped with the most modern instrumentation. At the present time, mechanical and viscoelastic properties are tested by rotational rheometer, by a mechanical spectrometer, by capillary rheometer, by relaxation balance, etc. The laboratory does calorimetric studies by differential scanning calorimetry, structural and morphological studies, infrared spectroscopy, and gel permeation chromatography.

The computer service has and develops programs for simulation of chemical processes, heat exchangers, separation processes, and thermodynamic properties. These are used by associated companies or those which sign specific work agreements. Information is distributed periodically regarding programs being developed or incorporated into the service. The computer capacity will allow, in a proposed expansion, the connection by means of terminals with the plants of the Complex. The computer service offers courses on programming, data acquisition, and microprocessor applications.

c) Process Engineering, Industrial Development and Research

Tests, verification, simulation, and/or design of Process Equipment are accomplished through the Industrial Technology Division. Projects of research and development are proceeding on hydrocarbon cracking, as well as

selective hydrogenation, modeling and optimization of petrochemical plants, processing of plastics, and polymerization reactors. The subject and work plan of these projects are agreed upon jointly between interested industries and PIDCOP.

Laboratory for catalysts testing and characterization: In this laboratory BET tests are done for surface area determination. Catalytic surfaces are characterized and metallic dispersion assessed. Catalyst selectivity, activity and aging tests are also done.

Information, documentation, and extension service: A petrochemical bibliography bulletin is published monthly. A library of books and technical journals is kept. This service is in charge of the editing and distribution of bulletins, articles, and petrochemical bibliographies and has a telex service for communication with scientific documentation centers.

UNIDO FUNDED ACTIVITIES IN 1980 AT PLAPIQUI

The following discussions will highlight major activities. It is intended to provide a general feeling of some of the types of capability that exist.

a) Training

The training program was focused on the needs of Gas del Estado and PBB. Three group training missions on the startup and operation of ethane and LPG extraction plants were carried out by Gas del Estado personnel (shift operators and supervisors). Besides, personnel from PBB participated in several training missions abroad covering the fields of piping design, rotating machines, basic engineering, industrial safety and ethylene plant operations. The most intense phase of the training program for startup and operation of the ethylene unit was scheduled for the last quarter of 1980. Eighteen engineers from PBB travelled to Spain, Germany and Norway to be trained in plants similar to the one of Petroquímica Bahía Blanca. PLAPIQUI personnel continued long term training through UNIDO fellowships in the field of computer modelling and optimization of chemical processes, chemical process control, and heat transfer. Other members of PLAPIQUI were on foreign fellowships doing graduate work in the fields of catalysis, (2) polymers, (2) applied

thermodynamics, and one was at an engineering company studying basic ethylene technology.

A Model 1501 process simulator-trainer was purchased from Autodynamics Inc. It will be the basis of a Training Center for plant operators and plant supervisors. Chemical plant control will be simulated and taught in the following subjects:

- Startup and Operation
- Process Optimization
- Utilities (air, steam, water, refrigeration and waste treatment)
- Energy Conservation
- Instrumentation training
- Proficiency training
- Gas Processing system training
- Petrochemical Operations training
- Refinery Operations training
- Emergency Operations

Operators will learn to recognize and react to realistic control and upset situations. The simulator-trainer is provided with standard programs more or less tailored to the processes in the complex.

The simulator trainer was installed provisionally at Petroquímica Bahía Blanca. It will subsequently be moved to the PIDCOP Project facility, where PLAPIQUI personnel will take responsibility for its use for the Complex. PLAPIQUI is establishing a set of rules for the use of the simulator trainer by the different companies.

b) SIPREQ Computer Package

A computer package for the prediction of thermodynamic properties and the computation of equilibrium processes, was developed.

The basic thermodynamic modules were implemented in the PDP 8e-mini-computer, but further development of this system had to wait until the arrival of the PDP 11/70. The new computer was fully operational at the beginning of January 1980, and since then a large number of computer capabilities have been added to the basic thermodynamic modules:

- 1) FLASH, EXPANSION, and COMPRESSION PACKAGE: This package includes subroutines to compute isentropic, polytropic and isenthalpic expansions, partial vaporization and condensation of mixtures, with or without removal of heat. It also includes subroutines to find the state of a mixture (fixing temperature, pressure, enthalpy or entropy) and to carry out multiple flashes or condensations.
- 2) WATER-HYDROCARBONS EQUILIBRIUM PACKAGE: These subroutines which allow for non-ideality, enable calculation of two and three phase equilibria, bubble pressures and temperatures, and liquid-vapor and liquid-liquid vapor flash calculations.
- 3) DISTILLATION PACKAGE: A complete package of subroutines for the rigorous calculations of complex distillation columns has been developed. The program allows the computation of strippers and fractionators with partial or total condensation. The program can handle directly multiple feeds, extractions, intermediate vaporizers and condensers. A package of shortcut methods for modelling absorbers and distillation columns has recently been added to the system.
- 4) COMPRESSION AND REGRIGERATION CYCLES: A series of subroutines are under development to model the compression and refrigeration cycles of the ethane and ethylene plants.
- 5) CHEMICAL REACTIONS EQUILIBRIUM PACKAGE: Free energy of reaction and equilibrium constants are computed as a function of temperature for a data bank of 50 components.

SIPREQ has been designed to be fully interactive with the user, allowing a series of alternatives with regard to the equation of state to be applied (four different choices), initialization (three choices), reference state (three choices), convergence procedure and printing of intermediate or final results. It is modular, allowing the use of specific subroutines to develop a new application.

Professionals and technical personnel of PBB and Gas del Estado have been trained in the utilization and capabilities of SIPREQ. As a result of this interaction, a number of studies were requested by both companies. Now, for certain problems, the system is directly used by their personnel. At the request of Gas del Estado, the ethane pipeline that runs from the Ethane Plant to PBB was

studied to determine condensation under different operating conditions and the dew points of pipeline natural gas with and without water present. PBB requested the modeling of the expansion at the top of the demethanizer column and of the exchangers for compressed cracked gas. A complete study on the operation of the depropanizer column for the case of bypassing the propylene splitter was carried out directly by an engineer from PBB to adapt this column to the production of supergas ($C_3-C_3^{\bar{}}$). SIPREQ is also being applied in the study of the exergetic efficiency of several processing units of the ethylene plant, and the first results of that work were presented at the Meeting of the Argentinian Chemical Engineering Research Society (August, 1980).

The application of SIPREQ to the modelling of the Ethane and the Ethylene Plants will require the utilization of a more powerful operating system. A new system, RXS 11+, will be installed and then the speed and capability of the PDP 11/70 will be greatly increased.

POLISUR has requested, for their process engineering group, a version of the SIPREQ package that includes together with the basic thermodynamic modules, short cut procedures for the design and costing of distillation columns.

The policy of the PIDCOP project is to supply to the companies at a member fee the software that is available for their direct use. Extensions of the basic SIPREQ and its application to new fields or processes are offered at an additional cost. These programs will be supplied as confidential material to companies. It is planned that the companies, through computer center terminals, will use SIPREQ on a time sharing basis. Special problems will be solved at the companies' requests through the Industrial Technology Division specialists.

c) Polymer Studies

In 1979 a contract was signed by PLAPIQUI to analyze samples of polystyrene and low-density polyethylene (LDPE) for the industrial firm IPAKO. IPAKO sends samples from their production, their imports, or other sources. At PLAPIQUI these samples are analyzed for molecular weight distribution, by gel permeation chromatography, and for rheological (flow) properties by Instron Rheometer and Mechanical Spectrometer. While a number of the first two instruments exist in Argentina, the only Mechanical Spectrometer is in PLAPIQUI. It was purchased with UNIDO funds and arrived early in 1979.

More ambitious joint projects include research activities in LDPE polymerization, the influence of branching on rheological properties of LDPE, and comparative studies of structure and properties of low and high pressure LDPE. In May, 1980, POLISUR S.M., one of the companies of the IPAKO group, joined PIDCOP and is sponsoring this research.

In August, 1979, a short course on Theory and Practice of Polymer Characterization was offered at PLAPIQUI under the auspices of PIDCOP. Lecturers were Prof. M. Tirrell of the University of Minnesota and Prof. E. Valles of PLAPIQUI. The course included hands-on laboratory experience with the unique assemblage of modern characterization instruments at PLAPIQUI. The course had an attendance of 24 professionals from different companies and, as a result of it, links between PLAPIQUI and industry were considerably reinforced.

ELECTROCLOR S.A. one of the companies present at the course, joined PIDCOP in May 1980 and sent several staff members to Bahia Blanca to propose projects to PLAPIQUI. These include studies on the influence of additives and lubricants on the rheological properties of PVC and evaluation of the influence of structure on ultimate properties.

INDUPA S.A., the other major PVC manufacturer in Argentina, also became a member of PIDCOP in 1980 and immediately sent several PVC samples to PLAPIQUI for rheological and molecular weight characterization.

In August 1980 a short course on Polymer Processing was offered to industry under the auspice of PIDCOP. Lecturers were Prof. R. Armstrong from MIT, and Prof. H. Winter from the University of Massachusetts. This time the course had an attendance of six professionals. This is probably an indication that the processing area is less developed and still resistant to interactions with academia.

d) Engineering and Technical Service Studies:

Table I lists the technical reports issued from January to October 1980 by the PIDCOP Project of PLAPIQUI for its client companies. The titles provide a succinct indication of the areas of mutual interest. Abstracts are available in the ARG/75/021 Project Progress Reports.

Note that a study on CO₂ removal from natural gas is listed on Table 3 for Companias Asociadas Petroleras S.A. (CAPSA). This was a technical-economic study to establish the feasibility of a plant to remove CO₂ from the natural gas coming from Yacimiento Diadema, in the South. Because of the capability and availability of PLAPIQUI, CAPSA solicited this work, even though it was not a

T A B L E I

JANUARY - OCTOBER, 1980, PIDCOP TECHNICAL REPORTS

T I T L E	T O
Decarbonylation for Ethane with Monoethanolamine	PBB
Evaluation and Characterization of Commercial Pd/Al ₂ O ₃ Catalysts	PBB
Cracking of Ethane at High Conversions	PBB
Analysis of Operating Conditions for the Ethane Pipeline	GdE & PBB
Simulation of an Aerocondenser	GdE
Dew Points in the Feed Stream to the Ethane Plant	GdE
Review of Work Done for GdE	GdE
Evaluation of Alternatives for Natural Gas Decarbonylation	CAPSA
Rheological Characterization of Polyethylene	UNIVERSIDAD NACIONAL DE MAR DEL PLATA
Comparison of ICI and UCI Selective Hydrogenation Catalysts	PBB
Selective Hydrogenation of Acetylene II Background in Practical Aspects and Inferences for Runaways	PBB
Determination of Vinyl Chloride Peroxide in Vinyl Chloride Monomer. I. Literature Searches	INDUPA
Simulation of Cryogenic Process Section	PBB
Program for Interstage Cooling System Simulation in the Compression of Cracked Gas	PBB
Simulation of an Industrial Reactor for Cracking Ethane	PBB
Molecular Characterization of PVC	INDUPA
Use of SIPREQ for Natural Gas Mixtures. I.	GdE
Use of SIPREQ for Natural Gas Mixtures. II.	GdE

member of PIDCOP. Similarly, even before joining PIDCOP, IPAKO had its experimental project on "Polystyrene and Polyethylene Characterization" proceeding at PLAPIQUI. Other experimental studies are presently in progress for VINISA on "PVC Transformations in Extrusion Processes".

Petroquimica General Mosconi and PLAPIQUI are negotiating currently a computer project to study the possible effects of changing solvent in the PGM sulfolane extraction unit.

The PIDCOP project of PLAPIQUI is not attempting to confine its services to companies of the Petrochemical Complex in Bahia Blanca. Rather, PLAPIQUI has reached a level of capability where it can provide engineering and technical service benefits to other companies and benefit from the interactions itself.

The PIDCOP Project also found that it was called upon by GdE to play an active role in their plant start-up. Three technicians were engaged by PIDCOP to provide round-the-clock shift coverage in the GdE Plant's chemical laboratory. It seems probable that, to the extent that there is need, PLAPIQUI will be called upon by other companies for help during start-up.

e) Graduate Education and Recruiting

There is a problem of availability of junior technical personnel to fill the ranks of PLAPIQUI and the plants of the Complex. A step to solve this problem has been the initiation of a graduate program in Chemical Engineering. During 1980, twenty new full time graduate students joined PLAPIQUI to participate in this program. They were selected from more than one hundred applicants in a national solicitation.

One result of the recruiting and graduate educational activities has been to bring graduates of universities other than UNS to Bahia Blanca. In 1979, the technical staff of PLAPIQUI, to a man, were graduates of UNS in Bahia Blanca. The comparative statistics, in Table II, are an impressive step toward diversifying the backgrounds of engineers in Bahia Blanca. The recruitment of personnel with higher education in the fields of corrosion, materials and metallurgy has proceeded with some success.

Short and regular courses in key Chemical Engineering topics are taught by PLAPIQUI staff and Visiting Experts. In addition, there is a Seminar Program as well as an annual International Petrochemical Conference that draws attendance from the other regions of Argentina. These conferences bring outstanding authorities to Bahia Blanca to provide, with PLAPIQUI staff, a rich mixture of

TABLE II

APPLICATIONS ACCEPTED FOR
MS in ChE PROGRAM AT U N S

	<u>1979</u>	<u>1980</u>
Graduated from Universidad Nacional del Sur	12	10
Graduated from Other Universities	<u>1</u>	<u>10</u>
TOTAL	<u>13</u>	<u>20</u>

educational opportunities for the graduate students and practicing engineers in the region. Experts who visited Bahía Blanca in 1980 are listed in Table III.

CONCLUSIONS

PLAPIQUI has evolved into a functional, well-equipped, central R&D-engineering-tech service facility for the Complex. The PIDCOP Project of its Industrial Technology Division meets the technical service, engineering, computational and training needs of the industries affiliated with the Complex. The Universidad Nacional del Sur now has a Master of Science Program in Chemical Engineering addressed to training technical personnel for the new industries.

The reception of technical input from PLAPIQUI by the companies is enthusiastic and exemplary. PLAPIQUI provides them with capabilities and facilities that would otherwise be individually unavailable. PLAPIQUI has become a source of employees for the companies and the new graduate program is attracting students from other parts of the country to Bahía Blanca for their education and their careers. The UNIDO funded visits and courses taught and the Fellowships and the Study Tours have developed a cadre of confident and skilled personnel in PLAPIQUI, GdE and PRB.

Now, the activities of PLAPIQUI are evolving to its next task, rendering assistance to the satellite companies, even as was done for PBB and GdE. The activities that have been proceeding for PBB and GdE will pass through a maximum and reach a steady-state level when their production operations are stabilized.

Educational and technical activities on behalf of every other company in the Complex will, in the course of the next few years, pass through analogous maxima.

And what will be the outcome? In a few years every plant in the Complex is expected to be in steady state productions. PLAPIQUI's goal is to be a mature organization, staffed and well-equipped, providing tailored facilities and services that would be uneconomic for any one plant to consider. The goal is for PLAPIQUI to be the permanent central research and development facility for the Complex, providing educational and training facilities for the technical personnel of the Complex, solving problems, optimizing, and even more important, providing the technical keystone for further growth of the Complex.

TABLE III
VISITING EXPERTS

CANDIDATO	TEMA	PUESTO	PAIS	ESTADIA
EDMISTER, Wyne C.	Propiedades Termodinamicas	Consultor	EE.UU.	12/5/80-6/6/80
BOOTH, Sterling	Materiales Criogenicos	CONSULTOR	EE.UU	26/5/80- 5/80
SAWISTOWSKI, Henry	Procesos de Separacion Avanzada	Profesor	INGLATERRA	29/7/80=25/8/80
TURNER, Robin	Termodinamica	Profesor	INGLATERRA	15/8/80-15/9/80
BUTT, John B.	Reactores Quimicos	Profesor	EE.UU.	12/7/80=17/8/80
WANKE, Sieghard	Catalisis y Quimica de Superficies	Profesor	CANADA	10/8/80-25/8/80
KERSHENBAUM, Lester Stephen	Control de Procesos Quimicos	Consultor	INGLATERRA	18/7/80-17/8/80
FINLAYSON, Bruce A.	Matematica Aplicada	Profesor	EE.UU.	1/1/80-31/8/80
ARMSTRONG, Robert	Procesamiento de polimeros	Consultor	EE.UU.	4/8/80-3/9/80
ROQUES, Michel	Complejo Petroquimico. Contaminacion Ambiental.	Consultor	FRANCIA	1/9/80-30/9/80
BOOKER, H.	Tecnologia de Etileno	Consultor	INGLATERRA	
HALLER, Gary	Experto en Catalisis	Consultor	EE.UU.	14/7/80-31/7/80
BATTU, Claude Pierre	Diseno	Consultor	FRANCIA	17/8/80-25/8/80
SCRIVEN, L.E.	Matematica Aplicada	Consultor	EE.UU.	17/8/80-25/8/80
WINTER, Horst	Polimero	Consultor	EE.UU.	10/8/80-25/8/80
GONZALEZ, Richard	Experto en Infrarrojo y Catalisis	Consultor	EE.UU.	10/8/80-15/4/80
WEISS, Alvin H.	Catalisis y Procesos Petroquimicos	AsesorTecnico Principio	EE.UU.	3/1/80-15/12/80

