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Organizational Patterns of Industrial Research Institutes

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The following organizational outlines show how three research institutes have developed to meet the widely different needs of their countries.

Brazil

The National Institute of Technology Rio de Janeiro

By Ing. Teodoro Oniga
Director, Centre for Study of Applied Mechanics

Historical Background

The National Institute of Technology is a federal agency forming part of the Ministry of Industry and Trade of the Republic of Brazil.

The present Institute originates from the Experimental Station for Fuels and Minerals, which was established at the end of 1921 with Ernesto Lopes da Fonseca Costa (died in 1952) as its Director. In 1933, the Station became the *Institute of Technology* which, in 1934 was renamed the *National Institute of Technology* but was organized on much more modest lines; there were eight sections to start with, seven divisions and auxiliary services in 1938, two new divisions established in 1956 (Metrology and Electricity), a training section organized in 1949 and the Centre incorporated in 1952.

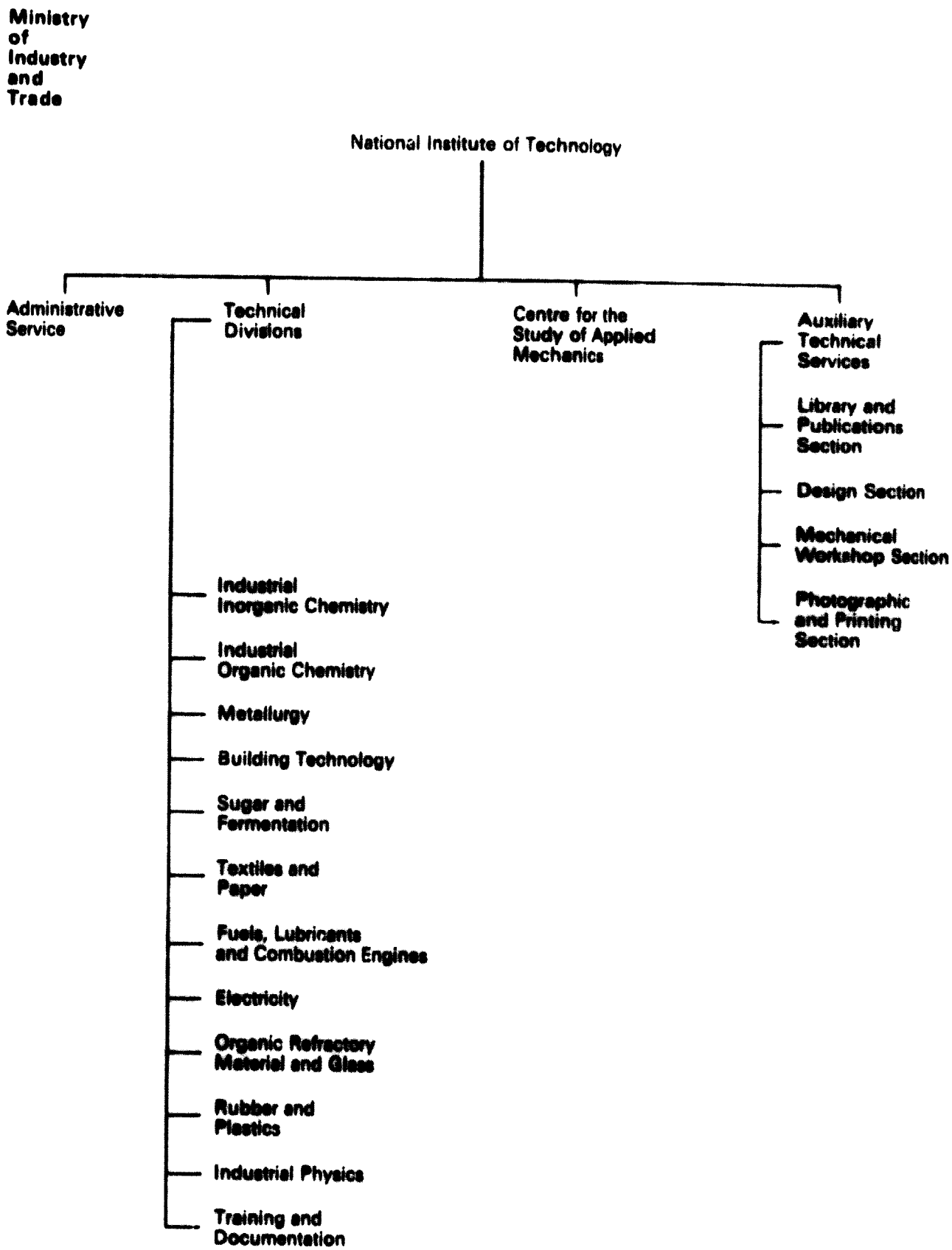
Structure

The Institute, as it has been organized since 1961, comprises an Administrative Service, twelve Technical Divisions, a Centre for the Study of Applied Mechanics and Auxiliary Technical Services. *The Industrial Inorganic Chemistry Division* analyses raw materials and national products of mineral origin, and studies ways of improving their use. *The Industrial Organic Chemistry Division* studies raw materials of vegetable and animal origin and their derivatives in order to improve their industrialization. *The Metallurgy Division* is concerned with metallurgical products of national interest and the manufacturing techniques best adapted to Brazilian conditions. *The Building Technology Division* examines the materials used in all types of building and carries out research aimed at improving building techniques in Brazil. *The Sugar and Fermentation Division* studies all matters bearing on the fermentation processes of interest to the national industry. *The Textiles and Paper Division* analyses the raw materials used and the products manufactured in the Brazilian textile industry, the most appropriate manufacturing processes and the technical problems of cellulose. *The Fuels, Lubricants and Combustion Engines Division* studies national fuels (solid, liquid and gaseous) and their use in combustion engines. *The Electricity Division* tests electric machines and instruments for measuring electricity, and carries out experiments in electricity and electronics. *The Ceramics, Refractory Materials and Glass Division* examines the raw materials used and the products manufactured in these industries and the manufacturing processes best adapted to national conditions. Until 1961, this was a section of the Metallurgy Division. *The Rubber and Plastics Division* from 1941 to 1961 was simply a laboratory of the second Division studying natural and synthetic rubbers and plastics with a view to promoting the use of national raw materials. *The Industrial Physics Division* deals with problems relating to the scientific and technical applications of physics. It was established in 1961. *The Training and Documentation Division* organizes specialized courses for technicians and university extension courses for students in the final years of higher education in highly practical sectors, such as the technical information service. Previously, this was only a section.

The Centre for the Study of Applied Mechanics is not strictly speaking an official section of the Institute. It was established in 1952 on the initiative of Professor Edmond A. Brun and financed by research funds allotted by the National Research Council. The Centre has built an aerodynamic tunnel and carried out a number of studies on fluid mechanics; applied mechanics; automation; cybernetics; and the use of solar energy.

The Auxiliary Technical Services include a Library and Publications Section, a Design Section, a Mechanical Workshop Section and a Photographic and Printing Section. Before its reorganization in 1961 the Institute also

Organization Chart



included a Division of Metrology which became the National Institute of Weights and Measures when the new Ministry of Industry and Trade (previously merged with the Ministry of Labour) was established. Metrological work on the measurement of time continued, nevertheless, to be carried out by the National Observatory.

Personnel

The present staff of the National Institute is very inadequate because of a planned total of 428, the Institute has a staff of only 176 (short 252), of which only 167 are actually full-time, as follows:

Engineers, chemists and other senior staff	57
Technologists, laboratory technicians and other intermediate technicians	45
Administrative and auxiliary staff	97
On detachment to other institutions	9

Furthermore, the average number of staff has steadily fallen in recent years: 258 in 1960, 245 in 1961, 220 in 1962, 198 in 1963, 190 in 1964, and 169 in 1965. At the same time, normal activities increased from 4,102 subjects dealt with in 1960 to 5,300 in 1965, showing that the number of questions dealt with *per capita* doubled in that period from an average of 15.8 to 31.4.

This decrease, which is very considerable, particularly in the senior grades, can be largely explained by strong competition from industrial and private establishments in the recruiting of technologists. In addition, a general and sometimes indiscriminate policy of reducing public expenditure has resulted in a severe limitation of funds for pure and applied research, and consequently in the loss of many research workers. This is typical of quite a number of developing countries and not only of Brazil.

Activities

The following are among the important problems in the solution of which the Institute has taken an active part:

Studies on coals in South Brazil: the first tests in Brazil are being made on their washability, on their combustion efficiency in stationary engines and in ship's boilers, on the use of these coals in the production of municipal gas, and on mixing them with imported coals (of low sulphur content and high fixed carbon content) for the purpose of satisfactory coking (this method is still used in Volta Redonda).

Testing the distillation of Brazilian pyro-bituminous shale to obtain fuel oils which can be substituted for petroleum (which had not yet been discovered in Brazil).

Experimental manufacture of ferro-manganese alloy to facilitate the use of ore of low manganese content, which is extremely abundant in Brazil.

Use of ethyl alcohol as a national fuel to enable this hydrated by-product of sugar refineries to be used in the generation of power, by promoting the establishment of factories to produce anhydrous alcohol for the same purpose. (Today alcohol is seldom used as an anti-knock ingredient and the bulk of production is used for other industrial purposes).

Research on surface signs indicating the existence of petroleum (the presence of asphalts, bitumens and soil exudation) and certain signs of subsoil deposits: the studies carried out at Lobato (Bahia) finally led to the discovery of a rich oil-bearing zone, after having provoked violent controversy at the time.

The introduction of gas generators for use in cars and lorries during the Second World War (fuel could not be imported and there was no domestic production yet).

Research on the economic value of samples of ores and industrial raw materials with a view to developing the exploitation of natural resources, including diatomite (*kieselguhr*); limestone for cement production; phosphates, pyrites; vegetable oils (*babassu, tung oil, carnauba, castor oil*); essential oils (rosewood, sassafras, vetiver, etc.); resins; natural fibres; salt (NaCl); potashes; and ceramic materials (kaolin, etc.). These studies have had practical effects on production, improvement of quality, etc.

Financial Status

The present budget of the National Institute of Technology is approximately 1,000 million cruzeiros or about $500,000, divided more or less equally between salaries and equipment. Taking the figure of 167 full-time staff, this represents an annual average *per capita* expenditure of $3,000 and means an average salary of $125 per month. (It is true that Directors of Divisions earn a little more than $200). The Institute's budget represents only 0.02 per cent of the national budget and the proportion in relation to the gross national product, which is about $25,000 million (approximately $400 *per capita*), is only 1:50,000 which is negligible.

The average cost to the State of an analysis, a report, or a current technical project comes to about $100, since more than 5,000 items were dealt with in 1965. This is certainly not a high figure, because a large proportion of the results obtained have very important economic repercussions.

Future Prospects

In a still under-developed country spreading over a vast area, such as Brazil, where everything still remains to be done or redone, a centralized body like the National Institute has been and will probably continue to be of fundamental importance.

Unfortunately, this federal institution, like dozens of other technological institutes throughout the twenty-two States which, with the Federal District (Brasília) and the three Territories, make up the Republic of Brazil, has not been given the needed priority in the allocation of public funds for the maintenance and development of technological research work.

Peru

Centro Nacional de Productividad (National Productivity Centre)

Lima

By Mario Ayllón A., Coordinator General

Organization

The National Productivity Centre is an autonomous non-profit organization headquartered at Lima (Peru), with activities covering the entire country.

The Centre is governed by the following bodies:

(*a*) a National Committee; (*b*) an Executive Committee.

The National Committee is composed of organizations and institutions such as the National Association of Industries (La Sociedad Nacional de Industrias), the National Peruvian Businessmen's Corporation (La Sociedad Nacional de Comerciantes del Perú), the Association of Chambers of Commerce, the National University of Engineering and other universities in the country.

The *Executive Committee* consists of the Director General, who serves as Chairman, and three Directors nominated by the National Committee.

Objectives

The Centre's objectives are the following:

(*a*) To promote the more economic and socially profitable use of the available resources by industrial, commercial, agricultural, mining and banking enterprises;

(*b*) To promote and facilitate the creation of new employment opportunities through the efficient channelling of new investment capital, and to carry out specific and general studies, both regional and national in scope, which will further Peru's economic development;

(*c*) To encourage friendly co-operation between management and labour;

(*d*) The activities of the Centre are designed to ensure:

(i) A reduction in the costs of production distribution and administration;

(ii) An increase in the consumption capacity of the population in general and an expansion of the market for goods produced by national industries in particular.

(iii) That the benefits deriving from increased productivity are equitably shared by management, labour and consumers.

Activities

The Centre's activities are as follows:

(*a*) Promotion and publicity: Promotion, publicity and creating an awareness of the ideas, principles and techniques of productivity and its importance in raising the level of living.

(*b*) Instruction and training in productivity techniques: Seminars, round-table discussions, training courses for managers, executives, supervisors, and non-manual and manual workers. In-service training at the request of the enterprise concerned.

(*c*) Research: Research on the measurement of productivity in different industrial sectors and in enterprises requesting this service.

(*d*) Advisory and consultative services: Advice is given to enterprises and institutions requesting it on applying the principles and techniques of organization and administration and on analysing and diagnosing problems. Consultative services.

(*e*) Co-ordination: Co-ordination and co-operation with the technical assistance services in the field of productivity sponsored by the United Nations, ECLA, the International Labour Organisation, AID and other international bodies.

Co-operation with institutions established to develop productivity programmes. Liaison and exchanges with productivity centres throughout the world.

The above-mentioned activities will be carried out by the competent officers as specified in the table of organization to be established in CENIP's rules and regulations.

Financial Status

1966 budget	*Soles*
Ministry of Labour and Communities	S /. 2'000,000.00
Ministry of Development and Public Works	1'000,000.00
Total	S /. 3'000,000.00
20 per cent discount allowed by law	600,000.00
Total government contribution	S /. 2'400,000.00
Contribution from Industry	500,000.00
Net Total	S /. 2'900,000.00

Publications

In order to publicize its studies, CENIP issues a quarterly review entitled *Productividad*, which is distributed to public and private groups both in Peru and abroad. Similarly, specific studies of certain economic sectors are published and distributed to interested individuals and institutions. Publications have been issued on: hides and skins; smelting; foods; slaughterhouses and cold storage; footwear, lumber; production engineering in Peru; costing and accounting for small industries, etc.

Yugoslavia

The Institute for Processing Techniques, Zagreb

By Dr. Mihajlo Mautner, Director*

The Process Industry

The mass production of chemicals, petro-chemicals, food products, ceramics, synthetic fibres, paper products, pharmaceuticals and many other products of today is accomplished in factories in which the most modern processing techniques are applied to move a continuous flow of raw materials and intermediates through different physical operations and chemical processes.

A special character of the processing industry is that it develops very quickly in the world today and that some of its branches take on the character of basic industry, since the products of this industry serve as raw materials for the development of final products.

The most noticeable characteristics of the processing industry are: the high speed at which its technology develops and changes, as well as its process and reaction techniques which cause quick obsoleteness; and the intensive need for research to enable the industry to compete successfully.

In Yugoslavia, experts, businessmen, enterprises and the State administration in 1960 made the first efforts to create an organization for study and solution of research problems in the processing industry.

In 1962, the "Centre for the Processing Industry" a business association, was founded by the manufacturers of machinery of the Federal Republic of Croatia; the most important task of this Centre was to initiate and develop scientific research work. It took a rather long time to ultimately define a research programme, to provide for financial means, to choose the staff and to establish a corresponding organization. In 1965, "The Institute for Processing Techniques" was founded. The Institute is a self-sustaining organization for scientific research which has been created with extraordinary efforts and which, in a way, is a specific example of public relations in Yugoslavia.

The founders are the leading machinery manufacturers in Croatia such as: "Jedinstvo", manufacturers of equipment for food processing and chemical industries; "Djuro Djakovic", manufacturers of rolling stock, industrial and power plants and steel constructions; "Tvornica Parnih Kotlova", steam boilers factory; "Ventilator", manufacturers of ventilation, thermical, gas and silo plants; "Institut Za Naftu", the Institute for Mineral Oil; "Zavod Za Kaloricna Mterenja I Regulacije", Establishment for Calorific Measurements and Regulations; "Konstrukcioni Biro Gradjevinske Industrije", Designing Bureau of the Civil Engineering Industry.

Full understanding, support and help to the Institute were given by the Executive Council of the Federal Republic of Croatia, the Municipality of the town of Zagreb, the Chambers of Trade of Croatia and of the town of Zagreb, and by an allocation of the funds for financing scientific activities of Yugoslavia and of the Republic of Croatia.

Organization of the Institute (Scheme)

Federal and republic laws in Yugoslavia regulate the organization and financing of scientific work and ensure its systematic development. A scientific research organization can be established if the technical staff and the material means are ensured and a scientific work programme is set up. These facts are verified by the Council for Scientific Work of the Republic.

The rapid growth of the economy makes it imperative to establish scientific research organizations even though at the time not all requirements are fulfilled. Often enough organizations are founded and the requirements met afterwards.

According to the law, every scientific research organization must have a Statute to regulate the programme of work, finances and administration and relations between the founding members and the organization. The Statute of "The Institute for Processing Techniques" provides that fundamental statutory decisions cannot be implemented without the founders' agreement, e.g. establishment and liquidating of the Institute, pooling or partial separation and changing its objectives.

The Institute's highest administrative body is the *Council, in which founding members are represented by one half of the membership and the scientific staff by the other half.* The Council decides on policy, nominates the Director, approves the work programme and the budget, allocates the financial means, etc.

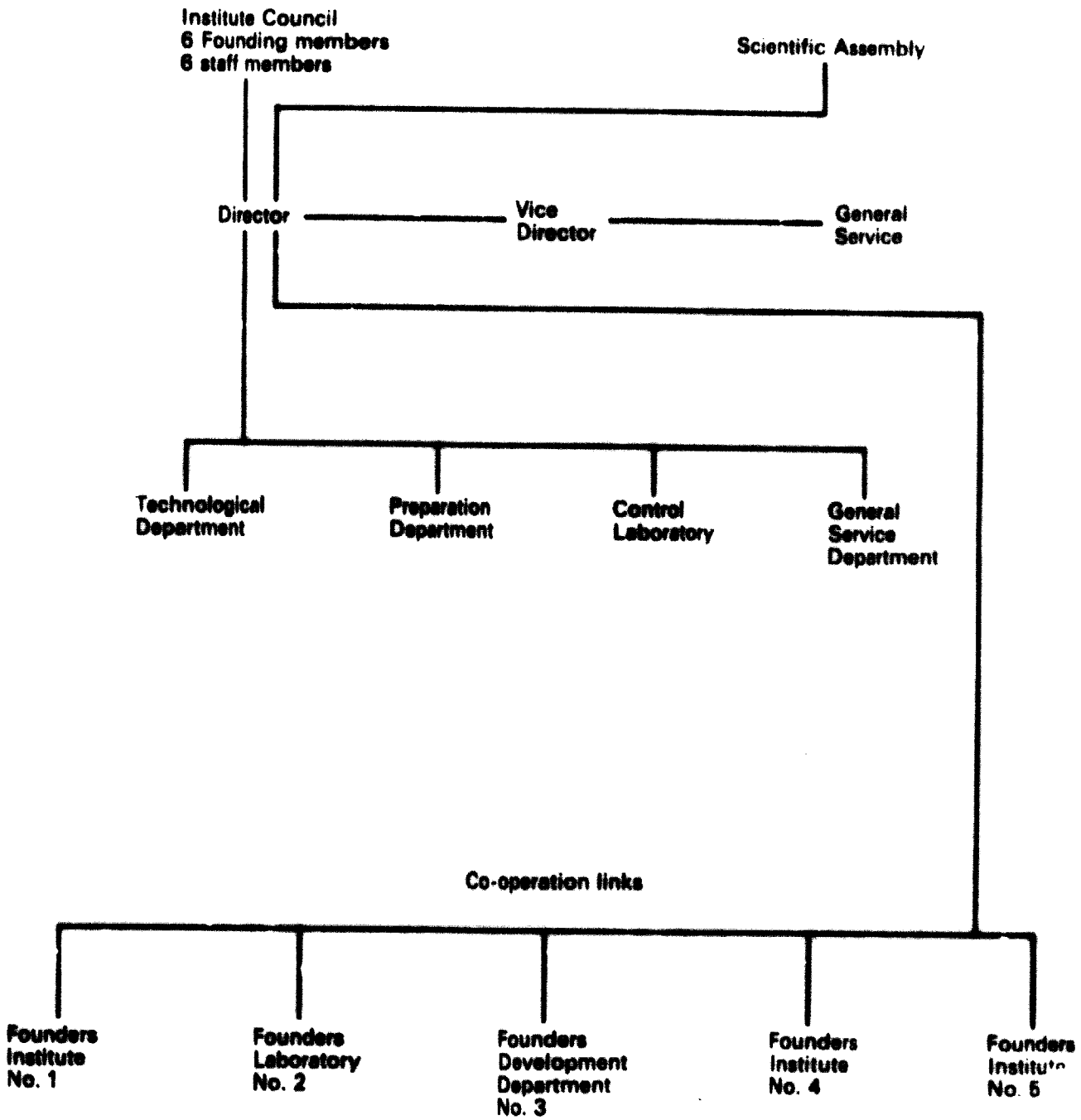
Besides the Council, the Scientific Assembly of the Institute acts in an advisory capacity.

The Scientific Assembly is composed of eminent scientists, both from inside and outside the Institute, as well as highly qualified executives and experts chosen from among the founding members.

The Scientific Assembly proposes to the Council the

* For a biographic sketch of Dr. Mautner see MEN IN RESEARCH

The Institute for Processing Techniques
Organization Chart



annual work programme, advises on the choice of collaborators and systematically promotes the development of the staff.

The Institute is managed by a Director, who is responsible to the Institute Council. He also supervises the work of all departments and services.

The Institute comprises the following departments:

Technological Department

This is a key department, the entire work of the Institute depends on the quality of work and measure of success of it.

The work programme of the Department is two fold, as is the Institute work programme. On the one hand, research work is initiated by the Institute or a scientist on the staff, on the other, sponsored research is undertaken after settlement with the sponsoring organization. Both types of research work are listed on the annual work programme.

A scientist, after completing a successful research project in the laboratory or pilot plant carries it forward through the various stages from design to the manufacture of the needed machinery for the application of results. Only after a successful completion of a project does a scientist return to research work.

This practice ensures the application of research results to industry and therefore promotes a faster development of processes.

Preparation Department

The scientific experiments developed in the Technological Department are carried out into practical application here. A mechanical workshop for proto-types, a pilot plant laboratory for routine experiments, and a testing station where proto-types and production lines are mounted and tested comprise the Department.

Control Laboratory

Check-ups and measurements are undertaken by means of chemical, physical and chemical-physical methods. Qualitative and quantitative analysis of products, both for the Institute and sponsors, are made and certificates issued.

General Service

This comprises matters related to personnel, administration and accounting.

A part of the staff and resources are lacking and the Institute building (main hall) is being built. The departments exist, but their structure has not been fully developed as yet.

Apart from the Institute for Processing Techniques, there are also research departments and laboratories as well as institutes within the founding members' enterprises. The work programme of their research and development organizations is a part of a complex programme in which the Institute for Processing Techniques is partly active. Thus, duplication of work is avoided.

The Scientific Working Programme

At the start, the dilemma was whether to choose a general research programme or a more specialized one. In other words, either to try to develop a great number of processes with average results, or further develop the processes that exist in the country which are considered great achievements, bring them to perfection and develop bold new processes based on them.

Since the programme had to be realistic and correspond to present and future intellectual and material resources, a specialized research programme has been chosen.

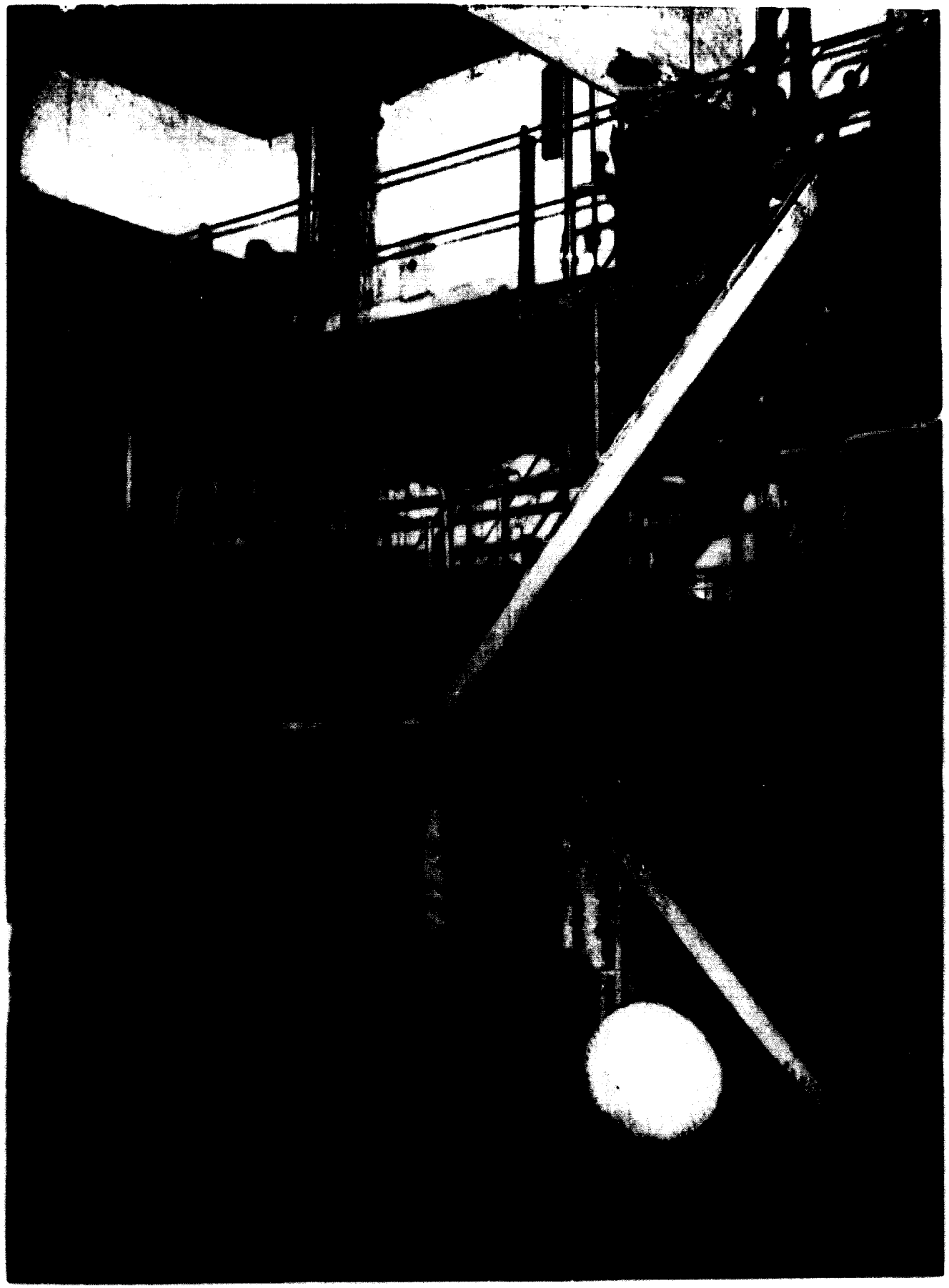
The research programme covers the following subjects:

1. Technological heat transfer, evaporation and distillation. Top results have already been obtained on the subject. Members of the Institute, led by the Director, have had remarkable international success before joining the Institute staff.

The well-known Swedish firm, Messrs. Alfa-Laval manufactured the centrifugal evaporator "Centri-Therm", based on the results of their research work, and the Yugoslav firm, Messrs. "Ventilator" produced the "Termorotor", winner of a gold medal award in Leipzig, in 1965.

Recha: Pilot Plant for lactic acid production

Below: One hundred foot tall fermentation vats for antibiotic processing produced by "Jedinstvo".



The centrifugal evaporator was described for the first time in 1959 by Zoran Rant as "Mautner's evaporator", in his "Verdampfen in Theorie und Praxis".[1]

The Institute is working at the moment on the following evaporators:

1. *Centrifugal tube heat exchanger "Spirotor".* The apparatus is described as an intensive continuous centrifugal heat exchanger which in a record short time (part of a second) effects the concentration of normal or very viscous liquids; it is of great practical value for concentrating many solutions in chemical, food processing and the pharmaceutical industry.

A proto-type was built and the Institute for Aerodynamical and Thermodynamical Research in Zagreb was requested to examine it. Through testing, the heat transmission co-efficient for the evaporation of water was determined as:

K = 8,000. Kcal m²h°C, or 1,640 BTU/ sqfth°F

For the evaporation of a 10 per cent sugar solution to 45 per cent concentration the heat transmission coefficient was determined as:

K = 6,800 kcal/m²h°C

and for a from 40 per cent–67 per cent concentration of a viscous glucose syrup to a dry substance it was determined as:

K = 4,600 kcal/ m²h°C

These outstanding results had never been achieved until now in laboratory, pilot or commercial evaporation experiments anywhere in the world.

2. *Centrifugal lamellar heat exchanger—"Lamoterm".* This is another intensive centrifugal heat exchanger with a very short evaporation time. Its properties are similar to those of the "Spirotor". The construction of a proto-type pilot plant for "Lamoterm" has been started.

3. *Expansion tube evaporator.* This is a stable, intensive evaporator with a huge heating surface, excellent tube wetting properties and a short period of exposure of the foam to heat. Its convenient over-all dimensions ratio to the heating surface offers many advantages for food, chemical and pharmaceutical processing operations. No separator is necessary, making the plant much cheaper, therefore. The proto-type pilot plant is presently under construction.

4. *Evaporator for sugar plants.* This is a stationary lamellar expansion evaporating station. The sugar solution is exposed to heat for a very short period of time. Laboratory experiments showed that the heat transmission coefficient increases from 100 to 150 per cent over the classic Robert's evaporator.

The proto-type project has been completed.

5. *Thin tube and lamellar heat exchangers.* These heat exchangers were developed for use with the above-mentioned evaporators, but they can be adapted to the requirements for heat transmission between two fluids, e.g. gas-liquid, liquid-liquid, with great savings of space and materials which is especially important in the chemical, metallurgical and nuclear techniques.

6. *Seawater desalinator.* The basic element of this automatic apparatus for the conversion of seawater into sweet water is the Spirotor. The high heat transmission co-efficient, makes possible a rational construction which permits working with very small temperature differences.

This project has been completed.

7. *Vacuum rectifying column.* The rectifying column operates in a vacuum and handles liquids with greater molecular weight and small evaporation rates in normal temperatures. It is a stationary, lamellar column, provided with a great number of trays.

The column is in the planning stage as yet.

Separation

The Institute has undertaken the following research problems:

1. *Extractor liquid-liquid.* This is a continuous centrifugal extractor, provided with a great number of mixing and separation stages. It is simpler than some known extractors such as Podbielniack's. Separators are indispensable for modern production of, for example, soap, refining of vegetable and mineral oils, dephenolization of waste waters, vitamin concentrates, antibiotics, etc.

The construction of the proto-type has been completed.

2. *Extractor solid-liquid.* This is a continuous separator of solid particles, intended for the treatment of waste waters.

The Institute directs its activity towards the study of apparatus of the greatest importance to modern processes and, at the same time, intensifies some of their operations. The compactness of the new apparatus permits a big production capacity in a smaller unit, thus a smaller outlay of capital for engineering construction work is required.

Tomato Paste

The process differs from the well accepted ones. It offers the following advantages:

Very short concentrating time (heat treatment): Tomato purée processing time is reduced from 1½ to 2 hours to a few seconds.

Smaller plants: Plant space requirements are reduced by 50 per cent.

Higher solids concentrates: Up to 70 per cent concentrates were obtained, compared with 28 per cent now possible.

Tests were carried out in 1965 in a pilot plant and the following results were obtained:

70 per cent solids concentrate paste;

282 mg vitamin C contents per kg;

3.5 per cent loss of colour only.

Extensive experiments will be carried out in 1966 in a food processing plant as a preliminary step for the establishment of a proto-type commercial plant.

[1] Rant, Zoran, "Verdampfen in Theorie und Praxis", Dresden, Teodor Steinkopff, 1959. 260 p. (Wärmelehre und Wärmewirtschaft in Einzeldarstellungen, Bd. 13).

Fruit Juices, Beer and Other Alcoholic and Non-Alcoholic Drinks Concentrates

The equipment consists chiefly of a pasteurizer, an evaporator and an aroma recovery unit. The treated material is converted into two components, a concentrate and aromatic alcohol.

The Institute has also developed other processes such as meat extract, gelatin, lactic acid fermentation, etc.

Personnel

Although the Institute is still in the planning and development stages, the nucleus of the staff is already working in a variety of research projects in co-operation with the research institutes and laboratories of the founding members' enterprises. At present, the Institute staff is composed of nine scientists and researchers. In addition, seven experienced skilled metal workers in the proto-type workshop make the apparatus and equipment required by the research staff to carry out their experiments.

The Institute is also assisted by voluntary researchers, greater in number than the Institute paid staff.

Equipment

The equipment provided for the proto-type workshop so far consists mostly of old machines. This is not, of course, a happy circumstance, but the lack of adequate financial means compelled such a concession.

The laboratory and pilot plant equipment, purchased abroad, represents an investment of US $102,500.

Equipment of the following types has been acquired: technical-mechanical apparatus, apparatus for mechanical separation, size reduction apparatus, apparatus for reactor techniques, laboratory apparatus, apparatus for physical-chemical examination, measuring and regulating instruments, and accessory outfit and miscellaneous apparatus.

Although the sum spent is relatively high, a considerable part of the equipment has still to be purchased.

To implement the programme the Institute needs the following additional resources:

2-man, 24-month special consultants service;
4-man, 6-month specialization for the Institute staff;
US $50,000 for basic research to be carried out, under contract, by specialized researchers and institutions.

Financial Status

The following sums have been invested in the Institute:

Equipment for the proto-type workshop (purchased in the country)	$ [illegible]
Laboratory equipment (purchased abroad)	$102,500
Total	$[illegible]
Construction of the Institute Building	$178,000
Grand Total US	$305,500

From the above the following was received as a subsidy:

French technical assistance (laboratory equipment, chiefly)	$ 9,350
The city of Zagreb (the unfurnished building, completed for the Institute)	$ 67,500
US	$ 76,850

The balance of US $228,650 was obtained as an interest-free loan against favourable conditions payable in 10 years.

The most difficult problem at this moment is to find the financial resources necessary to fulfil the goals as originally planned.

Fully automatic concentration plant for meat extract.

Planning for Industrial Development

United Arab Republic I

The Aswan Industrial Development Center*

Background

The Aswan High Dam will benefit the United Arab Republic by controlling the flow of the River Nile and by providing inexpensive power, however, the dam is only one of the resources of the Aswan region. The United Arab Republic Government recognized this fact a few years ago and set up a special organization known as Regional Planning of Aswan to conduct research regarding the resources of the region for the benefit of Aswan and of the country as a whole. To carry out the assignment some seven research and development centers have been set up namely, minerals, industrial, human resources, agriculture, water resources, transportation, and environmental planning.

Objectives

As one of the research centers, the Aswan Industrial Development Center serves existing industries and promotes new industries when feasible. It works closely with the minerals and agricultural centers, for these are constantly on the lookout for new materials of economic value.

At present, the chemical, metallurgical, ceramics and food industries show the greatest development potential but miscellaneous industries such as metal working, essential to all others, will be given special attention. To be specific, the Center has undertaken, or is in the process of undertaking, work along the following lines:

1. Co-ordination of the work of others in regard to industrial projects;
2. Analysis and tests of materials and products;
3. Use of waste materials and by-products and their improvement;
4. Development of new products and processes;
5. Feasibility studies in regard to proposed new industries;
6. Development of improved quality and performance standards for manufactured products;
7. Assisting industry in purchasing, marketing and production management problems;
8. Promoting small industries, both the product and service types.

In general, the Center generates ideas for new industry and in all cases evaluates proposed projects from both the technical and economic points of view. For feasible projects the Center must follow through on execution, working with various companies, organizations or private individuals to ensure that the projects are launched successfully.

Activities

General studies are undertaken to evaluate ideas, to explore possibilities and offer suggestions and recommendations for action on matters relating to the industrial development of the region. 84 possibilities have been identified and study outlines developed. Work has begun on some of them, but due to the unavailability of competently trained staff extensive work cannot be carried out at this time. An important requirement in this connection is to find qualified personnel.

Currently, studies are being conducted in six main areas:

1. *Chemical-metallurgical industries*: a chemical fertilizer plant and iron ore and phosphate rock mining are already in operation. Intensive studies are being conducted regarding an iron and steel complex, an aluminum plant and a phosphorous plant.

2. *Food processing*: two sugar mills are in the region and possible meat, fish, fruit and milk processing plants are under study.

3. *Fibre industries*: fibre board and paper pulp plants are already in operation making use of the bagasse from the sugar mills. The use of palm fibre and animal by-products offer opportunities for other products.

4. *Construction materials industry*: the development of granite and marble cutting and polishing appears feasible and the manufacture of other building materials such as concrete blocks, tiles, and precast concrete building units is under study.

5. *Ceramics industry*: good ceramic clays are available and the development of a ceramics industry is contemplated.

6. *Small industries*: A programme is underway to develop the various small service, maintenance, and fabrication industries which are necessary for an integrated industrial community. The Center expects to provide assistance in financing, building, management, marketing, and training to such industries.

It was indicated earlier that both technical and eco-

* Based on material submitted by the Aswan Regional Development Project.

nomic studies would be carried out in connection with proposed industrial projects. The technical investigations will require a number of laboratories and shops and these facilities are now being provided to cover the six areas listed above. More specifically the laboratories now being planned and equipped are:

1. Chemical Laboratory
2. Testing Laboratory
3. Food Technology Laboratory
4. Ceramics Laboratory
5. Metallurgical Laboratory
6. Chemical Processing Laboratory
7. Metal Working Laboratory
8. Wood Working Laboratory
9. Electrical Laboratory

In addition to laboratory equipment various pilot plant equipment is being procured to allow test runs on ore dressing, chemical processing, and metal treatment.

The purpose of a pilot plant is to determine operating characteristics, yields, operating problems, and plant design factors, all of which in turn contribute to a meaningful feasibility study of a research project. Two specific projects underway are: a plant to extract alumina from clay, thereby making possible an aluminum plant using local raw materials; and a plant to reduce iron ore directly to iron, making use of an electric furnace.

Both processes are well known in other parts of the world, but the purpose of the Aswan tests will be to determine the suitability of locally available raw materials for the processes.

Facilities Required

To carry out an ambitious work programme, a number of facilities are necessary. The requirements, stated broadly, fall under four categories:

A. *Research and Test Equipment* to be used largely in laboratory analysis and pilot plant work, which calls for specific analytical equipment. Beyond these requirements, caution must be exercised in enumerating equipment until needs are fairly clearly identified.

It is intended to charge nominal fees for specific services rendered, for free service is seldom appreciated.

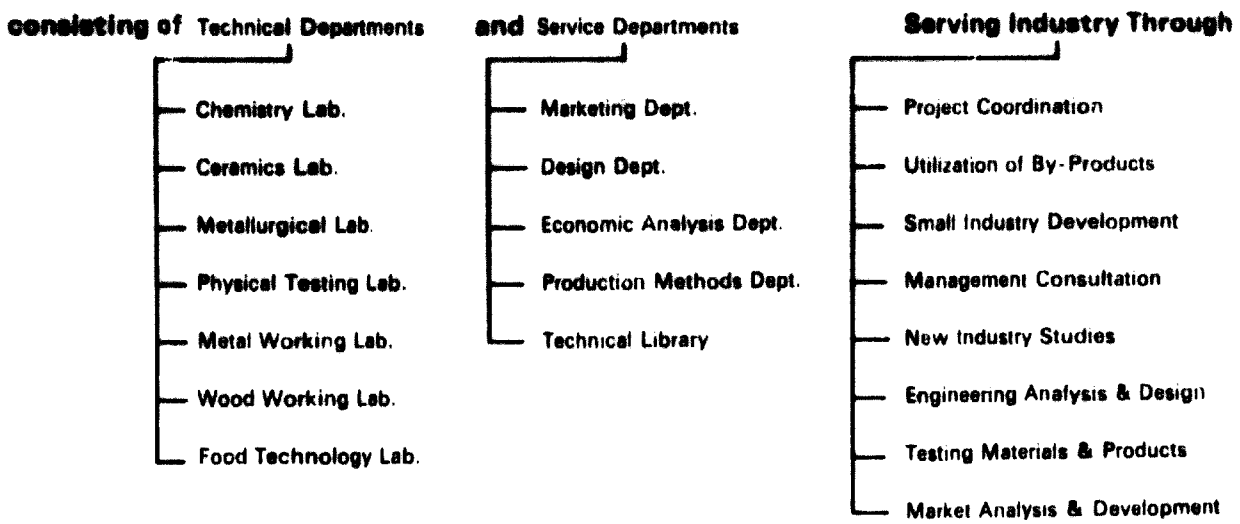
B. *General Purpose Equipment.* Uses of this equipment may be summarized as follows:

1. Maintenance and repair: since maintenance facilities in Aswan are painfully lacking, the Center intends to be responsible for maintenance and repair operations for all industries as well as for the other centers in the area.
2. Development of new products ideas and performance of prototype production runs of these products.
3. On-the-job training of personnel.
4. To start off new businesses in the area.
5. To carry out the research and development activities of the laboratories.

C. *Services:* Much of the general purpose equipment would fall into the "service category". Two almost purely service-laboratories are under consideration: an auto repair shop and a photo off-set shop. The auto repair shop is an absolute necessity and should be established immediately. The photo-offset shop is badly needed in Aswan, but certain technical problems need further study before a final decision on the matter can be reached.

D. *Library:* No research or investigatory activity of meaning can be carried out without adequate resource materials. A library of some 500 books and 20 periodicals have been ordered and are now arriving. It is expected that the Center library of technical materials will become a major attraction for technical people in the area.

Functional Chart — Aswan Industrial Development Centre



United Arab Republic II

The Central Textile Research and Development Institute, Alexandria

By Adel A. Sabet

Council of Scientific Research
Cairo, United Arab Republic

Background

The textile industry is the biggest industrial sector in the United Arab Republic; at present, it provides employment for more than 200,000 workers.

The application of improved production methods and techniques is required to increase production, to cut textile imports and to save much needed foreign exchange. In addition, cheaper and better products will fare better in the highly competitive world's textile market.

A Textile Research Institute with adequate financial resources, well-trained research personnel and modern technical equipment will meet the urgent research and development needs of such an important industry.

Organization

The Central Textile Research and Development Institute is an autonomous public institution which was created by Presidential Order 2269 of 13 July 1964. A Board, composed of the Director of the Institute who acts as Chairman, representatives of the industry and the textile departments of the universities, the heads of departments of the Institute and its General Secretary will govern its policy and provide general direction in the implementation of the research and development programme.

The Institute will have the following departments: Central Laboratories; Textile Mechanical Treatment; Textile Chemical Treatment; and Man-Made Fibres and Dye Stuff. It will work with the textile industries of the country and will be a link between them and the university textile departments, other research bodies in the U.A.R. and related institutions in other countries.

Functions

The main functions of the Institute will be as follows:

a) Applied research on problems facing the industry in making fuller use of raw materials and machinery.

b) Establish and operate testing laboratories and pilot plants to facilitate this applied research and other development activities;

c) Adaptation of machinery and initiation of a programme for the production of spare parts and related services required by the industry;

d) Collection and dissemination of data on modern advances in industry;

e) Assisting the industry to implement standards and to improve measures for quality control;

f) Training of technical personnel, both in the Institute and in industry;

g) Provision of extension services to industry as required.

Site

The Institute is to be established in Alexandria; a site of about 90,000 square metres and detailed architectural plans for the buildings and layout have been prepared.

Personnel

The Institute is still in the process of organization and development. The Head of the Textile and Allied Industries Department of the National Research Centre in Cairo has been appointed Supervisor of the project. A Consulting Committee assists the Supervisor in planning and follow-up on the various matters connected with the planning of the project.

The nucleus of the staff of about 40 scientists and engineers, plus 10 supporting staff, of the planned departments at present is a part of the National Research Centre; industrial research problems are undertaken by specialized teams at the Centre's laboratories.

Twenty members of the university teaching staff and of industry participate in the supervision and execution of research projects. In addition, the Government will provide a large number of professional counterpart staff members and laboratory and technical assistants.

Staff Training

Plans for industrial training have been prepared and two foreign experts have already been retained to supervise an initial programme of industrial co-operation with local factories. The Government will also contribute to the training and study tours proposed for these personnel as well as to the current operating costs of the Institute.

Scholarships to undertake advanced training in textile technology in foreign countries have been awarded to two members of the staff.

Equipment

Information and price quotations on machinery and equipment have been obtained from various foreign firms; the material received has been sorted out and is being studied.

Projects being Handled

The Institute will undertake applied research or "mill-type" research on raw materials; spinning; weaving; knitting, dyeing; printing; and finishing of all kinds of textile fabrics, as well as in related industries such as ready-made garments; man-made fibres; dyestuffs; textile auxiliaries; textile machinery; and instrument manufacturing.

These activities are being presently undertaken in an embryonic form by the Textile Department of the National Research Centre. Following are some examples of the type of work that is under way. They also give an indication of the expansion of the work of the Institute. It should be noted here that these activities form largely the over-all work of the mechanical and chemical departments.

1) Cotton preparation and bleaching technology, at Misr Mehall Mill, with the aim of reducing manufacturing costs, avoiding chemical damage and improving the obtained effects.

2) Cotton yarn sizing at ESCO Plant, with the aim of improving the sized yarn characteristics to reach higher weaving efficiency which will result in reduction of production costs.

3) Investigations on the causes of uneven dyeing in wool fabrics, at Misr Mehall Mill. The aim of the work was to prevent faulty dyeing and to get reproducible shades during dyeing of crabbed wool fabrics.

4) Investigation of combing preparation at Misr Fine Spinning and Weaving Mill, Kafr El-Dawar. The aim of this investigation was to modify the cotton combing preparation in order to get a better yarn quality coupled with reduced waste (noil) extraction.

The results of this project are very significant, considering the savings of raw material, a 2 per cent in cotton.

5) Investigations of the broad yarn count variation and high strength irregularity, at the ESCO Spinning Mills. Using the statistical methods known as "equal weights equivalent lengths" all the intermediate products in the production line were investigated and the faulty working machine stages detected.

Once the cause of the irregularity was located corrective action was undertaken.

Development Activities

The Institute will also undertake activities which have a close bearing on research work but may take some time to arrive at acceptable solutions. Examples of this type of work follow:

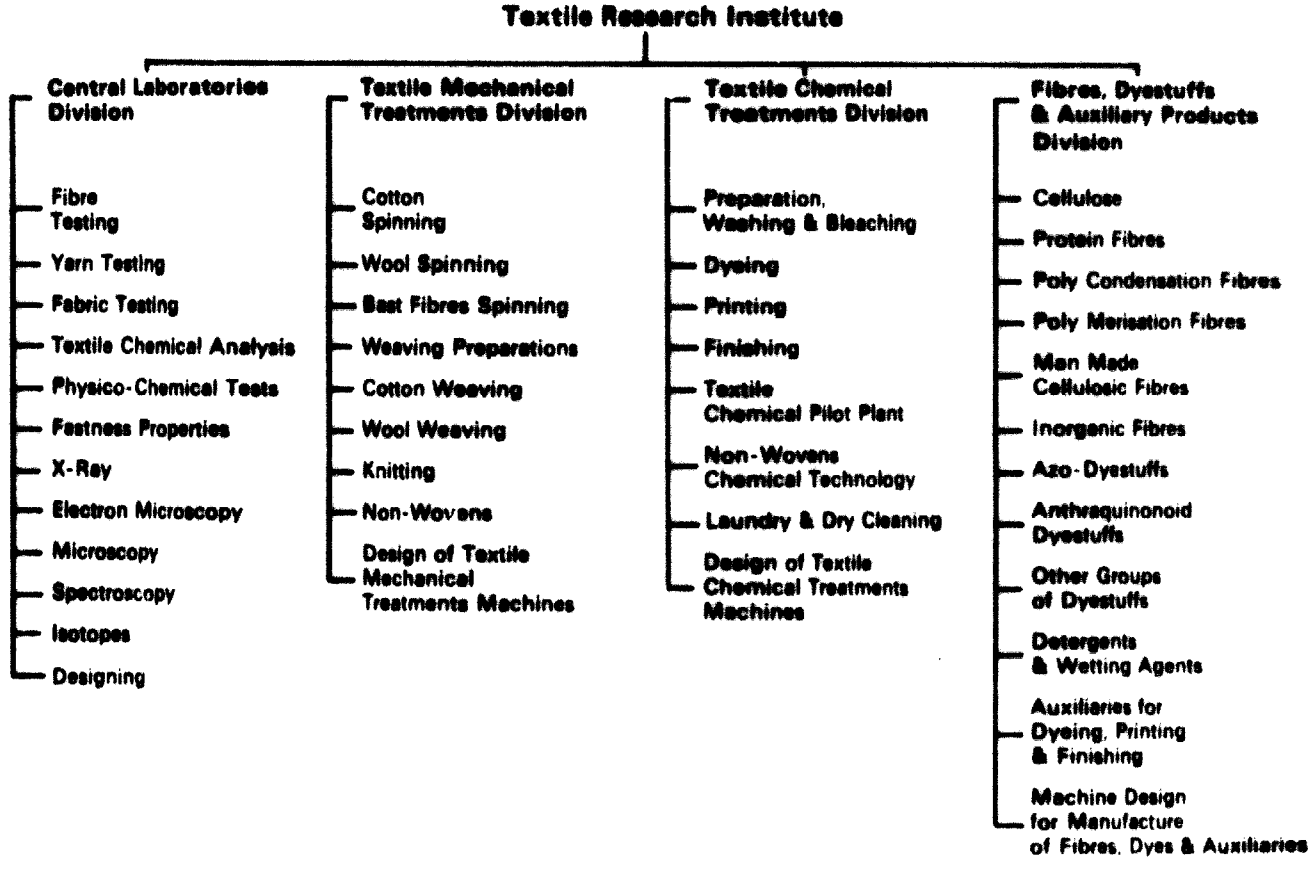
1) Chemical modification of cotton fabrics, to give them new properties such as crease resistance, antibacterial finish; stretch-cotton, etc.,

2) Preparation of cotton sizing and thickening materials used in textile printing, from local raw material, e.g., the preparation of CMC from bagasse;

3) Investigation of short fibre content and effects caused on yarn quality; and

4) Preparation of new dyestuffs and textile auxiliaries. The results of these investigations are to be handed over to the textile factory at Ismailia.

Supreme Council of Scientific Research Research Institutes



Research Projects

Each issue of *Industrial Research News* will present brief notes on a group of research projects on which information has been received. In this issue the list contains such varied projects as the preparation of sand for foundry use, the production of glazed wall tiles and the preparation of instant tea. This list represents the diversity of interests among our readers.

Hoverkiln

National Research Development Corporation,*
London, England

Since the war the development of kilns has been in the direction of large continuous tunnel kilns. These are often very long since the work to be fired has to undergo a heating and cooling cycle which may take up to 36 hours. A major difficulty is in moving the charge through the kiln and it is sometimes liable to jam up completely.

To ensure smoother passage through the tunnel the firm had devised a plan for a "Hoverkiln" in which the loaded pallets would be supported on a cushion of air. The air supply had the further advantage of promoting better heat transfer and thus reducing the heating and cooling cycle.

Automatic Foundry Plant

National Research Development Corporation,
London, England

In 1962 the Corporation was approached with a request for help to accelerate the development of an automatic core making and placing machine. The construction of this machine formed the second stage of a development programme begun by the company in 1956, in which year the client had devised an automatic flaskless high pressure sand moulding process for grey iron castings.

The first stage of the development covered the construction of an automatic moulding machine to carry out the process for uncored castings. After a period of intensive research and development a prototype plant came into commercial operation in the company's works in 1960. As soon as this was running satisfactorily the company embarked on research into the requirements for a satisfactory core making process and core placing technique and this was well advanced by 1962. The client company had kept abreast of all research work in this field and had maintained close contact with the British Cast Iron Research Association.

After detailed consideration of proposals put to it by the client, the Corporation decided on a joint risk arrangement for the development by the company of an automatic core making and placing machine for use with an improved version of the early prototype sand moulding plant. Although the preliminary process and technique studies have been completed, investigations are still in hand on core materials and the design of core boxes and patents. The plant layout and design are completed and site preparation and ancillary plant installation are well advanced. Trials of the improved moulding machine began in the Spring of 1966.

Cryogenic Engineering

National Research Development Corporation,
London, England

Cryogenics is that branch of engineering concerned with the production, maintenance and employment of very low temperatures (near absolute zero) and with the study of the new properties of materials and new physical phenomena which exist in these conditions. Cryogenics are finding or are likely to find applications in atomic piles, space simulation, rocket fuels, and in devices such as "masers" as used in the Goonhilly Telstar reception aerial.

To encourage the promotion in the United Kingdom of industrial facilities the Corporation co-operated in the setting-up of a Working Party on which, in addition to the Corporation, were represented four industrial firms. The skills and experience of these industrial firms together cover most cryogenic equipment needs. Their association has resulted in the formation of a new corporation with the object of securing contracts in cryogenics.

Before the formation of the new company, NRDC had arranged to support, on a joint venture basis, the development by Petrocarbon Developments Ltd. of a hydrogen refrigerator liquefier unit, for temperatures in the region of 4° to 20° K using expansion turbines operating with helium as the working substance and running on helium bearings. An experimental rig has been constructed and will be used in investigations in connection with a number of cryogenic projects.

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* The National Research Development Corporation is an independent public corporation organized to promote the development of new materials and processes and their adoption by industry.

The work of the Corporation is financed by the Minister of Technology with government loans. The Corporation is required to balance its accounts and maintain its activities on a sound commercial basis.

Shelling of Cashew Nuts

The Tropical Products Institute, *London, England*

Cashew nuts are widely grown in East and West Africa and India where they are processed mainly by hand. The African countries would like to process more of their nuts and have asked the Tropical Products Institute to develop simple equipment to do it.

The Process Development Section of the Institute is concerned at the moment with the major project of facilitating and speeding up shelling and at the same time, ensuring a high percentage of unbroken kernels. The problem has been approached with some success from two directions.

1) This process involves placing the nut in the correct position and then, using a hand or foot lever, bringing a knife down to cut it at its weakest point. The kernel must then be extracted by hand from the broken shell.

This method demands a great deal of manual work but is still faster and more efficient than the old methods of breaking the nut with a piece of wood.

2) The second method uses a specially designed centrifuge, the nuts are fed into the top of this and are flung into baffles to break the shells. Shells and kernels are separated on a riddle and, when the speed and other conditions are correct, a very high percentage of unbroken, high-grade kernels, is obtained.

The first method has already been tried out in some countries but present indications are that it is the centrifugal method which will have the widest application.

Further research is being done to try to find methods of pretreating the nuts to ensure easy cracking and a high quality kernel.

Kisii Soapstone Chalk

East African Industrial Research Organization, *Nairobi, Kenya*

Kisii soapstone is a whitish, soft, rather unctuous rock, it is not talcose but a mixture of sericite and kaolin, it is easily ground and when the white variety is finely ground, the resulting powder has the appearance of a white kaolin and does possess a certain amount of "slip" when rubbed between the fingers.

The Ceramics Section, in the course of an investigation into possible uses for the waste material from the Kisii soapstone carving industry, found that the finely ground stone could readily be cast into intricate shapes and hit upon the idea of making blackboard chalks from it.

A considerable amount of work was undertaken to establish a method of making the chalk and a satisfactory process has now been worked out to produce enough good quality chalks for the local market and the layout of a plant to be established in Kisii has been prepared. The plant, financed by the Industrial and Commercial Development Corporation, will produce 100 gross chalk sticks daily.

The chalks appear to be as good in all the necessary properties as the normal imported chalks which are made from plaster of Paris.

Glazed Wall Tiles

East African Industrial Research Organization, *Nairobi, Kenya*

The market for glazed wall tiles in East Africa is so small that manufacture on conventional lines involving high capital cost is unlikely to be economic. The high cost of existing types of tunnel kilns is one of the major deterrents. It seemed possible to the Ceramics Section that by using materials that would stand a rapid heating and cooling schedule, cheaper kilns could be constructed for a relatively small output, thus making manufacturing economic.

Wollastonite which is found in Kenya, seemed to be one of the most promising materials. Deposits in Tsavo National Park and Kajiado District were examined. Trials showed that 70 per cent Wollastonite to 30 per cent of a plastic clay from Mkuyu Hill, Machakos, gave good results. Dry 6 in. tiles at room temperature were pushed by hand into a small slot furnace at 1050° C. and kept there for various periods of time until it was shown that satisfactory glazed tiles could be withdrawn after a period of only 20 minutes.

As a result of these preliminary trials, a gravity-fed slot kiln, down which the tiles travel in a single layer, has been designed and is in construction. The kiln which will produce 35 to 45 6 in. tiles per hour will be 8 ft. long and, by itself, occupy a floor space of less than 10 square feet and will lend itself to automatic operation. Electric heating is being used, as much of the equipment required is already available in the laboratories.

Glazed Wall Tiles Drying at Small Scale in Western Kenya — Locally available materials are used in tile production.

Analyses of the Wollastonite and clay used in making the tiles are as follows:

	Wollastonite (*Kamaishi District*)	Clay (*Mineyama Hill*)
	per cent	per cent
Silicon (as SiO_2)	59.96	58.55
Iron (as Fe_2O_3)	0.08	2.85
Titanium (as TiO_2)	0.00	0.60
Phosphorus (as P_2O_5)	0.05	0.02
Aluminium (as Al_2O_3)	0.02	22.50
Manganese (as MnO)	0.01	0.02
Calcium (as CaO)	35.37	0.54
Magnesium (as MgO)	0.22	0.60
Sodium (as Na_2O)	0.00	0.67
Potassium (as K_2O)	0.11	2.08
Moisture (at 110° C.)	0.08	—
Ignition loss (at 1100° C.)	3.85	9.43
	99.78	99.44

A technical report on the operation of the kiln will be issued in 6 to 12 months' time, when various trials have been completed.

Oil Extension of Natural Rubber

Rubber Research Institute of Malaya,
Kuala Lumpur, Malaysia

A project to produce oil-extended natural rubber to compete with oil-extended synthetic materials is well advanced at the Rubber Research Institute of Malaya in Kuala Lumpur. A 75 parts oil, 25 parts rubber masterbatch is used in the extension of lower grades of rubber which are collected as lumps, not as latex.

There are two methods of producing a rubber compound which is extended: the first one, developed by the Natural Rubber Producers' Research Association in Welwyn Garden City, Herts., England, a sister organization of the Institute, involves the addition of oil to dry rubber in an internal mixer during compounding. This method has the advantage of overcoming tariff restrictions for the import of oil-extended rubbers.

The second method, now being pursued, is the incorporation of oil into the rubber before shipment. This process, patented under British Patent Number 1,000,588 granted to the Board of the Rubber Research Institute of Malaya by Mr. B. C. Sekhar, consists of making an oil-extended rubber compound in the form of coarse powder containing 75 parts of oil and 25 parts of rubber. An emulsion of rubber extender oil is added to a vulcanized latex. The mixture is coagulated with formic acid to form a crumb and subsequently washed and dried.

The properties of such compound are an improvement of those obtained by the process of dry mixing.

Research Studies on Tea

Tea Research Station,
Kanaya, Shizuoka, Japan
By Hiroshi Kato, Director

A series of research projects have been carried out to assist in the production of a high-grade instant tea and to study the effect of various factors on the flavour of tea. Among these research projects are:

Manufacture of Instant Tea

The study of the manufacturing methods of water soluble tea powder began in 1959 and was completed in 1964. The recovery of tea flavour lost during percolating and drying is now under study. The following processes are being studied: semi-countercurrent multistage extraction; dehydration; and freeze drying.

The semi-countercurrent multistage system was used for the extraction of tea. Concentrated extracts of good quality and about 20 per cent of soluble solid, with 20-25 per cent of yield were obtained.

On dehydration, the drying rate increases with the rise of temperature, but it is essential not to exceed 50° C. or quality might deteriorate. The pre-treatment of foaming of the tea extract caused a good puffing state during vacuum-drying, shortened drying time and made it easy to scrape out the product from the pan.

On freeze-drying, the drying time was prolonged according to the thickness of the extract fed but drying rate per weight unit increased slightly with the thickness, ranging from 2 to 10 mm. The dehydrated tea powder had a good solubility in cold water.

When dried tea leaves, having 3 and 5 per cent moisture, were stored at 5, 10, and 15° C., no reduction of ascorbic acid content and no significant difference of organoleptic qualities in it were found after 3 months.

Instant tea manufactured on a commercial basis by this method is on the market as a result of this study.

In Bulk Storage of Tea Leaves

As the size of tea factories increase, greater storage capacity is required. In general, tea is stored for a few days only. Research on the possibility of prolonging storage time without detriment to the quality of tea began in 1961.

The projects included the following: investigation of biochemical changes in freshly plucked tea leaves, the results of which would serve as a basis for the study of deterioration in quality while in storage; study of the effect of storage conditions on the quality of fresh leaves stored for one or two weeks; introduction of chemical control with growth retardants such as kinetin-like substances, to prolong storage time; and economic evaluation of improved storage methods which would be established as a result of the study.

Experiments showed that the qualities of flavour and taste of green or black tea made from stored tea leaves had deteriorated after only 2 days in storage at 25° C., but the leaves stored at 2° C. kept a good flavour and taste,

after 8 days. Next, pre and post-plucking application of kinetin or N^6-benzylaminopurine reduced the transpiration rate and depressed the oxidation degradation of chemical components of tea leaves, such as ascorbic acid, and the storage life of treated tea leaves was prolonged about twice as much. The new type of equipment, in which tea leaves could be stored in bulk was developed.

As a result of the research project, the storage of fresh tea leaves has improved and new storage facilities at 10 to 15 C. are being built for large-scale tea manufacturers. It is expected that low temperature storage will preserve the quality of tea leaves after plucking and protect tea made from stored leaves from deterioration of flavour and taste.

Investigation of Chemical and Biochemical Changes During Black Tea Manufacture

The aim of the project is to develop optimum processing methods for the fermentation of black tea in order to improve the qualities of flavour, aroma, taste and colour of the Japanese black tea.

The project includes the following: enzymological study of polyphenol oxidase in tea leaves, which operates on the oxidation of polyphenols during fermentation. The activity of it is related to the qualities of taste and colour of black tea; study of the oxidation products of polyphenols in black tea, the compositions and concentrations of which are related to black tea quality; and study of black tea essential oils, the results of which may be used as a basis for a further investigation and improvement of black tea flavour.

In the course of the investigation on polyphenol oxidase, tea leaf polyphenol oxidase, recognized as water in soluble enzyme until now, was dissolved with treatment of Tween-80, and three isozymes were recognized in the soluble enzyme. The isozymes showed different substrate specificity to odiphenol and triphenol. Enzyme activity in tea leaves fluctuated among tea clones, and black tea made from leaves of clones having a high level of enzyme activity, showed good qualities.

The study of the enzyme oxidation of various flavanols, alone or in combination, showed that the oxidation of mixtures containing catechol flavanols turned red. In addition to this, some other courses, producing flavin like substances, were formed. It suggested that there exist several kinds of substance, occupying similar positions on the chromatogram as spot Y of Roberts. The oxidizing products of tea polyphenols influence the colour and taste of tea infusion; so, they are the most important constituents which relate to the quality of black tea. The results of these studies will be useful to improve quality as well as manufacturing methods of black tea.

Surveys of black tea flavour followed. The use of oleoregin extracted from black tea, with an essential oil collected from the black tea infusion vapor by the sweeping method, and the components in essential oils identified by gas chromatography were studied. It was found that there are no differences in the components of essential oils among high, medium and low-quality black tea grades, but the relative quality of each component was different among them; it was also found that the relative quantity of linalool in essential oils in high quality tea was higher than in low quality tea. The changes in the components in the essential oils of tea leaves during black tea manufacturing process are now being investigated.

It is expected that the results of the research will serve to improve the quality of Japanese black tea.

Biosynthesis of Tea Polyphenols by Tracer Technique

Tea polyphenols, contained abundantly in young leaves, are the most important components in relation to the quality of taste, colour and aroma in tea.

Plants grown in Japan have somewhat less polyphenolic content than in Ceylon and India. Development of a tea plant with high polyphenolic content is important to

Left: Semi-continuous current multistage system experimental apparatus, Tea Research Station, Kanaya, Shizuoka Japan

Right: Freeze drying machine, Tea Research Station, Kanaya Shizuoka Japan

the improvement of black tea quality.

The biosynthesis pathway of polyphenols in tea leaves and the effect of some environmental factors affecting polyphenolic formation should be elucidated. Experiments using carbon-14 showed that radioactive carbon dioxide was assimilated by the tea plant in the light. The bulk of the radioactivity existed in sugar fraction, and a small percentage was detected in the catechins, the principal compounds of tea leaf polyphenol. Free catechins had higher activity than galloylesters of catechins.

An experiment in the administration of carbon-14 labelled compound to tea shoots cutting showed that phenylalanine was converted into catechins, and that the biosynthetic pathway of catechins in tea leaves was reasonably presumed to be common to the pathway of flavonoid formation in higher plants. Moreover, the effects of light and nitrogenous nutrition to the formation of tea polyphenols are under investigation and these results are anticipated to make a contribution toward the improvement of raw materials and to the evaluation of prunts in the tea industry.

Stronger Drawn Steels

Battelle Memorial Institute, Columbus Laboratories,
Columbus, Ohio, U.S.A.

Tensile properties of drawn steels are higher when the steels are deformed warm (100 to 700 F) than they are when the steels are drawn at room temperatures. For example, the yield strength of 1141 (steel containing about 0.41 per cent carbon) is about 100,000 psi when drawn at room temperature; when drawn equal amounts between 400 and 700 F, the yield strength is 135,000 psi. Some improvements in strength also can be obtained in certain grades of steel by aging at elevated temperatures after drawing at room temperature.

Although the benefits of warm drawing and aging are well known, very few data have been published on the metallurgical mechanisms responsible for strength improvement. If the mechanisms were known, it should be possible to control heat treatment or alloying so as to produce steels that are superior to any produced today.

Research inquiring into the improvement mechanisms has been conducted for the Applied Research Laboratory of the U.S. Steel Corporation. As reported by Arnold F. Gerds and Francis W. Boulger of Battelle's Columbus Laboratories, the investigation confirmed the theory that strengthening results from increases in the number of lattice defects, such as dislocations. Complete clarification of all mechanism details was not attained, but it is certain that the degree or amount of strain hardening is directly dependent on the number or density of lattice defects.

In order to better understand the basic mechanisms that influence strengthening, some experiments were performed with pure iron wire to which known and controlled small amounts of carbon and or nitrogen were added. Pure iron drawn at temperatures between 80 and 800 F to reduce its cross sectional area by 22 per cent showed comparatively little strengthening (up to 10,000 psi). With carbon and or nitrogen present in solid solution in the iron, however, strengths were increased up to about 24,000 psi by drawing at room temperature and up to 40,000 psi by warm drawing for equal reductions.

Similar strengthening was obtained with two experimental heats of 1018 steels, which contain about 0.18 per cent carbon. The presence of carbon and or nitrogen in iron apparently increases the number or density of dislocations formed by cold working. In general, the study demonstrated that the amount of strengthening is essentially independent of composition as long as the iron contains more than some critical amount of carbon or nitrogen (probably less than 0.0015 per cent) in solid solution.

Research also showed that aging at elevated temperature caused no significant increase in the tensile strength of either carbon- or nitrogen-containing irons or steels. Steel specimens strengthened most by straining were least affected by subsequent aging.

Generally, straining at the optimum elevated temperature caused 50 per cent more strengthening than did equal deformation at 80 F. In eight of twelve specimens, warm drawing caused more strengthening than did the combination of drawing at 80 F and aging at elevated temperature.

Gerds and Boulger conclude, on the basis of their data, that strengthening, whether caused by warm drawing or cold working followed by aging, results from the same set of mechanisms. Apparently, the aging reactions occur at the same time as, or immediately after, the formation of dislocations when the straining is performed at elevated temperatures. From study data, it was hypothesized that nitrogen is more effective in promptly locking dislocations than is carbon.

PA57, A New SP Rubber Masterbatch

Rubber Research Institute of Malaya,
Kuala Lumpur, Malaysia

PA57, a new Superior Processing rubber masterbatch has been developed in the laboratories of the Rubber Research Institute of Malaya in Kuala Lumpur. PA57 is in convenient masterbatch form, ready for blending with natural or synthetic rubbers. Compounds containing it are easier to process, either by extrusion or by calendering, than those made from unmodified rubber. Productivity is thus increased.

PA57 is prepared by mixing, in the latex state, 80 parts of crosslinked rubber with 20 parts of unmodified rubber; to this is added 40 parts of a light-coloured non-staining oil. PA57 contains, then, 57 per cent crosslinked rubber. After coagulation with acid, the product, in the form of crumbs, is dried in hot air.

Marketed in 100 lb. bales, wrapped in polythene-lined multiwall bags, PA57 may be stored safely without change, provided that exposure to high temperature or to excessive sunlight is avoided.

PA57 is produced by a number of organizations in Malaysia and can be obtained through normal trade channels. Further technical information and samples can be obtained from the nearest office or laboratory of the Malayan Rubber Fund Board.

Handling of Waste Waters in Beet Sugar Processing

British Columbia Research Council,
Vancouver, B.C., Canada

During the operating season just completed, the Division of Applied Biology assisted Manitoba Sugar Co. Ltd. in the design and operating control of one of the first completely closed fluming (beet transport) water systems in North America. Unique features of the system are the small total amount of water in circulation and pH control for the accelerated sedimentation and removal of soil particles together with inhibition of fermentation.

Details were presented by company personnel at the 21st Industrial Waste Conference held at Purdue University, in May 1966.

Standard Sand for Foundry Use

National Metallurgical Laboratory,
Jamshedpur, India

To evaluate the quality of bonding clays and synthetic binders for making foundry sand mixtures for moulds and cores, it is imperative that the foundry industry has a standard sand of uniform chemical composition, grain shape and fineness. In India, no attempt has been made so far to formulate a standard sand for such testing purpose nor have any efforts been made to examine the known sand deposits for such a use. The National Metallurgical Laboratory has undertaken this work and the standard specification has been formulated in collaboration with the Indian Standards Institution.

Considerable deposits of high silica sand, assaying more than 96 per cent silica, are known to exist in Madras State near Ennore beach. The Madras Public Works Department has set up a standard sand processing plant for cement testing using the Ennore sand deposits. The −25 mesh sand is obtained as a by-product while manufacturing the standard sand for cement testing. The annual production of −25 sand is about 600 tons.

To use the −25 mesh silica sand by-product, research work has been undertaken at the National Metallurgical Laboratory and the Foundry Station in Madras, in collaboration with the Madras Public Works Department to find out the suitability of the Ennore sand by-product for the purpose of preparing standard sand for foundry use. Preliminary work shows that it may be possible to produce a standard sand conforming to the proposed ISI specification of standard sand. Large scale pilot plant studies on the washing and upgrading of the −25 mesh sand will soon be undertaken to establish the economics of large-scale production. A comprehensive survey of the silica sands in Punjab has been carried out in collaboration with the Geological Department and Industries Department of the Punjab Government to assess their suitability for foundry practice. Similar work will also be undertaken at the Foundry Station in Madras, in collaboration with the State Geological and Industries Departments.

Rubber trees being tapped to get latex

Research Expenditure in Norway

The Managing Director of the Norwegian Council for Scientific and Industrial Research (NTNF), Mr. Robert Major, in his comprehensive report on the Council's activities to the Annual Meeting on 20 April 1966, expressed hope that Parliament would act soon and favourably on the Research Plan of 1964 which recommended that Norway's annual investment in scientific-industrial research and development be increased from 285 million kroner in 1964 to 600 million in 1968.

Mr. Major observed that state support for scientific-industrial research had approximately doubled from 1962 to 1965, corresponding to the progressive increase urged in the Research Plan. He noted with grave concern, however, that the increase for 1966 is only 3.5 per cent over 1965.

Norway spent some 350 million kroner for research last year, with the State and industry contributing about equal amounts. In percentage of the Gross National Product, Norway spent less than other industrialized countries of the world. In 1963, Norway's total research investment corresponded to .92 per cent of the Gross National Product.

Canada Plans to Assist a South American Country In Setting Up a Technical Information Service

The Technical Information Service of the National Research Council of Canada in Ottawa, plans to offer help to a South American country in establishing or extending such a technical information service locally. The service will be patterned on the co-operative information service which has functioned most effectively for the last fifteen or sixteen years between the National Research Council (Ottawa) and the British Columbia Research Council (Vancouver). This service operates as follows:

Technical inquiries are received by mail or telephone and answered by two full-time technical information officers on the staff of the British Columbia Research Council in Vancouver. Similarly, inquiries are passed on to one of its technical officers when he is visiting plants or private industry. If the needed information is not available locally, the inquiry is sent to the Technical Information Service of the National Research Council in Ottawa, which has a large library and more staff engaged in this type of work, as well as contacts with sources of technical information in the United States and the United Kingdom.

To carry the above proposed project into execution, the Head of the National Research Council's Technical Information Service would send a Canadian expert to the South American country for a year to assist in setting up the technical information office. Reflecting the above procedure, technical inquiries which cannot be answered locally will be sent to Ottawa for processing. At the end of the year, the expert will return to Canada but the services of the Technical Information Service will still be used by the South American country.

The cost of maintaining the expert in South America and of handling the inquiries at the Technical Information Service office in Ottawa would be underwritten by the National Research Council as a contribution to the assistance of developing countries. If found effective, the assistance may be extended to other countries as well.

No decision has been taken concerning which country would be the first to benefit from such technical assistance project.

Scientific and Technical Information Services in the U.S.A.

The National Referral Center for Science and Technology, Washington, D.C.

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In its active referral service, the Center answers inquiries as to where information may be found and advising of the identity, location and capabilities of the information resources considered most appropriate.

The Center's second service is the preparation and publication of directories listing the information resources available in selected scientific and technical fields.

Referral service is free; it may be requested by letter, telephone, or personal visit. Availability of directories, as they are published, is announced as widely as possible through the professional and technical press.

Requests for information should be directed as follows:

By correspondence:
The National Referral Center for Science and Technology
Library of Congress, Washington, D.C., 20540, U.S.A.
By telephone (Area code 202) 967-8087
Visits:
Library of Congress Annex, Fifth Floor
Second Street and Independence Ave., S.E.
Washington, D.C. 20540, U.S.A.

The Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.

A wealth of technical information is available to industry in printed form through the Clearinghouse for Federal Scientific and Technical Information in Springfield, Virginia, U.S.A.

This information is disseminated through a variety of publications issued by the Clearinghouse:

U.S. Government Research and Development Reports, issued twice a month, contains abstracts of all reports of U.S. Government-sponsored R&D projects released by the Department of Defense and other Federal Agencies;

Fast Announcement Service, reviews reports of special significance in a large number of industrial classifications; and

Technical Translations, published twice a month, contains information on translated technical literature available from the Clearinghouse and other associated sources.

For information on availability of publications, write to:

The Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151, U.S.A.

Institute Services to Government and Industry

It may be helpful to compare the varied ways in which Industrial Research Institutes are serving their countries. In this section, *Industrial Research News* presents a report on two Industrial Research Institutes.

United Kingdom

The Tropical Products Institute,* London

Background

In the past, many natural products have been exported from the tropics to be used as raw materials in other countries. Now the tendency is towards processing in the country of origin both to encourage industrial development and to increase the value of the export trade. The Tropical Products Institute, now part of Britain's Ministry of Overseas Development, is an organization which, by the application of science and economics, seeks to improve the production and use of the natural products of the developing countries of the world and so strengthen their economies. It was founded in 1895 and its library and technical index, which are available for use by the public, form an important part of its services. Despite its name the Institute does not restrict its aid to countries in the tropical belt though a large number of the less developed countries do in fact lie in this area. Though some sections of the Institute, such as Process Development, deal almost exclusively with industrial problems, almost all are concerned with industry to a greater or lesser extent.

The work of the Institute in industrial development can be divided into three overlapping parts: economics; technical advice; and research and development.

Economics

Perhaps the most unusual feature of the Tropical Products Institute is the existence of a Division devoted to economics in addition to the Technical and Scientific Divisions. It approaches the problems of the tropics, in cooperation with the scientific staff, from two angles. Firstly, it carries out market surveys so that a decision to grow a certain crop or to manufacture certain goods for export will be reached only after consideration of the short and long-term markets in the United Kingdom, Europe and elsewhere. Secondly, the Economics Division gives advice and produces reports on small industries suitable for developing countries. These are usually industries using local raw materials and producing goods required locally but at present imported, and the reports give all the details of equipment, cost and staff requirements which a local entrepreneur would require. Some of the small industry reports issued have been on confectionery, buttons, matches, and fibre suitcases and others are in the course of preparation.

The Institute does not always hear of instances where these reports have stimulated the establishment of new industries but it is known that already a match factory has been established in Fiji and a fibre suitcase factory in Sierra Leone.

An industry in which the Institute has always specialized is fruit canning, a type of manufacture needing very careful advice before it is established. A specialist in this field has made several visits overseas to help in feasibility surveys.

Technical Advice

Technical advice on industrialization is given by many of the sections. For instance, the chemists dealing with essential oils are able to advise on methods of distillation; the oilseeds specialists advise on methods of extraction, advice is given to growers of fibre on machinery for decortication; and cocoa farmers are recommended methods for the fermentation of the beans. In all these fields of study it is frequently a matter of passing on known knowledge to new producers and suggesting suitable firms which would be able to supply the equipment required. This type of advice serves a very useful purpose as it is often difficult for the overseas agriculturist industrialist to obtain unbiased opinions, particularly on the equipment and methods suitable for his needs. If necessary, the Institute can act as a liaison between people in the tropics and firms in the

* Material gathered with the kind assistance of F. S. Hiscocks, former Director.

U.K. For instance, in a recent case the Institute has advised on the development of a mobile decorticator for sisal. Sisal leaves were obtained from Africa and trials carried out in collaboration with the manufacturer on the basis of which the design of the machine could be improved. Another recent project involved the recommendation of suitable equipment for the production of a new essential oil, called "mindi", in Zambia and Malawi. This must be distilled from the flowers soon after the harvesting and the equipment must be simple and capable of producing the high quality product needed by the cosmetics and soap trade.

Research and Development

Much of the work on industrial development is, however, of a long-term research nature and a few projects could lead to the establishment of large-scale industries in developing countries.

Paper-making is one of these, and the Tropical Products Institute is concerned with the early developments which will precede the establishment of pulp mills in the tropics. Testing of the pulping properties of suitable timbers is the most important aspect of this work, so that the right trees can be planted to provide for a mill at a later date. As it is impossible for all the testing to be done at the Institute, other countries, for instance Malaysia and Nigeria, are being shown how to set up their own pulp and paper laboratories.

A small industry, but one still requiring considerable capital, is the production of particle board using agricultural wastes. So far this has made most progress with ground-nut shells and it has been shown that these make a very good board which could be produced economically in any areas having a large amount of surplus shells.

Another development of the use of waste has been the production of lightweight concrete blocks using rice husks as the aggregate. This could be done on a village scale and is an example of the Institute's concern with research in the field which is now becoming known as an "intermediate technology". This is the scale of industrialization between the primitive producer and large-scale industry. It involves relatively simple equipment and is labour-intensive, thus providing work for some of the many people who would otherwise be unemployed.

The future work of the Institute will probably be concerned even more than now with the development of small-scale industries and many of these will be industries producing food from locally grown raw materials.

Particle boards made from groundnut shells on a commercial scale compared favourably with the boards made at the Tropical Products Institute.

Testing pulp at the Tropical Products Institute.

Uruguay

Instituto de Tecnología y Química, Montevideo (Institute of Technology and Chemistry)

By Germán E. Villar, Director

The Institute was established to meet the needs of Uruguayan industry and its activities are distributed among four departments: Metals; Textiles and Cellulose Products; Ceramics and Plastics; and Chemical Analysis and Research. The Institute offers assistance to industry in the following sectors:

Applied Research: Research is performed at the request of industrialists, usually to solve problems incidental to the establishment or operation of industrial plants or processes. Applied research projects are also initiated by the staff. The Metals Department, for example, is investigating the use of a bentonite deposit as a source of supply for the preparation of sands for metal-foundry moulds. Several research projects have been completed using this raw material and research work is underway to bring bentonite up to a semi-industrial scale.

Another example is the Ceramics and Plastics Department's systematic study of the technological properties of Uruguayan clays and possible ways to improve them.

Technical Advisory Service: The Institute provides technical advice to professionals and technicians in the various industrial sectors, including assistance in problem-solving in the laboratory. All efforts are made to facilitate their work as well as to improve the quality of the products under study.

Bibliographical Service: The Institute Library which has a stock of 5,500 volumes relating to the main branches of industrial chemistry and technology published during the last decade, is open to professionals and technicians for consultation. Bibliographical information is also provided upon request.

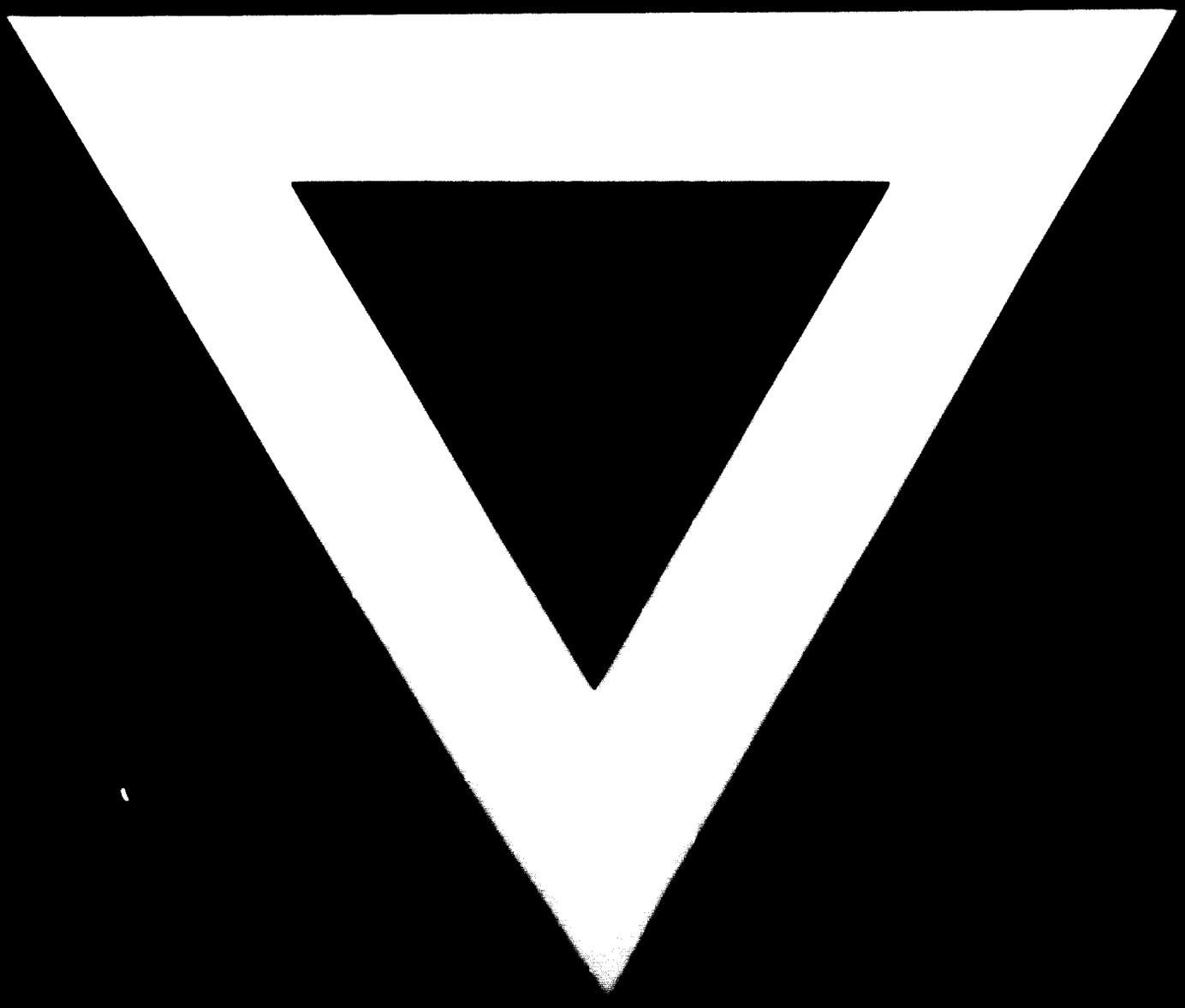
Testing of Raw Materials and Manufactured Goods: There has as yet been little industrial development in many parts of Uruguay, with the result that many establishments fall within the definition of "small industry". A testing laboratory requires the presence of a technician; consequently, there are no such laboratories in small industry, where the cost of installation and, in particular, of operation would have a disproportionate effect on production costs.

Due to the scanty supply of testing laboratories in Uruguayan industry, the Institute devotes a great part of its activities to analysis and testing of raw materials and manufactured goods.

In order to encourage industrialists to use the services and promote industrial development, the Institute of Technology and Chemistry charges relatively low fees for the work performed.

Textile Products Testing Laboratory — Instituto de Tecnología y Química, Montevideo, Uruguay.

Chemical Analysis Laboratory — Instituto de Tecnología y Química, Montevideo, Uruguay.



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