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THE CENTRAL AMERICAN RESEARCH INSTITUTE FOR INDUSTRY (ICAITI) 1/

- Development and Transfer of Technology -

by

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SUMMARY

The Central American Research Institute for Industry (ICAITI) is a non-profit institution created by the five Central American countries (Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua) with the purpose of conducting applied research for the benefit of the industries of the region. The Institute began operations on January 20, 1956. During its 20 years of existence ICAITI has provided valuable consulting services to the industry of the region and has carried out a considerable number of technical-economic studies and investigations on an ample selection of topics. With headquarters in Guatemala City, ICAITI has at present 133 employees of which approximately 50 percent is composed of technical and professional people.

At present the Institute relies on the following sources of funds: a) annual contributions from the five Central American Governments, and b) income derived from contractual services relating to applied research, analyses and technical economic studies for the private sector, the public sector and regional and international organizations.

The scientific and technological research is concentrated on the utilization of agricultural products and wastes and development of the local resources of the region, and, in recent years, in environmental problems.

The Institute has also extended its activities outside the country. It has provided technical assistance to Panama, the Dominican Republic and Haiti.

ICAITI has been active in the development and transfer of technology. Some of the problems faced by the Institute in this field stem from the fact that not enough is known yet about the technological infra-structure of Central America. Conscious of this, ICAITI has participated and is participating in several projects aimed at ascertaining the real status of the transfer of technology in Central America and establishing the proper mechanism for the obtention and adaptation of foreign technology.

The Institute has effected a significant transfer of technology through some cooperative arrangements with institutions in developed countries. The association maintained with the Denver Research Institute (DRI) has proved of great value to both institutions. On the basis of this fruitful experience, ICAITI has several proposals to conduct joint research in fields such as use of solar energy, industrialization of agricultural products, studies of environmental pollution in urban centers of Central America, etc.

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I. ESTABLISHMENT AND FACILITIES

The Ministers of Economy of the five Central American countries (Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua), meeting as the Committee on Economic Cooperation in Central America, adopted a resolution in August 1952, requesting the Technical Assistance Administration of the United Nations to provide a mission which could make recommendations on the establishment in Central America of an Institute for Industrial Research and Technology. An UNTAA Mission studied this request, and in May, 1955, its report was known and approved by the Committee. Later that year, the Basic Agreement establishing the Central American Research Institute for Industry (ICAITI) was suscribed to by the five countries, and on January 20, 1956, the Institute was officially inaugurated in Guatemala City.

ICAITI has its headquarters in Guatemala City and occupies an area of 38 350 square meters. The buildings occupied by the Institute in this site cover a constructed area of 6 845 square meters.

The facilities and equipment for research, analyses, and tests include:

- an organic chemistry laboratory
- an inorganic chemistry laboratory
- a leather technology laboratory
- a laboratory and pilot plant for pulp and paper
- a laboratory and pilot plant for textile products
- a food technology pilot plant and laboratory
- an industrial microbiology laboratory
- an instrumental analytical laboratory having, among other equipment, a) an atomic absorption spectrophotometer; b) an UV spectrophotometer; c) an infrared spectrophotometer; d) a mass spectrometer; e) several gas chromatographs, etc.
- a well equipped pilot plant.

ICAITI has also a scientific and technical Library and a reproduction unit.

II. GENERAL AIMS AND ACTIVITIES

The Agreement on the Establishment of the Central American Research Institute for Industry (ICAITI) was signed on July 23, 1955, by the Governments of Central America and the United Nations for the purpose of cooperating with the governments in the solution of their economic, social and administrative problems, especially those related to the economic integration.

The Basic Agreement specifies that the Institute top policy-making and supervisory body is the Executive Committee, which is formed by the Ministers of Economy of the five Central American countries, and the Director of the Institute. In this context the functions of the Committee are the following:

a) Determine the Institute's policies in scientific, technical, functional and administrative matters;

b) Approve the research programmes and decide on suplementary activities of the Institute;

c) Adopt the budget, determine the financial needs, dispose of funds, verify expenses, publish financial statements and supervise the general accounting of the Institute;

d) Appoint the Director of the Institute;

e) Delegate to the Director of the Institute such powers ad are considered appropriate;

f) Conclude agreements relating to regional technical assistance with the respective international organizations;

g) Establish a Board of Administration, Advisory Committee or other working groups in accordance with the needs of the Institute.

The principal aims and functions of the Institute as set forth in the Basic Agreement are the following:

a) To carry out studies on production, preparation and use of local raw materials now existing or which may be available in the future, with the aim of discovering or proposing new products, methods of manufacture or uses. The Institute may, with this object, create research centres and laboratories and experimental establishments;

b) To develop, improve and test procedures, methods, tools, utensils, equipment, and materials for new industries, for agricultural production, mining, domestic industries, artisan occupations and trades and for allied activities of management, conservation, storage, packing, transport, maintenance and repair services;

c) To carry out studies of existing production enterprises with the aim of solving technical problems, reducing production costs, improving production techniques discovering useful by-products, eliminating and reducing risks, and establishing top methods of verification and regulation of quality;

d) To undertake, free of charge or for a fee, research tasks for government institutions, industrial organizations, private enterprises or persons who desire to make use of the services of the Institute;

e) To undertake or participate in a practical form, in the preparation, publication and dissemination of technical information useful to the producers of the region;

f) To foster, in any other form, the progress of technology, of production, of research and of technical training;

g) To cooperate with the officers concerned of the governments of the Central American Isthmus, universities, technical organizations and other bodies, whether governmental or not, in the promotion of scientific and industrial research and the training of researchers and technical experts, artisans, and specialised workers.

As part of its general programme for furthering Central America's industrial development through applied research and technology,

available ICAITI services include market research and studies, economic and technical feasibility studies prior to the establishment of new industries and for the expansion of existing enterprises, technological advice on types of manufacturing processes, purchasing of equipment and machinery, site of plants and industrial installations. ICAITI also performs laboratory testing, analyses and research, pilot plant experiments on manufacturing processes and, finally, it is charged with the elaboration of Central American quality standards.

During its 20 years of existence ICAITI has provided valuable consulting services to the industry of the region and has carried out a considerable number of technical-economic studies and investigations on an ample selection of topics. Some of the projects carried through and consulting services given by ICAITI have been the following:

- Elaboration, conservation and refrigeration of agricultural raw materials, foodstuffs, fats, oils and cereals.
- Studies on the installation of fertilizer and insecticide plants.
- Industrial utilization of wastes from agricultural products.
- Advice in the installation and operation of a canned soup plant.
- Elaboration of a project for the manufacture of manioc (cassava) and corn starch, including the utilization of starch for manufacture of syrups, dextrine and others.
- Investigation of the dehydration of tropical fruits and vegetables.
- Assistance in the planning, modernization and expansion of textile mills.
- Study on the feasibility of establishing a steel plant in Central America.
- Development and patenting of a new process for the manufacture of corn flour. This project resulted in the installation of an industrial plant in a Central American country.

- Reorganization of the production, administration and accounting departments of two pharmaceutical industries.

- Study on the market of sheet glass in Central America.

- Study of the food and beverage industry in Central America.

- Projects for the establishment of modern slaughterhouses.

- Several geologic engineering studies.

- Study of building materials in Central America.

- Developing and patenting of a new process for obtaining cotton seed cake free of gossipol.

- Technical assistance in the exploitation of a salt and gypsum mine.

- Study of the economic and environmental consequences of the use of pesticides in cotton production in Central America.

ICAITI's laboratories have carried out a considerable number of analyses and investigations. Some of the most important ones have dealt with chemical products, fertilizers, foodstuffs, alcoholic beverages, flour, cosmetics, minerals, leather, fats, oils, industrial gases, textiles, residual pesticides, and forestry products.

Industrial economic studies play an important part in the Institute's activities. These studies are requested either by private investors or enterprises, or they are requested by the Central American Integration Authorities, development banks or similar organizations.

Evaluation of industrial projects is an important function of ICAITI within the Central American Common Market. As the region's impartial technical advisor, ICAITI is entrusted with the task of evaluating industrial projects that aspire to receive preferential treatment within the area under one of the regional instruments for industrial development.

III. PERSONNEL AND FINANCIAL RESOURCES

ICAITI has been cognizant of the fact that a large part of its success as an industrial research institute in Central America depends on the staff it has. Originally, a large proportion of the staff was composed of United Nations experts, most of them proved to be of invaluable assistance in the early work of the Institute.

At the present time, ICAITI has 133 employees of which approximately 50 percent is composed of technical and professional people. The professions represented are: chemical engineers, industrial engineers, civil engineers, mechanical engineers, geologists and mining engineers, economists, statisticians, chemists, industrial microbiologists, biochemists, bioengineers, and others.

In accordance with the specialized sections of the Institute, there are also experts in food technology, leather tecnology, pulp and paper, microbiology, etc. All these experts are entrusted with functions combining research, consulting services and training. That is, with the exception of a few staff members, all participate in one way or the other in the various activities of the Institute --industrial research, technological investigation, consulting services, standardization, etc.--, the main occupation of each staff member depending of course on the particular section or division he is assigned to. But there is no "specialization" in the full sense of the word, the general idea of the Institute being to encourage as much teamwork as possible between technical personnel (engineers, etc.) and economists and as much cross information as the work permits. The training aspect is also considered an important function of the Institute's experts, and each Division is active in training and upgrading its staff members.

The aims and the organization of ICAITI as a public entity and as consultant to private industry demands of its staff a well coordinated balance in terms of the approach to specific problems. Terms of reference and policy orientation have to be carefully established, on a general level, so that the individual staff members can act accordingly when engaged in work relating to the Common Market or work relating to the interests of an individual person, firm or organization.

Obtaining of qualified experts is one of the principal staffing problems the Institute is constantly facing. Efforts are made to attract

Central American professionals, and although the Institute has been successful up to now in securing their services, the situation is becoming more difficult in view of the more attractive offers that these receive from industries that are being established in the area. With respect to obtaining foreign experts, the question of salaries and suitability arises. In the first case, many foreign experts can be engaged only at rates that are beyond a regional Institute such as ICAITI, and in the second case, it is frequently very difficult to determine the suitability of a particular expert only through correspondence and recommendations.

The Institute has of course made use of the international organizations' facilities available for recruitment, and many times excellent candidates have been secured. The assistance of foreign countries' embassies has also been of value in some cases, mainly through the national recruitment offices established in the same. Finally, an important source for the obtention of experts for the Institute has been the personal recommendations and suggestions of existing staff members, and possibly it can be said that the best experts ICAITI has been able to secure during the past years, have originated this way.

Financial Resources

As a regional Institute, ICAITI relies at present on the following sources of funds:

a) Annual contribution from each of the five Central American Governments.

b) Income derived from contractual services relating to projects, analyses, investigations, technical economic studies, market studies, feasibility studies, etc.

These sources include:

i) Private Sector

Commerce, industry and financing entities

ii) Public Sector

Governmental institutions

iii) Regional and international organizations
Secretariat for Economic Integration (SIECA); Central American Bank for Economic Integration (CABEI); Regional Office for Central American Programs (ROCAP); Inter-american Development Bank (IDB); International Development Research Centre (IDRC) Canada); Organization of American States (OAS); United States Agency for International Development (AID); United Nations Industrial Development Organization (UNIDO); United Nations Environment Programme (UNEP); United Nations Development Programme (UNDP); United Nations Educational, Scientific and Cultural Organization (UNESCO); World Association of Industrial and Technological Research Organizations (WAITRO), etc.

Since ICAITI was established in 1956, the five Central American governments have given annual supporting contributions to the Institute. The amounts of these contributions have been slightly increased, but they have not kept pace with the growth and development of the Institute.

The United Nations Special Fund has also assisted ICAITI. During the first years of the institute's existence this assistance was made through experts and equipment; after 1959 specific programmes were set up through which the United Nations assisted ICAITI in carrying out specific projects, programmes, etc., as well as for the acquisition of equipment and supplies. The United Nations' aid ended in June, 1968.

ICAITI also derives funds from work it performs on behalf of private investors, development banks, and similar groups. The types of work most common during the past years have been the following:

a) Chemical analyses and testing; specialized testing in textiles, papers, oils and fats, leather, foods, etc.

b) Geological and mining studies.

c) Economic industrial studies, evaluations, management studies, etc.

d) Technical services to industries (plant layout, maintenance, productivitiy, location, work distribution, materials handling, processes, machinery, etc.)

At the termination of the United Nations' assistance, in order to increase income from the latter sources, ICAITI had to conduct an intense promotional campaign among local Chambers of Industry, Industrial and Commercial Associations, and similar industrial groups. Promotional programmes were also implemented with local, regional and international development banks and financing organizations. These promotional activities imposed an extra work load on ICAITI.

At present ICAITI's sources of funds show the following distribution: government contributions: 28.0 percent; Public sector: 22.8 percent; Private Sector: 8.2 percent; regional and international organizations: 41.0 percent.

As can be seen ICAITI depends to a major extent on income stemming from contractual services performed for regional and international organizations. This entails an unstable situation, for the availability of these funds is subjected to policy changes of such organisations with regards to allocation of their financial resources.

In order to remedy this situation the Institute has made many efforts towards securing a substantial and automatic inflow of funds. At present the most promising means of future financing are those contemplated in the proposed Treaty for the Central American Economic and Social Community. Several alternatives for financing the integration institutions are included in this document, but at present it is difficult to say which one would be approved.

Finally, although the following cannot be considered as source of funds --and therefore it was not included in the above list of sources--, it should be mentioned that ICAITI occasionally obtains assistance in terms of equipment, experts, training programmes abroad, etc. from. foreign governments and international organizations such as the United States International Programmes, the United Kingdom -through the Ministry of Overseas Development-, France, Italy and others. This assistance has been of great value to ICAITI, and it is hoped that it will continue in increasing rates in the future.

IV. ONGOING RESEARCH ACTIVITIES

The work in this field is centered on applied research oriented towards solving both present regional problems and to anticipate possible future situations which could seriously affect Central America's industrial development. At the present time the Institute is conducting the following research activities:

A. Microbial Protein Production from Agroindustrial Wastes

The objective is to design and operate pilot plant equipment to process wastes, such as molasses, coffee waters and other liquid by-products. Also to obtain growth data of filamentous fungi, yields, chemical composition and its acceptance for animal feeds.

B. Protein Extraction from Cottonseed by Wet Methods

Work is continued to develop a process to extract cottonseed protein by wet methods and to evaluate the possibility of obtaining products similar to cheese.

C. Pulp and Paper Production from Broadleaf Woods of Central America

This project consists of investigating the technical feasibility of pulp and paper production from tropical broadleaf woods of the Central American forests and to demonstrate the process profitability by an economic study.

D. Cellulose Biodegradation

The purpose is to isolate cellulolytic fungi from local raw materials being biodegraded in the field. Evaluation of the enzyme activi-

ties. Studies relating to enzyme production and substrates pre-treatments.

E. Production of Inverted Sugar

Work is being done to develop a process to invert sugar cane juice continuously employing immobilized invertase, and also to design and operate a pilot plant enzyme reactor.

F. Study of Pectinolytic Microorganisms

The objectives of this project are to isolate pectinolytic micro-organisms from local sources and to study pectic enzyme activities.

G. Microbial Transformation of Steroids

Continuation of the study to screen microorganisms capable of breaking the spiroketalic ring of steroidal sapogenins (diosgenin).

H. Handling and Storage of Fruits

To confirm low temperature conditions previously found as optimum for the storage of some tropical fruits and to explore the possibility of storing fruit in pastic containers to exploit the self-generated modified atmosphere.

I. Quality of Tropical Fruits: Chemical, Physiological, and Phytopathological Aspects

Continuation of the studies on the quality of some tropical fruits, the chemical changes associated with ripening and on the microorga-

nisms responsible for fruit decay and their behaviour towards several fungicides.

J. Proteolytic Enzymes from Higher Plants

Continuation of the study on proteolytic enzymes from higher plants and its possible use as rennet substitutes.

K. Sources of Essential Oils

Continuation of the physico-chemical characterization of the fruits and essential oils from pepper (Pimienta dioica), sweet lime (Citrus limeta) and cardamom (Elettaria cardamomum). To study the chemical composition of the oils from lemon grass and citronella.

L. Characterization and Concentration of Tropical Fruit Juices

Characterization of the rheological properties of the juices and purees from the following tropical fruits: banana, guava, mango, papaya, passion fruit and pineapple. Juice clarification studies employing soluble and immobilized enzymes. Design and operation of a continuous enzymatic reactor. Studies on the concentration of tropical fruit juices on several evaporators designs. Quality and storage evaluation of the concentrates and studies on aroma recuperation. Technical and economical characterization of the operation.

M. Fruit Dehydration

The objective is to study the drying processes of forced air, vacuum, osmosis and their combinations to produce tropical fruits dried segments. To study spray drying and foam mat drying for the production of instant tropical fruit powders.

N. Optimization of a continuous process for free gossypol decrease in cottonseed by dry methods

To optimize the pilot plant operation of a continuous process for the decrease of free gossypol in cottonseed meal.

O. Research Study on Drying and Preservation of Tropical Woods

The purpose of this study is to gather information regarding drying and preservation of the most abundant tropical woods in the Central American forests.

P. Full utilization of sugar cane for production of fuels, raw materials for synthetic plastics, microbial protein and pulp

A study of the technical conditions which are suitable for the high efficiency and low cost production of ethyl alcohol from sugar cane, a raw material common to all Central American countries.

Q. Study of Transportation, Handling and Preservation of Tropical Fruits

A technical study on the best conditions for transportation, handling and preservation of tropical fruits for export.

R. Study of Intermediate Chemicals from Renewable Resources

The purpose of this investigation is to ascertain the possibility of establishing a basic industry for manufacturing intermediate chemicals, in Nicaragua, from the following alternatives: 1) pyrolisis of wood, and 2) alcohol from fermentation of sugar cane products.

S. Sucrochemistry

This is a survey of the existing conditions in Central America for the industrialization of sucrose from sugar cane, with a view of making ethyl alcohol, and also to examine the possibility of obtaining ethylene and its polymerized derivatives.

Prospective Research

Scientific and technological research will continue to be centered on the utilization of Central America's resources, with particular emphasis on development of processing techniques or adaptation of existing methods, especially of raw materials which are not yet industrialised, but that have marketing potential (internal and external). Since agriculture is and will continue to be the main source of raw materials and the principal economic activity in the region, emphasis will be placed on projects relating to this field. Indeed, agriculture development and the urgent need to feed an ever-growing population will demand technological solutions for processing, preserving and marketing crops, in order to attain a better distribution of income. Research will also be directed towards the solution of problems to cope with the energy crisis of the area, by searching for energy sources different from oil.

V. ACTIVITIES OUTSIDE THE COUNTRY AND COOPERATION WITH LOCAL AND FOREIGN INSTITUTIONS

A. Activities outside the country

In recent years the Institute has given technical assistance to two countries outside the area, namely: the Dominican Republic and Haiti, with funds provided by the Inter-American Development Bank. In the case of the Dominican Republic, a contract was signed with the Central Bank whereby ICAITI was entrusted with the preparation and evaluation of industrial development projects. For this purpose ICAITI maintained a permanent mission in Santo Domingo for the duration of the project. Eleven pre-investment studies were made and offered to the private sector. ICAITI assisted also in the evaluation of industrial loan applications, and studies were made on four industrial segments, namely: Fats and oils; Leather and shoes; Metal-mechanic industry; and Textile industry. As a result of this work, ICAITI was contracted by the Central Bank to prepare a feasibility study for the establishment in Santo Domingo of a Dominican Institute for Industrial Technology (INDOTEC). After approval of the feasibility project, ICAITI was entrusted with the task of implementing the project. INDOTEC began operations in April 1975. ICAITI also has given technical assistance to the Institute for Industrial and Agricultural Development of Haiti (IDAI). This assistance was aimed at improving, structuring and reinforcing the managerial and technical capabilities of IDAI. ICAITI also conducted some sectorial studies on industries such as fats, oils, dairy products, fruits and vegetables.

This technical assistance given by ICAITI to two countries in the Caribbean provides a good example of what can be accomplished in the matter of horizontal technical cooperation, that is, cooperation between countries of similar degree of development.

B. Cooperation with Local and Foreign Institutions

The Institute maintains permanent contact with private and public organizations in the area. As an institution working on a regional

basis, and as part of the economic integration programme of Central America, ICAITI works in close cooperation with other integration organizations such as the Central American Bank for Economic Integration (CABEI), the Permanent Secretariat of the General Treaty of Economic Integration (SIECA), and others, providing technical information and elaborating projects to be used for the determination of economic and industrial policies on a regional scale. The Institute maintains close contact with local chambers of commerce and industry, private investors and various official economic integration agencies.

Aside from this permanent relationship with the integration entities, ICAITI collaborates with local development institutes (semi-autonomous governmental organizations) providing advisory services in the internal organization and in the working out of projects such as fertilizers, insecticides and chlorine-caustic soda plants, grain storage facilities, geological evaluation of known deposits and investigations of new ones, etc. In a number of instances, specific projects and advisory services are rendered to private organizations like local sugar cane growers, associations, cattle breeders associations, essential oil associations, and others. In some cases studies and reports have been elaborated which often resulted in the establishment of new plants, or modifications in the existing organizations, processes and products.

Some part of ICAITI's work has come directly from private enterprise and investors working on an individual or a corporate basis. Although in some cases the work entails technological investigations and applied research, the major part of ICAITI's services for this group consists of feasibility studies, market studies, determination of plant locations, evaluation of plants and supervision in the installation of new equipment and processes.

With some industries, permanent arrangements for regular and occasional laboratory inspections and quality control determinations have been set up, aside from the usual laboratory analysis service that the Institute provides for local industry.

ICAITI has cooperation agreement with the five national universities of the area. These agreements provide the frame of reference for specific mutual collaboration. Some joint programmes have been carried out, and many students have conducted their thesis research work at ICAITI.

In general, ICAITI maintains excellent relations with different international organizations. In fact, many of the activities initiated by ICAITI have been supported by such organizations. This cooperation has taken many forms, such as financing definite projects or providing technical assistance, fellowships, equipment or books.

In addition to the United Nations through the Special Fund first and UNDP after we should mention -not in order of importance- the Organization of American States (OAS); the US Agency for International Development (AID) and its Regional Office (ROCAP); the Inter-American Development Bank (IDB); the Institute for the Integration of Latin America (INTAL); the Economic Commission for Latin America (ECLA); the Latin American Institute for Social and Economic Planning; the US National Academy of Sciences (NAS); the International Development Research Centre of Canada (IDRC); the United Nations Environment Programme (UNEP); the United Nations Industrial Development Organization (UNIDO); the governments of Great Britain, France and Italy; and many other organizations.

By virtue of some agreements signed with some of the foregoing organizations, ICAITI has been able to widen its relations with some private, public and university research institutions. Thus, it has established cooperation programmes with the University of Concepci6n (Chile); the University of Campinhas (Brazil); the Polytechnic Institute of Ecuador; the Technological Research Institute of Colombia (IIT); the Mexican Technological Research Institute (IMIT), and the University of Pennsylvania. Through the CODOT Programme it maintains close cooperation with the universities of California, Wisconsin, Washington, Rhode Island, Michigan State, and others.

This cooperation has made possible the visit of many experts to ICAITI, as well as the visit of ICAITI's personnel to other institutions. This has resulted in a constant interchange of experiences and knowledge.

ICAITI has also cooperation agreements with the Denver Research Institute and Battelle Memorial Institute.

VI. SOME PROBLEMS IN DEVELOPMENT AND TRANSFER OF TECHNOLOGY

Some of the problems faced by ICAITI in the development and transfer of technology stem from the fact that not enough is known yet about the situation of Central America in regard to: a) the importation and adaptation of technology; b) the way in which this has influenced development; c) the adequacy of the technology applied; d) the costs, restrictions and difficulties encountered in the process of importing technology; e) the limitations of access to the best sources of technological knowledge; and f) the inability of the countries to have established appropriate policies, mechanisms and institutions, particularly in the crucial aspects of adaptation of foreign technologies to local conditions and the creation of indigeneous processes, products and engineering designs.

ICAITI, in collaboration with the OAS, has conducted some preliminary surveys on this field. There is now enough evidence that the Central American situation exhibits the following features:

- the local investors have preferred to deal with foreign suppliers of know-how, machinery and equipment for the acquisition of the necessary technology, without having in many instances the benefit of choice between alternative sources for selecting the technology most suitable to local conditions.

- other investors have preferred to enter in joint ventures with foreign firms which have the technology, the trade-marks, the patent and the managerial skills. The agreements generally involve equity participation plus royalties, license fees or other payments for the technical know-how. The arrangements again leave no choice as to the selection of appropriate technology and can be very expensive.

- a form of foreign investment commonly accepted is the establishment of branches or subsidiaries of multinational corporations. These set up their own production facilities in the region by utilizing their own technologies, patents, trade-marks and technical know-how. Again, in this case the recipient country has no choice regarding the imported technology.

- the local enterprises, particularly those of small and medium size, encounter difficulties in selecting the available technologies which are more suitable to their case. Although ICAITI is well equipped to give technical information and render industrial services, the industrialists do not frequently seek this information at the local level and prefer to start negotiations with foreign suppliers mainly from the U.S., Europe, and Japan, without the benefit of examining and appraising, with the assitance of an independent body such as ICAITI, the several alternatives that may be open to them.

- only a relatively small number of manufacturers have utilised the technical services available in the region and the research and development capabilities of ICAITI, except in aspects such as pre-feasibility and market studies, analysis and testing, quality control and, in limited cases, the applied research conducted in its laboratories and pilot plant.

As a result of this state of affairs, it is evident that the transfer of technology to Central America during recent years has presented many problems to private entrepreneurs and the governments.

ICAITI, conscious of these problems, participated from the beginning in the Regional Programme for Scientific and Technological Development of the Organization of American States, and within this programme made a survey of the scientific-technological resources of Central America. The results of this survey constituted the first regional diagnosis on the scientific-technological infrastructure.

Later on, ICAITI acted as coordinator of the part icipation of the Central American countries in the Pilot Project of Transfer of Technology established within the frame of the OAS programme.

The functions of the Pilot Project of Transfer of Technology were basically the following:

- Identification of technological requirements

- Information on existing technological alternatives

- Evaluation and selection of appropriate technologies

- Aid to negotiate the acquisition of technology

An important result of this survey was to ascertain that the technological requirements of a Central American industry could be satisfied by ICAITI through its own research.

A survey of a sample of 250 large establishments was also carried out with INTAL's collaboration in order to determine the technological characteristics of the Central American industry which includes several aspects related to the mechanisms used for the transfer of technology.

In addition, in collaboration with the Secretariat for Central American Economic Integration (SIECA) the Institute is conducting an exhaustive study in the field of Industrial Property. The following aspects are covered:

a) Survey of the situation of the industrial property in the five Central American countries.

b) Feasibility of establishing a Regional Office in this field.

c) A critical review of the projects prepared by SIECA on this matter.

The main problems faced by ICAITI in the development and transfer of technology is the lack of a technological infrastructure in Central America. Conscious of this, ICAITI has signed an agreement with USAID to initiate a Programme for the Transfer of Technology (PTT) for the purpose of establishing a technology transfer mechanism that has the capacity to initiate and sustain idea, information and technology exchange between foreign sources and Central America users. The Project will determine the feasibility and self support potential of a structured programme of technology utilisation, including the identification of small and medium industries requiring new technology, the identification of alternate sources of appropriate technology, the location of appropriate financing, the negotiation of transfer and the adoption and full-scale utilization of the technology.

The foregoing projects should make a substantial contribution towards solving some problems of development and transfer of technology in the five countries of Central America.

VII. A SIGNIFICANT CASE OF COOPERATION AMONG RESEARCH INSTITUTES

The cooperation between the Denver Research Institute (DRI) and the Central American Research Institute for Industry (ICAITI) provides a well-defined cooperative effort in this field. Since late January 1969, the two institutes are cooperating in the fields of exchange visits of top level management and research personnel for consulting, on-the-job training experiences, and jointly conducted research on problems of mutual interest.

In the course of the cooperation between DRI and ICAITI efforts were made towards initiating some joint research programmes. On the basis of an informal agreement, DRI and ICAITI initiated a programme of joint research on "The Application of Aerospace Technology to Central American Common Market Industry, for Processing of Coffee Industry and Distilling Industry Wastes." The objectives were:

a) To develop useful by-products from waste materials from the coffee processing industry and the alcohol distilling industry, and to prevent pollution of water and soil by these waste products.

b) To utilize the capabilities of the University of Denver to transfer aerospace-developed technology to important practical problems of Central American industry.

c) To afford an opportunity for interchange of participants in the programme between ICAITI and Denver in order to best utilize the skills of these people in the research programmes at both institutions.

The research results were successful and are ready to be taken into semi-commercial operations.

The cooperation between DRI and ICAITI has resulted in substantial benefits for both institutions. These may be summarised as follows:

- Technical backstopping from DRI has augmented ICAITI's service capabilities.

- The interchange of personnel between the two institutions have been mutually beneficial. The visits made by members of ICAITI's staff to DRI have given them new knowledge and experience on research management and related fields. Likewise, visits of DRI staff to ICAITI have given them first hand insight into the intricate industrial problems of a group of developing countries fully engaged in a programme of economic integration.

- DRI technical support has enabled ICAITI to embark into new fields of research of interest to the Central American region.

Some general problems can be singled out relating to this cooperative experience. The main problem encountered has been the difficulty in obtaining external financing for the cooperative activities of the two institutions on a long term basis. In some cases, it has been necessary to obtain funding from different sources and applied specifically to the work to be performed by each institution and not to the whole project. In other words, the funds allocated to any one institution cannot be transferred to the other. Obviously, this nature of the financing poses some problems that bear upon the continuity of the programme of joint research.

A more difficult problem is to obtain financial support of sufficient magnitude to set up a cooperative programme on a continous basis.

A minor problem in the cooperative ventures is that the institutes in developed countries have greater capabilities to receive staff members from the institutions in developing countries. Thus, the current of interchange personnel usually flows towards the developed countries. The opposite way, however, is the more desirable, since the transfer of knowledge, know-how and technology should be in this direction.

Notwithstanding these problems, the cooperative efforts resulted in substantial achievements. The capability of ICAITI to contribute markedly to the progress of the Central American Common Market was enhanced by utilizing: 1) the extensive know-how of DRI in the

interaction with private industry, and 2) the expertise of DRI in identification, modification and application of modern technology. This experience provided DRI with the basis for evolving a pattern for developing new international work.

The visits to Denver of some executive members of ICAITI's staff proved to be of immense value to this Institute in the field of research management, project promotion and accounting procedures. Likewise, the visits of DRI personnel to ICAITI for conducting specific workshops on preparing project proposals and report writing left substantial benefits to both institutions.

Major contributions to the success of this cooperative effort had been the continuing consultancy with the Associate Director of Denver Research Institute, and the multidisciplinary interaction between the top level staff of both institutions.

VIII. SOME POSSIBLE AREAS OF JOINT RESEARCH

The ICAITI-DRI cooperative agreement has yielded substantial benefits to the institutions involved. Securing a continuous financial support for this type of arrangement could produce a more fruitful harvest.

The pairing of this sort should be tailored to the needs, peculiarities and objectives of the institutions involved.

These cooperative efforts for joint research need not be limited to pairing an institute in a developed country with an institute in a developing country. In some cases, it would be advantageous and fruitful to establish cooperation agreements between institutes from developing countries. ICAITI has some positive experience in this aspect. By contractual agreement the Institute was responsible for preparing a feasibility project for establishing the "Dominican Institute of Industrial Tecnology (INDOTEC)", and after that was fully engaged in implementing such project. Now that INDOTEC is in operation it continues to draw upon the experience and backstopping of ICAITI.

Within the OAS's Regional Programme of Scientific and Technological Development, ICAITI is conducting some joint research with other Latin American Institutes in fields such as pulp and paper, food technology, utilization of agricultural wastes, etc.

Some possible areas of joint research could be the following:

- Use of solar energy
- Use of ethyl alcohol to alleviate the energy crisis
- Industrialization of agricultural products
- Basic studies of the level of environmental pollution in the principal cities of Central America.

This is only an illustrative list. The potential is enormous and this type of joint research will eventually contribute to the transfer of knowledge and technology to the developing countries.

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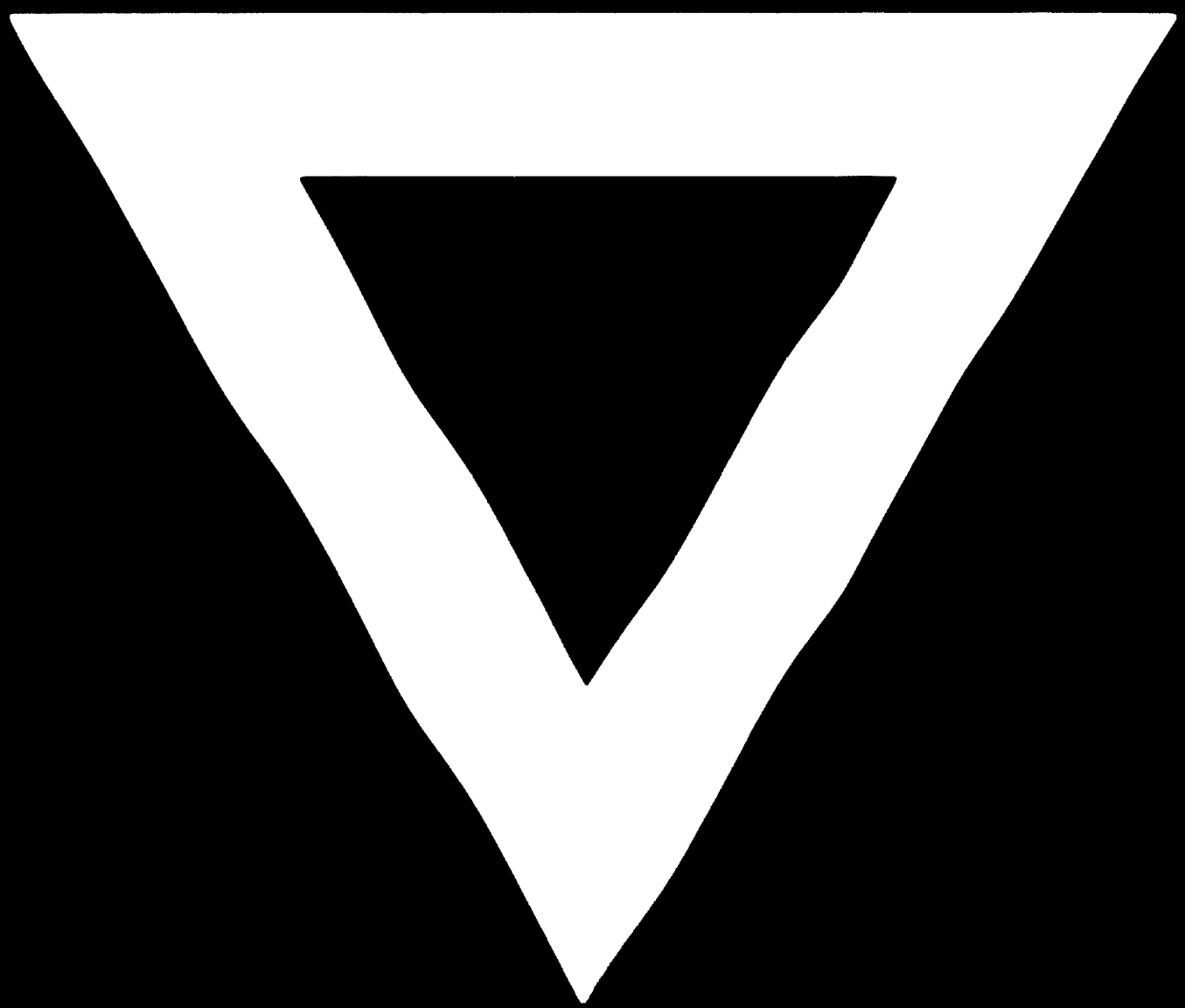

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