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THE UTILIZATION OF LOCAL INDUSTRIAL RESEARCH FACILITIES  
BY FOREIGN CONCERNS OPERATING IN THE COUNTRY 1/

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THE UTILIZATION OF LOCAL INDUSTRIAL RESEARCH  
FACILITIES BY FOREIGN CONCERNS OPERATING IN THE COUNTRY

S U M M A R Y

The present paper deals with some aspects of the development of the Brazilian industry and its relationship with the activities of the industrial research institutes. After an historical background, the three components of the Brazilian industry - local private companies, Government public companies and foreign private companies - are identified and an evaluation of their importance is outlined. An appraisal of the relationships between the local research institutes and the industrial community is followed by some detailed considerations of their relationships with the foreign sector of industry. Some suggestions for a more effective use of industrial research are presented. While the paper is based upon the Brazilian industrial development and research experience, mentions have been made whenever possible and appropriate of the experiences of the other Latin American Countries.

## I. HISTORICAL BACKGROUND

### a) The beginnings of industry in Brazil

Many international observers have remarked with surprise that the present Latin American elites often equate national development with industrial development, even where, as is the case for most of the Latin American countries, agricultural activities have enormous chances of improvement and could contribute very strongly to the over-all national growth. This present attitude in favour of a concentration of efforts for industrialization can be interpreted, at least in the case of Brazil, as an overreaction against a long historical conditioning.

Brazil had to endure initially a long colonial period that lasted since the discovery in 1500 until the independence in 1822; during those 322 years the interest of the Portuguese Crown was concentrated in the sugar cane plantations and in the exploitation of gold and diamonds. Immigration from Portugal was extremely small and the coming of settlers from other European countries was not encouraged if not prohibited by the Portuguese kings. Population had a very slow growth, the marriage of the few Portuguese men with the Indian women providing for most of the initial stock. The native Indians did not prove adaptable to the work in the sugar plantations and gold mines and negroes had to be imported from Africa. As labour was scarce, industry was forbidden and until 1795 the kings of Portugal kept sending instructions to the local governors to dismantle every factory that could be found in the colony, "to attend the interests of the gold exploitation and agriculture".

By the time of the independence, the country had a few small towns dispersed along the coast and in the mining regions; in the backward areas the Indian mestizos who had learned to raise cattle proceeded with the occupation of the land. Total population was then about 2.8 million freemen and 1.1 million slaves of African origin.

Brazil was made independent by the heir of the king of Portugal who proclaimed himself Emperor of Brazil and was later succeeded by his son, the second and last Brazilian Emperor. During this 67 years period ending in 1889 the country slumbered under the suave rule of the empire. The general situation of the country improved slowly through more commerce and through the influx of foreign settlers and foreign ideas. Some industrial initiatives soon appeared but the major part of the entrepreneurial capacity available was attracted by the two main businesses of slave trading and planting coffee. The end of the period was marked by two important series of events: the liberation of the slaves and the incentive to the white immigration from Europe. The population of the country experienced a faster growth and more manufacturing industries were developed in the main cities.

The overthrowing of the empire and the proclamation of the Republic in 1889 were accompanied by a strong drive towards the industrialization in the country, but the coffee interests soon dominated the new republican government.

A dichotomy of the economic forces of the country manifested itself in the form of a permanent conflict - the farmers allied to the merchants of the export-import trade at one side, and the newly formed industrial interests at the other. This dichotomy that had its origins during the empire was to survive until the second world war. The development of the industry in the latter part of the nineteenth century and in the twentieth has been slow; the country was poor in coal deposits and a faster industrial growth had to wait until hydroelectric power was made available many years later.

It was during the First World War and in the years following that an expanding manufacturing industry found a steady ground in the city of São Paulo and constituted the main nucleus of the industrialization of the country. In the city of São Paulo, industry met for the first time with the main requisites for its assertion, namely:

- 1) the growing availability of electric power;
- 2) a growing market represented by the coffee planters;
- 3) a capital accumulation through the huge profits of the coffee export business;
- 4) the existence of entrepreneurs and workers, both recruited from the immigrant waves that came attracted by the profits of the coffee plantations in the fertile lands of the State of São Paulo.

b) The consolidation and the expansion of industry in Brazil

The world crisis of 1929 wrecked the coffee business and so strangled the main source of foreign currency of the country; this fact acted as a protection for the São Paulo industry that could take over the national market without foreign competition and was able to prosper in spite of the bad years that followed the world depression. The Second World War came as a further incentive to the local industry; it also helped to change the attitudes of the agricultural elites who instead of continuing with the old attacks against the industrial movement chose to join it and in this manner to participate in the huge war industrial profits. By the end of the World War II the São Paulo industry was firmly consolidated; it had expanded and diversified to serve the whole national market and had also made substantial exports to various countries.

Colleges of Engineering in the country had started to gain some importance before the turn of the century. Initially the newly trained engineers were attracted mainly by the railroads and the public utility services; later as the cities and towns began to expand many of them turned to the building industry and led the introduction of the reinforced concrete structures in the city buildings. In 1934, an Industrial Research Institute (Instituto de Pesquisas Tecnológicas) was formed in São Paulo associated with the Engineering School and the importance of training for industrial activities began to be emphasised. The military schools of the country became also preoccupied with the training for technical careers. In this manner, by the time of the Second World War, a body of trained engineers was already available to lead the industrial expansion. Also important was the fact that after 1930 the new technically trained elite found support in the new government and started to influence the government policies. Since 1930, the Brazilian government has increasingly felt responsible for the economic development of the country and in many forms has intervened directly into the economy.

The country has known the participation of foreign companies since its independence. After the middle of the nineteenth century, there was a steady movement of foreign companies for the development of industrial services like city-gas, railroads, steam ship lines and harbours; later more companies came for the exploration of electric energy, telephone and telegraph. In the beginning of this century some foreign companies in the food industry business installed in the country, both for the internal supply and the export of goods, flour mills, meat-packing houses, starch production, beer brewery, etc. The earlier foreign investments in the steel industry and in the cement industry were made before 1930. But the steady flux of foreign subsidiary companies started in the late thirties and continued to grow after World War II. The same basic cause that stirred the development of the native industry, namely the shortage of foreign currency, spurred the foreign manufacturing companies to install subsidiaries in the country.

The technically trained elites that became influent in the Government since 1930 have attributed the state of under-development of the country to a certain lack of entrepreneurial capacity of the local free enterprise, especially noticeable outside the Sao Paulo industrializing area. Furthermore the existent free enterprises were predominantly of the family type and incapable of being incorporated into bigger companies. In this manner, if the Government maintained itself absent from the economic scene the bigger tasks would be all in the hands of foreign enterprises. Because of national security reasons and others, there was formed a consensus that certain activities should be kept in the hands of Brazilian nationals, or, more precisely, the centre of decision regarding some industrial activities should be kept within the country; but as the local private initiative did not show up to form big organizations, the government should have to take the responsibility of the corresponding enterprises. Within the frame of this basic policy, the Government has organized corporations to take charge of: electric power generation, communication systems, railroads, iron ore extraction and exportation, steel mills, petroleum production and refining, petrochemical industry, coal industry, etc.

An observation of the daily life of the Brazilian Government corporations can yet disclose remnants of the old bureaucratic style, but will also show the emergence of teams of very able managers, representatives of the modern schools of managerial thinking.

By the end of the Second World War, a picture of the three forces that were to lead the industrial development of the country was already apparent; the industrialization of the country was going to be based on three types of enterprises:

- a) private national companies;
- b) public Government companies; and
- c) private foreign companies or subsidiaries.

The picture is one of shifting contours and many of the original causes of its formation are still at work; also many new conditioning factors are active in its modification.

The recent official paper - Goal and Bases for the Action of Government - issued to present main government policies and objectives (September, 1970), envisages the Brazilian economic system as constituted of public corporations, private national corporations and private foreign corporations and foresees "the consolidation of an economic system in which an equilibrium between the government sector and the private sector reached through the right proportioning of the public corporations, the private national corporations and the private foreign corporation will guarantee continually the economic and political viability of the system".

A very recent characteristic of the Brazilian industrial picture is the appearance of hybrid forms; one can already identify the following types of joint ventures in the manufacturing industry:

- 1) private national and private foreign capital;
- 2) private national and public national capital;
- 3) private national, private foreign and public national capital.

Some important multinational companies have manifested their willingness to have Brazilian Government corporations as partners in new industrial joint ventures.



## II. THE INDUSTRIAL ENTERPRISES IN BRAZIL

### Comparative importance of the private national, private foreign, and public sectors

There is no general survey of the manufacturing companies that could explicit the participation of the foreign companies in the manufacturing industry. In 1969, the Instituto Brasileiro de Economia made a study of the major 500 corporations in the country, the corporations being compared not by their sales volume but by their net value. From the above study, Fernando Fajnzylber of ECLA compiled the data of Table No. 1 Annex, that comprehends the 378 major manufacturing companies in Brazil. (See Fernando Fajnzylber - Sistema Industrial y Exportacion de Manufacturas - Análises de la Experiencia Brasileira - ECLA - September, 1970).

The above study shows the dominance of foreign companies in the manufacturing sectors of Pharmaceuticals, Chemicals, Electric Products, Machinery, Automotive, Rubber products, etc. It shows also that, as an average in each industrial sector, the foreign companies are more than twice as big as the Brazilian private companies. Unfortunately the study doesn't give an estimation of the direct participation of the foreign companies in the total industrial income of the country. Nevertheless considering the different degrees of concentration of the different industrial sectors, one could guess that the participation of the major companies contemplated in the inquiry in the industrial income should not exceed 50 percent; in this case, taking into account the fact that the foreign companies are concentrated among the major ones, one could conclude that the foreign companies are directly responsible for not more than 20 percent of the Brazilian industrial income.

## III. THE NEED FOR INDUSTRIAL RESEARCH INSTITUTES IN AN INDUSTRIALLY DEVELOPING AREA

The development of the industrial area of São Paulo, that provides now about 65% of the total industrial income of the country, gives a typical example of the importance of the action of an industrial research institute. This fact was first raised by Professor David Carneiro Jr. in a paper read at the Institute of Latin American Studies, University of London, on the 24th of February, 1970, under the title: "The Development of Technological Progress in Brazil: a case study: IPT's role in adapting, transferring and creating technology". In general the rapid growth of industry in the area of São Paulo is attributed solely to the convergence of the four factors before enumerated: the availability of electric power, the formation of a market represented by the coffee planters, the capital accumulation through the coffee business, and the availability of both labour and entrepreneurs among the immigrants attracted by the coffee business. Professor Carneiro contends that a fifth factor has been commonly neglected. In 1934 a part of the laboratories of the Engineering School of São Paulo were instituted as an autarchic body by the Government of São Paulo to form the Instituto de Pesquisas Tecnológicas (Technological Research Institute), IPT for short. Several private companies (some of which were foreign subsidiaries) contributed with an initial fund to import equipment to the new institution, which immediately engaged in three lines of activity that were to be continued until now:

- 1) the specialization of young engineers;
- 2) the contracting of technical assistance and research services with Government agencies and industrial companies;

- 3) the organization of in-house programmes of adaptation of foreign technology and of research in fields considered of more importance to the industrializing area.

"Research was started in several areas of Chemistry, in Metrology (Weights and Measures), Building Structures, Soil Mechanics, Industrial Standards, and the production of high quality plywood"... "IPT also did pioneer work in different specialized areas of metallurgy, ferrous and non-ferrous alike"... "Its permanent assistance was vital to the motor industry and all sectors of different engineering industries when they went into production in the country. By its initiative the Brazilian Standards Association (ABNT) was formed and several industrial standards were first drafted at IPT. It also played a leading role in the creation of the Brazilian Metals Association, the Brazilian Steel Institute, the Brazilian Chemical Association, the Brazilian Portland Cement Association, and others"... "Technicians from several Brazilian states and firms and from other countries in Latin America worked there for varying periods, being trained in different industrial techniques. Finally, it also turned into an important source of entrepreneurial talent, many of the São Paulo leading industrial leaders having done several months or years of training in its laboratories, after graduation of even before"... "These men are or have been front rank entrepreneurs in important industries and financial groups." Professor Carneiro stresses also the importance of the proximity and the relationships between IPT and the Engineering School and he concludes that IPT or better, the complex IPT - Engineering School, constituted a dominant factor in the growth of the industry of São Paulo.

The initial development of the industrial complex of São Paulo was originally done with local resources and carried by the initiative of the local people, a large part of which was constituted by immigrants; the participation of foreign enterprises was then very limited. Later when the flux of foreign investment came to participate more intensively in the industrial development of Brazil, the largest volume of foreign enterprises chose to locate in São Paulo. Very few of the foreign manufacturing companies decided for an alternative location in the country, like Rio de Janeiro, Minas Gerais, Rio Grande do Sul, etc. This fact indicates that the technological progress previously attained in the São Paulo area has constituted a strong attraction for the foreign investment.

#### IV. ROLES OF AN INDUSTRIAL RESEARCH INSTITUTE CHOICE OF FIELDS OF ACTIVITY

The first industrial institute to be installed in an industrially developing area, as was the case with IPT, has to spread its activities on a wide variety of the most diverse cases and problems. For the sake of a systematization, its activities could be classed into three groups: technical activities, cultural activities and internal activities.

The technical activities comprise:

- Tests and analyses
- Supply of standard reference materials
- Supply of special technical instrumentation
- Research on specific problems
- Pilot plant experimentation and production
- Industrial metrology support
- Technical assistance and consulting

The cultural activities comprehend:

- Training programmes for students and young technicians
- Courses of extension and specialization for people in industry
- Cooperation with the technical associations
- Cooperation with the standardization agencies
- Technical publications
- Participation in government technical committees and councils

Finally, the main internal activities are:

- Training programme for the staff members
- In-house programmes for the adaptation of foreign technology and research in selected fields

The success of an institute will depend on a proper balance among the three groups of activities above; as will be shown later this problem is related with the resources available and the sources of income.

At least in the early years the demand will force the institute to develop an incredible variety of tests and analyses. The research and the technical assistance problems can be restricted to a narrower list of selected fields of competence. The in-house programmes should be organized in a manner to broaden the fields of competence for research and technical assistance. The choice of these fields of competence has been in general in accordance with the development of the industrial activities. Because of the importance of the building industry in a developing country, it started very soon with cement and concrete researches. In the cement industry, for instance, there was the problem of high magnesia, the limestone in Brazil having a tendency for a higher magnesia content. The techniques for the rational proportioning of concretes and the methods for the choice of the proper aggregates were first developed in Brazil by IPT; from there IPT expanded its field of research in building materials, to heavy ceramics, tiles, cement-asbestos materials, light aggregates, etc. As an outcrop of its preoccupations with the building materials, IPT has developed a ceramic research group which undertook the systematic study of Brazilian clays, assisted in the development of the refractory materials industry and the development of the white ceramic products. It has also developed many industrial uses of Brazilian clays as filtering agents in chemical processes or as components in paper and rubber industries and is steadily expanding its research competence in the general field of non-metallic minerals. As the buildings were becoming higher and there was a need for more elaborate and bigger public works like dams and roads, IPT has developed a field of competence in soil mechanics and foundations which later diversified in road building, applied geology, rock mechanics, etc.

In the metallurgical field, IPT developed first a capacity for the support of the metal using industries because the area of São Paulo had bigger interest in the working of metals rather than in extractive metallurgy. A field of competence in metals structure and properties based on a strong metallographic foundation was first developed; later an important development was made to help the foundry industry and only afterwards, because of the demand from other areas of the country, did IPT develop studies on ore treatment and methods of metal extraction.

In this diversification of fields of competence one must guard against the danger of spreading too thin the human resources available. There is a sort of minimum size for the research groups below which it is practically impossible to make a steady progress. IPT has suffered in many instances the ill effects of not following this principle.

## V. UTILIZATION OF INDUSTRIAL RESEARCH SERVICES

### a) By the Government

In the industrially advanced countries, government is a heavy buyer of research. Probably the armed forces are the heaviest buyers because of their vital interest in advanced technologies. Almost every advanced country has organized agencies for the development of certain advanced technologies of interest to civilian uses like atomic energy, satellites and their civilian applications, ocean technology, etc. More recently research efforts have been applied to the solution of some emerging new problem like environment pollution control, urban congestion and others.

The role of government in the economies of the developing countries is much bigger percentage-wise than that corresponding to the governments of the advanced countries, but the focus of interest, the programmes and plans are quite different. In general the governments of developing countries are directly interested in applying technology in programmes for:

- 1) building the economic and social infrastructures of the country;
- 2) promoting the industrialization of the poor densely populated areas;
- 3) expanding production of agriculture and basic industries; and
- 4) integrating in the economy the uninhabited regions of the country.

This being the case their main interests are concentrated in the adaptation of known technologies for local use and in the development of sound strategies for applying them. The advanced technologies are only of interest in so far as they may promise cheaper solutions for the old problems.

The Brazilian government agencies and state companies that have to their charge the expansion of basic services, the development of backward areas and the development of basic industries are yearly increasing the amount of research they buy from the Brazilian research institutes. Problems like the use of local materials for construction purposes, the adaptation of known industrial processes to particular ores or raw materials and the identification of industrial usages for new raw materials are the principle themes of the researches ordered. It is felt that research institutes will be of more help if they are able to overcome an internal shortcoming of their organization; they are in general more apt to develop a specific research in the laboratory than help to devise which is the better strategy to solve a specific problem and this stems from the fact that they have not yet been able to develop effectively the multi-disciplinary approach of research by which a problem once identified is examined under all its aspects and the alternative possible solutions are weighed as to their relative global merits.

In Brazil, as in other developing countries, there seems to be a general problem of a proper coordination between the research institutes and the other several national agencies for the economic development.

The developing countries have to organize almost at once a whole system of agencies to attend the needs of the industrial development. Besides research institutes, they have to create centres for technological higher education, either as a part of their universities or as separate institutions, investment banks and development corporations, normalizing and standardization agencies, institutes to organize and to enforce the usage of basic weights and measures, agencies for the systematic appraisal and the proper registration of patents and industrial marks, centres for industrial extension and productivity studies, etc.

There is a general tendency for the various agencies above-mentioned to act isolatedly without realizing the advantages that could be derived from a proper degree of coordination between them. The experience of INTI (Instituto Nacional de Tecnologia Industrial) of Argentina shows how important the relationships between the research institutes and the universities can be. In Brazil, at least in the area of São Paulo, very fertile relationships have been developed between the universities and the research institutes; also fairly good relationships between the national standards association and the research institutes have been reached in Brazil. The Mexican experience of the MITI (Instituto Mexicano de Investigaciones Tecnológicas) exemplifies the importance of good relationships between the research institutions and the investment banks and development corporations. It is felt that detailed studies at national level and an international comparison of their findings could do much in the way of a proper understanding of methods to be used for attaining a proper coordination of the different developing agencies and of the advantages that could be gained by the developing countries.

b) By the Business Community

The Instituto de Pesquisas Economicas Aplicadas - IPEA (Institute for Applied Economic Research) has recently made an inquiry upon the state of the industrial research in Brazil. The data below is from a paper by F.A. Biato and E.A.A. Guimarães of the IPEA, presented in the Meeting of The Industrial Research Institutions held in São Paulo in May 19-23, 1971.

The inquiry identifies 47 entities (institutes, laboratories, university departments, etc) that develop industrial technological programmes in the country. Out of the 47 entities only 21 have contracts with industrial enterprises, the remainder doing only in-house research.

The activities that these 21 entities develop in their contracts with the industrial enterprises could be classified in the following manner:

- 55% - Routine testing
- 34% - "Adaptive" research
- 7% - Pilot plant development
- 4% - "Creative" research

454 of the major industrial enterprises in the country answered to the inquiry. Of these, 292 declared that they made their own research and usually didn't buy from research institutes. Of the remainder, 100 industrial enterprises declared that they usually buy research services from research institutions, or from other companies. A part of the work of the research institutions is for smaller companies, not included in the inquiry.

Of the 47 research entities surveyed, 10 had no interest in communicating their activities to the industry; 27 of them would answer when solicited by the industry and/or maintained some sort of bulletin describing their activities; only the remaining 10 institutions had some form of a more aggressive approach in their contacts with the industry.

As the mentioned paper concludes, the inquiry indicates that the industrial sector uses the services of the research institutions only in a limited way and that the research institutions have only a limited interest in a more active relationship with the productive system.

Even the few more active research institutes in Brazil have yet much to learn as to methods of industrial liaison. And as remarked for the government sector, also in the industrial sector the lack of ability for working in interdisciplinary groups still prevailing in the industrial research institutes restricts the scope of many of the research activities to laboratory or pilot plant experimentations.

In the last thirty years, a big market for technology has sprung all over the world. Besides the traditional forms of sales of patent rights and of technological projects, other forms of merchandising of technical know-how have been developed and are being negotiated between companies of different countries; while in the relationships between two advanced countries this may be regarded as a mere systematization of the ways of exchanging technological knowledge, in the relationship between a developing country and an advanced one this takes the aspect of a characterization of the technological dependency of the former.

A recent study by IPEA (Institute for Economic Applied Research) has identified the following five forms of importation of technology (IPEA - Industrial Sector - The transference of technology in Brazil, December 1970):

- 1) Permanent technical assistance - an agreement presupposing a permanent vinculation of a Brazilian enterprise to a foreign company; the latter commits itself to supply services of process engineering, production engineering and product engineering as may be necessary for the development and improvement in Brazil of a certain product line by the Brazilian enterprise. The payment by the Brazilian enterprise will correspond to an agreed percentage of the monthly or yearly sales volume of the product line.
- 2) Temporary technical assistance - an agreement providing for the technical help of a foreign company to a Brazilian enterprise, for the development of a certain product line or for the implantation of an industrial process in Brazil. The payment by the Brazilian enterprise will be in the form of an agreed sum that may be paid in instalments.
- 3) Patent licence - a patent licensing agreement in which the licensor resides in a foreign country. The payment will in general correspond to an agreed percentage of the sales value of the products incorporating the patent licensed.
- 4) Licence for the utilization of trademarks - as in the case above, payments will correspond to an agreed percentage of the sales volume.

- 5) Engineering project - the supply by a foreign company of a comprehensive collection of technical studies based in specific researches and/or accumulated technical information and of designs and specifications organized to constitute the technical plan for the construction of a productive unit or for the manufacture of an industrial product. The payment will correspond to an agreed sum that may be paid by instalments.

The cited study shows that more than fifty percent of the agreements for technological transference in Brazil correspond to the Permanent Technical Assistance type.

Beginning at the close of World War II a growing number of industrial companies in Brazil have entered into technical assistance agreements with companies of the advanced countries. This growing technological dependency may have had the effect of diminishing the demand of the private industry for the research services of the local research institutes and is presently the object of the study by the Government sector, not so much on account of the foreign currency demand involved but because it may discourage not only research but also any other form of industrial creativity in the country.

It is now being recognized in Brazil that the creation of technology through research, the transfer of external technology and the use of new technologies by industry will have to be considered together within the frame of a national technological and industrial policy.

As it is now, the local research institutes constitute an important support for the industries that maintain technical assistance agreements with foreign companies. But the services demanded could be classified as "clinical services" in as much as they constitute a big variety of small specific technical problems; very seldom a study for the development or improvement of a process or of a product will be asked - these questions are transferred to their foreign licensors.

c) By foreign companies

Only in very few cases do foreign companies or subsidiaries of foreign companies look for the services of local research institutions in Brazil. This seems to be generally true of the research institutions all over the Latin American countries.

A foreign manufacturing company will only move into a Latin American country after learning that there is a local market for certain products developed abroad and after acquiring a reasonable assurance as to the availability of the necessary supplies either by local production or by importation. The foreign company is only interested in exploiting commercially in a new market the technical know-how and the management and marketing expertise it has developed abroad. As J.B. Quinn puts it (Technology Transfer by Multinational Companies, Harvard Business Review, Nov/Dec 1969), "Many corporate managers now paraphrase the theme: 'When you get down to it, all we have to offer in world markets is a superior technology and a better capacity to use it' ". The foreign company preoccupation is in developing a business it already knows and therefore it lacks interest for local research. On the other hand there is in the Latin American countries a ready acceptability for any change of style or design and for any innovation that have met the approval of the advanced countries and, therefore, it is a much safer business to introduce there a product developed abroad than to try to create locally something new.

In the Brazilian experience that seems very similar to that of other Latin American countries, the foreign companies or their subsidiaries have sought the

assistance of the local research institutes in the following cases:

- 1) To get support for the development of local suppliers.
- 2) For tests and analyses.
- 3) For solving some very specific manufacturing problems where only minor experimentation will suffice ("clinical services").
- 4) In some few cases, in the food industry, for the development of new products and for the production of trial orders in the pilot plants for market testing.
- 5) To get free information about the local production of raw materials, building materials and industrial goods as a preliminary basis for new projects.
- 6) To get an appraisal of the performance in the local conditions of products manufactured abroad prior to their introduction into the country.
- 7) To use the local industrial research institute as an agency for the quality control of products for export made by local enterprises.
- 8) To get an authoritative opinion in cases of the application of laws and regulations presenting technical interpretation problems such as import duties, draw-back regulations, sales taxes, etc.

#### VI. CONTRACTING OF WORK TO LOCAL INDUSTRIAL RESEARCH INSTITUTE BY FOREIGN CONCERNS

##### a) Foreign manufacturing or consulting companies operating in the country

In the experience of IPT the cooperation in the development of local suppliers presents the most interesting possibilities for contracts of the services of the local research institutes by the foreign manufacturing companies. No matter what line of products a foreign company develops in the country, a multitude of supplies of materials and parts will be generally required. For the sake of building a good public image, it is in the interest of the foreign company to utilize as its suppliers a large number of local enterprises, but these with all probability will need technical help to attain and maintain the required quality standards and to achieve competitive prices through higher productivity and lower scrap losses. The local research institutes are in general prepared to give this kind of technical assistance.

In some cases IPT has participated in specific development programmes of the above contemplated type; but in no case up to now has there been the preoccupation of jointly analysing the whole problem and planning in detail a proper strategy for action. In too many cases, the foreign manufacturers do not plan a proper technical assistance support for the suppliers and, in the experience of IPT, only after repeated difficulties will many of the suppliers seek the help of the research institute.

The future improvement of the relationships between the local research institutes and the foreign manufacturing companies, in Brazil as in other Latin American countries, will naturally depend upon action to be taken by each side. From their



part the research institutes will have to dismiss some prejudices the foreign companies have created about them, such as:

- 1) A feeling that a certain time-insensitivity of the local research institutes may render any forecast of delivery schedules impossible.
- 2) The impression that the institutes are "too official" and that this might interfere with the independence of the company's movements.
- 3) The notion that the expenses incurred in an agreement with a local institute are unpredictable and therefore cannot fit into a rigid budget.
- 4) A certain degree of doubt as to the technical capabilities of the research institutes.

On the other side, some of the actions that could be suggested for the foreign manufacturing companies are:

- 1) The honest decision of knowing more fully the local research institutes.
- 2) The organization of plans to fully use the local institute's capabilities and to supplement its weaknesses through members of their own staff.
- 3) The organization of plans of interchange visits of researchers both from the research departments of the parent companies and from the local research institute.
- 4) The development of attitudes conducive to a continuing understanding and collaboration.

The relationships with foreign engineering and consultant firms with IPT have been limited to the solution or the answering of very limited questions, mainly connected with local raw materials like woods, fibres, clays, minerals, or with local building materials. In this case the observation already made about the importance of truly developing interdisciplinary research is valid; from some recent inquiries it is possible to foresee a substantial increase in the services rendered to foreign consultants once the institutes are prepared for it.

b) Companies in other countries interested in developing products for the country or in importing products from the country

Both contemplated cases have commercial interest. In the first case, services of the local institutes may often be required when the products involved have their performance heavily dependent upon local conditions of climate, soil nature, etc. This is the case for instance of agricultural machinery, weed killers, pesticides, wood preservatives, fire retardants for wood, and many others. The contracts between the foreign concerns and the local institutes will foresee a general appraisal of performance eventually associated with the research of some minor modifications that may be necessary for the adaptation of the product to the local conditions. After a successful appraisal the product is imported into the country and may later be manufactured locally.

Companies interested in the importation of products made out of local raw materials may request the assistance of a local research institute to develop and to maintain the quality standards required by the foreign markets. IPT has had contracts of this kind in connection with some wood products and some essential oils.

VII. THE DEVELOPMENT OF MORE EFFECTIVE UTILIZATION OF INDUSTRIAL RESEARCH IN LATIN AMERICA

In common with most of the development problems, the problem of a more effective utilization of industrial research will require in each country or region the concerted efforts of different public sectors and of different organizations. The regional and international organizations can also make decisive contributions towards this development.

It may be appropriate here to propose a re-definition of the scope of industrial research in the developing countries of Latin America. In many of the Latin American countries "industrial research" has been connected with "industrial innovation", either in the form of a new process or of a new product and it should be remembered that "process improvement" and "product improvement" no matter how small the degree of improvement involved, are also legitimate objectives of industrial research. Many an industrial researcher of the Latin American countries will adopt a sort of prudish attitude in their contact with the real industrial problems and will shun his involvement in problems of counselling on the improvement of production methods and in quality problems that could not be strictly defined as an "industrial research". Now, considering the present limited experience of industry in the Latin American countries, and considering that in the near future most of the innovative processes and products will continue to be dictated by the advanced countries, the scope of "industrial research" in the Latin American countries should be broadened to be of more effective use to the local industries. I submit therefore that the following activities should be considered as "industrial research" in the Latin American countries, in the following order of importance to the local economies:

- i) The rational choice of the most appropriate technologies for each industrial sector of the country and the planning of their effective assimilation by the local industries.
- ii) The economic adaptation of existing technologies to local conditions of production scale, of raw materials, and of manpower skills.
- iii) The local development of process and product innovation, and of process and product improvement.

Some random suggestions leading to a more effective utilization of industrial research submitted below, have been grouped under the heading of one of the public sectors or organizations more directly involved in their implementation.

a) The local industrial research institutes

The organizations that are most interested in and are most responsible for a more effective utilization of industrial research by the local industries are the local industrial research institutes. Therefore they should be in a constant search for improvements of their internal structure and for refinements in their way of approaching and attending the industries, or as once Mr. J.J. Castellanos of the Mexican Institute for Research and Industrial Technology (MITI) has put: "the first and most important research project of a research institute should be the institute itself". And they should bear constantly in mind that while it is true that the value of an academic scientific research is independent of its applications, the effectiveness of an industrial research is only measured by its success in actual industrial use.

i) Contracting of work with industrial companies:

The practices of contracting, the procedures of attendance and the fees to be charged, should all be spelled out in a businesslike manner, that is the manner industrial companies best understand. As the establishment of criteria for evaluation of performance is frequently difficult at the beginning of research work, contracts should foresee successive steps or phases, the whole subject being reappraised jointly after the conclusion of each step or phase. In this manner the officers of the contracting company will participate in the orientation of the research work and will also feel confident that they are not committing company's funds out of proportion with what they are really getting.

The organization of a high level industrial liaison service should not discourage a permanent contact of the researchers with industry; it is through these contacts that an important number of research projects will come to the Institute.

ii) Research work--selection of appropriate fields:

As stressed in Chapter IV above, this is one of the most important factors leading to the success of the institute. Both the researchers and the management of the institute should engage themselves in a permanent revision of its fields of activity, checking their technical level and appraising their adequateness to the industrial milieu.

The forecast of the new fields to be entered should take into consideration the long time consumed in planning the research group and developing the proper levels of competence. In most of the Latin American countries this will frequently involve long training programmes because ready-made specialists cannot be found for the required fields.

Frequent discussions with industrial and engineering associations, with the appropriate government agencies and with leading elements of the industry are very important for a successful choice of the research fields.

iii) The development of technical skills:

In the Latin American countries the institutes will have to train specialists for industry besides training them for their own needs. This may be an expensive programme but if resources can be found and if the programme is well planned, it will in a few years start to pay dividends to the institute because it will greatly improve its contacts with industry.

The main problem comes when industry attracts more trained elements than planned and so depletes the number of trained personnel in some of the fields of competence of the institute to a low dangerous point. To avoid this situation the institute will have to be able to maintain its salaries at a level comparable with those prevailing in industry; at least in the Brazilian experience most of the institutes are submitted to government restrictions, their salary levels being tied to those prevailing for the civil service or for the university professors, and this fact has been the cause of the near-death of several research institutes. It has to be generally understood that a good technical staff is the only important asset of any type of research institution.

b) The Government

i) The relationships with the research institutes:

The importance of increasing the relationships between the industrial research institutes and the different government agencies has already been stressed under Chapter V. These relationships should constitute a means for maintaining a satisfactory number of research projects going on at each institute. They should also constitute a basis for the changing of the present dependency relationship of the institutes towards government in matters of financial resources to a new type of relationship in which they should be treated as independent organizations and would celebrate paid research contracts with the appropriate government agencies. Instead of granting endowments the government should buy research projects from the research institutes. Even in the case of some of their long maturing or highly deficit internal and cultural programmes, the government could empower one of their agencies in charge of technological matters for the purpose of negotiating and financing them. The important thing is to put the financing of every project or programme of the institutes on a more pragmatic basis of selling and buying because this will constitute a way of effectively appraising their performance and will contribute indirectly to the improvement of their relationship with the industrial sector.

ii) The government financing agencies:

The government financing agencies constitute a basic support for the development of the private industrial sector in the Latin American countries and they should use their influence for leading the industrial companies to contract, where appropriate, research projects with the local institutes.

They should also themselves contract with the local institutes broad projects pertaining to the development of whole industrial branches or regions; they could thus effectively contribute to the development of the modern multi-disciplinary approach in the institutes.

iii) The foreign industrial sector:

Considering the great participation of the foreign industrial sector in the Latin American countries, the governments should issue a strong recommendation to induce the foreign companies to put into effect plans for the use of the local research institutes, and should indicate that the acceptance of such a recommendation would have a weight in the official dealings with said companies. Principally the so-called multinational corporations have a huge influence in the general industrial development of the Latin American countries through a constant transference of technology; in many cases as has been stressed under Chapter VI, the local research institutes could be employed effectively in this transference process and this could be done in such a way as to benefit both the multinational company and the private national industrial sector.

c) Associations of Industries

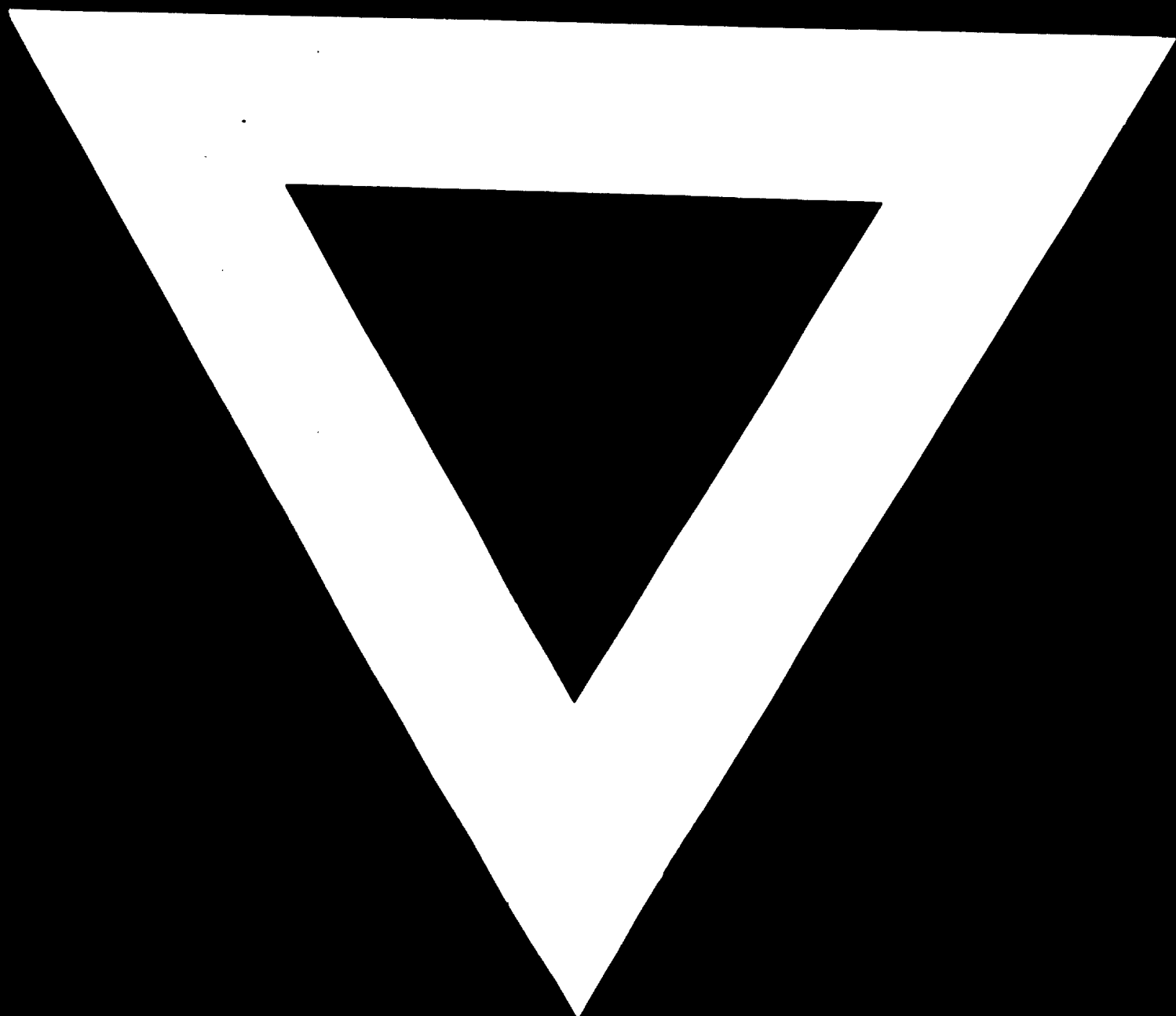
The trade associations of industry could have an important participation in many programmes for a more effective utilization of industrial research. Besides regular information to their associates on industrial research, they should lead the experimentation of forms of cooperative research, so common in the European countries but very rarely to be found in Latin America. They could also take the initiative of organizing in their countries plans of technical assistance for the small industries with the help of the research institutes.

A new form of cooperation between industry and a research institution is the one now being developed by the Comision Nacional de Energia Atomica (National Committee for Atomic Energy) of Argentina. Its research sector is giving the necessary support for the production by the local industry of a substantial part of the first Argentinian Atomic plant; and, furthermore, studies are being made to ascertain that this participation will be much more important in the next atomic project.

d) International agencies

The international agencies (UNIDO in particular) can promote the more effective utilization of industrial research in the developing countries through the strengthening and the support of the local industrial research institutes. Programmes along the following lines should be started or reinforced:

- i) Assistance to the research institutes in the development of some important skills as, for instance, project management and industrial liaison. Such assistance could be made in the form of international periodic courses and seminars.
- ii) The identification of successful approaches leading to more effective utilization of industrial research developed by the institutes of the developing regions and their diffusion.
- iii) The technical help in the project and the implantation of new institutions as well as in the expansion into new fields of the existing ones.
- iv) The organization of a technical consultancy to be used by the institutes whenever they may need expert help for specific technical problems.



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