UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

LIMITED

ST/CEPAL/Conf.53/L.4
19 November 1974

ENGLISH
ORIGINAL: SPANISH

ECONOMIC COMMISSION FOR LATIN AMERICA

MEETING ON SCIENCE, TECHNOLOGY AND DEVELOPMENT IN LATIN AMERICA

Mexico City, 2-7 December 1974

CONSIDERATIONS ON SOME RECENT EXPERIENCES IN THE PROMOTION OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT IN LATIN AMERICA

74-11-2527

CONTENTS

/INTRODUCTORY NOTE

INTRODUCTORY NOTE

Eleven years have passed since the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. This meeting brought the scientific and technical poverty of the economically less advanced nations into focus at the international level and opened the way for a group of measures to be adopted by the United Nations in this field.1/ One of these measures led to the setting up of the Advisory Committee on the Application of Science and Technology to Development, which was requested to study the characteristics presented by the unequal scientific and technological progress in the various countries and to suggest measures whereby the prevailing international disparities could be mitigated.2/

Since then the Advisory Committee has undertaken several measures, one being the formulation of the World Plan of Action for the Application of Science and Technology to Development.3/ This document, after stressing the importance of science and technology in economic life today, suggests guidelines which, as a matter of priority, must necessarily direct the United Nations' efforts in this field.4/ The Plan also indicates the institutional forms which

---

1/ United Nations, United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas (E/3772 and E/3772/Add.1), 1963.

2/ See United Nations Economic and Social Council resolution 980 A (XXXVI), 1 August 1963.

3/ United Nations, World Plan of Action for the Application of Science and Technology to Development, New York, 1971. See also United Nations, International Development Strategy (ST/ECA/139), New York, 1970, and Science and technology for development (ST/ECA/133), New York, 1971.

4/ Full information on United Nations activities aimed at scientific and technological development in the low-income countries may be found in Guy B. Gresford-Bertrand H. Châtel, "Science and technology in the United Nations", World Development, vol. 2, Nº 1, January 1974.

/the formulation

the formulation and implementation of policies aimed at promoting scientific and technological development could assume, and the volume of resources which should be earmarked for the purpose. It finally stresses that the continuous transfer of productive know-how entails a huge international co-operation effort, founded on broader bases than in the past.

These views are expressed more specifically in the Regional Plan of Action,5/ which presents information and criteria on the preoccupations of the countries of the area concerning scientific and technological development, examines some policies and institutions which have come into being in the region, and suggests future lines of action. The Plan stresses, in particular, that the machinery and possibilities deriving from the universal United Nations system should be put to more ambitious use, without losing sight of the internal changes which any style of scientific and technological development requires and involves.

Fully alert to these concerns, the Member Governments of ECLA, at the Commission's fifteenth session in Quito in April 1973, adopted resolution 322 in which the ECLA secretariat is requested to evaluate the incidence of the technological factor in economic and social planning and the adverse effects which might be produced by the indiscriminate use of technologies. In other words, it is considered necessary to determine the ways in which technical advances have been absorbed in the region, to evaluate the action taken to overcome any inadequacy or distortions in this field, and to examine the new subregional and hemispheric co-operation machinery which is already visualized. On the basis of the results of these tasks, ECLA will have to assume new responsibilities in this field.

The Governments' anxiety concerning the region's inferior position with respect to science and technology has also been reflected in several recent international meetings. For example,

---

5/ United Nations, Regional Plan of Action for the Application of Science and Technology to Development in Latin America.

/at the

at the sixth special session of the United Nations General Assembly it was deemed necessary 6/ to give the developing countries access to the achievements of modern science and technology in accordance with procedures which are suited to their economies. Hence the Programme of Action adopted by the General Assembly at the same session 7/ calls for the formulation of an international code of conduct for the transfer of technology.8/ Furthermore, the United Nations Conference on Trade and Development (UNCTAD), in compliance with the wishes expressed by the Governments, has continued to study the various aspects of the transfer of technical know-how to the relatively less developed nations.9/ Lastly, the Working Group entrusted with the detailed study of the Charter of Economic Rights and Duties of States agreed 10/ that the developed countries should co-operate with the developing countries in establishing, strengthening and developing their scientific and technological infrastructure.

6/ United Nations, Declaration on the Establishment of a New International Economic Order (A/RES/3201(S-VI), paragraph (p)), 9 May 1974.

7/ United Nations, Programme of Action on the Establishment of a New International Economic Order (A/RES/3202(S-VI)), section IV, 1 May 1974.

8/ This concern is shared by other agencies. See, for example, Anteproyecto de código de conducta sobre transferencia de tecnología, Comercio Exterior, Mexico City, May 1974, pages 430-434, drawn up by a working group on the basis of the decisions adopted at the twenty-third Pugwash Conference on Science and International Affairs, Geneva, 1-5 April 1974.

9/ See, for example, UNCTAD, Major issues arising from the transfer of technology to developing countries (TD/B/AC.11/10), December 1972, and The role of the patent system in the transfer of technology to developing countries (TD/B/AC.11/19), April 1974.

10/ UNCTAD, Working Group on the Charter of Economic Rights and Duties of States, fourth session (TD/B/AC.12/L.13), 28 June 1974.

/These measures,

These measures, which are aimed at the establishment of a new international economic order, should be viewed with cautious optimism. On the one hand, they reflect a genuine concern about the nature and seriousness of the problems which mankind is facing today in a context of increasing interdependence, but on the other hand, the critical nature of these serious issues may appreciably restrain any will towards international co-operation.

At the regional level, a recent development which may have far-reaching consequences was the Meeting of the Working Group on Science and the Transfer of Technology in Brasilia,11/ where it was deemed a matter of urgency to reformulate the co-operation machinery operating in the hemisphere with the aim of reinforcing the countries' scientific and technological systems, making better use of external flows of technology, planning the marketing machinery on a more ordered basis, and strengthening the institutions concerned with absorbing and conducting scientific and technical progress. This action suggests the desirability of extending and strengthening the co-existence and co-operation links in the region, particularly as regards scientific and technological expansion, whose potential effect on the various aspects of economic and social life seems undeniable. Action would be encouraged both within the multilateral frameworks at the world level and within those which may be instituted at the regional level.

On the basis of the foregoing, the present document attempts to examine recent experiences in connexion with the promotion of scientific and technological development in the region. It consists of four parts. The first contains general indications concerning the origins and manifestations of the inadequacy of science and technology in the region as a whole and describes the stages by

---

11/ See Organization of American States, First Meeting of the Working Group on Science and the Transfer of Technology (Brasilia, 24-28 June 1974), Washington, D.C., August 1974.

which the Governments have endeavoured to overcome this problem. The second and third chapters review the evolution and performance of various instruments of scientific and technological policy, on the basis of selected cases which appear to be representative of general trends. The document ends with an evaluation of the experiences noted in this connexion in the region, and suggestions are made for co-ordinating action to consolidate and promote scientific and technical activity, which might involve the reformulation of development patterns hitherto followed, with certain variations from country to country, in the region.

1. Science, technology and underdevelopment

In recent years - particularly during the last decade - Latin America's interest in science and technology within the context of development has increased considerably. This is reflected in different ways. One is the growing number of studies 12/ which, from quite different angles, tackle the problems arising from the inadequacy of science and technology in the region. Those dealing with this subject have placed the emphasis on different questions, i.e., the nature and evolution of the economic and educational structures from which this backwardness stems; the effect of this backwardness on the present structure of the labour markets; the

---

12/ For example, A. Sánchez Crespo, OAS, Esbozo del desarrollo industrial de América Latina y de sus principales implicaciones sobre el sistema científico y tecnológico, Washington, 1970; A. Herrera, Ciencia y política en América Latina, Siglo XXI, Mexico, 1971; J. Hodara, Productividad científica: criterios e indicadores, UNAM, Mexico, 1971; I. Sachs, "Selection of techniques: problems and policies for Latin America", Economic Bulletin for Latin America, vol. XV, Nº 1, 1970; K. Heinz Stanzick - H. Godoy, Inversiones extranjeras y transferencia de tecnologías, Editorial Universitaria, Santiago, Chile, 1972; M.S. Wienczek, Comercio de tecnología y subdesarrollo económico, UNAM, Mexico, 1973; M. Halty, El desarrollo tecnológico zonal y la transferencia de tecnologías, ALALC/SEC/PA/21, June 1973; F. Sagasti-M. Guerero, El desarrollo científico y tecnológico de América Latina, INTAL, Buenos Aires, 1974.

factors responsible for the weak capacity to select, adapt and apply the useful know-how created in the major industrial centres; the ways in which the techniques are disseminated and marketed and their impact on, in particular, the balance of payments and the distribution of income; and the benefits that would be obtained from channelling regional co-operation towards shared scientific and technological development. These concerns are convergent, and they undoubtedly indicate a broader understanding of the problem.

This growing interest did not only lead to interesting studies on this facet of under-development, however. As will be seen later, the Governments have adopted various measures to stimulate scientific and technical development. In some cases, significant progress has been made; in others, initial measures are being adopted, but in every case an effort has been made to remove obstacles which in differing degrees have hampered the expansion and adaptation of specialized knowledge.

A climate of opinion has therefore been created and is finding full expression at various national and regional meetings which, faced with the task of identifying the adverse factors that are hindering regional development, have concluded that among these factors are the restrictions imposed on economic and trade policy by the inadequacy of science and technology.13/

These opinions are neither arbitrary nor superficial. They are the outcome of both the examination of the scientific and technical lag and its implications, and the objective difficulties which are impeding Latin American development. Some comments may usefully be made in this respect.

13/ See, for example, the Sixth session of the High-Level Committee for the Restructuring of the Central American Common Market, San José, Costa Rica, 29 July to 2 August 1974.

Several studies 14/ have focussed attention on some of the circumstances which have made science and technology dynamic components of modern societies. Ever since the industrial revolution - which was preceded by substantial changes in the agricultural sector - these two forces have had a powerful influence on ideas and on the structure of productive activity.15/ The traditional concepts of nature and society have weakened, while other ideas regarding the improvement of human aptitudes have begun to gain ground. Moreover, technical innovations have improved communications and transport systems and facilitated the linkage of productive sectors. Correspondingly, industrialization and foreign trade have acquired unprecedented momentum.

Furthermore, science and technology have tended to make colonial domination more effective:16/ a factor which in different ways has been disturbing international relations. Quite apart from other

---

14/ The manner of dissemination and concentration of technical progress has been studied in detail by ECLA. Today the aim is to identify the components of the problem in the light of more detailed information and of the new trends presented by the international economic and political order. By way of illustration, see ECLA, Economic Survey of Latin America, 1971 (United Nations publication, Sales Nº: 73.II.G.1), New York, October 1972, Part One, and Latin America and the International Development Strategy: First regional appraisal (E/CN.12/947), 7 February 1973. For a more general approach, see United Nations, International Development Strategy (ST/ECA/139), New York, 1970, and Science and technology for development (ST/ECA/133), New York, 1971.

15/ According to D.S. Landes, "The heart of the Industrial Revolution was an interrelated succession of technological changes. The material advances took place in three areas: (i) there was a substitution of mechanical devices for human skills; (ii) inanimate power - in particular, steam - took the place of human and animal strength; (iii) there was a marked improvement in the getting and working of raw materials ...", in The Unbound Prometheus, Cambridge University Press, 1970, page 1.

16/ See E.E. Rich-C.H. Wilson, The Cambridge Economic History of Europe, vol. IV, Cambridge University Press, 1967, and C.M. Cipolla, Cañones y velas, Ariel, Barcelona, 1967.

considerations this circumstance may be a factor in the present concern of governments regarding the scientific and technology gap, for bridging this gap would also mean extending the boundaries of national independence.

These two forces have not had an equal incidence on the economies which are currently regarded as relatively less developed, however.17/ A detailed review of the causes of this situation falls outside the scope of this study, but some general observations can nevertheless be made.

The nature of the international division of labour which was established in the course of the last century and part of the present one has considerably influenced the procedures for the transfer of technical innovations. The industrial countries were compelled to promote science and technology in order to step up the productivity of the factors involved and to continue to enjoy the relative advantages they possessed at the beginning of the agricultural and industrial revolution. They had for the purpose an intellectual tradition in which emphasis had been placed on scientific activities, and also a favourable position in the international market.

In contrast, the entrepreneurs who staked their progress on the abundance and low cost of the natural resources of under-developed countries had little need of technical innovations, except to the extent required by the marketing of basic commodities. Technical progress reaches these countries, but only piecemeal and, in any case, tied to imported goods.18/

17/ For a first approach to this subject, see E.J. Hobsbawm, Industry and Empire, vol. III, Penguin, London, 1969, and P. Bairoch, El tercer mundo en la encrucijada, Alianza Editorial, Madrid, 1971.

18/ The uneven patterns of transfer and concentration of technical progress, which were given special attention in early studies by ECLA, have not been ignored in its recent studies. See, for example, ECLA, Economic Survey of Latin America, 1949, and Economic Survey of Latin America, 1973.

/But the

But the contrast between the intensive importation of technology and the large-scale export of primary products is only one aspect of the problem. Attention must also be given to internal factors which have prevented the advance of science and technology, such as the fact that the changes in the bases of the economies took place very slowly, while the higher educational institutions kept aloof from productive activity. Past experience indicates that scientific and technical development is accelerated when significant innovations are introduced in either all or some of the economic and social structures.

The industrialization schemes put into effect in most countries of the region during the 1930s certainly increased the demand for useful know-how. However, at that time, there was scarcely any inkling of the need to create effective intermediation mechanisms (productivity centres, standardization institutes, engineering consultancy firms) to link the availability of local scientific resources with the requirements of industrial development. In these circumstances, the entrepreneur had practically no alternative but to import technology, and in any case such importation worked out cheaper for him. There was no long-term view of scientific and technological progress at that time, and indeed such a view is still lacking today, although to a lesser degree.19/

These uneven patterns of production and absorption of scientific and technological progress have been accentuated with the passing of time. The industrial societies clearly perceived the interdependence between science, technology, economic progress and military power;20/ hence, increasing resources were assigned to these

---

19/ Both the productivity centres and the technical standardization agencies came into being after the import substitution industrialization scheme was adopted. With a few exceptions, the activities of these bodies have been of somewhat narrow scope. See Esbozo del desarrollo industrial de América Latina, op. cit.

20/ See, for illustrative purposes, the essays published in N. Rosenberg, The Economics of Technological Change, Part One, Penguin, London, 1971.

/activities at

activities at a rate which came to exceed the growth rate of the product.21/ The State played an active role in this trend, as regards both the financing and the orientation of scientific activities, particularly in the period following the Second World War. For this purpose, it was able to build on the basis of a fund of scientific and technical information established in earlier years.22/

The scientific and technological expansion of the industrial societies was not, it is true, determined by a set of concerted measures, and there can be no doubt that accident played a significant role. But in response to a stimulus which was relatively fortuitous, these economies were able to make good use of the resources available to them.

Obviously, then, the experiences of the industrial centres in this field are of limited although by no means insignificant value from the viwepoint of the peripheral countries. The context within which the latter countries must achieve scientific and technical expansion is substantially different from that which determined the development of today's industrialized nations. Hence, the questions - which have given rise to much controversy in the economically advanced societies - as to whether or not a science policy is desirable, and whether technology represents a destructive rather than a positive force, need to be reformulated in the light of the conditions visualized in the developing regions.

21/ In 1950, the United States assigned around 1 per cent of the GDP to research and development activities; the percentage is now over 3.

22/ See F. Chesnais-C. Cooper, La ciencia y la tecnología en la integración europea, in O. Sunkel, Integración política y económica, Editorial Universitaria, Santiago, Chile, 1970.

The countries with low incomes, either because they were overwhelmed by short-term problems or because of their marked and increasing heterogeneity, were late in realizing the cardinal importance of modern science in relation to the development of the productive sectors.

This partial view could not continue indefinitely, however. Structural and institutional changes in the economies led to consideration of the factors which were obstructing development. Slow, piecemeal technical change was undoubtedly one of these. It was no longer satisfactory that technical progress should be transferred solely through foreign trade mechanisms, and demands began to be made for active State participation in this process, as in the relatively more developed countries.

Public recognition of the importance of science and technology and of the establishment of proper training facilities was not free from obstacles. On the contrary, sustained efforts were necessary to overcome resistance of different kinds which directly or indirectly still hinders scientific and technological development today.

These considerations are of particular significance for the Latin American countries, because of the serious effect of the backward state of science and technology on all aspects of regional development.

What were the first steps taken by the countries of the region in this connexion? Four stages are to be distinguished. The first, which took place in the middle of the last decade, consisted of developing a consciousness of the inadequacy of science and technology, the factors responsible for this inadequacy, and its repercussions on the labour market, foreign trade and the balance of payments. The Governments' concern was reflected in the Conference on the Application of Science and Technology to Development in Latin America (CASTALA), which was held in Chile in 1965 under the sponsorship of UNESCO. The views expressed at that Conference were echoed in the Declaration of the Presidents of America

/(Punta del Este,

(Punta del Este, April 1967), who, recognizing that "science and technology offer infinite possibilities for providing the people with the well-being that they seek", called on the inter-American co-operation system to give impetus to scientific and technological development in the region.

After the extent of the problem had been determined, some measures were adopted which represented the second stage of the process. Institutional machinery was set up in some cases and consolidated in others, with the aim of increasing the availability of scientific resources. The common goal then was to integrate them into a system with the object of enhancing their impact on the production of goods and services. These trends found expression in the Conference on the Application of Science and Technology in Latin America (CACTAL), which was held at Brasilia in May 1972 under the sponsorship of the Organization of American States.

Other measures matured later, with the aim of putting into effect a technology policy aimed at stepping up local demand for technical services and re-examining marketing arrangements in this field. This was the third stage, in which some countries advanced more rapidly than others.

The objective in the fourth stage is to integrate these promotional measures into a coherent science and technology policy, bearing in mind not only the countries' experiences, but also the regional and international co-operation machinery which may be utilized for the purpose.

The next chapter analyses the nature and characteristics of the institutional mechanisms which have been entrusted with the promotion of scientific and technological development in the region: this analysis refers in general terms to the first two of the four stages mentioned.

2. The institutionalization of science and technology policy

(a) General observations

As already stated, the 1960s were a period in which the significant role that science and technology could play in development became more generally recognized in the region. This was partly due to the execution of studies which led to a fuller understanding of some aspects of the backward state of science and technology. A climate was thus created which favoured the establishment of institutions responsible for promoting scientific activity in co-ordination with other agencies. In 1960 only two countries had such institutions; today the number is significantly greater,23/ and in some cases there are institutions which actually promote science and technology within the context of the formulation of public sector policy.

Although these bodies may occupy different places in the public sector, their activities and functions are generally similar. In a first phase, they endeavoured to strengthen the scientific infrastructure through measures designed to make good the shortage of human and financial resources. Thus, for example, the studies undertaken by such bodies with the assistance of various international agencies - mainly UNESCO and OAS - revealed that the amount spent on research and development in the industrialized countries was significantly greater than that spent in the region. While in the United States and the Soviet Union this sum represented approximately 3 per cent of the gross domestic product, in the Latin American countries it ranged from 0.2 to 0.3 per cent.

23/ In this respect, see UNESCO, La política científica en América Latina (NS/SPS/29), Nº 29, Paris, 1971. The countries which have specialized institutions for the promotion of science and technology include Argentina, Bolivia, Chile, Colombia, Costa Rica, Cuba, Ecuador, Jamaica, Mexico, Peru, Trinidad and Tobago, Uruguay, and Venezuela.

/Although, admittedly,

Although, admittedly, this is only a very rough indicator of a fairly complex situation, in any case it permits a first approach to the subject. For example, it accounts for the sluggish growth in the number of scientific and technical personnel engaged in development and research, which in absolute terms amounts to barely 35,000 for the entire region. In relation to the population, the ratio ranges from 4.5 research specialists per 10,000 inhabitants in Argentina to 0.7 per 10,000 inhabitants in Mexico.24/

In the face of this shortage, the promotional bodies adopted measures aimed at improving the supply and calibre of scientific personnel through the launching of fellowships and training programmes. These activities were supplemented by supporting scientific and technological services 25/ and the conclusion of bilateral co-operation agreements with countries that had shown progress in some area of national interest. To sustain this action, the bodies sought funds from various sources, particularly the central government, and thus became one of the main channels for the allocation of available resources. This does not mean that these bodies assumed full responsibility for the formulation and implementation of development measures, however. Their sphere of action was and still is necessarily selective, and indeed it could not be otherwise in view of the complexity and multiple ramifications of scientific and technological under-development.

It was realized, therefore, that the fulfilment of these functions has a significant but limited value. It is undoubtedly a necessary requisite, but it is not enough. The expansion of

---

24/ See J. Carlos Gamba, Estadísticas científico-tecnológicas de América Latina, OAS, Washington, 1972.

25/ These include the following services: library and information; scientific experimentation and standards; museums, zoological and botanical gardens; geological, geophysical, meteorological and natural resources studies; compilation of data on economic and social questions; advisory services and patents offices. See the report of the Sussex Group, Science and technology for development (ST/ECA/133), United Nations, New York, 1971.

the supply of resources, if not associated with other measures which affect the local demand for personnel and services, has only a limited impact. In some cases it may even encourage the so-called "brain drain", a situation which indubitably aggravates the shortage of available resources. Accordingly, this first phase of establishing institutions and strengthening the infrastructure is followed by another in which the aim is to put into effect legal and administrative machinery that will regulate the transfer of techniques from abroad and influence local demand in the required direction.

This chapter deals mainly with the set of activities undertaken by the national bodies or councils for the promotion of science and technology. The analysis is based on a limited number of cases which do, however, appear to be representative of the general prevailing trends. The partial information available has not permitted a fuller investigation than that presented here. Subject to these reservations, a review of the measures adopted in Argentina, Brazil, Central America, Cuba, Mexico and Venezuela is presented below.

(b) Argentina

The Argentine case, one of the earliest experiences in this field, has some unusual features. From the institutional standpoint, there are a number of bodies with more or less well-defined responsibilities, some of them founded in the last century.

Among them are the Dirección General de Servicio Meteorológico (established in 1872), the Instituto Geográfico Militar (1879), the Servicio de Hidrografía Naval (1879), the Instituto de Investigaciones Aeronáuticas y Espaciales (1927), the Dirección General de Investigación y Desarrollo (1950), the Dirección Nacional del Antártico (1950), the Instituto de Investigaciones Científicas y Técnicas de las Fuerzas Armadas (1954), the Comisión Nacional de Investigaciones Espaciales (1960), etc.26/ Parallel to these,

26/ See Elba Roulet, Instrumentos de política científica y tecnológica, Subsecretaría de Ciencia y Tecnología, Buenos Aires, February 1973.

sectoral bodies directly responsible to the Office of the President or to one or other of the Ministries were also set up. Among them are the Instituto Nacional de Microbiología (1916), the Comisión Nacional de Energía Atómica (1950), the Instituto Nacional de Tecnología Agropecuaria (1956), the Instituto Nacional de Tecnología Industrial (1957), the Laboratorio Nacional de Hidráulica Aplicada (1967), and the Comisión Nacional de Estudios Geo-heliofísicos (1969).

The activities of these sectoral agencies are co-ordinated to some extent by the National Council for Science and Technology (CONACYT), and interministerial body headed by the highest authority of the country. The Council has an executive organ, SECONACYT which is attached to the Ministry of Culture and Education and has the status of a Secretariat of State. It may be mentioned that university institutions, which form two-thirds of the total number of institutions existing in the country, are responsible for executing the majority of the projects.

Compared with other Latin American countries, Argentina has relatively extensive scientific and technological resources. The total number of active research workers is 10,837 a figure which surpasses other countries both in absolute terms and in relative terms taking account of the population size. Furthermore, it has a diversified university system (almost 300,000 students and a teaching staff of more than 35,000) which could ensure the continuity of scientific development.27/ The effort seems, however, to have some less auspicious characteristics: only one-third of the research workers are employed exclusively in their own field of specialization, and these incline by preference towards medicine and biology (only 10 per cent work in the engineering sciences). Moreover, two-thirds of the scientific and technological workers are concentrated in the Metropolitan Area and Pampeana. Furthermore, the institutional scheme for conducting scientific and technological

---

27/ See UNESCO, La política científica de América Latina, op.cit.

policy does not seem to offer a unified approach. It is probable that some of the overlapping observed will be remedied in the reorganization planned for mid-1974, however.

Of course, the characteristics referred to are not peculiar to the Argentine case: they are also present in several countries which are moving towards a more advanced phase of development. In any event, they are already calling for the attention of the competent authorities within the framework of new measures to widen the scope and improve the co-ordination of research institutions.

An increase in the number of scholarships awarded for study in the country and abroad is one of the major concerns of SECONACYT. A marked preference for promoting professional development in the institutions of the country itself is to be noted. Furthermore, measures have been taken recently to facilitate the selective repatriation of specialists, particularly those capable of establishing new research nuclei.28/

In order to promote technological innovation in enterprises, at the suggestion of SECONACYT the Government introduced legislation (Law 18527) which provides special tax relief for private businessmen who set aside funds for this purspose. The scientific and technological content of the projects carried out in the enterprises is determined by an ad hoc committee. Emphasis is placed on the design of prototypes, the development of new processes using non-conventional raw materials, product engineering, the operation of pilot plants and similar activities. In addition, the importation of scientific and technological equipment has been facilitated by special measures taken to liberalize Customs procedures (Decree 732 of 10 February 1972). Such equipment not otherwise available in the country is exempt from import duties and taxes, charges, levies, or customs or port tariffs of any kind.

28/ Further information is to be found in the interview with Dr. Julio M.G. Olivera, published in La Opinión, 2 February 1974, p.10.

The machinery used to back up research is not limited to the instruments referred to. The activities of the Instituto Nacional de Tecnología Agrícola (INTA), for example, are financed by a 1.5 per cent ad valorem tax on exports produced in the sector, while funds for the Instituto Nacional de Tecnología Industrial are provided by a tax of 0.25 per cent on the funds provided to industry by the National Development Bank.

Recently the Argentine Government set up the National System of Scientific Research Institutes and Centres to give a greater impulse to scientific progress in the country. Complementary measures taken in respect of this initiative were the establishment of the National Oceanographic Programme and the setting up of the National Institute of Physical Research for Energy Production and the National System of Scientific and Technological Information.

(c) Brazil

Another case is that of the Brazilian National Research Council (CNPq). Set up in 1951 with a view to "promoting and stimulating the development of scientific and technological research in all fields of knowledge", the Council is one of the principal instruments of the Brazilian Government in this field.29/ This body operates through a vast institutional network in which some of the institutions have a long history (agricultural research, for example, goes back to the founding in 1887 of the Imperial Agricultural Station). In addition, it forms part of the Planning Secretariat of the President's Office, which implements economic, administrative and technological policy measures. The following organizations operate under the co-ordination of this Secretariat: the Research Council itself, the National Development Bank (BNDE), the Institute for Financing Studies and Projects (FINEP), the Institute of Economic

29/ For further information see Francisco de Paula Storino, Consejo Nacional de Pesquisas, Informe sobre la experiencia brasilera, III Seminario Metodológico sobre Planificación de la Ciencia y de la Tecnología, OAS, Caracas, 6-10 May 1974.

and Social Planning (IPEA), and the Brazilian Institute of Geography and Statistics (IBGE). The Bank provides subsidies for holding post-graduate courses in various disciplines through the Fund for Scientific and Technological Development (FUNTEC). The amount of such subsidies increased from 30 million cruzeiros in 1969 to 72 million in 1971. Drawing up this institutional scheme entailed major efforts in order to achieve co-ordination and convergence of activities, without adversely affecting the individual identify of each body.

The Council has shown great concern with the training of qualified staff. It should be noted that Brazil has barely 8,000 research workers in technical fields. The number of scholarships offered increased from 607 in 1964 to almost 5,000 in 1973, their distribution centering especially on the medical and biological sciences, agronomy, and engineering. Furthermore, the Council provides financial assistance for research projects, fosters the participation of Brazilian scientists in international competitions and encourages the return of Brazilian specialists living abroad.

The Council has made a marked effort to decentralize activities. In 1973 it invested almost 1,500,000 cruzeiros in the establishment of a physics centre at the Federal University of Pernambuco. At the same time, it has fostered the programmes of the National Institute for Research on Amazonia (INPA), particularly as regards natural resources, forestry and biological research. In addition it provides assistance to 85 post-graduate groups at various national universities.

The rapid industrial development of Brazil seems to call for the expansion of the country's scientific and technological potential. It should be noted that the most dynamic branches of industry have a high technological component (motor vehicles, chemicals and the manufacture of metal products), yet national research and development expenditure is relatively low (approximately 0.3 per cent of the

GDP).30/ The Basic Plan of Scientific and Technological Development (1973-1974) formulated by the Office of the President of the Republic is adapted to meet this requirement. It is an integrated programme which seeks to trace new paths for scientific and technological development. Emphasis is placed primarily on promoting new technologies (nuclear energy, space and oceanographic research) and the technologies of the spearhead industries (electronics, chemicals, aeronautics). In second place come the efforts directed towards the consolidation of the scientific infrastructure and supporting services, in particular the National Institute of Technology (INT), the Brazilian Agricultural Research Agency (EMBRAPA), the Oswaldo Cruz Foundation (FIOCRUZ), and university laboratories. Finally, projects are also being drawn up with a view to strengthening the links between industry, governmental agencies and the universities. At constant prices, the funds provided increased from 100 million cruzeiros in 1968 to more than 2,000 million this year. This big increase will in all probability have a strong impact on the organization of scientific and technological activity. In institutional terms, the plan will receive support from the National Research Council, the National Development Bank's aid Fund (FUNTEC), and other agencies.31/

(d) Central America

The regional integration policies also gave an impulse to scientific and technological research. Thus, the Central American Governments set up the Central American Institute of Research and Industrial Technology (ICAITI) and the Nutritional Institute of Central America and Panama (INCAP). The former carries out studies on the use of local raw materials, the development of manufacturing processes and the adoption of modern methods. In addition, it

30/ For further details, see N. Fidelino de Figueiredo, The Transfer of Technology in the Industrial Development of Brazil, ECLA (E/CN.12/937), September 1972.

31/ Office of the President of the Republic, Plan básico de desarrollo científico y tecnológico, Brazil, June 1973.

/collaborates in

collaborates in setting standards for raw materials, intermediate and finished products. Fields of research include food, the use of agriculture wastes, textile fibres and hides.

INCAP receives assistance from the World Health Organization (WHO). It is carrying out a major research programme which puts emphasis on four areas: (i) new sources of proteins and nutritional biochemistry; (ii) ecology; (iii) calories and proteins in nutrition; and (iv) haematological studies and the control of vitamin A deficiency.

In addition to these two centres, a network of institutions engaged to varying extents in research has been set up. In 1971, they numbered 171, the majority of them belonging to the public sector and being institutions of higher education.32/ Expenditure on research and development continues, however, to be low (0.2 per cent of the overall product of the six countries, i.e., approximately US$ 0.76 per person compared with 114 dollars in the United States and 39 in the Soviet Union).

Naturally, the scope and effectiveness of the action that these institutions may carry out in the future will depend considerably on how the Central American integration programme functions. If it performs unsatisfactorily, this will perforce be reflected in the institutions and vice-versa.

In 1972 Costa Rica decided to set up the National Council for Scientific and Technological Research (CONICIT) with a view to improving information on the scientific and technological potential of the country and laying the foundations for co-ordinating the activities carried out by the various research centres.33/ The Council is co-operating with the Office of Economic Policy and Planning of the Office of the President with a view to joining efforts to promote

---

32/ ICAITI, Estudio de los recursos destinados a actividades científicas y tecnológicas en América Central, Guatemala, August 1974; and ICAITI, Lineamientos de una acción común para para el desarrollo científico y tecnológico de América Central, Guatemala, August 1974.

33/ CONICIT, Resumen de la política científica y tecnológica de Costa Rica, San José, Costa Rica, August 1974.

the Government's socio-economic plans. The repatriation of professionals and the improvement of information and documentation services are two fields of action which are receiving priority attention at present. Of course, the future scope and effectiveness of the action undertaken by these institutions will depend considerably on developments in the Central American integration programme. Any setback in the programme will perforce be reflected in the institutions and vice-versa.

(e) Cuba

Cuba's recent scientific and technological development displays some special characteristics. The radical transformation of the institutional and structural patterns which had guided the evolution of this country up to the end of the 1950s unleashed forces which continue to exercise a favourable impact on the cultural levels of the population. The transfer of key activities in the economy to the public sector, the successful introduction of far-reaching agrarian reform, the subsequent reduction of extreme inequalities and, in particular, concern with the consequences which could stem from continued backwardness in the field of science and technology gave rise to rapid rates of technical change in various sectors of activity.34/

In keeping with the nature of the new factors in national life, special emphasis was placed on changing the traditional orientations of higher education, since these had constituted a considerable obstacle to the involvement of men of science in the socio-economic realities of the country. This tendency is revealed in the changes which are taking place in the composition of university students. Between 1959 and 1971, the number of students studying agriculture more than sextupled (increasing from 759 to 5,182), the number of

34/ Republic of Cuba, National Council for Science and Technology, La experiencia de Cuba en la vinculación de la programación de la ciencia y la tecnología con las políticas de desarrollo, Report to the ECLA Meeting on Science, Technology, and Development, Mexico City, 1974.

/those studying

those studying technical specialities almost tripled (3,211 to 8,606) and those studying sciences tripled (1,479 to 3,889). In contrast, the number studying the humanities fell (from 3,757 to 1,749), and in the Institutes of Economics and of Education the numbers fell from 5,144 to 1,289, and from 5,180 to 1,241 respectively.

The effort was not limited to the modifications of the content and the aims of education policy. There were, simultaneously, various moves in the national scientific system to establish institutional frameworks for research nuclei. Such steps were promoted mainly by the Academy of Sciences, which was reorganized in February 1972. Thus, the following organs came into being: the Instituto de Investigaciones de la Caña de Azúcar, the Instituto de Suelos, the Instituto de Geografía and the Instituto de Metereología, the Instituto de Investigaciones Nucleares, and the Instituto Cubano de Investigación de los Derivados de la Caña de Azúcar (ICIDCA).

The foundation was thus laid for an infrastructure which at present includes 105 research centres with a staff of more than 13,000 of whom 2,430 (18.4 per cent) are university graduates.

In the 1960s priority was given to the setting up of a network of scientific organizations and to the training of cadres to ensure the continuity of scientific development. In the present decade, the initial results of those efforts are already in sight. Furthermore, steps have been taken to make use of existing international co-operation machinery in this field, particularly that set up by socialist countries.

On the basis of these experiences, in June 1974 (Law 1271) the Cuban Government decided to create the National Council for Science and Technology as an organ of the Council of Ministers. This body, which is headed by the Vice-Premier for Education, Science and Culture, has been made responsible for the design, implementation and appraisal of the country's scientific policy, taking account of the need to relate this to economic and social problems. For this purpose there will have to be close co-operation between the Council and the Central Planning Board. The Council is

/responsible for

responsible for the study and approval of the scientific research plans of the different State bodies, with a view to the optimum allocation of resources.

The country's future action will be directed to finding solutions to the problems affecting it. In all probability efforts will continue to be directed towards the training of cadres. At the same time, attempts will be made to keep these efforts in line with national targets which appear to be concentrated on the improvement of agricultural productivity, the diversification of foreign trade, and the stimulation of the construction sector. It is felt that efforts in this direction can prepare the country for tackling the complex tasks involved in an industrialization process based on the intensive use of science and technology: an objective which is already taking shape in the development strategy of this country.

(f) Mexico

As in other countries of Latin America, the formation of the Mexican Council for Science and Technology (CONACYT) was preceded by various attempts, varying in scope, which sought primarily to create a basic educational infrastructure.35/ In the early decades of the century the main higher educational institutions and some research centres were established. The National Council for Higher Education and Scientific Research was created in 1935, for the purpose of promoting higher education. This institution was later replaced (1942) by the Commission for the Promotion and Co-ordination of Scientific Research (CICIC), which awarded scholarships for the training of research workers and carried out studies in fields related to mechanical and electrical engineering. In addition, it sponsored the establishment of specialized committees dealing with problems of national interest. On the basis of this experience,

35/ For information on this subject see in CONACYT, Bases para la formulación de una política científica y tecnológica en México (Preliminary version) Mexico 1974; and CONACYT, Informe al III Seminario Metodológico sobre Planificación de la Ciencia y la Tecnología, OAS, Caracas, 6-10 May 1974.

the authorities decided to broaden the links between research and development by setting up, in 1950, the National Institute of Scientific Research. This measure was backed-up by the establishment of institutes and the organization of seminars, which, in their respective spheres, launched the promotion of scientific and technological research.

These events precipitated the need to set up a public body to promote the activities as a whole with the full support of the Federal Government. Thus, in December 1970, a law was passed creating the National Council for Science and Technology (CONACYT),36/ whose terms of reference were "to act as advisor to the Federal Executive in the planning, programming, co-ordination orientation, systematization, promotion, and channelling of activities related to science and technology, their links with national development, and external relations in these fields".

One of the first tasks of CONACYT was to expand the programmes for training human resources. In 1970 the country had 3,200 research workers, of whom only 635 had master's or doctor's degrees. Such a situation was unacceptable in view of the economic and demographic potential of Mexico. This led to the decision to increase the funds for this branch, which rose from 13 million pesos in 1971 to 62 million in 1973. The number of scholarships was considerably increased, particularly for such branches as engineering, technology, agriculture and social sciences. Special incentives were offered to those who decided to work, after their training, in public institutions, centres for advanced research, and enterprises in which the majority capital was in Mexican hands. Additional financial support was also provided for research projects (in 1971 assistance was provided for only one project, for a total of 153,000 pesos, whereas in 1973 the number of projects rose to 107, for which 26 million pesos were allocated). In

36/ CONACYT, Ley del Consejo Nacional de Ciencia y Tecnología, documents series Nº 2, Mexico, 1974.

/collaboration with

collaboration with other national institutions the Council promoted the establishment of nine research centres in different regions of the country, with a view to decentralizing activities and bringing them more closely into line with local problems. In addition, the indicative programmes were formulated for questions of national interest, food, health, energy, demography, ecology, marine resources and minerals.37/

These measures, directed towards the establishment of a system of science and technology sensitive to the problems of development, were complemented by the signing of co-operation agreements with both international agencies and individual countries.

In the four years which have passed since its establishment, the Council's achievements have been substantial. At the same time, it has also consolidated its position as a decentralized public sector body Because of these achievements it has been entrusted with the design of the National Plan to direct the efforts of the country in the field of science and technology. CONACYT is not completely free, of course, from difficulties and constraints, and this is fully recognized by those who run it,38/ but the majority of these difficulties stem from the fact that, as yet there is no overall picture of the relative priorities among the various development needs of the country in this field. Therefore, machinery for dealing with the different aspects of the pboblem, both in the short as well as the medium or long term is either lacking or not fully effective. This situation is not peculiar to the Mexico Council: it is shared by similar institutions in other countries of the region.

37/ CONACYT, Informe del Director General, Mexico, June 1974, page 42.

38/ See Informe del Director General, op.cit.

(g) Venezuela

The National Council for Scientific and Technological Research (CONICIT) began operations in 1967, following several years of preparatory work. The Council's function consists of providing advisory services to the National Executive in activities related to the training of human resources and the co-ordination of institutions concerned with scientific research. CONICIT works in close collaboration with the Central Office of Co-ordination and Planning (CORDIPLAN).

One of the main concerns of the Council is to gain a wider knowledge of the scientific and technological potential existing in the country. In order to do this it makes use of the surveys initiated in 1963 for examining the characteristics of research centres, their complement of staff and equipment, and their respective fields of study.39/ These inquiries revealed that over the period 1906-1957 there was a very modest increase in the number of research nuclei; the expansion was significant between 1957 and 1962, but it lost impulse in recent years. In the first period the majority of the organizations (96 per cent) were linked with the public sector, particularly in activities inherent in higher education, special emphasis being placed on agricultural and medical sciences. This tendency did not change significantly in later stages, although events of some importance took place such as the passing of the Universities Act, which made research work compulsory, and the establishment of the Venezuelan Institute of Scientific Research.

39/ See CONICIT, Diagnóstico de la actividad de investigación y desarrollo experimental que se realiza en el país, Caracas, May 1973.

/The aim

The aim of the Plan of Action recently prepared by CONICIT 40/ is to promote scientific and technological development within the framework of national objectives. Efforts will be directed to six areas: the petroleum industry, industrialization, agricultural development, urbanization, education, and health. In order to ensure that these actions flow smoothly, the setting up of an interministerial committee for science and technology is recommended.

The considerable inflow of foreign income generated by the increase in the price of petroleum has opened up a whole range of opportunities for the country, but it also clearly reveals the weakness of the available scientific cadres. These circumstances demand, to a greater extent than in the past, the ordered organization of institutional machinery and the substantive strengthening of the technical infrastructure.

(h) Conclusions

Examination of the experiences amassed by the national councils for science and technology gives a basis for some general remarks. The creation and diffusion of these institutions is in keeping with the concern felt in the public and private sectors over the technological backwardness of the region. Academic circles naturally share this concern. All maintain, with different shades of meaning, that technological dependence seriously handicaps the capacity for development. This is not only because of the direct costs involved. In the medium and long-term it also increases the vulnerability of the economies and keeps them outside an international order which is based on the systematic exploitation of specialized knowledge. It is felt that, whatever the circumstances, the quest for development alternatives and the achievement of some of these have little chance of success in an inadequate scientific and technological framework.

40/ CONICIT, Ciencia y tecnología para el desarrollo nacional, Caracas, 1973.

/In view

In view of the importance of the problem, the Governments formed the organizations mentioned, in some cases as interministerial committees, and in others as autonomous public institutions. The first tasks of these bodies were the evaluation of the scientific and technological potential and the identification of the obstacles which appeared to limit it. This action clearly revealed the inadequacy of the human, physical, and financial resources available, compared with those available in the industrialized countries. Thus, a new gap of fundamental importance was discovered.

But the councils did more than just call the attention of the authorities and public opinion to the magnitude and implications of the scientific and technological backwardness. They also represent an institutional means of expression of the scientific community, which is permanently short of funds. Furthermore, they have begun to make systematic and selective use of the bilateral and multilateral co-operation machinery, which complements domestic efforts, and they are already taking shape as one of the driving forces behind Latin American regional integration. In sum, their achievements, which are already considerable, are likely to increase in the future.

The limitations on the councils should not, however, be underestimated. Just like any other organization, there is a danger that these may become "objects of adornment destined to serve as show cases for displaying the degree of learning of government authorities and administrators",41/ but devoid of any decision-making capacity. It is reasonable to expect that at an early stage of internal organization the councils may record significant achievements, but, to the extent that they seek to give a greater impulse to activity in this field, they may come up against the

---

41/ See the records of the third Seminario Metodológico sobre Planificación de la Ciencia y la Tecnología en América Latina, organized by the OAS and the Venezuelan National Council for Scientific and Technological Research, Caracas, 6-10 May 1974.

/rigidity and

rigidity and lack of experience which tend to be characteristic of public administrations. It will then probably become necessary - there already seems to be a pressing need for this in some countries - to revise the institutional arrangements governing action in this field. Interministerial working committees, duly assisted by technical groups, could be one suitable means of doing this.

This pressing need for institutional co-ordination reveals both the weakness as well as the strength of the councils. As regards the first, it must be pointed out that in many cases capacity for action depends on the recognition which the council members enjoy, both in academic circles and in the decision-making centres of the public sector. From one group, intellectual legitimacy must be secured, while from the others the necessary support to implement the action must be obtained. This is a difficult task which puts a strain on the flexibility and capacity of communication of these institutions.

On the other hand, however, this situation offers a wider and more interrelated view of scientific and technological underdevelopment and of the instruments available for alleviating it. In other words, the Councils are beginning to gain an overall view of the problem which enables them to form a complete picture instead of the generally unilateral points of view held by the research community and some public sector bodies. It is to be hoped that this capacity will grow in strength over the course of time.

In any event, it seems obvious that the councils cannot limit their role to that of mere pressure groups in the scientific community, concerned only with the allocation of resources. Some of them have tried to go further, having seen the advisability of co-ordinating efforts with other institutions connected with the public and private sectors. Examples of action along these lines are the co-operation agreements reached with international organizations and with industrialized countries for the provision

/of selected

of selected assistance in some fields on a multilateral or bilateral basis. Recently, new initiatives have been taken to give an impulse to hemisphere-level co-operation in scientific and technological development. These concern attempts to seek joint forms of action directed at strengthening the local scientific and technological infrastructure, improving the use of the potential achieved by the industrialized countries, setting standards for the transfer of technology, and fostering the creation of institutional machinery at the government level to sponsor and guide the scientific and technological progress of the countries.

In short, the pillars have been erected on which it is already possible to build specific projects to alleviate this scientific and technological poverty - a problem which is by no means limited to a single country and which prevents the achievement of rising levels of development. However, there still seems to be a lack of precise criteria for drawing up a selective incentive policy capable of dealing with the particular problems of each country and with the changing aspects that the problem presents when looked at from the short, medium and long-term viewpoints.

The following chapter considers some instruments of technological policy which represents a step forward along the road already begun.

3. Transfer, marketing and registration of technology

(a) Preliminary considerations

The initiatives of the Latin American countries have not been limited to the implementation of mechanisms and institutional frameworks directed toward the promotion and spreading of scientific knowledge. In recent years complementary measures have been taken to achieve more selective incorporation of technological advances. This tendency reflects the conviction - held particularly in the relatively less developed countries - that efforts on behalf of the scientific-technological infrastructure could mature more

/rapidly if

rapidly if suitably backed up by a set of measures to broaden the local demand in the medium-term for specialized knowledge. A concerted set of impulses is needed to overcome the most evident manifestations of technological insufficiency.

As pointed out in the first chapter of this paper, various stages can be distinguished in the region in the decision-making process concerning scientific and technological development. In the first stage, it was believed that technological progress would be transmitted with ease by means of the mechanisms of international trade. This expectation, together with other circumstances, gave rise to attitudes of passivity in respect of the region's scientific lag. When it was noticed that the results of technical progress were being concentrated in the large industrial centres and that the new techniques which were arriving unilaterally in the region achieved only weak internal dissemination, however, action began to be taken to gain more understanding of the ways in which technological knowledge is transmitted. It was thus established that technology comes attached principally to the flows of foreign investment, which tend to be directed to the most dynamic sectors of the economies. This is why there is a growing propensity to try to isolate the flows of external technology from those of capital and assistance.42/

Several aspects of technological inferiority merit particular attention. One of these concerns the effects that the indiscriminate importation of technology was having on the configuration of the labour markets. According to this point of view, the high capital intensity of the innovations introduced reduces jobs in the modern sector of the economy: a most undesirable effect when the trends, structures and income levels of the economically active population are borne in mind. This lack of correspondence between the type of

---

42/ See in this respect K. Heinz Stanzick and H.H. Godoy (eds.), Inversiones extranjeras y transferencia de tecnología en América Latina, Editorial Universitaria, Santiago, 1972.

technology adopted and the supply of resources seems to be reflected in the increasing underemployment and unemployment, thus adversely affecting certain dimensions of social development. The indiscriminate importation of technologies may be one reason for the marked inability of industrial development to expand employment opportunities at the necessary rate. There are other factors that enter into this, of course, but the above appears to have particular import.

Another aspect was detected, however, whose effects were no less negative: namely, the fact that payments for the importation of technological know-how represented a heavy burden on the balance of payments. In 1970, for example, Argentina paid 115 million dollars for patents, licences, technological methods, trademarks and administrative services, a sum that amounted to 0.49 of that country's gross domestic product and 6.5 per cent of the value of its exports. Brazil, Colombia and Mexico, for their part, paid 104 million, 27 million and 200 million dollars respectively. In the case of Mexico, this expenditure represented 16 per cent of its export income.43/

In general, these figures approach, and sometimes exceed, those of expenditure on the internal promotion of scientific research. Since the beginning of this decade, measures aimed at changing the situation have become one of the cardinal concerns of governments. It has finally been understood that the continuation of passive attitudes in the face of external technological dependency could severely hamper the expansion of productive forces and labour markets.

This constriction of the labour markets and the serious tensions in the balance of payments in turn affected the export capacity of the Latin American countries, and not only because of the internal distortions which the two phenomena carried in their

43/ United Nations Conference on Trade and Development, Major issues arising from the transfer of technology to developing countries, TD/B/AC.11/10, December 1972.

train. External technological dependence undermined - and continues to undermine - the ability to negotiate with the big transnational enterprises, which are the main providers of techniques in the dynamic sectors. This dependence has thus been seen to be one of the gravest threats to national and regional development.

This stage of analysis and characterization of scientific and technological underdevelopment was followed by another in which a start was made on formulating legal and administrative directives with a view to establishing norms on the transfer of technology on more suitable bases. These activities broadened understanding of the aspects involved in this transfer, particularly the special nature of the international technology market and the procedures which could be adopted to strengthen bargaining capacity. The market shows imperfections which are magnified by, and even act to the detriment of the technological limitations of the buyer country. A vicious circle is thus produced, in that where a modest domestic supply of technical know-how limits bargaining power with the external suppliers, this in turn causes the aggravation of the initial inferiority.44/

Once aware of the situation, Governments and regional agencies studied the strategies adopted by other countries to improve their marketing capacity and their ability to absorb techniques. In carrying out this task, the countries of the region put into effect important initiatives which are leading the way to the emergence of a more advanced stage in which the scientific and technical progress of the area could be boosted with greater security and deliberation.

Now that these general appreciations have been made, an examination of some experiences which to a large extent reflect the most important trends in this field is called for. To begin with, an analysis will be made of the measures adopted by the signatory countries of the Cartagena Agreement, and this will be followed by an evaluation of the action taken by Argentina, Brazil and Mexico.

44/ J. Sábato, El comercio de tecnología, OAS, Washington, 1972.

The consideration of these cases does not imply any underestimation of the importance of the experience which other countries are already beginning to acquire. Because of the limited bounds of the present document, the accent has been placed on the most representative trends, on the basis of the information available.

(b) The Andean experience

Late in 1970, the five Andean countries (Bolivia, Chile, Colombia, Ecuador and Peru) making up the Cartagena Agreement laid the foundations of a new system aimed at establishing standards for the flows of foreign investment and technology, in line with the aims of the regional integration policy. The system agreed upon specifies the criteria which should govern the treatment of foreign investment and suggests uniform standards for reformulating the system of patents and trademarks. It also promotes, the exchange of data on the authorization of investment and the transfer of technology, so as to improve bargaining capacity with respect to third parties.45/

Special emphasis should be placed here on the content of some of the articles of Decision Nº 24 - which establishes the system mentioned above - as they affect the marketing and production of techniques. First, the willingness of the five Governments to set up official agencies responsible for applying the policy on imports of technology and foreign investment should be mentioned. For two countries (Chile and Colombia) the effect of this undertaking amounted to expanding the activities being implemented by the royalties committees, while for the remaining countries it involved the creation of new institutions.

These Government agencies are empowered to evaluate and approve purchase contracts both for technology and for other forms

---

45/ See Cartagena Agreement, Política subregional de desarrollo tecnológico, (COM/XIII/DT.2), 26 October 1973, and Cartagena Agreement, "Fundamentos de la política sobre tecnología de los países del Pacto Andino", in M.S. Wionczek (ed.), Comercio de tecnología y subdesarrollo económico, UNAM, Mexico, 1973.

of industrial property (patents, trademarks, models, industrial designs). At the same time, the Governments are called on to intervene to safeguard national interests in negotiations on the transfer of technical know-how between branches of foreign-owned firms and their parent offices.

Decision Nº 24 was not merely limited to setting up new institutional machinery. It also implied the implementation of norms aimed at abolishing restrictive trade practices inherent in purchase contracts, such as limits on exports, "tied" clauses, the control of the size and structure of output, recruitment of personnel, and related aspects. The principle was also laid down that any conflict connected with the sale of technology should be subject to the jurisdiction and competence of the receiving country. Additional measures were agreed upon with a view to restricting tax evasion and the denationalization of local enterprises and assisting the exchange of information on these questions.

Thirdly, Decision Nº 24 marked out an action programme aimed at encouraging a comprehensive technological policy, which began to take shape in the recently-adopted Decisions 84 and 85 of the Commission of the Agreement.46/ Under the terms of these latter Decisions, the signatory Governments undertake to actively promote the links between the technological infrastructure and production activities, in the light of the economies of scale resulting from the expanded market. Decision Nº 24 indicates the stages which the subregional technological development policy should follow. The first of these would consist in improving basic services, training human resources, and strengthening links between the centres which create technologies, the institutions which formulate and implement development policy, and the units of production. In a second stage, these activities would be evaluated and new orientations indicated for technological policy.

46/ Cartagena Agreement, Thirteenth Extraordinary Session (27 May to 5 June 1974, Lima), Decision 84.

/Preferential areas

Preferential areas of attention are: (a) the importation of technology; (b) assimilation; (c) retrieval of know-how existing in the subregion; (d) application of this know-how in production activities; (e) establishment of a comprehensive information system.

The Decision underscores the need for breaking down the technological "package" so as to identify the elements which could be supplied from local sources. In order to assist in this task it lays down that requests for imports of technologies must be accompanied by information which will enable the specific technologies of the product or process (backbone technologies) to be distinguished from those which are generally known (peripheral technologies). Thus, backbone technologies are those which are basic to the production of an article or a process, while peripheral technologies are of a general and complementary nature, and concern the execution and application of processes. These are relatively easily accessible in proportion as a country builds up its technological knowledge, whereas the backbone technologies represent know-how that is protected in some way or other.

Studies on the breakdown into backbone and peripheral components showed that the latter accounted for a substantial proportion of the total purchase.47/ Thus, the breakdown process implies the selective import of know-how not possessed by the country and the utilization of that available locally. Not only is foreign exchange saved by these means, but the national and regional capacity for offering the services required and for absorbing technical change to better advantage is considerably reinforced.

47/ See A. Ferrer, Políticas y planes de desarrollo científico y tecnológico. Monograph presented at the Third Seminar on a Methodology for Basic Studies on Scientific and Technological Planning, sponsored by the Organization of American States, Caracas, May 1974.

/The member

The member countries also agreed to negotiate with the Board of Directors of the Andean Development Corporation regarding the adoption of measures to assist in financing these activities.

Decision 85, approved during the second half of 1974, lays down standards governing the ownership of know-how. It aims at abolishing exclusive patents, and also limits the validity of patents in time. The Decision ratifies the proposal to put into practice a common technological policy.

The guidelines laid down in recent years by the Commission of the Board were the fruit of various experiences acquired by some Andean countries during the 1960s. For example, the Royalties Committee of Colombia, set up in 1967, plays an important role in the study and approval of licensing contracts. As it is empowered to authorize or reject such agreements, the Committee assists national enterprises in negotiating with external suppliers: its work is carried out in close co-ordination with the agencies responsible for the control of international trade and foreign investment. In many cases it has secured the renegotiation of agreements on more favourable conditions for Colombia. By way of illustration, it may be noted that in four years of activity (from the second half of 1967 to June 1971) the Committee reviewed a total of 395 contracts and rejected 61. Its activities brought a saving of eight million dollars per year in the overt costs of transfers, together with a reduction in the number of restrictive clauses in the contracts.48/

A second experience which preceded the joint action of the Andean countries was that of the Chilean Comisión Revisora de Contratos de Regalías, founded in 1967. This agency was made responsible for studying and evaluating contracts for the purchase of patents, trademarks and technical assistance agreements. Between 1967 and 1970 it succeeded in reducing royalty payments

48/ G. Oxman - F. Sagasti, La transferencia de tecnología hacia los países andinos, OAS, Washington, 1972.

/considerably and

considerably and in abolishing those which were considered superfluous or unjustified. The Commission also established maximum royalty rates, according to the relative importance of the branch of industry. Thus, for example, the limit was fixed at 4 per cent of net sales for the food industry but was as much as 8 per cent in the case of chemical products. In some industries (motor vehicles, electronics, textiles) royalty payments are not basically limited, but their amount is subject to more detailed study. In addition to these measures, others were taken to reduce the duration of contracts to an average period of three years.49/

On the basis of this experience, and on the lines of the initiative taken by the Board of the Cartagena Agreement, Peru set up an institute known as the Instituto de Investigación, Tecnología Industrial y de Normas Técnicas (ITINTEC) with a view to building up a system of interrelations between enterprises, universities, research centres and individual specialists. This institute is supported by financial resources derived from a 2 per cent tax for the promotion of technological research levied on the net income of industrial enterprises (Law 18350).50/

As already stated, these initiatives not only meant an appreciable saving in foreign exchange, but also improved understanding of the features of the international technology market. For example, they brought home the position of inferiority of the purchaser who lacks the necessary information. Furthermore, it was observed that inadequate information aggravates one of the deficiencies of the market, i.e., its excessive concentration in geographical terms, by enterprises and sectors. Since it was considered that the freedom of action of the purchaser is frankly limited, the analysis also aimed at determining the importance of

---

49/ For further information, see United Nations Conference on Trade and Development, A case study of Chile (TD/B/AC.11/20), 17 May 1974.

50/ See ITINTEC, Hacia una política tecnológica nacional, Lima, April 1974.

other restricting factors, such as the existence of clauses hindering the export of goods produced with techniques acquired abroad, the tying clauses imposing a commitment to purchase intermediate and capital goods from the same source as that which supplied the technical know-how, and the overpricing of imported products practiced by the branches of foreign firms.

The understanding of the modes and costs of the transfer of technology assisted in the formulation of new trends in this field, and not only in the Andean area: other countries of Latin America and outside the region also benefited from these studies. In short, the experience of the Andean countries has cleared the way to outlining a coherent technological policy, backed up by the scientific research institutions and the agencies responsible for the implementation of national and subregional development plans. Future achievements in this area, will, of course, depend on the development of the integration programme of the Andean countries. A strong boost for regional co-operation will have a favourable impact on the implementation of a coherent technological policy. Progress in this area will also strengthen the links which the programme has succeeded in establishing.

(c) Argentina

A second case may now be examined. This is Argentina, which up to 1971 had no legal measures providing for the review of contracts for the marketing of technology: the parties were completely free to come to any desired agreements on the amounts of the royalties, compensation for technical services, and time limits and arrangements for sending remittances. Under the influence of the above-mentioned Decision 24, and because of the pressures exercised by national industrial sectors, however, the Government of Argentina took measures (Laws 19135 and 19231 of July and September 1971) to reduce the outflow of foreign exchange for acquisitions of technology in the motor-vehicle industry and to channel the supply of know-how within the framework of the Registro Nacional de Contratos de Licencia y Transferencia de

/Tecnologías. This

Tecnologías. This agency operates in the National Institute of Industrial Technology (INTI), and its principal aim is to evaluate and control the transfer of foreign technology to Argentina. It is empowered to revoke purchase contracts when these involve imports of technology at a level probably already obtainable in the country, involve restrictions on exports and ties regarding equipment and raw materials, or fix prices which are not consistent with the licence taken out. In order to carry out these functions, Law 19231 requires INTI to create the corresponding administrative and technical organs and puts it in charge of making global diagnoses of the characteristics of trade and technology and industrial research and development activities.

These initiatives enabled a clearer picture to be gained of the volume of remuneration paid by Argentina to foreign suppliers of equipment. Thus, in 1971 the total amount was 50 million dollars, rising to 120 million in 1972. The highest payments were made in respect of the motor-vehicle and pharmaceutical industries. Approximately one half of the payments went to United States companies, followed by Italian and Swiss firms.51/

The measures which led up to the establishment of a National Register setting standards for purchase contracts were complemented by other measures relating to the treatment of foreign capital and the industrial promotion system. Thus, in July 1971 Law 19151 was published, laying down the norms governing the investment of foreign capital in Argentina. Under the terms of this decision, the Government of Argentina will establish in each case the extent to which specific foreign investments contribute to national economic development, and will promote their association with local capital, the incorporation of modern techniques, the use of natural resources or inputs produced in the country, the training of local professionals, and the siting of investment in relatively less developed regions.

51/ A. Arâoz, La importación de la tecnología en Argentina, INTI, Nº 25, December 1973.

Law 19904 (October 1972), for its part, lays down measures aimed at expanding, consolidating and modernizing the industrial enterprises of the country. It puts the accent on carrying out basic and applied research within the enterprises sponsoring regional development and the expansion of employment opportunities.

The measures for customs relief in respect of imports of scientific equipment and the reorientation of the purchasing power of the State with a view to encouraging local supplies of technical services are directed in such a way as to benefit local technological development.

(d) Brazil

Brazil's present activities as regards technological development have a considerable history. Since 1962, there has been a tendency to discriminate between the different components of foreign investment. On the basis of Law 4131 promulgated in that year, a register of contracts for the acquisition of technology and technical assistance was established in the Central Bank. Limits were set on royalty payments and on the legal time limits for them. In the course of the years, the scope of Brazilian policy was expanded to include the selective search for techniques which would meet the industrial requirements of the country and the development of local invention. Along the same line of action, it was resolved in 1970 to set up the National Institute of Industrial Property (INFI), responsible for adopting, for the economic development of the country, measures to speed up and regulate the transfer of technology and establish better conditions for the negotiation and use of patents (Law 5648)

Among the factors which hastened this action was the increase in payments abroad (239 million dollars in 1972 and nearly 400 million in 1973) and the excessive dependence on a few suppliers. The law on industrial property became a powerful instrument of technological policy when it prohibited the patenting of chemical and pharmaceutical products and processes. At the same time, the Government began to add

professionals responsible for studying and transmitting technological information which could be useful to Brazil to its embassy staff in selected countries.

These activities were based on a fairly accurate picture of the problems and benefits which accompany the transfer of technology from abroad. When it is borne in mind that the country has been growing rapidly (around 10 per cent per year), particularly in the capital- and research-intensive branches, the assumption that technological services have been appreciably strengthened seems justified.52/ It is now planned to introduce a selective process of importation of technology, mainly oriented by industrial policy. This would be complemented by the strengthening of the country's scientific and technical infrastructure. In the medium-term, this could mean an increase in outflows of foreign exchange, but this would be countered by the sustained expansion of industrialization.

The distribution of imported technology (measured by payments abroad) among the different branches of the industrial sector is very uneven in Brazil. For example, the motor-vehicle industries - including those which manufacture parts and spares - absorb more than half of the total imports of technology. The next biggest user is the steel industry, but it only accounts for 4.1 per cent of payments. A similar percentage is accounted for by the pharmaceutical sector.53/ Obviously, a priori assumptions should not be made regarding the significance of this situation. It could be held, for example, that these imports are adequately offset by the magnitude of the local effect which they generate in terms of goods and services connected with a specific branch. More detailed studies should give a more exact idea of the benefits and costs involved in any particular decision in this matter.

52/ N. Fidelino de Figueiredo, The Transfer of Technology in the Industrial Development of Brazil, ECLA, E/CN.12/937, September 1972, and F. Almeida Biato et. al., A transferencia de tecnología no Brasil, IPEA, Nº 4, Brasilia, 1973.

53/ See United Nations Conference on Trade and Development, Major issues in the transfer of technology to developing countries, op. cit.

/In any

In any case, the analysis of purchase contracts revealed the pressence of restrictive clauses here too. These were mainly of three types: (i) prohibition of exports of products for the manufacture of which the foreign technology was acquired; (ii) prohibition of the use by the local enterprise, once the contract has expired, of the technical know-how transferred; (iii) compulsory appropriation by the foreign vendor enterprise of the rights relating to any improved process introduced by the concessionary of the process or product. As already stated, the Central Bank tends to reject the inclusion of these restrictive conditions.

(e) Mexico

As in the previous case, the rapid industrialization of Mexico has involved considerable absorption of technical innovations.54/ This is due to the trend of the import substitution process towards intermediate and capital goods, which are technology-intensive. Furthermore, the sustained diversification of the machinery of production was not accompanied by the strengthening of local technological potential, which would have enabled the rate of transformation to be speeded up. Consequently, at the end of the 1960s, Mexico was spending approximately 200 million dollars per year on the purchase of technology, and this sum had been growing at an annual rate of 20 per cent.55/ This trend coincided with the manifest inadequacy of the network of scientific institutions existing in the country at that time. The number of researchers was barely more than 3,000, and the majority worked in higher education centres and for the public and semi-public sectors

---

54/ See M.S. Wionczek, "La transferencia de tecnología en el marco de la industrialización mexicana", Comercio de tecnología y subdesarrollo económico, op. cit.

55/ See United Nations Conference on Trade and Development, Major issues in the transfer of technology to developing countries, op. cit.

/(the private

(the private sector accounted for only 4 per cent). The proportion of researchers employed in technological and industrial activities was extremely small (2.3 per cent).56/

The adverse implications of the disparity between speeded-up industrial development and local technological backwardness were apparently aggravated when the Mexican Government decided to encourage the export of manufactures, with a view to making the patterns of national development more flexible. The need then arose to correct the imbalance mentioned. The creation in 1970 of the National Council for Science and Technology, already mentioned in the last chapter, and the opening of the National Register for the Transfer of Technology in 1972, were decisions aimed at mitigating the country's scientific and technical inferiority. Brief mention may be made here of the sphere of action of the Register.57/

This agency operates within the Ministry of Industry and Commerce and has various aims: (i) to lay down standards for the conditions imposed in contracts, in the national interest; (ii) to strengthen the bargaining position of enterprises; (iii) to keep a detailed register of contracts, with special attention to the supply of useful know-how and the provision of basic or detailed engineering, technical assistance and related services. The registration of agreements by enterprises is a prerequisite for taking advantage of the benefits provided by the Law on the Development of New and Necessary Industries and other legal or regulation measures. Furthermore, payments in respect of contracts which have not been registered will not be considered when estimating income tax.

56/ See National Institute for Scientific Research, Política nacional y programas en ciencia y tecnología, Mexico, 1970.

57/ See CONACYT, Bases para la formulación de una política científica y tecnológica en México (preliminary document), Mexico, January 1974; and M. de María y Campos, "La política mexicana sobre transferencia de tecnología, una evolución preliminar", Comercio exterior, May 1974.

/The influence

The influence of the experience of other countries - Japan, India, Argentina, Brazil and the Andean group - in this area is to be seen in the nature of the grounds for the rejection of an agreement: (i) when the price or compensation has no relation with the technology required or involves a very high charge; (ii) when the heaving or resolution of lawsuits arising in respect of the agreements assigned to foreign tribunals; (iii) when excessive periods of validity are laid down (these should not exceed ten years for the receiving enterprise); (iv) when the agreement involves restrictions on exports, production, the use of complementary technologies, restrictions on the acquisition of equipment and raw materials, and other similar cases.

Between January 1973 - when the Registration Law came into force - and April 1974, 5,625 contracts were presented. The two years' grace period which the law grants to contracts made before its promulgation so that they can adapt to the new norms was conferred on 4,112 of these. The rest were presented for registration. By April 1974, 965 had been evaluated, of which 299 were rejected for infringing the legal provisions. The most frequent infringements concerned payments which were excessive or not in keeping with the technology acquired. Generally speaking, the agreements also contained other clauses constituting infringements, apart from the above-mentioned.

Although an evaluation of the impact of the Register is premature, there are nevertheless indications that the abolition of restrictive clauses is benefitting the export capacity of the country, while the reduction of excessive payments means savings in foreign exchange. At the same time, the bargaining power of the local entrepreneur vis-à-vis the suppliers of technology is beginning to grow stronger, while the reduction of the period of validity of the contracts is already boosting the rapid absorption of the innovations and assistance acquired.

/(f) Recapitulation

(f) Recapitulation

The poor quality of the scientific "cadres" is just one aspect of the region's scientific and technical shortcomings. The problem is more complicated. It cannot be overcome - although it may be attenuated - by allocating more resources to higher education, and even less by mere exhortations to bring the structure of professions so more in line with the requirements of development. While important, it is also not enough just to make institutional arrangements so as to rationalize the efforts being made. Something more is needed, namely, concerted action to deal with the numerous nuances and ramifications of a deficient scientific and technical structure.

As has already been noted, several countries of the region seem to have decided on this path. They have focussed their attention on the problem and undertaken a number of initiatives that give them greater latitude for resolving it. Measures governing the external purchase of technology are not intended merely to save currency and promote foreign trade but also to increase the region's participation in world knowledge. Progress, however, has been neither homogenous nor sufficient. The more economically advanced countries have moved ahead more quickly than the less developed; some of them are trying to ensure that their concern for the backwardness of science and technology should be reflected in regional integration policies. Furthermore, a great deal remains to be done in connexion with the adaptation, improvement and creation of technology. As progress is made, it is becoming increasingly clear that scientific development policy cannot be divorced from the other motive forces of economic and social development if there is to be regional coexistence.

4. Bases for future action

The inadequacy of Latin America's development has attracted attention to the shortcomings of its scientific and technological structure as a secondary, and sometime primary, factor. This is inevitable at a time when multinational enterprises are being widely discussed and when, in the large industrial centres, the validity of growth patterns devoid of any firm ethical basis is being challenged. The promotion of technical progress, on the one hand, and its reorientation, on the other, would seem to demand the most urgent attention.

It should be no surprise, therefore, that the examination and implementation of scientific and technological policies should involve a review of the various patterns of economic and social behaviour that have been adopted hitherto. This interplay of influences between economic and technological progress must be borne in mind when deciding upon future action.

Foreign trade is one of the fields which have clearly proved to be adequate. Regional participation in international transactions is tending conspicuously to decline (in general terms it has dropped from 11 per cent in the 1950s to 5 per cent at the beginning of the 1970s).58/

The decline in Latin America's importance in world consumption is attributable to a number of complicated situations, some of which have to do with insufficient domestic growth and others with various restrictive factors that affect the world market. It is impossible,

---

58/ See ECLA, Economic Survey of Latin America, 1971 (United Nations publication: Sales Nº 73.II.G.1), October 1972. Special attention should be paid to the relative decline by country. Latin America's share in the imports of the United States fell from 35.4 per cent in 1950 to 10 per cent in 1972, of Western Europe from 8.5 to 3.2 per cent, and of Japan from 4.3 to 3.3 per cent. See also A. Krieger Vasena and J. Pazos, Latin America - A Broader World Role, Ernest Beun Limited London, 1973, p. 27, et seq.

/however, to

however, to hide the fact that the region's technological inferiority is a serious drawback. The more advanced economies have put their scientific and technical potential to use in their most dynamic and research-conscious industries. In some cases, this has led to the introduction of new production lines and the abandonment of traditional lines. Although efforts to promote the export of manufactures have increased recently,59/ this has not occurred in similar degree in all of Latin America.

Technological backwardness is also holding up industrial development schemes, and the possibility of making headway would seem to depend inter alia on the acceleration of technical change. The branches making least progress are precisely those that require greater technical capability.60/ Consequently, the promotion of the region's scientific and technological progress could be conducive to a more selective pattern of industrialization and agricultural development, particularly if combined with other economic and social policy measures.

This raises the question of employment, which is closely related to that of technology. Ample reference has already been made to the unsuitability of imported techniques in terms of local availability of resources; moreover, the increase in unemployment and underemployment threatens the very stability and future growth of Latin American societies. The technology that is transferred from abroad is the product of characteristics that are peculiar to advanced economies, such as large and growing markets, relative shortage of unskilled manpower, abundance of capital, and the

---

59/ The share of manufactures in the world total rose from 0.4 to 0.7 per cent during the 1960s. However, that of the developed countries also rose, from 83.9 to 85 per cent. See ECLA, Strategy for non traditional exports (E/CN.12/967), 8 October 1973, table 1.

60/ See ECLA, Integration, import substitution and economic development in Latin America (preliminary version), 1974.

availability of a more highly qualified labour force.61/ In these respects, the situation in Latin American countries is quite different, and this difference is responsible for the slow growth of employment opportunities in the modern sector of their economies and has negative repercussions on their rapidly expanding population.

It is therefore argued that a two-pronged action is needed to overcome the persistent scientific and technical backwardness and shortage of employment opportunities: on the one hand, the more rapid absorption of technical progress generated in the large industrial centres so as to improve the domestic supply of goods and services, and, on the other, the creation of labour-intensive techniques and procedures in order to increase the number of employment opportunities. This is a deliberate technological dualism, whose effects have yet to be fully studied.

Moreover, technological progress must be applied to several notable shortcomings in Latin America's social development. A conspicuous, although far from unique illustration of this is the low level of alimentation. It has been found 62/ that in half the countries of the region the average consumption of food is below the internationally accepted minimum, a problem which is aggravated by the fact that there is very little variation in the nutritional diet.

The threat of a world food crisis makes it essential to increase the product and productivity of the agricultural sector, either to avoid a further reduction in food levels or to take advantage of existing opportunities on the world market, as the case may be. However, this is not very likely to come about

---

61/ See S. Teitel, Algunos aspectos del desarrollo industrial de América Latina. Temas del BID, Nº 12, April 1971.

62/ See ECLA/FAO Panel, La alimentación en América Latina dentro del contexto mundial, Thirteenth Regional Conference of FAO for Latin America, Panama, 12-23 August 1974.

unless a specific effort is made in the field of technology at both the national and regional level. Partial data indicates that some such efforts are already being made; what is needed now is to co-ordinate them by means of an agricultural development strategy.

The integration of national markets will certainly make it easier to give the proposed action definite form. For example, there are branches of industry whose development requires scales of production that are far greater than those that any individual country, or even the region as a whole at present income levels, can offer. The market for chemical products and non-electrical machinery of the entire region, for example, is at present smaller than that of a European country such as France.63/ This disparity could be corrected by strengthening regional systems of coexistence so as to achieve economies of scale that would, in turn, provide an incentive for industrialization.

It would be superflous to list here all the advantages to be gained from regional integration in various aspects of economic and social life, as this has already been done in other ECLA studies. It should suffice to mention a few specific forms that co-operation in the field of science and technology could assume, based on the dynamic effect that the joining up of national markets would have.

The technology component is to be found in every facet of integration. Take, for example, infrastructure. Linking the communications media and expanding the systems of electrical interconnexion are activities that involve a considerable technological input. It is therefore advisable to join forces under a specific programme based, first, on the available resources in each country concerned and, second, on international co-operation.

One more example: it is probable that behind the unequal distribution and benefits and costs of integration - a problem which has diminished the prospects of certain regional initiatives - lies

---

63/ ECLA, Integration, import substitution and economic development in Latin America, op.cit.

/an unequal

an unequal technological capability. Compensatory policies would only have partial success if they failed to consider also how to work together to correct this disparity.

In addition, several countries in the area suffer from the same shortcomings that limit the exploitation of such resources as river basins, tropical forests, sea and energy sources. Here again, there is a choice between a regional effort with a good chance of success and isolated initiatives with a next to no chance. The formation of regional research centres by branch of production could therefore be a promising line of action.

Of course, a basis already exists for combined efforts. The idea of integration dominates the patterns of development of certain countries and has aroused the interest of regional and international agencies. They have in fact actively promoted it. All that is needed is for those involved to join in a clear discussion of scientific and technical backwardness and to implement measures to overcome it.

This study would be incomplete without a reference to the situation and trend of education in Latin America. Unless the problem of education is tackled at the same time, international trade, industrialization, alimentation and integration hold out few prospects. Various aspects of the problem, such as random coverage, antiquated programmes, poor scientific approach, lack of practical co-ordination, shortage of staff and equipment and inadequate financing, have been widely studied.64/

In other words, the obstacles to the development of Latin American economies at both the domestic and external level point to the need to extend considerably the useful experience that the countries have begun to acquire in the field of science and technology.

64/ See ECLA, Education, human resources and development in Latin America (E/CN.12/800), May 1968, and Secondary education, social structure and development in Latin America (E/CN.12/924), November 1971.

/There is

There is hardly a single aspect of the economic and social scene that does not impose or require the intervention of one or the other, or both. It would therefore seem advisable to organize future action mainly on three levels: (i) basic studies; (ii) reformulation of economic and social policy instruments; (iii) new methods of Latin American co-operation. The following paragraphs refer briefly to these aspects.

Thanks to the work carried out by national and regional institutions, a clearer idea now exists about the scientific and technical potential of the region, the characteristics of the marketing of technology, the multiple impact of scientific and technological backwardness and the decisions that should be taken in this connexion. In addition to completing the information on the subjects mentioned, it would seem desirable to carry out a comprehensive and regular evaluation of actual experiments carried out. For example, the point has been made that the creation of promotional institutional mechanisms - such as science and technology councils, and registration offices - although necessary, is not sufficient. There are various obstacles to the operation of such mechanisms. Moreover, they need the support of other machinery so that the objectives originally proposed can be fully achieved. The nature of the difficulties faced by such institutional instruments and the kind of complementary support that they require could be the subject of basic research at the national and regional level.

More attention should be devoted to the requirements that would arise from the reorganization of certain economic and social policy instruments. Take, for example, the system of over-protection from which several branches of industry benefit and which, thanks to mechanisms that remain to be studied in detail, is presumably inhibiting the development of a domestic technological capability. Or consider the kind of values that are being advocated by Latin American education; changing them may involve something more than a change of traditional school syllabuses. It would therefore seem advisable to modify patterns of behaviour in these and other fields on the basis of extensive studies of action taken.

/Finally, there

Finally, there are great possibilities of Latin American co-operation in the field of science and technology, some aspects of which have already been mentioned. What is needed now is to extend such activities to research, productivity, standardization and information centres. The limited potential of the countries would be rapidly depleted if they attempted to undertake any form of scientific and technological development on their own.

With regard to the problem of information, acquiring a reasonably extensive knowledge of available techniques, distinguishing between them and deciding how to apply them are tasks which, generally speaking, are beyond the possibilities of a single country. The same can be said of negotiations with large multinational enterprises or the training of human resources and the establishment of units of production. In this field too, therefore, regional co-operation is essential.

In view of the ramifications of this problem and of the steps that the region is taking to remedy its scientific and technological backwardness, it is fair to say that the latter is both the cause and the symptom of limiting factors that have held up the development of Latin America for the past twenty years. Furthermore, an intelligent approach to the problem may well mean reconsidering the patterns of economic and social conduct that have characterized the region in the past. Given, on the one hand, the serious repercussions of the present complex international situation and, on the other, the shortcomings which in varying degree have held up the region's development, it would seem impossible to postpone this reconsideration any longer.