UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED

E/CEPAL/CEGAN.9/L.2
28 December 1983

ENGLISH
ORIGINAL: SPANISH

E C L A

Economic Commission for Latin America

Ninth Session of the Committee of High-Level Government Experts (CEGAN): Science and Technology for Development

Montevideo, Uruguay, 23-24 January 1984

LATIN AMERICA AND THE VIENNA PROGRAMME OF ACTION: SCIENCE AND TECHNOLOGY FOR DEVELOPMENT IN THE 1980s */

*/ Prepared by the Economic Commission for Latin America (ECLA) and the United Nations Centre for Science and Technology for Development (UNCSTD).

83-11-2164

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/SUMMARY

SUMMARY

The purpose of the present paper is to put at the disposal of the governments of the region information and elements of judgement for examining and evaluating the advances made in the execution of the Vienna Programme of Action on Science and Technology for Development (PAV) and its Operational Plan, the former having been adopted by the General Assembly in December 1979 and the latter by the Intergovernmental Committee on Science and Technology for Development in June 1981.

Given the nature and characteristics of these two instruments, the method chosen for carrying out the assessment consisted basically in comparing the situation in these last years with that prevailing in the region, first, in the 1950s and 1960s, and then in the decade of the Vienna Conference, that is, in the 1970s. This comparison was made on the basis of the eight fields or programme areas into which the operational activities proposed for putting PAV into practice were grouped, and which constitute its Operational Plan.

In reviewing the situation in the 1950s and 1960s attention must be drawn to the leading role assigned to technical progress and its international dissemination in the initial conceptualization of development problems elaborated by ECLA as well as to the analysis of the relations between Latin American development and technology with emphasis on industrialization.

Various regional events, such as the Punta del Este Presidential Meeting (1957) and the conferences organized by ECLA, UNESCO, and the OAS in the 1960s and 1970s may be regarded as landmarks in the growth of awareness of the importance of the technological factor in development.

This increased concern for scientific and technological development gave rise to the creation of several policy organs, the establishment of centres and research units by the governments, the broadening of research activities in the universities, and the initiation of a group of studies on scientific and technological problems. Perhaps the most notable feature of the period prior to the decade of the Vienna Conference in the institutional field was the initiation of the activities of the national entities for scientific and technological research in various countries of the region, an area in which it fell to UNESCO -as is known- to play a fundamental role. All this largely contributed to the incorporation of many of the regional proposals into the Vienna Programme of Action, with the result that a major part of its recommendations coincided with policy measures already in force in the region.

It is not easy to distinguish accurately between the situation which existed in the region when the Vienna Conference was held and the subsequent advances achieved, since scientific and technological progress in the region in the past 20 years has been the result of a continuous and gradual process, and the information that ought to accompany it is fragmentary and usually out of date. Nevertheless, it is possible to indicate the main changes and trends observed in Latin America since the adoption of PAV and to complement this information with some overall appraisals of the importance and scope of these changes.

/The analysis

The analysis of the information available */ does not establish a clear and direct relationship between the changes and trends observed in the region and the adoption of the Vienna Programme of Action. Along with the action this Programme may have inspired, there are other factors more closely linked with the dynamic of Latin American development and with regional scientific and technological development which are probably more important.

Nonetheless, the Vienna Conference served to legitimize regional proposals, conferring on them the support of the international community; it stimulated the crystallization of concern over the need to have an endogenous scientific and technological capacity; it represented a guide-post for the investigation of technological development in the region and the developing world and likewise helped to systematize the analysis of the contributions of science and technology to the aims of development.

An overall appraisal of the advances made in the region since the Vienna Conference in August 1979 shows some progress in the application of science and technology to development, though this has been affected by the economic crisis. In the field of scientific and technological policy, although there have been no marked changes, there is a noticeable increase in the dynamism of some subregional agencies. In the case of scientific and technological infrastructure there are relatively minor changes. As regards transfer of technology there were retreats and advances in different countries of the region, given that whereas some dismantled the mechanisms regulating imported technology, others extended their range of competence. The continuance of the flow of exports of technology should, however, be mentioned as a significant fact. The training of human resources followed a moderate course and postgraduate programmes in science and technology continued to expand -although less rapidly- in the large countries.

The financing of scientific and technological development showed some variations and, in greater or lesser degreee, all the countries of the region felt the impact of the economic crisis and the austerity in public expenditure, which prompted a reduction in the resources available for science and technology. As regards the information systems, mention should be made of the efforts to set up subregional and regional networks. The work of research became more closely linked with the productive sector, but with varying results in the different countries of the region; there was also an increase and expansion in the activities of regional and international co-operation, although some of these schemes of a bilateral, subregional, regional and extraregional type are only recently beginning to function or are in their initial stages.

Similarly there was progress in the conceptualization of scientific and technological policies, although a review of the approaches proposed is needed in the light of the advances in new technologies -particularly those linked with microelectronics- and the new socioeconomic context observable in the region.

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*/ The main source of information has been the questionnaire prepared by the United Nations Centre of Science and Technology for Development, answered by 18 countries of the region, together with national reports, technical papers, scientific articles and reports of other international bodies.

/To complete

To complete this appraisal of the regional changes and trends in science and technology since the Vienna Conference mention might be made of some concrete achievements in the field of the generation, adaptation and application of technologies to the problems of development.

In Brazil the programme for the substitution of petrol by alcohol (PROALCOOL) led to the solution of a number of technical and economic problems in aspects of agriculture, finance, distribution and marketing, and also in industry.

Moreover, this country has begun to produce microcomputers and is experimentally producing microchips and has made appreciable progress in the investigation and production of optic fibres and in the use of laser beams in telecommunications; it has constructed several models of aeroplanes with its own design and technology (Bandeirante, Xingu, Brasilia), through EMBRAER, although some parts and components continue to be imported.

Mexico can also point to considerable successes in technological development and application in the past decade, a trend which has continued during the last four years. The energy sector is the one that has advanced the most in this respect, particularly through the processes perfected by the Mexican Petroleum Institute (IMP), the Electrical Research Institute (IIE), and the Nuclear Research Institute (ININ).

It is also noteworthy that, in the metallurgical sector, the HYLSA process of direct reduction has continued to gain international acceptance.

In Argentina the National Institute of Agricultural Technology (INTA) has developed new varieties of seeds, devised systems for the management of soils and conducted research on the best use of fertilizers and pesticides, which has fostered the notable increase in agricultural yields in recent years. The programmes in the nuclear energy field have continued to make significant progress and it is foreseen that the construction of the four nuclear power plants contemplated in the Nuclear Plan for 1979-1997 will be largely a national enterprise.

In the Andean group, the Andean Technological Development Projects (PADT) have led to the design of processes and equipment for the bacterial leaching of copper; to the elaboration of new food products based on raw materials available in the region (cotton-seed, fish, cereals, etc.), and to the efficient use of hard and heterogeneous tropical timber in housing construction.

Other examples would be the progress made by the Meat Institute in Uruguay, which has devised an industrial process for destroying the virus of foot-and-mouth disease in newly-slaughtered meat, and by the Central American Technological Research Institute (ICAITI), which has invented the Ex-Ferm process for the production of ethanol from sugar cane, a method which differs from that adopted in Brazil, in that it permits and economic production on a reduced scale.

/The outlook

The outlook for the application of science and technology to the development of the region during the present decade and its projections up to the end of the century is closely bound up with the changes that have been taking place in the scientific and technological system, with the challenge inherent in the recent technological advances at world level -in particular microelectronics and biotechnology, including genetic engineering- and with the new socioeconomic situation, both regional and international. The full application of the Vienna Programme of Action in Latin America is conditioned by these three factors.

As a result of the efforts made during the last 25 years, and particularly in the decade of the 1970s, which culminated in the Vienna Conference, the region possesses a scientific and technological potentiality capable of rapid expansion and orientation towards the realization of its development possibilities. Even so, as has been stated above, it is clear that the international and regional reality which governed the preparation of the Vienna Conference and the elaboration of the Programme of Action there agreed has undergone a profound change in the four succeeding years and there seems to be every indication that this process of change will continue for several years.

In these circumstances it would appear to be necessary to undertake a continuous follow-up of this changing reality, regarding it as an essential factor in the search for new perspectives for the development of science and technology at the national and regional level. A follow-up process would enable elements of judgement and criteria to be extracted which could be used on the occasion of the aforementioned mid-decade review to be carried out in 1985, in order to analyse the practical application of the Vienna Programme of Action on the national, subregional and regional levels. If necessary it would appear apportune to modify and advise on strategy in the light of the events and trends analysed.

Similarly, it would also be appropriate to consider the possibility of requesting the region to indicate some priorities, in the context of the programme areas and the wide range of activities covered by the Operational Plan, so that future efforts and resources could be concentrated in areas of particular interest to the region, given its distinctive features.

The viability of the Financial System of Science and Technology for Development seems likewise to require the region to take up a position in the matter. As will be recalled, the System was created with an initial funding of US$ 250 million for the period 1980-1981, which were to be gradually increased to a level of approximately US$ 600 million annually towards the mid-1980s. In actual fact, only 38 million has been available in the period 1980-1981 and eight additional million in 1982. This needs to be taken into account in proceeding with the execution of PAV and requires the adoption of a regional position on the subject.

Introduction

1. The Vienna Programme of Action on Science and Technology for Development,1/ adopted by the General Assembly at its thirty-first session,2/ made the regional commissions directly responsible for promoting the application of science and technology to the development of the developing countries (paragraph 93 c and d). In it the organs, organizations and bodies within the United Nations system were also assigned the task of assessing and revising the implementation of decisions and recommendations of international conferences related to the field of science and technology (paragraph 106 a).

2. In this same connection the Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development 3/ confirmed and specified the functions to be carried out by the regional commissions in the field of science and technology (paragraph 49). It likewise suggested that they place on the agendas of their meetings in 1983 a review of the implementation of the Vienna Programme of Action (paragraph 61).

3. The Medium-term Plan for the period 1984-1989 4/ also reiterated that the follow-up and review of the Operational Plan would be carried out in close co-operation with the regional commissions and moved the date of the regional examination of the implementation of the Vienna Programme of Action for 1984 so that it coincided with the sessions of the regional commissions scheduled for that year (paragraph 2014).

4. The ECLA Programme of Work for 1984-1985 5/ approved by the Commission and submitted to the General Assembly for its consideration, provides that, in accordance with programme component 20.1.4, Evaluation of the process of application of science and technology to development, technical documents be prepared in which consideration is given to the progress and achievements realized in that process.

5. This document, prepared in co-operation with the United Nations Centre for Science and Technology for Development, meets this requirement and makes available for the governments of the region background data and criteria for examining and evaluating the progress made in the implementation of the Vienna Programme of Action.

6. The review and assessment of the implementation, both at national and regional level, of the Vienna Programme of Action on Science and Technology for Development and its Operational Plan will be carried out at the ninth session of the Committee of High-Level Government Experts on science and technology for development 6/ which will be held at Montevideo, Uruguay, on 23-24 January 1984. It is also expected that its results will contribute significantly to the mid-decade review scheduled for 1985, as provided for in the above-mentioned Operational Plan (paragraph 62).

7. First of all this document considers the background information on science and technology for development in the region up to the end of the 1960s and then describes the situation prevailing during the 1970s which culminated in the holding of the Vienna Conference. Secondly, it contains a description of the main trends observed in Latin America during the past 20 years in the fields of action considered by the Operational Plan, and finally it includes a short examination of the main problems considered by the region in the application of science and technology to development in the 1980s.

I. SCIENCE AND TECHNOLOGY FOR THE DEVELOPMENT OF LATIN AMERICA PRIOR TO THE VIENNA CONFERENCE

A. The 1950s and the 1960s

8. The problems related to science and technological development are a matter of growing concern in the region. The drive towards economic growth, and in particular, industrialization, from the time of the First World War, which was accelerated by the international depression of the 1930s and by the Second World War, was a contributing factor in the incorporation of new production techniques and new services into industry and other production activities. All this became more dynamic with the implementation of deliberate policies of industrialization by virtue of which new technologies were incorporated even when their incorporation was not an explicit objective of such policies. It must be confessed that the concern to win relative national autonomy in the fields of science and technology was rather a marginal part of those policies.

9. Technical progress and its diffusion at international level played a leading role in the initial conceptualization of the problems of development by the Economic Commission for Latin America. Back in 1949 7/ an indication was given of the extent to which technical progress and its result were inequitably distributed to explain the differences between central and peripheral countries. Shortly thereafter, another study devoted much space to the subject of technical progress, pointing out inter alia its effect on the demand for primary products and on the region's imports, its influence on real income, the way in which it affected productivity in the centre and in the periphery as well as how it determined the distribution and use of the factors of production. However, other concerns of ECLA in the 1950s and the 1960s, such as the external imbalance, the process of industrialization, and planning and social development made it impossible to go deeply into the subject of the technical progress generated by endogenous capacity, although it may be stated that the concern for science and technology and their impact on the socioeconomic development of the region has been latent in the thinking of ECLA and in the studies produced by other regional organizations and by distinguished Latin American thinkers.

10. In the regional paper for the Vienna Conference,8/ ECLA summarized the relationship between the Latin American development process and technology, as follows:

"The great majority of the Latin American countries have begun a process of gradual industrialization and import substitution in the course of the last two or three decades. Unlike developments in developed countries, a great part of Latin American industrialization has been based on an imitative use of technological design originating abroad several years previously. Generally speaking, the

/absorption of

absorption of these has been associated with the granting of subsidies both to national and foreign capital and more recently has involved the entry of transnational corporations, engineering firms and financing agents from the developed world. Since most of the technology brought into operation originated outside the region, and since the countries have had to obtain it in very imperfect markets, it is hardly surprising that the opening up of new branches of industry and technological change in the Latin American countries have been linked with the extraction of surpluses from the production system of these countries, particularly in the form of the tapping of oligopolistic income by the transnational corporations."

11. "Analysis of the scientific and technological problems of Latin America and the Caribbean should not be concentrated solely on the industrial sector. Although it may be stated with some certainty that in the region the agricultural sector has experienced notable technological progress -characterized, inter alia, by the application of improved crop and livestock techniques; improved management of farms; the use of new varieties of seeds; the use of mechanical power and equipment, the use of herbicides, pesticides and chemical fertilizers; and improved use of water- it must be admitted that the average yields of numerous agricultural products have shown very little increase, particularly in comparison with the levels obtained in other parts of the world. Modernization has been accompanied by processes of proletarianization of campesinos, the crystallization of new forms of social stratification, an increase in rural unemployment and the expansion of the agricultural frontier as the principal resource in increasing production."

12. This describes some of the main problems confronting the region in ensuring that science and technology make an effective contribution to socioeconomic development.

13. As the socioeconomic development process advanced in the past three decades, the governments of the region became aware of the growing importance of the technological factor in the development process. It should be pointed out in this respect that although this awareness took shape during the 1960s, some countries had previously already initiated efforts in the field of scientific and technological policy. Attention might be drawn to the following basic landmarks in this process of growing awareness concerning the subject; the Punta del Este Presidential Meeting (1977), the Conference on the Application of Science and Technology to the Development of Latin America (CASTALA) organized by UNESCO in 1965; the creation of the OAS Technological Development Unit in 1966; The Regional Plan of Action for the Application of Science and Technology to Development, prepared by the United Nations Advisory Committee on the Application of Science and Technology to Development (UNACAST), in co-operation with ECLA on the basis of the World Plan of Action, between 1970 and 1972; the OAS, Conference on Application of Science and Technology in Latin America (CACTAL, Brasilia, 1972) and the ECLA Meeting on Science, Technology and Development in Latin America, held in Mexico City in 1974. This increase in the concern shown for scientific and technological development gave rise to the creation of various political bodies, to the establishment of research centres and units by governments, to the extension of research activities in universities and to the initiation of a series of studies on scientific and technological problems, which gradually became what is known as the "Latin American School" in scientific and technological policy.9/

/14. All

14. All these concerns, taken together with the work previously done by ECLA, did not, however, constitute enough incentive for the creation of significant scientific and technological capacity to deal with the regions main development problems during the 1950s and 1960s. This happened only -and then only partially- during the 1970s, when the efforts made in the region largely changed this situation. As a result of the acceleration of economic growth and of certain policies deliberately aimed at science and technology, a large number of Latin American and Caribbean countries made significant progress with respect to the establishment of scientific and technological capacity. This progress was not exempt from problems and contradictions, as ECLA indicated in the aforementioned regional document prepared for the Vienna Conference.10/

15. "In brief, the region presents a complex situation in which the countries which differ with regard to how far technical progress has penetrated into them, are simultaneously facing old structural problems; these include the lack of fairness in society's share in the fruits of progress, manifested in unemployment, underemployment and urban and rural marginality, and the high degree of external dependence, which, although it varies from country to country, has a decisive influence on the weight of the government and the possibility of progressing towards more complex structures of production. Together with these phenomena there are positive elements, such as the appearance of local technological efforts in the modern sector (industrial, agricultural or commercial in some of the countries), the relative importance in the world context of the natural resources which the region possesses, and some awareness of the possibilities of intra-Latin American co-operation on the basis of the semi-maturity and complementarity achieved in the production systems in the different countries."

16. During this decade of transition from the 1970s, the awareness of the characteristics and magnitude of and possible solutions to the problems emerging from the application of science and technology to the activities undertaken in that direction put the region in a position of honour with respect to the thought and action engaged in by the developing countries on the subject. An example of this is the adoption in 1970 in the Cartagena Agreement of common treatment of foreign investment and the transfer of technology and a subregional technological policy and standard regulations concerning industrial property. Argentina, Brazil and Mexico had been the first to adopt a group of measures in the field of scientific and technological policy and planning and in the regulation of technology imports. Perhaps the most outstanding institutional development of the period prior to the decade of the Vienna Conference was the entry into operation of national science and technology research models in various countries of the region in connection with which UNESCO has a fundamental role to play. Mention might also be made in this connection of the establishment in 1961 of the Pan-American Committee on Technical Standards (COPANT) to co-ordinate the work of all the institutes engaged in standardization in the region.

17. The result of all this was that much of the region's thinking was incorporated into the Vienna Programme of Action so that many of its recommendations coincide with policy measures already applied in the region.

/B. The

B. The decade of the Vienna Conference 11/

18. The Vienna Programme of Action was the result of an "upward process" of preparation, in the first stages of which entities at national level participated; then regional bodies were brought into the process and, finally, the negotiations were held at global level. The aforementioned Operational Plan for the implementation of the Vienna Programme of Action 12/ envisaged eight fields, or programme areas, on the basis of which consideration will be given in this section to the situation prevailing in the region when the Vienna Conference was held. In the following section the main changes and trends observed recently will be identified.

19. The eight main programme fields identified in the Operational Plan are as follows:

I. Scientific and technological policies and plans for development.
II. Creation and strengthening of scientific and technological infrastructures.
III. Choice, acquisition and transfer of technology.
IV. Development of human resources for science and technology.
V. Financing of science and technology for development.
VI. Scientific and technological information.
VII. Strengthening of research and development in and for developing countries and their linkage to the production system.
VIII. Strengthening of co-operation in the field of science and technology among developing countries and between developing and developed countries.

1. Area I: Scientific and technological policies and plans for development

20. At the end of the 1970s, when the Vienna Conference was held, the region had achieved significant progress in the field of scientific and technological policy, primarily in the realm of institutions and the formulation of policies and plans of a conceptual nature for the implementation of plans and programmes and for staff training.

21. With regard to institutions, in 12 countries of the region science and technology councils had been set up; one country had a department of science and technology and six countries had established science and technology units in their planning agencies. It may be said that at the end of the 1970s "the majority of the Latin American and Caribbean countries had the minimum number of institutional structures needed in the realm of science and technology which to varying degrees, made it possible to define, establish, co-ordinate and execute scientific policies and, to a lesser extent, technological policies".13/

22. In spite of the fact that at first many of these institutions took their inspiration from the efforts made by the industrialized countries to regulate the rate and trend of scientific and technological activities and although scanty attention was given in the region to different contexts in which such policies were applied,14/ during the 1970s a process of institutional apprenticeship was embarked upon, which led to a number of reforms designed to increase the efficiency and improve the operations of the central scientific and technological policy bodies. This process of apprenticeship, which to some extent was promoted

by regional and subregional international bodies, such as UNESCO, OAS and the Cartagena Agreement, made it possible for the various countries of the region which had created or reorganized their own scientific and technological policy institutions at the end of the 1970s to benefit from the experience of countries which had gone before them in this process of institutionalization.15/

23. During this period the region's scientific and technological policy bodies formulated a considerable number of plans, programmes and policy documents at both global and sectoral level, many of which were not intended to exceed the scope of those bodies so that they could not be based on factors which would permit the necessary and sought after incorporation of science and technology in the development process. Although a study of the content, impact and degree of implementation of these plans and programmes has yet to be carried out, the general impression is that most of them did not result in any practical application and that to a large extent, the region's scientific and technological capacity developed with few formal guidelines from the central scientific and technological policy-making bodies.

24. In spite of this comparative ineffectiveness of the formal plans, a number of countries of the region established national programmes, identified priorities and formulated policies which guided governmental action for scientific and technological development. In Argentina, for example, a limited number of "National Programmes" were drawn up in fields such as electronics, food technology, epidemic diseases and non-conventional sources of energy, which had preferential status for the channelling of resources.

25. In Brazil the first Scientific and Technological Development Plan covering the period 1973-1975 had the merit of focusing the country's attention on the importance of science and technology for development. The second plan, covering the period 1975-1979, sought to increase the science and technology available for structuring the national science and technology development system (SNDTC).

26. In Mexico two scientific and technological plans were formulated, the second of which covered the period 1978-1982 and had as its objectives technology import substitution, the exportation of technology and the technological strengthening of the structure of production. In the mid-1970s Cuba established the State Science and Technology Committee to co-ordinate the scientific and technological activities of the institutes belonging to the Academy of Sciences and the universities. Other countries identified priorities, indicative programmes and special projects, which concentrated on the allocation of resources.

27. With regard to conceptual progress, a number of methodologies for the formulation and implementation of science and technology plans and programmes were developed and applied in the region. As in the case of institutions, a process of conceptual and methodological apprenticeship was developed which enabled Latin America to overtake other developing regions. The point studies included, inter alia, the application of the systems approach to scientific and technological policy,16/ technological innovation and the upgrading of adaptive technological activities,17/ the differentiation between implicit and explicit science and technology policies,18/ and the emphasis placed on the generation of

demand for local technologies and innovations.19/ Likewise, technological policy systems related to the process of integration, such as, for example, the subregional technological policy adopted by the Cartagena Agreement,20/ were identified in the region.

28. The countries of Latin America used a variety of instruments to put their scientific and technological policies into practice. The aforementioned regional document for the Vienna Conference identified a number of instruments for policy formulation and the adoption of technology and its incorporation into the production sector to provide an incentive for the demand for technologies generated domestically and to train human resources.21/ By the close of the 1970s, the region had tried out a wide range of mechanisms and instruments for implementing science and technology policies and plans.

2. Area II: Creation and strengthening of scientific and technological infrastructure

29. Paragraph 108 of the Operational Plan defines the scientific and technological infrastructure as being "the set of institutions, organizations, facilities, programmes and activities which, in an efficient manner, strengthen the capacity of the developing countries to choose, acquire, generate and apply the resources of science and technology for development". The document also makes it clear that this institutional infrastructure is necessary but is not in itself sufficient for ensuring that science and technology advance the realization of the objectives of development.

30. When the Conference of Vienna was held, numerous countries of Latin America had already established their own institutional infrastructure for science and technology at various levels, so that in the region as a whole there was evidence of significant progress by comparison with the situation which prevailed during the 1950s and the 1960s.

31. The institutional infrastructure for science and technology, especially in the fields of agriculture, industry and mining, was being gradually consolidated in the region. In this connection it should be pointed out that medicine and biology had already reached an advanced stage of development.

32. At the same time there was growing awareness concerning the negative effects of the indiscriminate importation of technology, and as a result the creation of bodies responsible for regulating the flow of imported technology were created. However, the process of institutionalization did not involve the production sector and tended to be confined to the State domain.

33. The region shows great heterogeneity as to the development of the institutional infrastructure for science and technology. Countries such as Barbados, the Dominican Republic and Panama indicated in their country reports for the Vienna Conference that this infrastructure was very limited and was in the process of expansion. In Colombia's country report it was pointed out that the infrastructure was biased in favour of scientific research institutes with little connection with the production centre. Argentina's report indicated that the

/main problem

main problem was the need to co-ordinate the large variety of institutions engaged in scientific and technological activities. Brazil indicated that it possessed a very broad and complex range of institutions created in response to specific problems and that an effort was being made to co-ordinate them by creating the aforementioned national scientific and technological development system under the leadership of the National Council of Scientific and Technological Development (CNPq); and Jamaica noted the overwhelming importance of the university within its infrastructure and the need to establish other institutions.

34. In the 1970s the strengthening of the institutional infrastructure for science and technology in the region received significant support from bodies in the United Nations system. With financing provided by the United Nations Development Programme (UNDP) in many cases, UNESCO promoted the establishment and regional co-ordination of centres for research in basic and applied sciencies, FAO lent support to research and agricultural extension systems, UNIDO provided numerous technological research, standardization and productivity centres with technical assistance and UNCTAD contributed to the establishment and the improved operation of bodies to regulate imported technology. In addition, the OAS Regional Scientific and Technological Development Programme provided technical and financial assistance to a large variety of scientific and technological organizations in Latin America, thereby helping to strengthen the institutional infrastructure.

3. Area III: Choice, acquisition and transfer of technology

35. During the 1970s, Latin America continued to import the majority of its technology from the industrialized countries. However, trade in technology was one aspect of the region's scientific and technological development which experienced significant change during the 1970s. Pursuant to decision 24, adopted by the Cartagena Agreement in 1970, governments began to intervene in the importation of technology in a number of countries of the region. The objectives were to reduce costs, increase the bargaining power of local purchasers and to ensure more or less that imported technology accommodated the socioeconomic needs -objectives which were all to some extent met. In general it may be stated with some certainty that the controls referred to tended to be concentrated in what may be considered to be an intermediate phase of the import operation, i.e., in the terms of the import contracts rather than in the preceding stage, in which alternative technologies are selected, and still less in the subsequent stage, in which the technology thus introduced is absorbed in such a way as to ensure an effective transfer. At the time of the Vienna Conference, the five members of the Cartagena Agreement (Bolivia, Colombia, Ecuador, Peru and Venezuela) and Argentina, Brazil and Mexico had established technology transfer registries; and some other countries (Costa Rica, Guatemala, Jamaica and the Dominican Republic) were studying the possibility of creating similar bodies.

36. In addition, during the 1970s, the relatively more advanced countries began to export technology to other countries in the region, consisting, in particular, in engineering services and capital goods and even in "turn-key" plants. All this took place in the context of a growing tendency to import capital goods and with transnational corporations constantly making their presence felt in the technologically more highly developed sectors of Latin America.

/37. The

37. The region's position with regard to the importation of technology showed some improvement during the 1970s. This is indicated by the decrease in some countries in the ratio between payments for royalties and exports. For example, between 1970 and 1976, in Argentina, payments for royalties and technical services as a percentage of exports fell from 3.4% to less than 1%; in Brazil they dropped from 3.1% to 2.6% and in Mexico, from 8.5% to 5.4% of the value of exports.22/ It must, however, be noted that payments for royalties and technical services constitute a very relative indicator of the real cost of imports of technologies since, as has been shown, contractual arrangements do not necessarily reflect the total flow of payments resulting from a transaction.

38. In spite of these relative improvements, payments of royalties and fees are still fairly high in these countries. In 1975 such payments come to US$ 595 million in Brazil, and in 1980 Mexico paid US$ 450 million for royalties and fees. Moreover, it has been estimated that in Brazil registered remittances for foreign technology came close to US$ 500 million in 1977, while covert payments are said to have amounted to over US$ 1 billion.23/ Thus, it might be estimated that the region spent approximately US$ 1.5 billion in direct payments associated with the importation of technology under license contracts, without considering covert payments and other costs associated with this kind of transfer, which would probably raise this figure by between 50% and 100% (see table 1).

39. The importation of technology incorporated in capital goods has also been rising constantly in the region, and its volume and diversity makes it much more significant than the importation of technology under license contracts, as may be inferred from the information contained in the following paragraph.

40. In 1969 the region's balance of trade in capital goods closed with a negative balance of US$ 5 780 million; in 1976, this negative balance had risen notably to US$ 18 709 million, a figure which has risen still further during the past five years. In some recent estimates for 19 countries of the region, it is indicated that in 1979 US$ 23 460 million were spent on imports of capital goods.24/

41. On the basis of some estimates, the technology "incorporated" in capital goods might represent, on average, from 10-15% of the values noted.

4. Area IV: Development of human resources for science and technology

42. Up until the mid-1970s, Latin America possessed approximately 55 000 scientists and engineers engaged in research and development activities, which represented about 1.8% of the world total. In spite of this relatively small percentage, the region made notable efforts to train highly qualified human resources for science and technology during the decade preceding the Vienna Conference held in 1979. The enrolment rates in post-secondary education grew by about 15% a year on average between 1970 and 1977, and in 1978 approximately 35% of the 350 000 university graduates were engaged in activities directly related to science and technology.25/

/Table 1

Table 1

LATIN AMERICA: PAYMENT OF ROYALTIES AND FEES FOR TECHNOLOGY IMPORTS

(Millions of dollars)

Country	Year	Royalty and title payment
Argentina a/	1974	101.0
Bolivia b/	1979	1.8
Brazil c/	1975	595.0
Colombia b/	1979	6.32
Costa Rica d/	1976	6.5
Guatemala e/	1976	12.7
Mexico f/	1980	462.7
Peru g/	1980	7.48
Trinidad and Tobago a/	1975	18.0
Venezuela h/	1979	101.0

a/ United Nations Commission on Transnational Corporations. "Transnational Corporations in World Development: A Re-examination", New York, E/C 10/38, 20 March 1978, table III-68.

b/ Board of the Cartagena Agreement, Subregional Statistical Information System, Indicadores Socioeconómicos 1970-1979, Lima, October 1981.

c/ Country papers submitted by Brazil to the United Nations Conference on Science and Technology for Development, Vienna, August 1979.

d/ Country papers submitted by Costa Rica to the United Nations Conference on Science and Technology for Development, Vienna, August 1979.

e/ Country papers submitted by Guatemala to the United Nations Conference on Science and Technology for Development, Vienna, August 1979.

f/ Department of Foreign Investment and Technology Transfer. Anuario estadístico, inversiones extranjeras y transferencia de tecnología, Mexico City, 1981.

g/ Gustavo Flores Guevara, Principales tendencias de la política tecnológica industrial en el Perú durante los años setenta (in publication).

h/ Wiston Briceño, Algunas ideas en torno al Fondo Andino para el Desarrollo Científico-Tecnológico, JUNAC, July 1982.

/43. However,

43. However, the figures on personnel engaged in research and development show that there are differences in the situation within the region. In 1970 the largest countries -Argentina, Brazil and Mexico- possessed 68% of the graduates in scientific and technological activities and 70% of the total number of graduates; in 1978 these figures had risen to 70% and 73%, respectively, whereas the population of those countries represented only about 60% of the population of Latin America.

44. Table 2 shows the number of scientists and engineers and technicians engaged in research and development activities at the end of the 1960s. The heterogeneity of the scientific and technological communities in the various countries of the region is clearly shown in table 2. On the basis of a number of research workers, it is possible to place the countries of the region in three main categories. There are the large countries -Argentina, Brazil and Mexico- which at the time of the Vienna Conference, possessed more than 8 000 research workers (24 000 in the case of Brazil). These would be the countries which would be able to exceed the minimum requirements for the critical mass judged necessary for the establishment of a viable (although modest by comparison with the developed countries) scientific and technological community;26/ then there are the medium-sized countries in the Andean subregion with scientific communities fluctuating between 1 500 and 4 000 research workers. However, to judge by data on full time researchers, the upper limit for the size of the scientific communities of the Andean countries would probably be 2 500 research workers whereas some countries of Latin America and the Caribbean have a very limited number of research workers, varying between 400 and 800 in a country.

45. During the 1960s and the 1970s, the region extended its fellowship programmes and post-graduate courses significantly. In Mexico, the number of fellowships awarded rose from 580 in 1971 to over 12 000 post-graduate fellowships between 1971 and 1977; in the mid-1970s, Venezuela organized the "Mariscal de Ayacucho Programme", which granted close to 10 000 fellowships, and Brazil increased its post-graduate programmes in a number of scientific and technological fields by 200%. 200%.

46. Finally, although there are no recent comparative data on the problem of the migration of professionals, it seems there was a relative decrease in the emigration flows during the 1970s, especially in the larger countries. Thus, in 1978 an increase was recorded in the number of foreign scientists working in Mexico, which probably exceeded the number of Mexican scientists emigrating for good. In Brazil the emigration of highly qualified professionals remained at its usual low level and, what is more, many foreign scientists, especially Argentineans, Chileans and Uruguayans, were attracted to that country. The same may be said of Venezuela. The problem of emigration became more severe in the Southern Cone countries, while in the medium-sized and small countries, the lack of local job opportunities continued to provide impetus for the emigration of highly qualified personnel. In this connection, it should be noted that, for example, over half the Peruvians with Doctorates in mathematics were working abroad towards the end of the 1970s.

/Table 2

47. The most important change in the emigration flows was the fact that the United States and Europe were largely replaced by Brazil, Mexico and Venezuela as countries of destination for a growing number of scientists and engineers from other countries of the region. Thus, the migrations were taking on a primarily intra-regional character, while net departures from the region were tending to diminish.

5. Area V: Financing of science and technology for development

48. In the mid-1970s, the region spent slightly over US$ 1 billion on research and development, which represented slightly over 1% of the total world expenditure on this item. The region's effort in science and technology during the decade prior to the Vienna Conference was characterized by a substantive increase in the allocation of financial resources, although this growth was not uniform nor was it of the same magnitude and expensiveness of the growth in available human resources. Thus, it might be estimated that at the end of the 1970s, Latin America was spending close to US$ 3 billion annually, including the expenditure of the private sector, which is even more difficult to estimate.

49. Table 3 shows the financial resources for research and development available in the Latin American countries and the percentage of the GNP which those resources represented at the end of the 1970s. The majority of the countries of the region were spending between 0.20 and 0.40% of their GNP a year on research and development -figures which are very much lower than the minimum recommended in various international conferences (1% of GNP) and than that of the developed countries, whose average expenditure exceeded 1.75%. The two exceptions in the region were Brazil (0.61% and Venezuela 0.56%).

50. It is also possible to distinguish between three categories of countries on the basis of the amount of financial resources they allocated annually to research and development at the end of the 1970s:

a) The largest countries (Argentina, Brazil and Mexico) and, in addition, Venezuela, with expenditure exceeding US$ 200 million a year. It should, however, be noted that Brazil, with an expenditure of US$ 1 150 million a year in 1978, could be placed in a higher category, especially in view of the fact that this figure does not include the expenditure made by the private enterprises, which might conceivably represent not less than an additional 20%.

b) The medium-sized countries in the Andean subregion, excluding Venezuela, whose annual expenditure on research and development fluctuated between US$ 20 million and US$ 70 million a year. Cuba, with over US$ 100 million a year in expenditure on research and development,27/ might be considered to be in this category.

c) The small countries of Central America and the Caribbean, which allocate between US$ 5 and US$ 10 million a year for research and development. Paraguay and Uruguay are also in this category.

/Table 3

Table 3

LATIN AMERICA: TOTAL EXPENDITURE ON RESEARCH AND DEVELOPMENT (R AND D) SHARE OF THIS EXPENDITURE IN GROSS NATIONAL PRODUCT (GNP) TOWARDS THE END OF THE 1970s

Country	National currency	Year	Total expenditure on R & D (thousands) National currency	US dollars	Percentage of GNP
Large countries					
Argentina	Peso	1978	195 278 000	245 386	0.39
Brazil	Cruzeiro	1978	20 781 000 a/	1 150 028 a/	0.61
Mexico	Peso	1980	8 550 000	371 739	0.24 b/
Andean countries					
Colombia	Peso	1978	805 372	20 600	0.11
Chile	Peso	1979	2 445 290	65 652	0.33
Ecuador	Sucre	1979	290 663	11 627	0.13
Peru	Sol	1976	2 763 000	48 111	0.36
Venezuela	Bolívar	1977	865 435	201 616	0.56
Other South American countries					
Paraguay	Guaraní	1971	167 265	1 328	0.20
Uruguay	Peso	1972	1 858	3 300	0.15
Central America					
Costa Rica	Colón	1981	81 333	5 186	0.17 */
El Salvador	Colón	1974	11 900	4 760	0.31
Guatemala	Quetzal	1978	13 504 */	13 504 */	0.22 */
Honduras	Lempira	1971	2 962	1 481	0.20
Nicaragua	Córdoba	1971	7 847 c/	1 121 c/	0.14
Panama	Balboa	1975	3 296	3 296	0.17
Caribbean					
Cuba	Peso	1978	83 163	112 270	n.a.
Jamaica	J. dollar	1973	6 200	6 820	0.36
Dominican Rep.	Peso	1972	1 561	1 561	0.08
Trinidad & Tobago		1970	5 171	2 586	0.32

Source: Jan Annerstedt, A Survey of World Research & Development Efforts, Institute of Economics and Planning, Roskilde University, Denmark; UNESCO, Scientific and technological policy in Latin America and the Caribbean - 4; Scientific policy studies and documents No. 42; Statistical Yearbook, 1980, and Statistics on the scientific and technical personnel and the expenditure on research and experimental development in Latin America and the Caribbean, 1981; International Monetary Fund, International financial statistics, Yearbook 1981. In the case of the Andean countries and Brazil, Costa Rica and Mexico, some of the data have been extracted from various official documents and some unpublished studies.

*/ Estimated figures.

a/ Does not include enterprises engaged in private production.

b/ Percentage of GDP.

c/ Data based on information from two research centres only.

/51. Thus

51. Thus, at the time the Vienna Conference was held, only four countries of the region exceeded the US$ 100 million estimated around 1970 as being the minimum needed for a critical mass of research and development.28/ The substantial increase which this requirement must have experienced around the end of the 1970 provides some indication of the need for regional and subregional co-operation in the joining of efforts for the development of scientific and technological capacity.

52. The general impression of backwardness which prevails in respect of Latin America where science and technology are concerned has to some extent been mitigated by the great effort made by some countries of the region during the 1970s. In this respect, it is important to draw attention to the case of Brazil, not only because of the high level of its expenditure on science and technology but also because of its high growth rate. In that country, the public finances allocated to science and technology grew on average by over 20% a year in real terms between 1970 and 1979.

53. This reflects the decision taken by the Government of Brazil to incorporate science and technology and research in particular into its development plans and programmes, allocating huge amounts of financial resources to them. The effects of a similar political decision may also be observed in Mexico and Venezuela, although to a lesser extent.

54. The financial resources allocated for science and technology also show heavy concentration in a few countries of the region; at the end of the 1970s, Argentina, Brazil, Mexico and Venezuela, with nearly 60% of the population of Latin America, were responsible for over 85% of the regional expenditure on research and development.

55. During the 1970s, there were some changes in the financing of research in so far as the destination of the resources was concerned. There are indications of a gradual change in emphasis so that research projects carried out in Guatemala and independent centres would be channelled towards those which incorporated the production sectors. For example, the Indicative Science and Technology Programmes of Colombia and Mexico began to incorporate enterprises of the production sector; INTEC of Peru greatly increased its participation in the formulation and execution of research projects, while FINAP in Brazil granted a larger share of its easy loans and donations to public and private enterprises.

56. Finally, at the end of the 1970s, greater interest was noted on the part of the international bodies in the financing of science and technology. IDB had granted loans to Brazil and Argentina, OAS was continuing with the Regional Scientific and Technological Development Programme and UNDP was beginning to channel more resources for the development of the region's scientific and technological capacity.

6. Area VI: Scientific and technological information

57. During the 1970s, the region made significant progress in the establishment of scientific and technological information systems, in particular by comparison with the situation which prevailed during the 1960s, in which there had been very few bodies in this field and practically none which were linked with the production sectors.29/

/58. During

58. During the period under review, notable progress was recorded in respect of the establishment of information and similar centres. Figures are available which indicate the level reached in some countries. For example, in 1976 Argentina possessed 189 specialized libraries in the university sector alone;30/ at the end of the 1970s, there were 196 information and documentation institutes in Uruguay;31/ in 1978 Bolivia had 168 specialized libraries and documentation centres,32/ around 1979 Jamaica had established a network of 150 information units, libraries, archives and documentation centres;33/ in the mid-1970s, there were 140 libraries, archives and information and documentation centres in Costa Rica;34/ while in 1975 Chile possessed 380 specialized libraries and documentation centres.35/

59. In addition, there are some countries which are trying to integrate their documentation and information centres into national networks, as shown by Brazil's effort to set up specialized networks in fields such as human biology and medicine and nuclear and agroindustrial research. Mexico established the Data Bank Consultation Service (SECOBI) to integrate the specialized data centres, while Cuba made an effort to co-ordinate over 500 scientific and technological information and documentation units. Likewise, efforts were made to link the scientific and technological information systems with the production sectors (see for example the work done by the Fund for Information and Documentation for Industry (INFOTEC) in Mexico, with special emphasis on small and medium-sized industry; the Institute for Research in Industrial Technology and Technical Standards (ITINTEC) in Peru, with its system of consultations and bibliographical retrieval for entrepreneurs, and the Technological Research Institute (INTEC) in Chile, with its information and extension service for industry.

60. At the time of the Vienna Conference, some efforts of a regional and subregional nature were also recorded in connection with the establishment of chronological information systems. In 1979 a meeting of government experts was held under the Cartagena Agreement in which consideration was given to the proposal to establish the Andean Technological Information System (SAIT) and to facilitate its adoption by the Cartagena Agreement Commission. In January 1979 the Latin American Economic System (SELA) convened a meeting of governmental experts and representatives, which recommended the formation of an action committee for the establishment of the Latin American Technological Information Network (RITLA), a recommendation agreed to by the SELA Council in its decision No. 36 of September 1979, in which Rio de Janeiro was specified as the headquarters of this Committee

61. This shows that systems for scientific and technological information for development had to some extent been institutionalized in the region by the time of the Vienna Conference. However, some problems still remain, such as the linkage between these systems and the production sector and the co-ordination of the various information and documentation centres.

7. Area VII: Strengthening of research and development in and for developing countries and their linkage to the production system

62. At the close of the 1970s, the region's research and development capacity had reached a stage of significant development, particularly by comparison with the situation which had prevailed in the two preceding decades, as shown by the information contained in the preceding sections concerning the financial and human

resources allocated to research and the progress made in respect of its institutionalization. Nevertheless, the expenditure on research and development in the region around 1974 amounted to only about 2.6% of the expenditure by the United States of America on this item 36/ and around 1977 only slightly more than 1% of the authors published in international scientific journals were Latin Americans.37/ This indicates, that even with the considerable effort made during the 1970s, the region had a long way to go to develop scientific and technological research capacity.

63. Scientific and technological research in the region is scattered over three sectors -the universities, including all higher educational facilities in which research is conducted; the government, including independent government agencies, agencies dependent on the central government and public and mixed enterprises, and the private sector, including independent private entities and private enterprises. Table 4 shows the way in which the research effort is distributed over these three sectors. It may be seen that in spite of the fact that the highest concentration of research workers was to be found in the universities (for example, 70% in Venezuela, nearly 65% in Brazil and 58% in Costa Rica), the government sector received the largest share of the financing. The predominance of the public sector in the sectoral distribution of financial resources was particularly evident in Peru (82%); in Brazil and Venezuela, although their figures are not entirely comparable with those of the other countries because no information is available for the expenditure of the private sector and other sectors, the situation may be said to be similar.

64. In Mexico, Chile, Colombia and Ecuador, governmental centres absorbed between 60% and 64% of the total expenditure on research and development. In Costa Rica the situation was different, in that the universities and the government both played a significant role in the allocation of financial resources for research (48% and 43%, respectively). This indicates that in most of the countries on which information was available, at the end of the 1970s there were imbalances between the allocation of financial resources and the distribution of human resources for scientific and technological research in the different executing sectors.

65. To see the way in which research was oriented and its link with the problems of development at the end of the 1970s, please consult table 5, which summarizes the research profiles of five countries of the region (Brazil, Mexico, Colombia, Venezuela and Costa Rica) in terms of the number of research workers and the distribution of the research expenditure among the different fields or sectors of research.

66. In nearly all these countries, agricultural research was the most important in respect of financial support, receiving 48% of such support in Brazil, 45% in Colombia and 46% in Costa Rica. Venezuela and Mexico attached comparatively less importance to this field than did the other three countries.

/Table 4

Table 4

LATIN AMERICA: DISTRIBUTION OF RESEARCH WORKERS AND EXPENDITURE ON RESEARCH AND DEVELOPMENT IN SELECTED LATIN AMERICAN COUNTRIES AROUND THE END OF THE 1970s AND BEGINNING OF THE 1980s

(Percentages)

Countries		Executing sector			
		Universities	Public sector	Private sector and others	Total
Large countries					
Brazil	Research workers (1978)	65	35		100
	Expenditure (1980)	27	73	...	100
Mexico	Research workers (1980)	37	55	8	100
	Expenditure (1978)	25	62	13	100
Andean countries					
Chile	Research workers	...	...	...	100
	Expenditure (1978)	17	63	20	100
Colombia	Research workers (1978)	44	46	10	100
	Expenditure (1978)	27	60	13	100
Ecuador	Research workers (1979)	40	52	8	100
	Expenditure (1979)	14	64	22	100
Peru	Research workers (1976)	56	36	8	100
	Expenditure (1976)	13	82	5	100
Venezuela	Research workers (1977)	70	27	3	100
	Expenditure (1977)	28	72	...	100
Other countries					
Costa Rica	Research workers (1981)	58	34	8	100
	Expenditure (1981)	48	43	9	100

Source: F. Sagasti, et al., Un decenio de transición: ciencia y tecnología en América Latina y el Caribe durante los 70, op.cit., tables 20 and 21, on the basis of official figures.

/Table 5

Table 5

LATIN AMERICA: DISTRIBUTION OF RESEARCH WORKERS AND EXPENDITURE ON RESEARCH BY FIELD OF APPLICATION IN SELECTED COUNTRIES

(Percentages)

esearch area	Large countries				Andean countries				Other countries	
	Brazil (1978)		Mexico (1978)		Colombia (1978)		Venezuela (1971)		Costa Rica (1981)	
	Research workers	Expenditure on R and D	Research workers	Expenditure on R and D	Research workers	Expenditure on R and D	Research workers	Expenditure on R and D	Research workers	Expenditure on R and D
. Environment and natural resources	n.a.	4	6	27	10	10	5	6	8	7
. Agriculture, hunting, forestry, fishing	n.a.	48	13		20	45	24	28	37	46
. Exploitation of mines and quarries	n.a.	4	1	33	1	1	2	2	1	1
. Manufacturing	n.a.	12	12		14	7	12	9	3	2
. Energy resources	n.a.	11	9	7	1	-	2	2	2	5
. Housing and construction	n.a.	-	3	8	2	1	3	2	2	1
. Transport and telecommunications	n.a.	2	1		2	2	-	-	-	-
. Health	n.a.	5	15	12	27	16	23	22	18	15
. Social Development	n.a.	10	29	10	22	18	12	12	24	19
. Basic Know-how	n.a.	4	9	3	1	-	5	4	5	4
. Other	n.a.	-	2	-	-	-	12	13	-	-
Total	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

urce: F. Sagasti, et al., Un decenio de transición: ciencia y tecnología en América Latina y el Caribe durante los 70, Lima, GRAPE, March 1983, table 22.

/67. Afte

67. After this common denominator has been taken into consideration, it is possible to identify two situations. In the first place, the large countries (Brazil and Mexico) put priority on industrial technology and energy research. Brazil spent 12% and 11%, respectively, on these two fields, while Mexico devoted 33% of the financing to the field of industry and mining and 7% to energy. In the big countries research in health and the social sciences was relatively less important. Brazil spent 5% on health and 10% on social development, while the corresponding figures for Mexico were 12% and 10%, respectively.

68. In the medium-sized and small countries, the ratio between these two areas of research was inverted. Research in health and social sciences followed agricultural research in importance, with regard both to the number of research workers and to financial support. Research in health absorbed 16% of the funds in Colombia, 22% in Venezuela and 15% in Costa Rica. For social development, the percentages in these countries were 18, 12 and 19, respectively. In addition, industrial technology research absorbed only 7% of the financial resources in Colombia, 9% in Venezuela and 2% in Costa Rica, while even less attention was paid to energy research.

69. These data seem to indicate that there is a certain very natural correlation between the sector which was given preference with regard to the effort made in scientific and technological research and the problem areas of development with which some countries in the region were dealing at the end of the 1970s. In addition, as the decade advanced, a number of countries in the region took measures to establish closer links between their scientific and technological research capacities and the production system -a matter of constant concern in the region. Mention has already been made of the case of Peru, when ITINTEC increased the number of research projects executed by industrial enterprises under its supervision. In the case of Brazil, the São Paulo State Research Institute (IPT) oriented its activities increasingly towards the provision of services to industry. Likewise, national programmes, such as PROALCOOL and the Nuclear Programme, were organized with the active participation of the production system, and in Mexico and Colombia indicative research programmes were undertaken which were directly oriented towards development problems in such fields as nutrition, housing, energy and health.

70. The consulting and engineering aspects of projects have been one of the main links between the research centres and the production sector of the industrialized countries. Consulting and engineering firms made significant progress in Latin America during the 1970s so that when the Vienna Conference was held, the region possessed many firms with considerable experience in this field.

71. Table 6, the source of which is the register of the Latin American Federation of Associations of Consultants (FELAC), shows the number of consultants' firms existing in the region around the end of the 1970s. Of course, these figures do not reflect the total number of consultants' firms in existence since all firms in this category do not belong to the associations members of FELAC. Brazil, which has over 60 firms and close to 7 500 full-time consultants, Argentina and Mexico lead the other countries in this connection. The development of this activity in Paraguay is explained by the demand for engineering services responsible for the construction of the Itaipú dam and hydroelectric power station.

/Table 6

Table 6

CONSULTING SERVICES IN LATIN AMERICA: FIRMS, PROFESSIONAL STAFF AND TURNOVER AT THE END OF THE 1970s

Countries	Number of firms registered			Staff (FELAC)				Invoice (thousands of US$)	
	FELAC a/	IDB	World Bank	Professional staff	Technicians	Others	Average number of professional staff and technicians per firm	Total	Average per firm
Big countries									
Argentina	41	102	28	1 089	592	445	41	70	1.7
Brazil	64	128	53	7 403	13 246	11 030	322	820	12.8
Mexico	40	96	21	1 197 b/	1 295	953	62	70	1.8
Andean countries									
Bolivia	25	49	10	98 c/	74	47	7	7	0.3
Colombia	59	401	36	832	450	340	21	51	0.9
Chile	46	93	15	455	355	195	17	35	0.8
Ecuador	22	41	8	304 d/	375	167	30	28	1.3
Peru	42	86	12	116 e/	111	70	6	10	0.2
Venezuela	52	38	7	547 f/	575	433	21	50	1.0
Other South American countries									
Paraguay	22	33	6	406 g/	238	307	30	25	1.1
Uruguay	13	17	4	145	92	49	18	10	0.8
Total	426	1 084	200	12 592	17 403	14 036	70	1 176	2.8

Source: FELAC Directory, Lima, 1981 and SEC/INTAL, advance copy of Boletín sobre inversiones y empresas latinoamericanas (BIEL), May 1982.

a/ Latin American Federation of Associations of Consultants.

b/ Corresponds to only 39 of the 40 firms.

c/ Corresponds to only 7 of the 25 firms.

d/ Corresponds only to 17 of the 22 firms.

e/ Corresponds to only 29 of the 42 firms. Consideration has been given to firms with one owner and to individual firms made up of one professional only.

f/ Corresponds to only 38 of the 52 firms.

g/ Corresponds to only 18 of the 22 firms.

/72. Howev

72. However, with a few exceptions, the consulting and engineering firms in the region have been concerned more closely with the adaptation of imported technology than with the development of plans, projects and designs based on local research activities. In many cases, especially in the smaller countries, national firms have worked in close association with powerful foreign firms in a subsidiary position, particularly when projects were financed with external resources.

73. In addition, in a number of regional and subregional programmes, the link between the scientific and technological research capacity and the production system in the Latin American countries has been promoted. The Andean Technological Programmes (PADT) organized during the 1970s under the Cartagena Agreement have covered such fields as the use of timber resources from tropical forests, the concentration of minerals by bacterial leaching and the production of foods with high nutritional value. The Andean Inter-university Development Centre (CINDA) experimented with a number of programmes to link the university to the production sector, and OAS and UNDP financed projects to develop the results of research to the point where they were incorporated into the production sector. Attention should also be drawn to the work done by the Latin American organizations concerned with appropriate technology created during the 1970s (the "Las Gaviotas" Integrated Development and Tropical Research Centre) in Colombia, the Third World Economic and Social Studies Centre A.C. (CEESTEM) in Mexico and the Meso-American Centre on Appropriate Technology (CEMAT) in Guatemala.

74. Finally, the activities carried out in the region by the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico, the International Potato Centre (CIP) in Peru and the Inter-American Tropical Agriculture Centre (CIAT) in Colombia, have made it possible to develop varieties which are better adapted to local conditions and have been widely used by farmers in the region.

8. Area VIII: Strengthening of co-operation in the field of science and technology among developing countries and between developed and developing countries

75. Scientific and technological co-operation in Latin America gathered momentum during the 1970s. When the Vienna Conference was held, there were regional associations of scientists sponsored by UNESCO (for example, the Latin American Physics Centre (CLAF), the Latin American Biological Sciences Centre (CLAB), the Latin American Council for the Social Sciences (CLACSO), the Regional Centre of American Seismology (CERESIS), the programmes organized by OAS, the Cartagena Agreement and SELA; a considerable number of technical co-operation networks;38/ the Andrés Bello Agreement among the Andean countries and a number of bilateral agreements on scientific and technical co-operation among the countries of the region.

76. Five main sources of financing supported and promoted regional co-operation and co-operation with other countries outside the region -the OAS Regional Scientific and Technological Development Programme, whose budget in the period 1968-1978 exceeded US$ 86 million; UNDP, whose contribution in resources for science and technology was approximately US$ 64 million in the period 1971-1980; the Inter-American Development Bank (IDB), which through loans and technical co-operation

/channelled some

channelled some US$ 1 120 million for scientific and technological education between 1961 and 1982, about 15% or 20% of which was specifically earmarked for promoting scientific and technological development and was utilized primarily in Argentina, Brazil and Mexico and bilateral programmes with developed countries, channelled through the United States Agency for International Development (AID); the Canadian International Development Agency (CIDA); the International Development Research Centre (IDRC), also of Canada;39/ the Office for Scientific and Technical Research Overseas (ORSTOM) of France, the Technical Co-operation Association of Germany and other private international entities and foundations.

77. Regional and subregional integration arrangements paid varying amounts of attention to scientific and technological co-operation. In its constitution the Latin American Economic System (SELA) considered the development of a regional technological capacity to be a priority objective. It carried out activities primarily in connection with the co-ordination of regional positions in international forums, such as the negotiations relating to the Codes of Conduct on the Transfer of Technology and on Transnational Corporations. It also established the Latin American Technological Information Network (RITLA), with an Action Committee made up of seven countries with a view to exchanging information on research activities, transfer of technology and consulting and engineering services. At the same time, some of the SELA Action Committees, such as those concerned with ocean and freshwater products and housing, promoted and supported co-operative research activities.

78. When the Vienna Conference was held, the Cartagena Agreement was the integration arrangement which had made the most progress in scientific and technological co-operation in Latin America. Around the end of the 1970s, a technological policy had been defined, which was applied both at the national level in the five member countries and at the subregional level, through the Board of the Cartagena Agreement. This policy, as stated above, makes reference to foreign investment, technology transfer, industrial property, technological research and information.

79. In addition, the Andean Group helped to strengthen the region's scientific and technological infrastructure and capacity through the PADTs. Their implementation led to the establishment of hydrometallurgical laboratories in Peru and Bolivia, the creation of the Andean Laboratory for Wood Engineering in Lima, and the creation of two timber laboratories in Colombia and Ecuador. Likewise, they promoted a number of activities in the fields of technological research and the extension and application of technologies, as shown by the PADT on food, which led to the production of edible flour, a milk substitute and foods for babies and diabetics.

80. In the implementation of the subregional technological policy under the Cartagena Agreement, special emphasis was placed on the transfer of technology. National registers of license contracts were set up in the five member countries, common regulations being adopted for the treatment of foreign capital and the transfer of technology, and other common regulations for industrial property.

/Programmes were

Programmes were also initiated for breaking down the "technology" package, especially in the chemical processing industries; an inventory was completed on technological capacity in the capital goods sectors and various training programmes were organized. Finally, towards the end of the 1970s, the Board of the Cartagena Agreement completed studies for the creation of the Andean Technological Information System (SAIT), whose establishment was approved early in the 1980s. In the case of the Central American Common Market, attention should be drawn to the work of the Central American Technological Research Institute for Industry (ICAITI).

II. TRENDS AND CHANGES IN SCIENCE AND TECHNOLOGY FOR DEVELOPMENT IN THE REGION AFTER THE VIENNA CONFERENCE IN 1979

81. As indicated above, it is difficult to draw a precise distinction between the situation prevailing in the region at the time of the Vienna Conference and the progress made since then, since scientific and technological progress in the region in the past 20 years has been the result of a gradual process and the information concerning it is fragmentary and often out of date. However, making use of the eight programme areas in the operational plan, this section contains a brief description of the main changes and trends observed in Latin America after the Vienna Programme of Action was adopted. In addition, it contains overall assessments of the changes in the science and technology situation in the region in the past four years.

82. The analysis of the information available is not such as to permit the establishment of a clear and direct relationship between the changes and trends observed in the region and the approval of the Vienna Programme of Action. In addition to the action to which this programme may have given rise, there are other factors which are related more closely to the dynamics of Latin American development and to regional scientific and technological activity, and these factors are probably of greater importance. However, the Vienna Conference served as a forum to give legal status to regional suggestions, providing them with support from the international community; it made it possible to concretize concerns about the need for an endogenous scientific and technological capacity; it constituted a landmark for the examination of technological development in the region and in the developing world and it also helped to systematize the analysis of the contribution made by science and technology to the attainment of development objectives.

83. In view of the aforementioned dearth of recent quantitative data and the dispersion of that up-to-date information which is available, it is impossible to make a detailed comparison of the situation which prevailed in 1975 when the Vienna Conference was held and the situation now, in 1983. For this reason, this section contains a kind of evaluation and review of the main trends observed, together with specific data on some countries of the region and on regional and subregional bodies.

84. The main sources of information for this section have been the questionnaire prepared by the United Nations Centre on Science and Technology for Development (UNCSTD) created by General Assembly resolution A/Res/34/218 of 19 December 1979, to which 18 countries of the region responded,40/ as well as a large number of national reports, technical documents, scientific articles and reports of international bodies.

1. Area I: Scientific and technological policies and plans for development

85. Of the 18 countries which answered the questionnaire referred to, only three did not possess central scientific and technological policy bodies; four of them had bodies which were created after the Vienna Conference. Moreover, only one-third of those countries possessed national systems for the compilation and processing of statistics on science and technology. Eleven of the 18 countries reported significant progress in policy formulation, eight indicated progress in the formulation of scientific and technological development plans, while only six mentioned any progress in the field of statistics on scientific and technological activities.

86. With regard to regional and subregional co-operation in science and technology policies and plans, attention may be drawn to the fact that in July 1981 the Science and Technology Council of the Caribbean was established with the aim of co-ordinating and promoting regional co-operation and acting as an advisory body for Belize, Cuba, Dominica, Grenada, Guyana, Haiti, Jamaica, St. Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago. The initial activities of the Council gave priority to an assessment of the science and technology capacity of its members, assessment, which together with other elements, will provide a basis for the formulation of a science and technology policy for the Caribbean region.

87. The Andean Pact continued to work in the field of subregional technological policy, and in April 1980 the first Subregional Meeting on Science and Technology was held, in which the Board of the Cartagena Agreement showed, inter alia, that some countries had not incorporated all the provisions of decisions 24, 84 and 85 in their internal legislation. In this meeting consideration was given to the possibility of establishing the Andean Science and Technology Council, an organ formally constituted in July 1983 to advise the Commission and the Board. It was agreed to provide for continuous follow-up of the Vienna Programme of Action, and a number of recommendations were made concerning subregional co-operation, co-operation with other countries outside of the subregion and international negotiations in connection with transnational corporations and technology transfer.

88. In 1981 the Board submitted to the countries in the Andean Pact an evaluation of the progress made in the implementation of the subregional technology policy, calling attention to the need to expand and strengthen the machinery for technological integration and make it more dynamic, the need to approve the establishment of an "Andean system for science and technology" and the importance of promoting the practical application of the results of the Andean technological development projects, also proposing the creation of an Andean Scientific and Technological Development Fund, which is envisaged for 1984. Decision 154 adopted by the Commission in June 1980 also established the Andean Technological Information System (SAIT), as already noted.

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2. Area II: Creation and strengthening of scientific and technological infrastructure

89. The establishment and consolidation of the infrastructure for science and technology in the region continued at a comparatively slower pace than in the 1970s, primarily because of the scarcity of resources due to the economic crisis and perhaps also because of the fact that considerable progress had been recorded in this area. The majority of the countries which answered the questionnaire prepared by the Centre for Science and Technology for Development indicated that no significant progress had been made since the Vienna Conference in the creation and expansion of the laboratories, research centres and other facilities and services for scientific and technological research.

90. In particular, shortcomings were observed in the support services for scientific and technological activities. Thus, only six of the countries answering the questionnaire possessed specialized programmes for scientific and technological radio and television broadcasting or specialized press facilities.

91. Similarly, with regard to services, in spite of the fact that 10 of the countries surveyed had experts for the maintenance of research equipment, only eight had adequate facilities for calibrating instruments, and only three had plants for manufacturing them.

92. The countries covered by the questionnaire suggested that priority should be given to the creation and strengthening of institutions for the preparation of human resources highly qualified in science and technology, that bodies for regulating the importation of technology should be strengthened so as to enable them to evaluate technologies prior to the importation process and also that regional centres for research and development and scientific and technological information networks should be extended.

93. In general, the countries surveyed consider that significant progress has not been achieved since the Vienna Conference with regard to research infrastructure, education in science and technology, support for scientific and technological associations and organizations and publication of books and journals in this field. Only three countries reported any progress in these matters.

3. Area III: Choice, acquisition and transfer of technology

94. In the majority of the countries of the region, the adoption of policies and the creation of bodies for regulating the transfer of technology antedates the Vienna Conference. Of the 18 countries covered by the questionnaire, nine possessed bodies for regulating the transfer of technology, all of them created in the 1970s. In spite of this, it is noteworthy that only four countries had training programmes in technology transfer for government officials and only one had training programmes for the private sector. Moreover, only four countries considered that there had been significant advance in this field since the Vienna Conference. The priorities identified as a result of the survey are the strengthening of the capacity to evaluate technologies prior to the importation process and the strengthening of the regional and subregional machinery for information on technology transfer, particularly through RITLA and SAIT.

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95. In addition, some changes and variations in the process of importing technology by some Latin American countries have recently been noted. For example, in 1980 Mexico paid over US$ 460 million for royalties and fees, and in 1981 it is estimated that payments for those items rose abruptly, to US$ 745 million,41/ although it is possible that because of the crisis this figure may have fallen again.

96. In some countries in the Southern Cone -Argentina and Chile in particular-, when neoliberal economic policies were put into effect, a tendency was noted towards the reduction, and even the elimination of the monitoring of technology imports, particularly that effected through the review of license contracts. The argument used in both countries was that the best custodian of their interest in this field was the entrepreneur itself. In the case of Argentina, the National Institute of Industrial Technology (INTI) with UNIDO support offered information services to guide entrepreneurs in the identification of technological options, but there is not much up-to-date information on the use of these services.

97. By contrast, in Brazil, Colombia and Mexico the systems for regulating the importation of technology were retained, and in the specific case of Brazil, they were expanded to cover not only the terms of the contract but also the need for and advisability of importing and even the subsequent absorption of the article imported by the production system.

98. The attention paid to the import of technology under license contracts during the 1970s to some extent contrasts with the relatively feeble financial flows associated with technology imports by that means. Awareness of this fact gradually stirred up interest first in the importation of technology "incorporated" in capital goods and second in that of project engineering and consulting services. Table 7 shows the payments made in respect of different aspects of the importation of technology in selected Latin American and Caribbean countries. It may be seen that the importation of capital goods is clearly in the lead and that royalty payments are relatively smaller, and this gives some indication of the greater significance of technology which enters in "incorporated" form, although it must be acknowledged in connection with the figures in table 7, that some margin of error and differences of interpretation must be allowed for. In this same connection, it should be pointed out that estimated data for Peru show that the payments for consulting and engineering services represented close to 10% of the importation of capital goods at the beginning of the 1980s, which is several times higher than the amount paid for royalties and direct foreign investment. All this has meant that in recent years more attention has been given to those other channels of technology transfer.

99. The export of technology in its various forms by the big countries of the region began to acquire a certain amount of significance in the 1970s. In accordance with data compiled in a number of studies carried out by IDB,42/ at the end of that decade, Argentina, Brazil and Mexico were exporting "incorporated" and "unincorporated" technology representing hundreds of millions of dollars a year. Those exports included infrastructure projects (engineering and construction), industrial projects (design and turn-key plants) and consulting services. Direct investments abroad by those countries have also been recorded, and these tendencies

/Table 7

Table 7

LATIN AMERICA: PAYMENTS ASSOCIATED WITH DIFFERENT CHANNELS USED IN THE IMPORTATION OF TECHNOLOGY, 1978-1980

Countries	Channels						Total	
	Direct foreign investments (1980)		Importation of capital goods (1979)		Payment of royalties and fees			
	Thousands US$	%	Thousands US$	%	Thousands US$	%	Thousands US$	%
Big countries								
Argentina	740.6	24.5	2 175.8	72.1	101.0 a/	3.3	3 017.4	100
Brazil	1 568.3	28.4	3 444.9	62.5	500.0 b/	9.1	5 513.2	100
Mexico	1 852.1	22.9	5 781.1	71.4	462.7 c/	5.7	8 095.9	100
Andean countries								
Bolivia	41.5	11.6	313.7	87.9	1.8 d/	0.5	357.0	100
Colombia	233.0	16.2	1 195.3	83.3	6.32 d/	0.4	1 434.6	100
Peru	26.9	3.4	749.2	95.6	7.48 c/	1.0	783.6	100
Venezuela	54.7	11.0	4 334.8	87.0	101.0 d/	2.0	4 982.8	100
Central America and the Caribbean								
Costa Rica	12.2	4.1	275.8	94.0	6.5 e/	2.2	294.5	100
Guatemala	111.0	23.0	360.3	74.4	12.7 e/	2.6	484.0	100
Trinidad and Tobago	216.5	41.8	283.2	55.0	18.0 f/	3.5	517.7	100

Source: IDB, Economic and social progress in Latin America: 1982 Report; ECLA, Economic survey of Latin America, 1980, and Statistical synthesis of Latin America, 1960-1980; and F. Sagasti and C. Paredes, La situación de la ciencia y la tecnología en América Latina y el Caribe, GRADE, Lima, March 1982.

a/ 1974.
b/ 1977.
c/ 1980.
d/ 1979.
e/ 1976.
f/ 1975.

/have continued

have continued even during the regional economic crisis, although probably not so dynamically. It is possible that promotional systems have played an auxiliary but significant role in those exports.

100. In accordance with the data available, the engineering services for physical infrastructure projects play the largest role. Brazil is the biggest supplier of engineering services, while Argentina provides the largest number of industrial plants. Technology exports by Argentina, Brazil and Mexico are directed primarily towards other Latin American countries. In the engineering services category, at the beginning of the 1980s Argentina directed 90%, Brazil 68% and Mexico 100% of their projects towards countries in the region. The corresponding figures in the case of industrial projects are Argentina, 100%; Brazil, 60% and Mexico, 73%.

101. Some diversification is also beginning to be noted in connection with the destination of technology exports, especially in the case of Brazil. The countries of Africa and the petroleum-exporting countries in the Middle East constitute the leading clients outside the region. Africa received 10% of the infrastructure projects exported by Argentina and 13% of those exported by Brazil. Other data indicate that out of 48 projects in the hands of Brazilian consulting firms in the exterior, 29 were being carried out in Latin American countries and the rest in Africa, the Middle East and Portugal.43/ The same source indicates that 30 of the region's 50 largest consulting firms were Brazilian firms, seven were Argentine firms, eight were Mexican firms and the rest were located in Bolivia, Chile, Paraguay and Venezuela.

4. Area IV: Development of human resources for science and technology

102. Seven of the 18 countries covered by the questionnaire prepared by the Centre for Science and Technology for Development indicated that since the Vienna Conference the supply of highly qualified human resources has grown significantly while, the remaining countries said that the situation had not changed appreciably. In addition, in the reports of two of the countries, it was indicated that the emigration of professional and scientific personnel had increased. This contrasted with the information provided by another four countries, where programmes to facilitate the return of highly qualified personnel had met with success. In answering the questionnaire, the countries of the region pointed out that the main problem in connection with the training of highly qualified human resources for science and technology was financing.

103. The development of human resources is a long-term activity, whose results take 10 or more years to become apparent. It is considered that seven years is the minimum needed to train a generation of scientists at the doctorate level abroad, and that when those scientists return, they will require another seven years to train a new generation of master's or doctor's degree holders locally. For this reason, countries which embarked on a massive effort to prepare human resources in science and technology in the 1960s -such as Argentina and Brazil and, at the beginning of the 1970s, Mexico- began to see the results at the end of the 1970s and the beginning of the present one and are constantly increasing the number of their highly qualified scientific and technological research workers.

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104. This increase in the supply of human resources for science and technology is closely tied to the expansion of the post-graduate programmes in the universities of Latin America. During the past four years, Brazil and Mexico have kept up the rate of expansion of their post-graduate programmes in science and technology initiated at the beginning of the past decade, while the other countries of the region have still not undertaken such decisive action in this field.

5. Area V: Financing of science and technology for development

105. Of the 18 countries which answered the questionnaire, eight have no bodies engaged specifically in the financing of science and technology; only three have established incentives for promoting investments in research and development, and only two possess machinery for providing enterprises using the results of research projects with liability insurance.

106. Generally speaking, only four of the countries which answered the questionnaire reported a significant increase in the availability of resources for science and technology, while two mentioned reductions of considerable magnitude. The countries suggested the establishment of machinery similar to that of ITINTEC in Peru, which requires enterprises to earmark 2% of their profits for the implementation of technological research projects under the supervision of ITINTEC. They also suggested that regional and subregional machinery should be created to finance scientific and technological activities.

107. In some countries of the region, the systems of financing in respect of science and technology have achieved notable progress. For example, in 1981 Brazil possessed 23 institutions engaged specifically in financing scientific and technological activities, not to mention the activities of development banking in general. For the purpose of supplementing the activity of other State bodies, in 1979 CONACYT of Mexico also established a shared liability programme for enterprises using the findings of research projects.

108. In another connection, Argentina, Brazil, Colombia and Peru have in recent years developed procedures for consolidating the budgetary allocations for science and technology, relying on the support of UNESCO for this purpose. The Chile Foundation, established jointly by a transnational corporation and the Government of Chile to carry out activities relating to technological research, advisory services and the performance of other services for the private and governmental sectors, is a unique case in the region. The Cartagena Agreement, for its part, is carrying out base line studies and consultations prior to the establishment of the Andean Scientific and Technological Development Fund envisaged for 1984, as mentioned above.

109. The multilateral banks have also begun to show interest in financing scientific and technological activities in the region. During the 1970s, the Inter-American Development Bank (IDB) granted loans to Brazil and Argentina to finance scientific and technological development programmes in an amount totalling more than US$ 100 million, and more recently it extended another loan to Brazil channelled through CNPq; a loan to Mexico in the amount of US$ 50 million, through

/CONACYT, and

CONACYT, and a loan to Colombia for US$ 30 million, administered by COLCIENCIAS. In addition it has sent a mission to Peru to study the possibility of granting a loan through CONCYTEC. The World Bank has progressed in the formulation and negotiation of a loan which could amount to US$ 500 million for Brazil, which may take shape during 1984 and has also sent a mission to Peru to examine the possibility of granting a loan to enlarge the technological research capacity in that country.

110. The greater interest of the region's development banking circles in the development of a scientific and technological capacity during the past few years is clearly reflected in certain activities of the Latin American Association Finance and Development Institutions (ALIDE). In co-operation with IDB, ALIDE sponsored a study on the role of development banking in scientific and technological development and is including this subject in its training courses. This study 44/ is based on the fact that in the countries of the region, development banking, agencies concerned with scientific and technological policy and research centres are totally disassociated. On the basis of an inventory of experiences in this field and an analysis of the role which development financing bodies might play, the study suggests ways in which development banking might take action. These include the financing of technological development services, the financing of enterprises producing machinery and equipment which incorporate local technology or technology adapted to conditions in the region, the financing of industrial projects which envisage a policy for the purchase of technologies of local origin, the financing of activities to adapt and absorb imported technologies and the adoption of the role of promoter of the use of appropriate technologies on the basis of the requirements which development banks can impose in respect of project formulation and evaluation.

111. After the Vienna Conference, international and bilateral financing agencies played a greater role in the field of science and technology for development. For example, the resources provided by UNDP to the countries of Latin America for science and technology rose from 2.8% of the total allocation in the 1977-1981 programming cycle to 6.9% in the 1982-1986 cycle. The United Nations system for financing science and technology for development, whose immediate predecessor was the temporary fund created at the Vienna Conference while the financial system was being organized, channelled over US$ 6.6 million to the region since it went into operation in 1981 (annex I contains a list of projects approved by the financial system in the region).

6. Area VI: Scientific and technological information

112. Of the 18 replies received, seven report the availability in 1983 of national systems of scientific and technological information while 12 report the presence of sectoral networks, most of them in agriculture and health. However, only five countries reported substantive improvement in this field, and the majority considered that the situation had not changed since the Vienna Conference in 1979. The suggestions made by the countries refer to the co-ordination of networks at the subregional and regional levels and to the co-ordination of sectoral networks at national level.

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113. The most significant progress in information on science and technology development in the region during the past four years was made in the Cartagena Agreement, where the Andean Technological Information System (SAIT) was established and in SELA, where the Latin American Technological Information Network (RITLA) was created.

114. Under decision 154 adopted by the Cartagena Agreement Commission in 1980, the gradual establishment of SAIT was decided with the idea that it would act as a permanent subregional co-operation machinery in the field of technological information. SAIT possessed, in addition to a Board of Directors, co-ordinating committees for each of the networks making up the system, with a permanent secretariat in the Board of the Cartagena Agreement and a number of operational units responsible for information on the various matters covered by SAIT in the countries members of the Andean Pact.

115. At the first meeting of the Board of Directors of SAIT held in 1981, it was decided that the system would give priority to information on foreign investments, international prices, contracts relating to transfer of technology, requests for patents and brand names, patents registered in the subregion, local supply of marketable technology, alternative technologies, procedures and regulations for the exchange of information and country papers relating to the technological activities carried out by the member countries. By the end of 1982 six specialized and sectoral networks had been set up, whose activities complemented those relating to the training for the personnel participating in the SAIT networks.

116. Following the creation in January 1982 of the RITLA Action Committee in the Latin American Economic System, it was decided that the network would be structured to include the fields of negotiations and importation of technology, activities of technological institutes and the provision of support to the consulting and engineering capacity. RITLA is made up of a Board of Directors, which is the central nucleus located in Rio de Janeiro; the national co-ordinating centres and the executing agencies which are expected to perform as users and sources of information and technical assistance. In September 1983 the Action Committee ceased operating since the network, which is scheduled to go into operation at the end of 1983, had been formally established.

7. Area VII: Strengthening of research and development in and for developing countries and their linkage to the production system

117. Only three countries mentioned that they had legislation and specific measures for the purpose of promoting research by the enterprises in the production sector, while two of them had taken measures to provide incentives for the carrying out of research projects by foreign enterprises. This confirms that during the past few years most of the governmental action in the region has been oriented towards the strengthening of research and development in universities, independent centres and technological institutes and other governmental agencies, without much attention being paid to the performance of these activities by the production sector. The fact that 11 countries consider that they do not possess a sufficient number of consulting and engineering firms which can act as a link

/between research

between research and production and that only three have established special programmes for bringing the university closer to the production sector supports the prevailing impression that research activities and production are somewhat disconnected. Moreover, the majority of the 18 replies indicate that there has been no progress in this connection since the Vienna Conference.

118. The picture which now emerges in the region with respect to research and development and their relationship with production is a bit confused. There are signs and trends which point in different directions. To some extent this has been due to the economic crisis experienced in Latin America in recent years and to the different approaches to economic policy taken by the countries of the region. As might have been predicted, one of the consequences of the crisis and of the programmes adopted which advocate austerity in public expenditure has been the reduction of the contributions of the State to research and development. State contributions have a very high share in the total allocated for this purpose owing to the traditional weakness of the private sector in this connection.

119. These changes may be illustrated by the case of Brazil. The disbursements made by the Studies and Projects Financing Institution (FINEP), one of the main agencies for the financing of scientific and technological development in that country, grew continually during the 1970s, but already in 1979 a downturn began, and in 1981 and 1982 the annual disbursement figures represented little more than 50% of those for 1979 and two-thirds of what was spent in 1980. These reductions have been accompanied by a change in the destinations of the financing; actually, although government resources channelled to the universities showed a continual increase towards the end of the 1970s, during the 1980s financing favoured State research enterprises and centres.45/ This has been accompanied in Brazil by the emergence of research units in the State enterprises to which much support has been provided in such areas as optical communications, data processing and microelectronics and air transport.

120. In addition, much progress has begun to be made in connection with the operational approach insisted upon by some governments in the region, under which research and development institutes must be self-financing. Although a certain component of self-financing is necessary to ensure that institutes respond more appropriately to the concerns and problems of the production sector as their principal customer, this could result in institutes abandoning important research activities which yield results in the medium term but have no immediate commercial value. The excessive emphasis placed on the provision of services to industries, agriculture and mining as represented by trials, tests, quality guarantees, market studies and similar activities, may put research and experimental development in a subsidiary position.

121. However, the operational approach which has made research institutions depend almost exclusively on annual budgetary allocations has resulted in instability in the availability of resources owing to problems in the annual negotiations to establish national budgets. In some cases, such as that of the National Institute of Livestock Technology (INTA) in Argentina, the elimination of a stable financing mechanism related to agricultural exports has caused problems. A similar situation has been recorded in connection with the National Institute of Industrial Technology (INTI), in the same country.

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122. Likewise, some attempts to create a more effective link between the university and the production sector have recently been observed in the region; mention should be made in particular of the project implemented by the Inter-University Andean Development Centre (CINDA) in co-operation with ECLA, UNESCO and UNDP, under which consideration is given to various ways in which the university's scientific and technological research capacity can be utilized to benefit the production sector,46/ which has resulted in a number of university activities being carried out in the Andean subregion for this purpose. The Federation of Latin American Advisors' Association has begun to call its members attention to the important role which consulting and engineering firms can play in the application of research findings to the production sector. Finally, in various initiatives taken by international and regional bodies it has been evident that it is important to link research with production, as in the case of the United Nations Advisory Committee for Science and Technology for Development, a subsidiary organ of the Inter-Governmental Committee on Science and Technology for Development, which held a special meeting on the subject in Lima in October 1983.

8. Area VIII: Strengthening of co-operation in the field of science and technology among developing countries and between developing and developed countries

123. In eight of the 18 countries surveyed, there are specialized bodies for scientific and technological co-operation with other developing countries, although most of them were created prior to the Vienna Conference. Nearly all the countries have at least one bilateral co-operation programme, while two countries have entered into between 25 and 50 bilateral agreements in this field. The majority of the countries reported an increase in international co-operation during the past four years; seven of them indicated that their participation in the co-operative programmes of regional and subregional bodies had increased and seven countries also mentioned that their co-operation with other developing countries had increased significantly. The prevailing views and the suggestions made by the countries indicate that co-operation in science and technology for development has been acquiring greater importance since the Vienna Conference and that the establishment of regional institutions for training human resources and for research, both in traditional fields and in new technologies, needs priority attention.

124. Many bilateral co-operation bodies have recently been organized in the region. There is an extensive network of agreements signed by national scientific and technological research councils, but the impression is that in many cases the action taken within that context has not been as effective as expected. On the other hand, the relationships established between the technological institutes would seem to have yielded more results. Two of the most active countries in this field have been Brazil and Mexico. In the case of Brazil, attention should be drawn to the agreements between CNPq and its counterparts in Peru (CONCYTEC) and Ecuador (CONACYT) in projects relating to the tropical wetlands, medicinal plants and tropical forest resources; the agreement with Argentina on joint research and exchange of findings in the field of nuclear energy; the agreement with Suriname for research into bauxite deposits in that country and the fellowship and internship programmes for students and Latin American professionals

/in various

in various branches of science and technology. In addition, Brazil has extended its co-operation programmes to other developing countries outside of the region, such as Angola and Mozambique, and its experiences with the programme for substituting alcohol for gasoline (PROALCOOL) has awaken the interest of a number of African countries.

125. At the subregional co-operation level, the Caribbean Common Market (CARICOM) has initiated a series of activities in agriculture. Participants in these activities include the Ministries of Agriculture of the member countries, the University of the West Indies and the Caribbean Agriculture Research Institute; technical assistance activities with resources provided by UNDP, the Canadian International Development Agency (CIDA) and the Development Fund of the European Economic Communities; and training activities, specifically in the fields of energy and livestock research.

126. The Andean Pact has also continued the work it has engaged in since the Vienna Conference to promote subregional technological co-operation, as described above. At regional level, OAS has continued with the regional scientific and technological development programme, and in October 1983 it convened a meeting of experts to examine the progress made under that programme and to study possibilities for its future.

127. Moreover, in spite of the fact that UNDP has programmed an increase in the share of the resources it allocates to science and technology in the 1982-1986 cycle, it has encountered financial difficulties so that some of the scientific and technological co-operation activities envisaged under the initial programme may have to be cut. SELA for its part, entered into a number of agreements between 1980 and 1983, designed to promote horizontal technical co-operation among the Latin American countries and has begun to put together a mechanism ensuring contacts among the international technical co-operation bodies of the member countries and providing for a permanent exchange of information among them.

128. With regard to regional technical co-operation, the entrepreneurs have begun to play new roles in the past four years. For example, the associations of Latin American entrepreneurs,47/ whose co-operation used to be limited to production and marketing, have begun to show interest in aspects of scientific and technological co-operation, such as training and the gathering and exchange of technical data, the analysis of common technological problems and the establishment of linkages with regional and subregional bodies engaged in scientific and technological co-operation. Encouraged by the interest displayed by the entrepreneurs, SELA and RIAL are sponsoring a project on new regional co-operation agents in Latin America in which a number of sectoral associations of entrepreneurs are participating. To a large extent this eagerness for co-operation has resulted from the difficult situation faced by Latin American industrialists due to the economic crisis and the new awareness (as in the case of producers of capital goods) that joint action would make it possible to orient the demand for goods and services from other production sectors (electric power generation, petroleum, iron and steel, etc.) towards enterprises in the region.

/129. Finally,

129. Finally, some changes are also observed in co-operation with the developed countries. Following the Vienna Conference, the Government of Canada, acting through the International Development Research Centre (IDRC) established a programme to finance joint research between Canadian entities and the developing countries. This programme is embarking on activities in the region in such fields as the geosciences. For its part, the United States Agency for International Development (AID), working through the Science and Technology for the International Development Board of the United States National Academy of Science, has established a programme to finance research in developing countries, from which a number of institutions in the region have benefited. Finally, the Government of Spain, together with Ibero-American countries in the region and ECLA, is sponsoring the drawing up of a scientific and technological co-operation programme in connection with the celebrations to mark the 500 year anniversary of the discovery of America. It is envisaged that this programme will cover such fields such as agriculture, biotechnology, use of the biomass, catalysis and absorbents, microelectronics and new energy sources and conservation of energy. The preliminary projects relating to specific action with regard to co-operation between Spanish institutions and the region are being finalized with the idea that once it has been approved, the programme will initiate its activities in 1984.

130. Mention should also be made of the joint ECLA, ECA and UNDP project INT/80/908 on promotion of technical and economic co-operation between Africa and Latin America, one of whose most important components was science and technology for development and in which a number of areas and mechanisms are identified so that the countries of both regions might co-operate with a view to enjoying the benefits to be derived by combining efforts and resources.

III. AN OVERVIEW OF THE PROGRESS MADE BY THE REGION SINCE THE VIENNA CONFERENCE

131. Since the Vienna Conference was held in August 1979, the region has experienced some progress in the application of science and technology to development, which has, however, been affected by the economic crisis. In the field of scientific and technological policy, the situation has not changed appreciably, except that some subregional bodies are showing greater dynamism. In the field of infrastructure for science and technology there have been relatively minor changes. With regard to the transfer of technology there have been regression and progress in different countries of the region in that while some countries dismantled their machinery for the regulation of imported technology, others have enlarged their field of competence. The training of human resources has not experienced appreciable change, and the expansion of postgraduate programmes in science and technology has continued, although less rapidly, in the large countries.

132. The financing of scientific and technological development has shown some variation, and to varying degrees, all the countries of the region have felt the impact of the economic crisis and the austerity in public expenditure which resulted in a reduction in the resources available for science and technology. Significant changes have not been shown with regard to information systems, except for the attempts to set up subregional and regional networks. There has been a slight effort to orient research activity more closely towards the production sector; regional and international co-operation activities have increased and expanded although some of the bilateral, subregional, regional and co-operation arrangements with countries outside of the region have only recently been put into operation, or are in their initial phases.

133. In the conceptualization of scientific and technological development, the region has shown significant progress in recent years, which has resulted in new approaches to research for the 1980s. The Research Programme on Scientific and Technological Development in Latin America carried out under the auspices of IDB, ECLA, UNDP and IDIC has resulted in over 60 monographs in its two stages and has made it possible to amass valuable material on the nature of innovation and technical change in Latin America, providing useful elements and criteria for the formulation of economic policies in general and industrial development policies in particular.48/ Likewise, progress has been made in the conceptualization of scientific and technological policies although there is need to review the approaches proposed in the light of the progress made in new technologies (microelectronics, in particular) and the new socioeconomic context of the region in this decade.

134. Together with this recent progress, the differences in scientific and technological capacity in the region have increased. From what has been said in the preceding sections, it is possible to make a clear differentiation between three groups -the three largest countries; the Andean countries, including Chile; and the rest of the Central American, South American and Caribbean countries-, reflecting their levels of economic development. Argentina, Brazil and Mexico are still able to rely on a scientific and technological community which is felt to

/be viable,

be viable, although the economic difficulties they now face might seriously undermine their scientific and technological development programmes.

135. The countries in the Andean subregion have shown moderate growth in their scientific and technological activities in recent years. Venezuela, which showed significant growth in its financial allocations for science and technology in the 1970s, has encountered serious difficulties in the past two years. A certain amount of stagnation can also be seen in the Central American and Caribbean countries in terms of the development of their scientific and technological capacity. All this means that the differences in scientific and technological capacity which appeared during the 1970s are still evident and underlines the need to consolidate and expand co-operation programmes.

136. Finally, to complete this evaluation of regional changes and trends in science and technology since the Vienna Conference, it is worth drawing attention to some concrete achievements in connection with the generation of technologies and their adaptation and application to development problems. Although some of the technologies which might be mentioned as examples came into being during the 1970s, attention should be drawn to their present application and dissemination, it being noted that this is a list of examples and in no way proposes to be a full or systematic picture of the many technological achievements in the region.

137. In Brazil, the solution was found to a number of technical and economic problems relating to the agriculture, financial, distribution and marketing and industrial aspects of the programme for the substitution of alcohol for gasoline (PROALCOOL). There was an increase in efficiency in the production of ethanol from sugar cane, with methods being designed for the use of the residue and the reduction of pollution. Actually, approximately one million of the eight million vehicles in Brazil use alcohol as a fuel, whereas the rest use gasohol (a mixture of 80% naphtha and 20% alcohol). Progress has also been recorded, although to a much lesser extent, in the substitution of vegetable oils for diesel oil and gas oil.

138. Brazil has also managed to produce photoelectric cells out of monocrystalline silicone, has begun to produce microcomputers and is producing microchips experimentally. Likewise, it has developed technics for obtaining fuel oils from bituminous shale (PETROSIX process), has made significant progress in research and production of optical fibres and the use of laser beams for telecommunications and has developed various models of aircraft using its own design and technology (Bandeirante, Xingu, Brasilia), through EMBRAER, although some parts and components are still imported.

139. Mexico has also had significant success in the development and application of technologies over the past decade, a trend which has continued during the past four years. The energy sector has made the most progress in this connection, particularly through the application of processes developed by the Mexican Petroleum Institute (IMP), the Electricity Research Institute (IIE) and the Nuclear Research Institute (ININ). In connection with crop raising, the National Institute of Agricultural Research (INIA) and CIMMYT have continued with their programmes relating to the genetic improvement of seeds (maize, wheat, sorghum and pulses), while in the iron and steel sector, the HYLSA direct reduction process has continued to gain international acceptance.

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140. In Argentina, the National Institute of Agricultural Technology (INTA) has developed new varieties of seeds, designed systems for handling soils and carried out research on the best use of fertilizers and pesticides, which has facilitated the notable increase in crop yields in recent years. The programmes in the field of nuclear energy have continued to advance significantly, and it is envisaged that the country will have a majority share in the four nuclear power stations provided for in the 1979-1997 Nuclear Plan its contribution ranging from basic and precision engineering to the construction of vital parts and components. Progress has also been recorded in such fields as metrology and quality control and in industrial sectors such as the treatment of leather.

141. In the Andean Group, the Andean Technological Development Projects (PADTs) have led to the design of processes and equipment for the bacterial leaching of copper, the production of foodstuffs from raw materials available in the region (cotton-seed, fish, grains, etc.), and the efficient use of hard, heterogenous woods from tropical forest in the construction of housing.

142. Other examples might include the progress achieved by the Meat Institute in Uruguay, which has developed an industrial method for inactivating the foot and mouth disease virus in slaughtered animals and by the Central American Technological Research Institute (ICAITI), which has developed the Ex-Ferm process for the production of ethanol from sugar cane, a method which differs from that adopted in Brazil and permits economical production on a smaller scale.

IV. PROBLEMS RELATING TO THE SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT OF LATIN AMERICA DURING THE PAST 80 YEARS AND FINAL COMMENTS

143. The prospects for the application of science and technology to the development of the region during this decade and up to the end of the century depend greatly on the changes which the scientific and technological system has been experiencing as a result of the challenge represented by the recent technological advances at world level and of the new regional and international socioeconomic context. The full implementation of the Vienna Programme of Action in Latin America depends on these three factors.

A. Changes in the scientific and technological system

144. One of the main problems which will confront the region is the training of research workers, technicians, professional personnel, civil servants and entrepreneurs who can play an active role in the scientific and technological development process. To train qualified staff with a broader base, local post-graduate programmes of high academic quality are needed. This, in turn, calls for a heavy investment of financial resources and at least 15 years, half of which time is needed to train a team of lecturers-research workers in foreign universities and the other half for those trainees to set up local postgraduate programmes. So far a few countries have embarked on this task -Argentina, at the end of the 1950s; Brazil and then Chile, in the mid-1960s; Mexico, at the beginning of the 1970s and Venezuela, in the second half of the 1970s. Some of the remaining countries have also made considerable efforts, but the majority of them have still not initiated the process of making enormous investments in the training of high-level human resources. It is possible that the problem of obtaining financing and of these being a sustained demand for local scientific and technological activities, so that they can make this effort independently is a serious obstacle, in the medium term, at least.

145. The changes in the technology trade in Latin America are another problem which will continue to require attention. It will be necessary to regulate the importation of technology incorporated in capital goods and in so far as possible to reorient the demand for these goods towards suppliers from the region. The medium-sized and small countries will probably find it necessary to establish rules for intra-regional trade in technology in order to strengthen their position in transactions with the larger countries which export technology. With regard to transnational corporations, it would be advisable to establish an on-going assessment of their contributions to regional scientific and technological development, especially since direct foreign investment is losing in importance by comparison to the role played by transnational banking. The selection and evaluation of imported technologies and the problems related to their actual absorption, the strengthening of bargaining power and the achievement of greater access to information are problems which purchasers of technology must treat as priorities. Finally, it will be necessary carefully to consider complementarity and the balance between importation and the local generation of technology in specific activities.

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146. The problems relating to the establishment and consolidation of capacity for generating technology will still be present and will acquire greater importance to the extent that the costs associated with the importation of technology continue to rise. The selection of areas in which research and experimental development capacity can be developed and the rationalization of existing activities will certainly be viewed as priorities by the financial entities. It is not very likely that there will be a significant increase in the number of governmental entrepreneurial and educational institutions engaged in scientific and technological activities. For that reason there will be greater interest in productivity and efficient administration of these activities.

147. The promotion of innovation and technological change in management, a subject which began to stir up interest during the decade in which the Vienna Conference was held, is likely to become a basic issue in the current decade. This is related to the production sector's capacity for adapting and absorbing technology and to the promotion of the demand for local scientific and technological activities. In Brazil at the beginning of the 1970s, in Mexico at the end of the 1970s and in Venezuela at the beginning of the 1980s, financial institutions came into being for the purpose of promoting innovation as part of the effort to develop a capacity for generating and regulating technology imports. In the same connection, more engineering and consulting services will soon be provided so that the countries of the region are likely to adopt measures specifically aimed at protecting engineering and consulting firms (following the example of Mexico and Brasil) so as to promote the export of services in this field.49/ The production sector has likewise begun to pay greater attention to technological management as shown by the entrepreneurial extension courses on this subject, which have increased rapidly in some countries of the region, Brazil, Mexico, Colombia and Chile, in particular.

148. As for the problem of financing scientific and technological development, it is estimated that this will become even more important during this decade and up to the end of this century. The financial resources allocated the previous decade, which even then were not enough to support the consolidation of scientific and technological capacity, are likely to decrease as a result of the crisis of 1981-1983.50/

149. Thus, it may be deduced that it will be very difficult for the region to come close during this century to the growth of 1% of the gross product proposed in 1970 by the United Nations Advisory Committee on the Application of Science and Technology to Development as the target for expenditure on research and development or the more modest goal of at least, twice the present percentage of the gross domestic product to be devoted to scientific and technological research as provided for in the Regional Programme of Action for Latin America in the 1980s.51/

150. There is also need to draw attention to a factor of great significance in scientific and technological development and also in connection with possibilities for increasing or limiting trade within the region and with the rest of the world. Standardization, methodology and quality control are basic components of what are known as science and technology services on which the process of generating and applying scientific and technological developments largely depends.

151. A great deal still remains to be done in the region with respect to the design of activities relating to standardization, methodology and quality regulations aside from the work carried out by national bureau of standards and the aforementioned COPANT.

152. At a recent meeting on the OAS Integrated System of Standardization, Metrology and Quality, held in Mexico City in 1981, it was noted that the countries of Latin America were at a stage whose characteristics differ radically from the historical circumstances in which activities wer undertaken in this field and that it was therefore necessary to adopt new lines of action taking into account the acceleration in the technological process, the increasing interdependence at the international economic level and the rigorous competition involved in guaranteeing markets, raw materials, energy and indispensable foreign currency. Thus, for example, with regard to technical standards, it is necessary that these new lines include a consideration of their function as a contribution to the ordering of trade; the rationalization of the use of materials, parts and accessories; the protection of the interest of users and consumers and the protection of the environment and its use as a vehicle for and possible means of regulating the transfer of technology.

B. The challenge of the new technologies

153. Another group of factors which will have a decisive influence on the scientific and technological prospects of Latin America is related to scientific and technological progress at world level.52/ The advances made in solid state physics and molecular biology have given rise to new technologies which are transforming the structure of production activities. For example, it is possible that the increasing complexity of microelectronics may in the medium term introduce an important change in the life style of the industrialized countries, also having a big effect on the activities of the developing countries. The imbalances which are appearing in the job structure of the industrialized countries as a result of the "microelectronics revolution" will change consumption patterns, industrial production and international trade, with significant results which are hard to predict for the region,53/ especially with regard to certain comparative advantages which will have a decisive impact on many of its exports of manufactures.

154. Similarly, advances in biotechnology particularly in genetic engineering, may affect a large number of industrial and agricultural activities, in ways ranging from the improvement of factories and the processing of foods to the production of antibiotics and including any number of activities such as the concentration of minerals using bacteria, the production of bioinsecticides and the processing of hydrocarbons.

155. These advances present the Latin American countries with hazards, opportunities and challenges. In relatively new fields, such as biotechnology might be possible to approach the frontiers of knowledge rapidly and therefore to be selective in establishing an appropriate scientific and technological capacity which would make it possible to generate technolgies based on scientific discoveries, particularly in areas related to the availability of natural resources (tropical forests, hydrocarbons, minerals, agricultural resources, etc.). For

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example, the significant effort which Brazil has been making for a few years in the field of biotechnology, preparing highly qualified personnel, establishing laboratories, initiating academic programmes in universities and financing research projects, represents a serious attempt to approach the frontier of biotechnology. Argentina, Mexico and Venezuela are also initiating programmes of the same kind.54/

156. In the midium-sized and small countries of the region it would be necessary to combine the selection of areas of concentration with scientific and technological co-operation. This would result in a joining of efforts and would introduce the critical mass of personnel, equipment and financing which would, at least in a small number of areas, make it possible to generate technologies based on scientific discoveries and to reach the frontiers of knowledge.

157. In this respect, attention must be called to the need of the region, and of its governments in particular, to pay continuing attention to the developments which are taking place with increasing rapidity in these new areas of technological advance. Keeping abreast of these trends and evaluating their results must be a basic component of the policies and decision-taking of the countries of the region. Although action at national level is indispensable, the characteristics and peculiarities of the subject make it advisable to supplement national action with joint action by the countries. In this connection, it should be noted that, in fulfilment of the Vienna Programme of Action (section III, subsection E) and its Operational Plan (paragraph 84-87) the United Nations Centre for Science and Technology for Development has proposed the establishment of a mechanism called the "Advance Monitoring System" on Technological Developments", whose initial phase of operations may be envisaged for 1984-1985.

158. It is important to stress the need to act rapidly to take advantage of the opportunities offered by these new developments, particularly in the international context analized above. At present, particularly in the field of biotechnology, there are no very tight controls over key technologies by the enterprises of the industrialized countries, but this situation is very likely to change in a few years, limiting the region's opportunities.

C. The new socioeconomic context

159. The third category of factors which will have an influence on scientific and technological activity in the development of Latin America operates in the socioeconomic context, both internationally and in the countries of the region. At the international level, particulary in the economies of the industrialized countries, a long period of slow growth, "structural adjustment" associated with the change in the composition of the product, high rates of inflation and persistent unemployment, is expected.55/ Likewise, it is envisaged that the next two decades will see a number of changes in the technological systems in which the production activity of the industrialized countries is carried out. These changes, which might lead to a new international division of labour, provide the region with opportunities and challenges.56/

160. However, because of a combination of circumstances related to, inter alia, finances, production and international trade, the region is in a deep economic recession, in which the inflation is beginning to re-emerge, real income is

/deteriorating and

deteriorating and the level of external indebtedness is unprecedented in the economic history of Latin America. In the schemes which are being elaborated to confront this crisis, the scientific and technological aspect of the matter has begun to be considered in an explicit way. Thus, in the aforementioned Regional Programme of Action for Latin America in the 1980s,57/ ECLA expresses the need for accelerating the development of the region's scientific and technological capacity, for which purpose, as has already been stated above, at the end of the decade consideration must be given to a) the allocation of resources equivalent to twice the present percentage of the gross domestic product; b) an attempt to find mechanisms to facilitate the supply of technological innovations and their incorporation into the production process (a link between the supply of and demand for technology); c) the opening up and breaking down of the technological packages, especially those made up of contributions from transnational corporations; d) harmonization in the treatment of foreign technologies and e) the extension of technology to small and other enterprises. Similarly, ECLA and SILA propose a series of activities and measures designed to promote regional economic co-operation, interregional trade and the co-ordination of production activities, which would require very close co-ordination in the scientific and technological services supporting such activities.58/

161. One of the consequences of the seriousness of the situation through which the region is passing is the increase in the demand for scientific and technological know-how concerning the betterment of living conditions in the marginal urban environment, the generation of employment, the provision of low-cost services, and the conservation of the environment. Making the existing scientific and technological capacity adequate and seeing that it expands in the direction of this new set of social issues are central problems with regard to the formulation and implementation of scientific and technological problems, especially in view of the limitations imposed by the international context and the history of science and technology in the region.

162. The foregoing leads up to the consideration of a subject which for a number of years has been a matter of concern to the governments of the region, and particularly to those of their agencies which operate in the field of planning and also to a number of international organizations: how best to incorporate the technological dimension into national decision-taking processes. Annex 2 contains some notes on this subject, which has recently been brought to the attention of the ministries of planning of the region.59/

D. A few last remarks

163. In analysing what has happened in Latin America in the field of science and technology since the Vienna Conference, it is possible to see that the region has continued to move at its own pace and that the Vienna Programme of Action has to a large extent reflected regional thinking on these subjects. However, at both country level and within the subregional and regional mechanisms for co-operation and economic integration, scientific and technological activities are being seriously undermined as a consequence of the economic problems associated with the present crisis.

164. As a result of the efforts made during the past 25 years and particularly during the 1970s, culminating with the Vienna Conference, the region possesses

scientific and technological potential capable of rapid expansion and of being used to enhance its development possibilities. However, as stated above, it is obvious that the international and regional context which served as a background for the Vienna Conference and the preparation of the Programme of Action adopted at it has experienced a profound change in the four years since the Conference. Moreover, everything seems to indicate that this process of change will continue for a number of years.

165. In such circumstances it would seem necessary to keep constant watch over this changing situation, considering it to be a basic factor in the quest for new prospects for the development of science and technology at national and regional level. Follow-up will make it possible to isolate elements of decision and criteria which might be used on the occasion of the aforementioned mid-decade review to be carried out in 1985 with the objective of analysing the inclusion of the Vienna Programme of Action in national, subregional and regional plans. Where necessary, it would seem advisable to amend and recommend strategies in the light of the events and trends analysed.

166. In this same connection, it would be appropriate also to consider the possibility of the region's adopting, in the context of the areas covered by the programme and the extensive range of activities included in the Operational Plan, some priorities so that, if necessary, efforts and resources may be focused on areas of particular interest for the region, given its distinctive characteristics. There can be no doubt that all this would require considerable effort in terms of regional co-operation and that this in turn would call for the harmonization and co-ordination of the activities of the various institutions concerned with science and technology for development in the region. In this connection, attention must also be drawn to the role which both the Vienna Programme of Action (subparagraphs 93 c) and d) and its Operational Plan (paragraph 49) assigned to the regional commissions (called a "focal role" in the latter) in the preparation and implementation of national and regional scientific and technological development activities.

167. The viability of the Financial System related to Science and Technology for Development also seems to call for the taking of a regional position in the matter. It will be recalled that this system was created with resources initially totalling US$ 250 million for the period 1980-1981, which were to be gradually increased until an amount of approximately US$ 600 million a year around the mid-1980s was reached. Actually, it was possible to raise only US$ 38 million in the period 1980-1981 and an additional US$ 8 million in 1982. This must be taken into account in the further implementation of the Vienna Programme of Action, and it is considered necessary to adopt a regional position in this respect.

/Notes

Notes

1/ *Report of the United Nations Conference on Science and Technology for Development* (United Nations sales publication, Sales No.: S.79.I.21).

2/ See General Assembly resolution 34/218 of 19 December 1979.

3/ See document A/CN.11/12, adopted by the Intergovernmental Committee on Science and Technology for Development in resolution 2 (III) of 5 June 1981.

4/ See document A/37/36, adopted in General Assembly resolution 37/234 of 17 December 1982.

5/ See E/CEPAL/G.1252.

6/ ECLA subsidiary organ established by resolution 310 (XIV) and which was subsequently instructed under resolution 357 (XVI) to take responsibility in the field of science and technology for development, as well as in other fields.

7/ ECLA, Economic Survey of Latin America, 1949 (E/CN.12/164/Rev.1).

8/ ECLA, Science and technology in Latin America: Regional diagnosis and action programme (A/CONF.81/PC.16/Add.1), paras. 35-37.

9/ See, for example, Jorge Sábato (compiler), El pensamiento latinoamericano sobre la problemática ciencia-tecnología-desarrollo-dependencia, Paidós, Buenos Aires, 1976.

10/ ECLA, Science and technology in Latin America: Regional diagnosis and action programme, op. cit., para. 56.

11/ The main sources of information for this section were the country papers submitted to the Vienna Conference; ECLA, Science and technology in Latin America: Regional diagnosis and action programme, op. cit., and a variety of statistics and official reports taken from various studies. See, for example, the UNESCO reports on scientific and technological policy in the region, the series of monographs published by OAS, and, finally, F. Sagasti et al., Un decenio de transición: ciencia y tecnología en América Latina y el Caribe durante los 70, GRADE, Lima, March 1983.

12/ See A/CN.11/12, op. cit.

13/ Enrique Martín del Campo, "Central structures of scientific and technological policy of Latin America and the Caribbean and their role as national focal points for the implementation of the Vienna Programme of Action", United Nations Centre for Science and Technology for Development, New York, 28 March 1982.

14/ ECLA, Science and technology in Latin America: Regional diagnosis and action programme, op. cit., para. 76.

15/ In particular the conferences of directors of scientific and technological policy sponsored by UNESCO in 1971, 1975 and 1978 provided a framework for the exchange of experience in the region.

16/ See F. Sagasti, La política científica y tecnológica en América Latina: un estudio del enfoque de sistemas, El Colegio de México, Mexico City, 1983.

17/ See the monographs published by the IDB/ECLA/UNDP/IDRC programme on research in scientific and technological development in Latin America, directed by Jorge Katz.

18/ A. Herrera, Ciencia y política en América Latina, Mexico City, Siglo XXI Editores, 1970.

19/ M. Halty-Carrere, Producción, transferencia y adaptación de tecnología industrial, OAS Department of Scientific Affairs, 1972.

20/ See decision 84 of the Cartagena Agreement Commission.

21/ ECLA, Science and technology in Latin America: Regional diagnosis and action programme, op. cit., paras. 101-114, and the final report on the project on scientific and technological policy instruments: Ciencia y tecnología para el desarrollo: informe comparativo central del Proyecto STPI, International Development Research Centre, Bogotá, 1978.

22/ Latin American Weekly Report, Latin American Newsletters Ltd., London, 28 November 1980.

23/ Latin American Economic Report, Latin American Newsletters Ltd., London, 3 March 1978, vol. VI, No. 9.

24/ Jorge Beckel and Salvador Lluch, "Capital goods: size of markets, sectoral structure and demand prospects in Latin America", CEPAL Review, No. 17, August 1982, pp. 111-120.

25/ UNESCO and OAS figures taken from the report by F. Sagasti, et al., Un decenio de transición..., op. cit., pp. 24 et seq.

26/ In about 1970 the smallest number of research workers needed in a viable scientific community was estimated to be approximately 10 000, a figure which probably increased towards the end of the century. See A. Herrera, Ciencia y política en América Latina, op. cit.

27/ This figure might be an overestimation owing partly to problems with regard to the conversion of the national currency into dollars.

28/ Amilcar Herrera, Ciencia y política en América Latina, op. cit.

29/ See Misión de evaluación de los sistemas de difusión de información tecnológica en Uruguay, Argentina, Chile, Perú, Brasil, Venezuela, Colombia y México, OAS Department of Scientific Affairs, 1970.

30/ Guía de las bibliotecas universitarias argentinas, Library Science Research Centre, University of the South, Buenos Aires, 1976.

31/ Directorio de Servicios de Información y Documentación en el Uruguay, National Library, Montevideo, 1981.

32/ Directorio de bibliotecas y centros de documentación de Bolivia, Development Information System and National Fund, Ministry of Planning and Co-ordination, La Paz, 1978.

33/ Directory of Information Units in Jamaica: Libraries, Archives and Documentation Services, National Council on Libraries, Archives and Documentation Services, Kingston, 1980.

34/ Guía de bibliotecas, archivos y centros de información y documentación en Costa Rica, Department of Information and Documentation, CONICIT, San José, 1975.

35/ Guía de bibliotecas especializadas y centros de documentación de Chile, CONICYT, Santiago, Chile, 1975.

36/ Jan Annerstedt, A Survey of World Research and Development Efforts, Institute of Economics and Planning, Roskilde University, Denmark, 1977.

37/ Institute for Scientific Information, Who is Publishing in Science?, Philadelphia, 1978.

38/ See A. Araoz, Redes de cooperación técnica en América Latina, mimeographed paper, September 1979.

39/ The International Development Research Centre (IDRC) of Canada, channelled close to 55 million Canadian dollars towards scientific and technological research in the region during the period 1971-1981.

40/ When this report was being prepared, the 18 countries which had replied to the questionnaire sent to national focal points by the Centre for Science and Technology for Development were Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Colombia, Ecuador, El Salvador, Grenada, Guyana, Haiti, Mexico, Paraguay, Peru, St. Lucia, St. Vincent and the Grenadines and Uruguay. Later on, replies were received from Chile and Dominica, conveying information which could not be included in this document.

41/ "Guidelines for technological transfer", R & D Mexico, August 1982, No. 11, pp. 34-40.

42/ See Economic and social progress in Latin America, 1982 Report, IDB, Washington, D.C., chapter 6.

43/ SEC/INTAL, Latin American Development Bulletin (BIEL), April 1982.

44/ Cristovam Buarque and Sergio C. Buarque "La promoción de tecnologías apropiadas: hacia una política de tecnología de la banca de desarrollo de América Latina", ALIDE, October 1982.

45/ Renato Peixoto Dañino, "Nova vanguarda da sociedade?", Revista Brasileira de Tecnología, vol. 14, No. 2, March-April 1983, pp. 46-52.

46/ See, for example, Carlos Martínez Pavez, "Cooperación universidad-sector productivo: experiencia de las universidades del CINDA", CINDA, Santiago, Chile, December 1982.

47/ Latin American Iron and Steel Institute (ILAFA), Latin American Association for Reciprocal State Action in the field of Petroleum (ARPEL), the Regional Electricity Integration Commission (CIER), the Latin American Shipowners' Association (ALAMAR), the Latin American Railways Association (ALAF), the Latin American Pharmaceutical Association, the Latin American Preserves and Allied Manufacturers' Association (ALICA), etc.

48/ See, for example, Jorge Katz, Domestic Technology Generation in LDCs: A Review of Research Findings, IDB/ECLA/UNDP/IDRC Programme, Buenos Aires, November 1980, and the most recent monographs published under this programme.

49/ Studies are in progress concerning an attempt to establish a regional preference for engineering and consulting services within the context of the Latin American Integration Association (ALADI).

50/ In the study entitled Proyecciones de requerimientos financieros para investigación y desarrollo en América Latina by Javier Escobar (University of the Pacific, Lima, Peru, July 1983), based on ECLA projections to 1990 and 2000, it is estimated that if present trends continue, nearly US$ 2.7 billion may be spent in the region in 1990 and close to US$ 4.7 billion in the year 2000, or 0.43% and 0.42%, respectively, of the gross regional product in those years based on expenditure in 1980 of some US$ 1.6 billion at 1970 prices. If certain more favourable growth hypotheses are adopted, those percentages would rise to 0.49% and 0.56%, respectively, an increase which would result from an annual growth rate of 10% between the years 1980 and 2000, a rate very difficult to attain and maintain over a period of that length.

51/ See Regional Programme of Action for Latin America in the 1980s, adopted in ECLA resolution 422 (XIX) (E/CEPAL/G.1189), November 1981, para. 34.

52/ See the report of the International Forum on Technological Advances and Development, entitled Technological Advances and Development: A Survey of Dimensions, Issues and Possible Responses (ID/WG.389.3), forum sponsored by UNIDO and held at Tbilisi, USSR, in April 1983.

53/ ECLA, La microelectrónica y el desarrollo de América Latina: problemas y posibilidades de acción (E/CEPAL/R.317) and the Report of the UNIDO/ECLA Expert Group Meeting on implications of microelectronics for the ECLA region, Mexico City, 7-11 June 1982 (ID/WG.372/17).

54/ See Tendencias recientes y perspectivas de aplicación de la biotecnología a los problemas de desarrollo de América Latina, prepared by ECLA for the ECLA/UNESCO Meeting of Experts on the implications for Latin America of advances in biotechnology including genetic engineering, Montevideo, 21-25 November 1983.

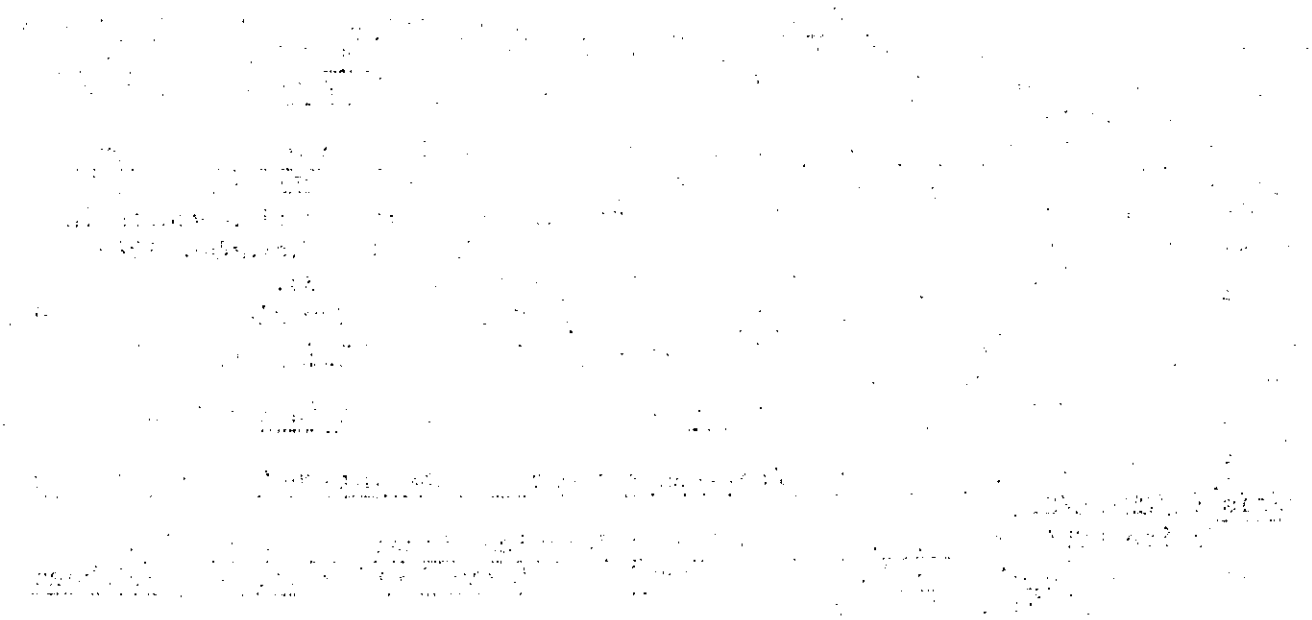
55/ OECD, Technical Change and Economic Policy, Paris, 1980.

56/ See G. Mensch, Stalemate in Technology, Ballinger, Cambridge, Mass., 1979; and C. Freeman, J. Clark and L. Soete, Unemployment and Technical Innovation, Frances Pinter, London, 1982.

57/ ECLA, Regional Programme of Action for Latin America in the 1980s, op. cit.

58/ ECLA, Bases for a Latin American response to the international economic crisis (E/CEPAL/G.1246), 16 May 1983.

59/ See ECLA, Report of the Meeting of Technical Experts of the Third Conference of Ministers and Heads of Planning of Latin America and the Caribbean (E/CEPAL/ILPES/R.34), 22 December 1980.



Annex 1

PROJECTS IN LATIN AMERICA FUNDED BY THE INTERIM FUND AND THE UNITED NATIONS FINANCING SYSTEM FOR SCIENCE AND AND TECHNOLOGY FOR DEVELOPMENT

BOLIVIA

Title	: Formulation of mining policies and introduction of electronic data processing techniques in the mining sector
Executing arrangements	: United Nations Department of Technical Co-operation for Development
Government inputs	: US$ 153 800
UNFSSTD inputs*	: US$ 98 000

BRAZIL

Title	: Development and optimization of carbon fibre technology
Executing arrangements	: UNIDO
IFSTD contribution**	: US$ 1 351 994

COSTA RICA

Title	: Support to national science and technology planning and the strengthening of the science and technology infrastructure of the country
Executing arrangements	: Government-executed
IFSTD contribution	: US$ 591 500

CUBA

Title	: Development of mineral processing technologies
Executing arrangements	: UNIDO
Government inputs	: 19 500 (pesos)
UNFSSTD inputs	: US$ 52 000

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*/ United Nations Financing System for Science and Technology for Development.
**/ Interim Fund for Science and Technology for Development.

DOMINICAN REPUBLIC

Title : Strengthening of the national planning capacity for science and technology

Executing arrangements : Government-executed

IFSTD contribution : US$ 530 050

HAITI

Title : Improvement of fish production through research and development in the field of biology and hydrobiology, Phase I

Executing arrangements : FAO

IFSTD contribution : US$ 256 100

HONDURAS

Title : Wood for energy - technological programme

Executing arrangements : FAO

IFSTD contribution : US$ 381 202

JAMAICA

Title : Upgrading the scientific and technological capabilities of the Jamaica Bauxite Institute

Executing arrangements : UNIDO

IFSTD contribution : US$ 950 800

MEXICO

Title : Industrial technology prospectives - Phase I

Executing arrangements : UNIDO

IFSTD contribution: US$ 94 200

PANAMA

Title : Support for the development of a national programme for science and technology - preparatory assistance

Executing arrangements : Government-executed

IFSTD contribution : US$ 60 000

PARAGUAY

Title : Post-graduate training and research in the chemistry of natural products

Executing arrangements : UNESCO

IFSTD contribution : US$ 300 000

PERU

Title : Inter-university project for strenghtening and developing science and technology - Strengthening of Masters' Programmes - Stage I

Executing arrangements : CONCYTEC Programmes and International Co-operation Office, Catholic University of Peru and the "Cayetano Heredia" University of Peru

Government inputs : US$ 9 900 000

UNFSSTD inputs : US$ 97 000

URUGUAY

Title : Industrial methods to inactivate the foot and mouth disease virus in meat and meat products with a view to making such products competitive for export markets

Executing arrangements : Government-executed

IFSTD contribution : US$ 300 000

ANDEAN COUNTRIES, SUBREGIONAL

Title : Programme for the progressive establishment of the Andean technological information system

Executing arrangements : Board of the Cartagena Agreement (Government-executed)

IFSTD contribution : US$ 1 452 410

CARICOM, REGIONAL

Title : Preparatory assistance and refinement of a plan of action for science and technology projects in the CARICOM region

Executing arrangements : CARICOM (Government-executed)

IFSTD contribution : US$ 125 000

CENTRAL AMERICAN COUNTRIES,
SUBREGIONAL

Title : Ex-Ferm fermentation process for ethanol production, Phase I

Executing arrangements : UNIDO, in association with ICAITI (Government-executed)

IFSTD contribution : US$ 50 000

REGIONAL

Title : Establishment of regional fermentation programming for the production of antibiotics and other pharmaceuticals in Latin America, Phase I

Executing arrangements : UNIDO

IFSTD contribution : US$ 162 000

REGIONAL (Argentina, Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela)

Title : Regional technical assistance project for non-destructive testing - NDT

Executing arrangements : UNIDO, with the IAEA as an associated agency

UNFSSTD input : US$ 54 200

Annex 2

NOTE ON SCIENCE AND TECHNOLOGY AND PLANNING FOR DEVELOPMENT

Planning consists basically in the juxtaposition of two factors: knowledge of the structure and functioning of the system under which an attempt is being made to act and a definition of purposes and objectives. Uncertain or partial knowledge of plannable systems just as the ambiguous definition of objectives can lead only to the design of imperfect and often counterproductive action. The history of planning in the region is full of this kind of lessons since it consists in a long trail of hard-to-come by achievements and many failures. However, the planning approach has gathered strength, and what we now have is institutionalized planning fully articulated with the political aspect and many regional efforts to bring it to perfection.

Historically, the planning process has been focused on the production process, viewed primarily from the economic perspective. It has echoed the prevailing theories of economic development, generating a set of instruments and approaches appropriate for an economically-based and partial view of plannable reality. As knowledge of this reality advances, other "non-economic" dimensions appear to explain its behaviour. The same thing happens when objectives are better defined and mere economic growth yields to fuller concepts such as the "quality of life". It is at this stage that the social dimension, the environmental dimension and the scientific and technological dimension become explicit and are bound to appear in the planning process. At this point a basic dilemma emerges: Do we accept the present approach to economic planning as the valid one and try to put those new dimensions in economic language so that they can be incorporated, or do we explore the validity of the present tools of planning and consider possible changes which should be made if these new concepts are to be incorporated? So far the first option, consisting in putting the new dimensions referred to into the language of economic planning has prevailed. This approach has its limitations, which in some cases are insurmountable, and does not draw on the strength of the planning concept. It is therefore essential to explore the other approach, i.e., to take a serious look at the art of economic planning (sometimes also called "economic and social planning") with a view to equipping it to deal with reality in all its dimensions.

However, when this happens, it is hard on the planning process. In the first place we are far from having reached maturity in what is known as economic planning. New and complicated superstructures must be built on its still rather shaky foundations. Furthermore, although more is now known about plannable systems, they have been subjected to radical change and have become infinitely more complex. It has recently been learned that it is not enough to plan our own actions but that it is also absolutely essential to predict the actions of others, i.e., to plan with "opponents". The international role is no longer just a frame of reference but an increasingly powerful and complex systematic relationship. Weak subsystems have no freedom of action but in most cases must be content to "take what comes". In such cases, planners become to some extent semiautonomous administrators of the effects which the development of other peoples have on the system itself rather than being active and independent protagonists of the construction of their national futures.

It should not be forgotten that the final objective of planning is the "construction of desirable and possible futures" within given political frameworks. Its role is to help to rationalize technically the decisions made by the government in defining and achieving its objectives and, in mixed economies, to work in harmony with the machinery of the market. Even in traditional economic planning, not everything is plannable nor can many decisions be planned advantageously. The experience of each national reality and each political system has been to seek the most appropriate area of action and planning. The need and appropriateness of incorporating new dimensions into planning (even when planning is performed within the most conservative views of economic management mentioned above) means that the environment and the depth of what is plannable must be rephrased, which may even involve questioning the effectiveness of the planning activity itself in certain fields.

The relationship between science and technology for development and planning presents the following alternatives:

- Planning of resources for science and technology without reference to the national development plan;
- Planning of science and technology within the framework of the national development plan;
- National planning which incorporates the science and technology dimension in the formulation and design of its action.

The first case is the most frequent, it being almost a natural consequence of the much-talked-of deparation of the government, the scientific-technological community and the separation apparatus. It results from partial efforts to achieve rationality without reference to national priorities, either because those priorities have not been defined or because their relationship with science and technology, especially within the narrow time limits of economic planning, is not apparent.

The second alternative describes the efforts which some planning systems of the region have made to seek some articulation between the action and resources related to science and technology and the priorities of national planning. The results of such co-ordination normally appear in some development plans as a chiefly editorial effort.

The third option, which at first sight may be confused with the one which precedes it, is the one which makes it really possible to put the science and technology dimension to the service of the practical construction of "desirable futures". In other words, it seeks to include the science and technology dimension in the government's decision-taking and to promote action in the national system in which the science and technology variable is appropriately handled, not as exogenous data, but as a "domesticated" variable subject to the conscious will of the decision-makers responsible for the national future.

The explicit incorporation of science and technology in planning is not a matter merely of including new elements in a partial or imperfectly understood national or regional system but also of throwing light on characteristics which have hitherto not been taken into account, in which new components and relationships

will appear and relationships which have already been established will be reappraised. In this connection the following points should be considered:

i) The research and scientific-technological development process is subject to much longer time cycles than those considered to be normal in economic planning. This characteristic makes it all the more necessary to work in the long term.

ii) Planning is a rational way of guiding a production system which exists and is in operation; the science and technology variable may give rise to activities which are non-existent in the system.

iii) Traditional economic planning operates well if the sectors are considered separately and are integrated only in the final process. The science and technology variable is always present in all national activities and therefore generates institutional problems of intersectoral co-ordination and vertical relationship.

iv) The economic process is becoming increasingly well known and is being directed towards a greater degree of rationality; the same is not true of the scientific-technological phenomenon, especially within the social perspective.

v) The traditional approaches to cost-benefit evaluation presents serious difficulties for those activities whose benefits, while being very late in appearing and highly dispersed, are of the utmost importance, as are the results of action and activities in the area of science and technology. New evaluation techniques of the so-called "multicriteria" type, in which representatives of the community participate, may be an alternative which should be explored.

vi) The introduction of the science and technology variable makes it obligatory to consider not only those groups which have so far been participating in planning but also representatives or components of the scientific-technological community.

It must be borne in mind that the incorporation of science and technology is bound to continue to be viewed with some indifference at the political level, where an attitude is maintained which causes technological options to receive marginal treatment. The general view that the science and technology variable is a factor which has already been determined by the "style of development" and the relationship with the central countries must also be challenged.

Even when planning constitutes a rational arrangement of decisions, other factors, such as ideologies; legislative pressure, the pressure of public opinion and electoral pressure; the technical apparatus of the government, and the centres of power and exterior activities, exert a strong influence on it. This characteristic, together with the growing complexity of the socioeconomic systems, makes it necessary to increase the efficiency and effectiveness of the planning process, which to a large extent is occurring as it persists and its selectivity increases.

When we examine the national decision-taking system and its interrelationships to determine the places in which the science and technology variable plays a basic role and where the rationality of a planned development policy is needed, the following areas become immediately apparent:

i) design of a standard model in which the political project should be reflected;
ii) analysis of the so-called "problem areas" in which the differences between the present situation and the proposed standard model appear;
iii) project design phase;
iv) action area consisting in the methodologies and machinery needed to be able to act: first, the improvement of planning and its action machinery, and second, the improvement of methodologies and machinery which make it possible to interact with the science and technology variable within the objectives of a planned development policy.

Attention should be drawn to the need to incorporate the science and technology variable in the formulation of images which are desirable and possible in the long term. This activity is oriented towards the exploration of the future, for the purpose of analysing the evolution of a national system, in respect both of its internal consistency and of its role in the international context. In conceiving a long-term image, thought should be given to social systems, natural systems, constructive systems, ideologies and science and technology; and since we are talking about a national image, which must necessarily be viewed within a world context, consideration should be given to the type of interrelationships which the role it plays in that context creates.

The scientific-technological community should, in the course of a continual dialogue, supply the planning system, with many technological, creative, timely and varied technological options and with a breakdown compatible with the design needs of a long-term image. In this way it might be possible to alter the immediatist nature of planning by incorporating trascendent national development objectives, establishing a valuation pattern in which the diagnostic function could refer to the "desirable future" and it could be decided what action or projects should be initiated in the short- and medium-term to achieve that "desirable future".

The main link between science and technology on the one hand and planning on the other should be incorporated at the highest possible level, without prejudice to intense contact at the lower levels in terms of co-operation on problems of a more specific nature. The scientific-technological community is normally not properly represented in those public organs which constitute the higher decision-making levels. It therefore seems necessary to design a body for participating in this process of incorporating the science and technology dimension and which would enjoy the confidence and participation of the scientific-technological community, remembering the role of the Academy of Sciences of the Union of Soviet Socialist Republics or that played not many years ago by the National Academy of Sciences of the United States of America and now played by the National Science Foundation (NSF). A similar role is played by the Scientific and Technological Policy Committee of the Organization for Economic Co-operation and Development (OECD).

Where concrete recommendations are concerned, we cannot fail to point out that it would be appropriate for the first dialogue between planners and scientists and technologists on a given project to be held at the "project idea" level. Normally, such a dialogue is not held or is held late, when the project is in the engineering stage and the design has become considerably more rigid. At this point many ideas and alternatives have already been discarted without having being duly

analysed from a scientific-technological perspective, all the effort being concentrated on bringing a single alternative to perfection.

An organization for science and technology should deal with problems such as:

i) long-term planning of the general objectives of science and technology;
ii) budget formulation and allocation of resources at operational levels;
iii) co-ordination between public research bodies, universities and the private sector, where needed;
iv) management and promotion of research and development activities and the executive function;
v) the provision of general advise on science and technology;
vi) handling those information activities not carried out by agencies specialized in that field;
vii) creating a climate of public opinion favourable to the development of scientific and technological activity.

There are at least two other functions of great importance which must be attended to. The first relates to the training of the staff required to take up the technological challenge. In connection with this function, attention should be drawn to the need for the incorporation of science and technology in the educational process from the earliest stages. The development of the students' inventiveness and "innovative potential" should be an active concern of the government, private enterprise and the universities.

The second and more important function relates to the participation of the scientific-technological community in the national decision-making process, either directly or through the national planning system.

To put these ideas into practice, requires a real "apprenticeship project", within the context of the region but also taking big national differences into account. There are no clear-cut responses ready for application. The search for such responses led in recent years to regional co-operation initiatives, consisting in a project for examining the real situation of the region as reflected in a small number of countries representative of it. It was thought that on that basis it would be possible to make some recommendations aimed at the appropriate incorporation of science and technology into development planning. This project has yet to be put into implementation.*/

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*/ See ECLA, Planificación, ciencia y tecnología y toma de decisiones para el desarrollo de América Latina y el Caribe, E/CEPAL/ILPES/R.38, 15 April 1981.