UNITED NATIONS

ECONOMIC
AND
SOCIAL COUNCIL

LIMITED

E/CEPAL/L.183/Rev.3
December 1978

ENGLISH
ORIGINAL: SPANISH

C E P A L
Economic Commission for Latin America

SCIENCE AND TECHNOLOGY IN LATIN AMERICA: REGIONAL DIAGNOSIS AND ACTION PROGRAMME

78-12-2923

CONTENTS

/INTRODUCTION

INTRODUCTION

1. In 1976, the Economic and Social Council of the United Nations recommended that a world conference should be held to study and determine new modes of co-operation in the field of science and technology,[1/] so as to foster closer and better relations between countries and strengthen their social and economic development,[2/] along the lines laid down in the New International Economic Order. It recommended that in earmarking the resources of science and technology, priority should be given to correcting glaring overall and local imbalances by removing obstacles to the free flow and appropriate application of knowledge. It was considered that this could solve critical problems and improve the capacity of all the countries for selecting and absorbing technical and scientific innovations, thus making possible due attention to the needs of broad sectors of humanity.

2. Attention continues to be given to the study and adoption of an overall unified scientific and technological development policy, and this has received encouraging support in Latin America and the Caribbean, where Governments and regional organizations have been expressing the desire to organize and promote scientific and technological activities in an effective manner, and make them compatible with development and co-operation criteria. Certain moves in this direction have already been studied[3/] and, generally speaking, they respond to the markedly inadequate nature of recent development experience in the region and to the expectations that technological advance might make it possible to overcome obstacles of a structural nature.[4/]

1/ Economic and Social Council, E/RES/2028 (LXI) and 2035 (LXI), August 1976.

2/ United Nations, Declaration and Programme of Action on the Establishment of a New International Economic Order, A/RES/3201 (S-VI) and 3202 (S-VI), May 1974.

3/ See Final Report of the Intergovernmental Meeting on Science, Technology and Development in Latin America (ST/CEPAL/Conf.53/L.5/Rev.1), México City, November 1974.

4/ See Report of the Latin American Meeting of Government Experts on Science and Technology for Development (CEPAL/MEX/ELCT/5/Rev.1), Mexico, November 1977, and the suggestions of the Latin American Group of the Advisory Committee on the Application of Science and Technology to Development (ACAST), Mexico, 1-2 June 1978 (CEPAL/MEX/ACAST/RGLA/1/2).

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3. It would be desirable to delve more deeply into the general and specific aspects of scientific and technological dynamics, at least in the following three areas:

(a) Analysis of the problems facing the Latin American countries, both in negotiating and absorbing imports of capital and technology from abroad, and in developing innovations at the local level;

(b) Study of the opportunities being opened up for encouraging increased collaboration among developing countries with similar problems - stemming from inadequate economic, scientific and technological progress - and their limited means of solving them. Common situations which are linked to historical events and similarity of stages of development are to be found, and also deep-seated differences. The former could lead to the establishment of combined technological development programmes which could contribute to overcoming the limitations. The latter should constitute the basis for technical assistance programmes among countries of the region. A better knowledge of these possibilities should therefore reinforce Latin American solidarity with other developing regions, through the sharing of technological co-operation machinery and programmes; this has already begun to happen and should be consolidated in the future;

(c) The countries of the region share an interest in obtaining trouble-free access to the store of knowledge possessed by the industrialized countries in order to help to solve the common problems affecting the developing countries in the use of science and technology in the development process. Consequently, more thorough study is required of possible forms of co-operation and of the machinery for negotiation.

4. The present document sets forth some ideas and attitudes which have emerged in the region vis-à-vis scientific and technical progress, and sums up the policies which have been applied in this respect with the aim of putting out ideas which, from the standpoint of Latin America and the Caribbean, will contribute to defining the concepts and aims of the United Nations Conference on Science and Technology for Development (UNCSTD).

5. It endeavours to analyse the principal aspects of the current scientific and technological development of the Latin American

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countries, with the basic aim of helping to establish in a programme the criteria and the machinery which will contribute to surmounting present structural deficiencies, and determine the factors which will make it possible to narrow the gap in technological know-how between the different countries and foster co-operation and solidarity among them. For this purpose it is necessary:

(a) To link the objectives of the action programme with the measures proposed in the New International Economic Order;

(b) To make a diagnosis of the situation of science and technology in Latin America and the Caribbean, and prepare a suitable action programme for a better response to these questions in terms of world and regional development, eliminating or neutralizing the determinants of the deterioration of the technological component of trade relations, increased technological dependence, the uneven progress of scientific potential and other cardinal questions;

(c) To stress aspects detrimental to social and economic progress and scientific and technological progress resulting from the negative aspects of international structures and the transnational corporations.

6. A first version of this document was presented at the Regional Preparatory Meeting for the United Nations Conference on Science and Technology for Development, held in Panama from 16-21 August 1978. At this meeting, the countries submitted recommendations to the secretariat on the regional document and on the proposals for the Action Programme.5/ The present version has been revised by the Secretariat in keeping with the recommendations of the Panama meeting, of the group of governmental experts which met at Mexico City from 30 October to 2 November 1978 and of the Second Latin American Regional Preparatory Meeting for the United Nations Conference on Science and Technology for Development.

7. This regional document outlines the circumstances which led to the convening of the World Conference and their repercussions in the context of Latin America; examines some characteristics of the development of science

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5/ See "Report of the Latin American Regional Preparatory Meeting for the United Nations Conference on Science and Technology for Development" (ST/CEPAL/Conf.66/L.3/Rev.1), September 1978.

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and technology in the region, relating them to features of its recent economic and social evolution; outlines the policies which have governed this development; and discusses aspects which these policies have left on one side, as well as institutional measures and new forms of international co-operation.

I. SCIENCE, TECHNOLOGY, DEVELOPMENT AND CO-OPERATION IN LATIN AMERICA

A. THE CONFERENCE AND THE PROBLEMS FACING THE REGION IN THE USE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PROCESS

8. The United Nations Conference on Science and Technology for Development (UNCSTD) should give priority to analyzing the limitations experienced in the main by the developing countries in using science and technology in their development processes, and to suggesting solutions for overcoming them, and then study the form in which international co-operation (multilateral and bilateral) can contribute to modifying the present situation.

9. In investigating these limitations, it must be borne in mind that it has not been possible to make adquate use of the historically unprecedented stock of useful knowledge available to resolve the basic needs of broad strata of mankind.

10. Science and technology integrate with the classic factors of production (natural resources, capital and labour), imbuing them with new potential, which is easily identifiable in the industrialized countries, and producing large-scale changes in the context and conditions of economic competition, and in the projections of sectoral and international interdependence. Although production activity and technology reinforce each other mutually, they result in periodic cycles of expansion and breakdown. But while those countries have an endogenous base of science and technology, scientific activity in the countries of the region has remained almost virtually isolated from the apparatus of production.

11. However, this is not the principal reason for the relative backwardness of scientific and technological development in the region. The cause should be more properly sought in the historic characteristics of the region, which are common to those of other developing regions insofar as their patterns of inclusion in the world economy are concerned. Starting with an initial substantial difference in the levels attained by technical progress in the central countries and in the countries of the

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periphery, the "raw materials" exporter model - which, except in a very few cases, characterized the economic development of the region for several decades - restricted dissemination of the technical progress of the regional economy to those areas in which it was necessary to produce raw materials and foodstuffs at low cost for the great industrial centres. Meanwhile, technical progress was disseminated in a relatively short period of time in these centres to the entire productive apparatus. Consequently, whereas the productive structure of the region remained specialized and heterogeneous, that of the centres was diversified and homogenous.

12. The familiar phenomenon of a deterioration of trade relations caused Latin America and the Caribbean to lose part of the fruits of the limited technical progress attained, which were transferred to the centres; this, in turn, prevented the necessary levels of savings and rates of accumulation from being attained, and consequently limited the possibilities for reducing the structural lag.

13. The process of substitutive industrialization that succeeded the model described above, although it made greater diversification possible, was not able to eliminate the lack of complementarity in the production sectors. Furthermore, as the capital goods producing sector continued to function essentially in the centre, the impetus of the investment effected in the region to minister to the internal market was directed towards the centre, thereby reviving the initial imbalanced situation at another level. In addition, modern technology demanded the establishment of productive units whose capacity exceeded the size of the internal market, consequently promoting the creation of monopolistic production structures in which transnational corporations have been playing an ever-increasing role.

14. The world picture of which technological change is part has moreover been undergoing changes of some consideration in recent years. This is the case both of the countries which generate technology and those which obtain it internationally. These changes condition the planning of technological policy in the different countries of the region.

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15. With regard to the countries which generate technology, the following facts are worthy of note:

(a) Some countries are acquiring relative importance as generators of technology; this reduces the relative bargaining power of the main traditional supplier country.

(b) A trend towards a slowing of the growth rate of the resources earmarked for research and development in several of these countries is to be observed, and simultaneously, an increase in the average cost of research activity. This last had led to the suspension of research programmes and to the fact that some transnational corporations are slowly beginning to shift research and development efforts towards other countries in order to rid themselves of the risks of pollution or to take advantage of lower costs.

(c) The rate of innovation is not the same in different branches of industry. Some industries - electronics and optics, for example show a notable speeding-up and concentration. Others, however - oil-refining, steel, motor-vehicles, carbochemicals, etc. - show slower progress. This unequal performance affects the scientific and technological gap separating this group of countries from the developing countries.

(d) Differences are also to be seen in the innovative capacity of different transnational corporations even in the context of enterprises producing goods for the same market, such as pharmaceuticals, steel and other industries, which means that some have lost ground, relatively speaking.

16. Some of the above factors have led to growing pressures to achieve a higher level of protection in some industrial countries. Generally speaking, the major research and development programmes would appear to be losing relative importance, while strategies which are very close to minor innovation (for example, differentiation of products, new forms of presentation and marketing, etc.) are gaining in importance.

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17. With regard to the variety of the advanced technologies being used, their degree of complexity and the extent of their dissemination within the production apparatus, it is necessary to recall the existance of certain developing countries - among which the three largest of the region - that have attained a stage of intermediate development that recent literature describes as "latecomers" or "newcomers",1/ and of others in which the mass of society is several decades behind the industrialized world and the developed sectors of the nations of the first sub-group.

18. The situation described, considered in conjunction with other variables, gives rise to a group of new occurrences in the Latin American scenario: (i) exports of manufactures of significant technological complexity (ranging from vehicles and machinery to antibiotics, by way of steel, chemicals and electronic products); (ii) sales - although still incipient - of technology through licences, the delivery of entire "turn key" plants, etc.; (iii) direct investment of Latin American capital; (iv) technical assistance in developing areas of the infrastructure, such as the nuclear energy industry, the highways and airport network, etc. All in all, these new technological-commercial manifestations - which occur both at the level of the subsidiaries of transnational corporations and at the level of local enterprises - are evidence of an incipient form of intra-regional "internationalization", almost unknown in Latin America to date.

19. To sum up, a complex, dynamic, technological programme of great structural heterogeneity is to be found both in the international scenario and in Latin America and the Caribbean. As a result, a useful diagnosis of the technological phenomenon should take account of the range of options and situations presented both in the countries offering technological know-how and in those acquiring it, and also consider the historical dynamics of the development process, and how science and technology find a place in it.

20. Although from the point of view of the economic analysis, a significant part of the technology may be considered to be another piece of merchandise that is sold on the international market, this market is influenced by a

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1/ A. Hirshman, in "The political economy of import substitution", Quarterly Journal of Economics, February 1968, was the first author to begin to use the term "late latecomer" to refer to Brazil, and to differentiate its industrial development from that characterizing Germany, Japan, and the Soviet Union several decades earlier; they in their turn were "latecomers" compared with Great Britain and the United States.

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series of factors which cause it to function imperfectly. The main factors are the inadequate dissemination of information,2/ the difference in the bargaining power of buyers and sellers, the variable presence of external economies in the technologies sold, the different degrees to which the profits from the expenditure on research and development are appropriable (in some cases the know-how created is more characteristically public property than in others), and other elements typical of oligopolistic markets.

21. For the above reasons, the price mechanism operates inefficiently in these markets, and fosters the generation of oligopolistic returns which are transferred to the sellers of technology, or does not provide sufficient incentives for research and development. Hence the intervention of the public sector is required to safeguard the economic interests of the developing countries.

22. The correction of the imperfect operation of the price system, however, would not be enough to achieve a volume and structure of expenditure on research and development, which would meet the needs of the population of the developing countries in particular. These countries lack adequate technologies for the mass production of food, housing, and health and transport services, etc., and it does not seem feasible to wait for technological know-how to be created spontaneously in these areas. The action of the public sector as financing and executing agent and disseminator of science and technology is therefore considered to be increasingly essential. It is also considered necessary that the productive sector should channel some financial resources to research and development to supplement State action and meet its own technological needs.

23. In the circumstances, international co-operation has an outstanding role. It should be borne in mind that the institutions and machinery established by the international community, including the United Nations system, have played a fragmentary and, to all intents and purposes, inadequate role in alleviating this situation.

24. The above considerations on the inequality of the countries in terms of the availability of science and technology, the concentration of technological progress and the limited applications of productive knowledge,

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2/ This gives rise to the famous paradox according to which the purchaser of technology has to acquire know-how too in order to know that technology is most suited to his needs.

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converge in one of the main problems brought before the World Conference: the limitations of the multilateral and bilateral machinery for increasing dissemination of the store of science and technology. The traditional systems of bilateral co-operation between the industrial countries and the countries of the region have moreover meant in some cases that the context for the selection of technology in investment projects is restricted to that of the countries providing the bilateral assistance, thus limiting autonomy of decision in technological matters.

25. Although the international community has established forums and procedures to deal with problems of the monetary system, financing and trade, science and technology have to a large extent been left on one side, except in certain bilateral forms of co-operation. The United Nations has set in motion a series of agencies and programmes which have tackled different aspects of technical co-operation in order to study specific aspects of knowledge, and has sponsored forums to examine the transfer of technology and industrial property. It has not, however, been possible to arrive at a unified conception of world scientific and technological development, nor does an adequate co-ordination system yet exist.3/

26. The Conference should provide indications which will make it possible to channel the action of the international community in a co-ordinated form so as to give impetus to the scientific and technological capacities that are both useful and essential for world economic, social and cultural development, taking maximum advantage of the restructuring of the United Nations system, and other elements and organizations which go to make up international co-operation. The form of dealing with this problem should be examined by the Conference and tackled in its longest term perspectives. In this task, the Conference should bear in mind the following elements, inter alia:

(1) The differences in circumstances existing between countries with similar degrees of development;

(2) The predominance in some country situations of obstacles to scientific and technological development arising out of the lack of national scientific and technological infrastructure.

3/ For a detailed examination of the background to UNCSTD see United Nations Conference on Science and Technology for Development: background, objectives and regional implications (CEPAL/MEX/ELCT/2), September 1977.

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(3) In other cases, the predominant lack of connexion between supply and demand in science and technology as a central obstacle.

(4) In further cases, the preponderant lack of harmony between scientific and technological development efforts and other national development efforts.

(5) Lastly, in a still different case, the existence of situations basically of an economic nature, which restrict the internal efforts of scientific and technological development.

27. Such restructuring should take into account the following problems affecting the system:

(a) Co-operation activities for development are commonly conceived in sectoral terms in accordance with the fields of action and interests of the offices, organizations or agencies of the system without analysis of the principal interactions that a well-founded development process should include among the various sectors forming the national realities of each country;

(b) United Nations aid for development programmes and projects is often based on the theoretical supposition that the evolution process of countries is linear in nature and composed of stages, and hence that it must follow the path taken by the industrialized nations. Such an imitative concept of development tends to reinforce the introduction of productive structures foreign to the developing countries, a factor that contributes toward inhibiting the creative capacity of these countries;

(c) Most of the aid activities carried out by the United Nations system are heavily influenced by the interests of the donor countries and the organizations that implement such activities;

(d) In many cases the numerous component parts of the system act in an autonomous and isolated manner without due consideration for the relations that should exist among the diverse sectors of the economy, thereby leading to a lack of co-ordination among programmes that should be considered as a whole;

(e) The ways and means, concepts, terms and deadlines for implementing co-operation programmes are decided upon in the respective headquarters, a fact that affects the efficiency and effectiveness of co-operation for development;

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(f) The technical departments of the offices, organizations and agencies of the system are principally concerned with the results of projects and do not pay sufficient attention to the training of human resources;

(g) Certain organizations of the system tend to promote the establishment of national institutions, which may prove to be counter-productive if the necessary co-ordination of the production sectors of the country is not given due consideration in order to prevent a repetition of the structural limitations affecting the United Nations system;

(h) Considerations of a technical nature prevail over economic, social or cultural considerations in the carrying out of studies, a situation that prevents interested countries from applying the conclusions drawn without producing serious social, cultural or economic disturbances.

28. As can be seen, the problems which have led to the holding of the Conference are not foreign to Latin America and the Caribbean; rather, they have been present in different guises throughout their development process. For this region, however, the choice is not between an indiscriminative transfer of know-how or a self-induced segregation of world scientific and technological flows; it is rather a matter of adding together an increase in local capacity and stocks and an intelligent selection of these technologies, and also including a discriminative selection of those elements of the traditional technologies which could contribute to the socio-economic development of the countries of the region. This will make it easier to meet the needs of the dynamic activities, and find the solutions required by the marginated sectors and strata.

29. This flexibility should not be considered in any way fortuitous. It reflects the characteristics of regional evolution and is part of the role which science and technology should play in removing the obstacles that hinder their development. In this sense, Latin America is called upon to formulate an agreement on the criteria and machinery which should be applied to mobilize its resources, whether locally or as part of the re-ordering of its external relations. This agreement could be reached during the preparations for the Conference, although in time it may acquire its own dynamics in keeping with regional characteristics and priorities. The

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responsibility of planning and co-ordinating the activities to be carried out will of course, devolve on the national governments; as they overcome resistance and distortions they will be able to imbue the consensuses obtained with vigour and realism.

30. The future restructing of international co-operation which should result from UNCSTD in support of the establishment of the New International Economic Order must cover at least five areas:

(a) Local creation and dissemination of science and technology;

(b) International transfer of science and technology;

(c) Support of co-operative programmes among developing countries in order to tackle specific lines of research, technological creation and exchange of information;

(d) Support of technical assistance programmes among developing countries based on the relative progress which some of these have achieved in specific fields;

(e) Financing of technological development.

31. It should be borne in mind that the institutions and machinery set up by the international community, including the United Nations system, have played a fragmentary and clearly insufficient rôle for surmounting this situation.

32. The full and adequate use of the United Nations system for a real application of science and technology for development should include the following basic aspects:

(a) Redefinition of objectives, policies and criteria, in response to the general desire to integrate science and technology in the establishment of a New International Economic Order.

(b) Adjustment of the objectives, policies and programmes of the United Nations system and other international agencies to the development objectives and the priorities agreed upon by the countries, especially the developing countries, at the national, regional or international levels.

(c) Harmonization in the objectives and policies of the different international agencies and co-ordination in their programmes so that they will converge - each in its own field of action - in a global programme which will avoid repetition and waste effort.

(d) Adoption of specific programmes which will really contribute to achieving development targets, by means of co-ordinated action which includes both the general and specific interests of the relatively less developed countries.

/B. DEVELOPMENT

B. DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN LATIN AMERICA

33. This chapter gives a general analysis of the milieu in which the use of science and technology in the development process takes place. It begins with a summary of the main characteristics of the region's economic evolution in recent years,[4/] and then compares them with the form in which the technological innovations have been carried out. Lastly, in view of the diversity of national situations, the outline of a framework representative of the capacities existing in the region to absorb and develop scientific and technological innovations is attempted.

1. Characteristics of the Economic Evolution

34. Although the examination of the development policy has not made it possible to clarify adequately the role which technical change has played, it is ever less frequently considered as an exogenous variable, and the great importance of local effort in the development of local capacity to make technological innovations is recognized.[5/] Mention has also been made of the possibility that the rate, nature and trend of the technological change taking place in a country have a close relation of interdependence with social and political processes and the general functioning of its economy. There can be no doubt that both the development style and strategy and the external factors which characterize international relations, in terms of the local utilization and transfer of science and technology, have a decisive influence on the type of technological policy which should be encouraged.

4/ For a more detailed analysis, see The Economic and social development and external relations of Latin America (E/CEPAL/1024/Rev.1), March 1977.

5/ In the course of recent years, the Economic Commission for Latin America, in association with the Inter-American Development Bank and UNDP, has investigated in detail the endogenous nature of technological creation in some branches of industry, in several countries of the region. A summary of the results arrived at can be found in Jorge Katz, Cambio tecnológico, desarrollo económico y las relaciones intra y extrarregionales de América Latina, Monografía de Trabajo No. 30, BID/CEPAL/36, August 1978.

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In each case, the role and participation of the State, foreign investment and public or private enterprises should be different, like the incentives or monitoring policies, and the relative priorities assigned to the different sectors of economic activity and to social development.[6/]

35. 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 designs originating abroad several years previously. Generally speaking, the 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.

36. 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 attained in other parts of the world. Modernization has been accompanied by processes of proletarianization of

6/ See Scientific and Technical Progress for the Development of Latin America (ST/CEPAL/Conf.53/L.3), Mexico 1974.

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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.

37. Health is another field towards which all the countries of the region earmark ever-increasing resources. Nevertheless, in most countries, the manner in which such services are organized - viewed in their broadest sense, which includes administrative organization - increases their costs disproportionately. For this reason they have solely benefited - and only to a certain degree - the urban, and middle and high income populations. The supply of these services suffers from technology that is inappropriate to the needs and possibilities of the countries of the region. Generalization of such technology would imply such high costs that it would probably be impracticable.

38. The region quadrupled its total gross product between 1950 and 1975, increased its output of manufactures by five times, its output of cement six times, its energy eight times, its machinery and equipment nine times, and steel fifteen times. These marked changes of scale were related to modifications in the structure of supply, and this important development of industry has placed the region in a position of being increasingly able to supply the transport, communications and construction sectors, and satisfy a consumer structure which covers non-durable industrial goods and important lines of durables. In many countries of the region, therefore, the development of certain sectors of basic inputs, such as steel and petrochemicals, which represent the first stages of heavy industry, is in full flood. Nevertheless, high levels of idle capacity continue to persist, coupled with insufficient patterns of consumption that prevent more harmonious industrial development.

39. In several countries of the region, this process has given rise to modern branches of industry which make increasing headway in the use of production processes and the manufacture of vanguard products which have succeeded in penetrating the export markets, both in the region and in some areas of the economically more advanced world. Alongside this industry, a stratum subsists whose importance is relatively much greater in terms of

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number of establishments and employment; it is composed of the medium-sized, small and artisan-type establishments, whose levels of efficiency are very low and whose contact with the modern sectors are minimal. The familiar problem of the structural heterogeneity which characterizes Latin America is thus brought into evidence.[7/] In the overall situation of the region, it may be observed that a minor section of the population works in the modern sector (barely over 12%), and yet this sector produces more than half of the goods and services. This situation is also seen in agriculture, where the modern sector also absorbs a small proportion of the labour force, and where the inequalities in productivity levels are similarly heightened.

40. The last section of the scale contains what is known as the primitive sector - in which agriculture, industry, trade and other services all have a share - which still absorbs more than one-third of regional employment, although it is estimated that its contribution to the product of goods and services is only 5%. A large proportion of agricultural employment (around 65%) and the agricultural product (nearly 20%) is linked to this primitive sector. It seems clear that an appreciable figure of rural own-account consumption is to be found here.

41. These strata - the technologically modern sector based on product designs and processes of foreign origin, the sector of medium, small and artisan-type establishments (industrial or rural), and lastly the primitive sector, obviously have a very unequal share in the absorption and adaptation of external technology, and in the local creation of technological know-how. They also profit very unequally from the benefits of modernization and technological change.

42. In the first of these sectors some local technological efforts, for the most part of a minor nature, may be observed, aimed at "adapting" imported technology to the national context. The empirical data available mainly refer to Argentina, Brazil and Mexico. Two studies on the manufacturing sector in Argentina show that annual research and development expenditure towards the end of the last decade fluctuated around

7/ See Aníbal Pinto, "Styles of Development in Latin America", CEPAL Review, first half of 1976.

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30 million dollars.[8/] This represented an approximate average of between 0.3% and 0.4% of the annual sales of the industrial establishments surveyed in these two studies. Other recent studies show similar figures, perhaps marginally higher in the chemicals-pharmaceuticals sector or in the area of electronic products. A recent report on the case of Mexico (which only covered institutionalized research, since the "innovative work devolving on production and maintenance staff, although certainly of importance for the industry of the country, was not discussed," puts expenditure on research and development in manufacturing in Mexico at around 12 million dollars, which is approximately equal to 0.1% of the value of production of the establishments involved.[9/] The situation in Brazil confirms the presence of research and development expenditure in the modern sector, and also shows the rapid growth of the research efforts carried out by the public sector.[10/] In these three cases mentioned, it is possible to imagine the 100 or 200 major industrial enterprises engaging in research and development expenditure which on average could be calculated at around an annual 150, 000 dollars per firm; this budget certainly allows them to employ experimental research and technological development teams which - again on average - could be composed of as many as 8 professionals and technical experts. As was indicated earlier, the technological efforts carried out by these engineering teams are basically of a "minor" nature and aimed at "adapting" technologies designed in more developed countries. A similar

8/ See, (a) J. Katz, Importación de tecnología, aprendizaje local e industrialización dependiente, Fondo de Cultura Económica, México 1976; and (b) National Institute of Industrial Technology (INTI), Aspectos económicos de la importación de tecnología en la Argentina, Buenos Aires, November 1974.

9/ The analysis of the case of Mexico may be found in CONACYT, Política nacional de ciencia y tecnología, Mexico, 1976.

10/ The present science and technology programme in Brazil implies a spectacular rate of growth in research activities. In 1968, annual expenditure on science and technology in this country was only 200 to 300 million cruzeiros (at 1975 prices), while in the present science and technology plan, annual expenditure of the order of 6 billion cruzeiros is being programmed for the first three years of the plan. See, II Basic Plan for Scientific and Technological Development Presidency of the Republic, Brasilia, 1976.

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situation was observed in Peru as a result of the technological research programme sponsored by ITINTEC in the industrial enterprises, although the volume of the investment per enterprise was smaller. It should be stressed that State expenditure on these activities has risen greatly in some countries. In Cuba, for example, the present budget for current expenditure on science and technology is over 75 million pesos employing over 21,000 people in some 105 units, more than one-third of which are related to the industrial and construction sectors.

43. In the intermediate strata of enterprises (industrial or rural) formed by a great number of medium and small establishments, the Latin American countries as a whole emerge as using technologies which cause pollution and are generally several decades behind the average technological practice of the modern sector. Both product design, the production processes employed and the equipment used correspond to much more primitive conditions and a family-type organization of a rudimentary nature.

44. Lastly, the primitive sector, the relative situation of which has deteriorated compared with the modern strata, has practically not undergone technological or organizational changes which provide evidence that it has emerged from a mere subsistence level. However, in some countries of the region, this sector possesses a traditional stock of technology which could be recovered and combined with scientific inputs to improve productivity and speed up the course of its activities. There are historical instances, particularly in the Incan, Mayan, Aztec and other pre-Columbian cultures, in which the technological correspondences adopted were in keeping with the environment and made it possible to meet basic human needs to some extent. This aspect is especially important in the construction of the habitat, in which side by side with imported technologies of limited application because of their high cost subsist individual or "informal" forms of empirical organization and technologies that have been developed by low-income groups. The "informal" system is also characterized by its decentralization, inasmuch as it is based on the active participation of the users in construction activities.

45. Scientific and technological progress has not always produced favourable results in the agricultural sector. Studies carried out by the United Nations Research Institute for Social Development (UNRISD) demonstrate with abundant

/examples that

examples that high-yield seed varieties (particularly wheat and rice), which created such high hopes in the 1970s, were, in almost all countries using them, especially beneficial to only a minority of producers. In this sense the "green revolution" contributed towards intensifying the processes of social polarization characteristic of agriculture in most of the countries in which it took place. Even governmental policies were not free of blame in this regard, inasmuch as the spectacular and rapid yields led to allocating resources to the few farmers who could make use of the new technology, thus acting in detriment to the great majority and, in some cases, at the expense of the basic foodstuffs of the population.

46. In addition, a great difference persists between the numerous endeavours in scientific and technological research related to agriculture for export and the paucity of studies related to the production of basic foodstuffs, despite the evident crisis of traditional systems of tropical subsistence agriculture (shifting cultivation method) leading to increasing deterioration of man/land relations.

47. Other phenomena have accentuated these trends and have contributed to reinforcing structural differences. During the present decade, the importance of external financing to cover the very large deficits in the trade balance and on current account has increased; on the other hand, the decisions of the transnational corporations weigh increasingly heavily on the regional economy.

48. Together with the changes described above modifications have been registered in the structure of exports and imports. In the former, a modest reduction in the degree of concentration of primary products is to be observed, while the share of manufactures has increased. This is particularly related to the growth of the modern sector and the consolidation of the transnational corporations. It should be recalled that in 1970 around 36% of regional exports came from transnational

/corporations, and

corporations, and this percentage does not appear to have changed markedly. In imports, the most important change was the smaller share of consumer goods and the increase in the share of capital goods.

49. No attempt is made here to give an exhaustive enumeration of the Latin American features which condition types of technological policy and inputs, and only those which seem most outstanding are mentioned. In addition to the relations with the exterior and the structural heterogeneity already discussed, mention should be made of the high rate of population growth in the region and its effect on the problem of absorption in employment, unemployment and the search for appropriate technologies, the notorious inadequacies of the educational system, and the relative abundance of natural resources, which place the region in a privileged position for the supply of specific products in the world context.

50. With regard to this, it is increasingly accepted that a well-founded use of these resources will depend on how far more modern techniques are used, in an effort which should take the form of the research and development of a vanguard technolgy. The region does have problems for which there is no solution in the industrialized world, such as, for example, the integral development of the tropical areas of the Amazon.

51. It must therefore be clear that the introduction of technology to the region should take place in terms of pre-existing situations and conditioning factors, and in each case seek the most appropriate means of action to achieve an efficient allocation of resources and the maximization of collective welfare. This could mean - as far as the modern sector is concerned - a group of instruments which will pave the way to the purchase of appropriate external technology under the best possible conditions, and the generation of local technologies in all sectors in which the existence of creative capacity or the desirability of autonomous technological development justify the earmarking of resources for scientific and technological research, and take due account of the priorities of the developing countries. With regard to the medium, small and artisan-type strate, the main objective of the

/instruments of

instruments of scientific and technological dissemination should be to reduce the relative dispersion to be observed in the efficiency of these establishments and the gap which generally separates them from the enterprises of the modern sector.

52. Lastly, with regard to the primitive sector, which mainly affects the rural areas, the public sector research programme should give priority to drawing up alternatives for implementing specific public works (rural roads, schools, etc.), or providing certain services (medical assistance, environment hygiene, etc.) or to the recovery and the appraisal of the traditional technologies mentioned above, and other machinery which will make it possible to absorb underemployed human resources.[11/]

53. A long-term perspective of the economic and social future of Latin America would make it possible to appreciate the complex and changing role which the science and technology variable must play. The dynamics of Latin American development have basically depended on impulses and pressures activated by local demand, external trade and the regional market, and the back drop to these has been constituted by the changes in income level and distribution.

54. In the industrial sectors, there has been some shift of the production units towards the region, as a result of the differences in labour costs. It usually takes the form of subcontracting and is manifested as highly labour-intensive activities with a high export tendency. These new activities are generally subordinated to the decisions of major enterprises, and receive from them technological, organizational and financial contributions, but are governed by global long-term policies which do not necessarily coincide with national interests. Although the governments have acquired experience in

11/ See UNESCO, Report of the Standing Conference of Directors of National Councils for Science Policy and Research of Latin American and Caribbean Member States (fifth meeting), (Quito, May 1978), Chapter II, Section E.

/establishing

establishing norms for the conduct of the transnational corporations, these are flexible enough to adapt to the most diverse restrictions without economic losses of any consideration.

55. Latin America should go forward in establishing policy instruments to strengthen and use local bargaining capacity in the context of a closer "horizontal" link with the developing regions of Asia and Africa and in the spirit of the Buenos Aires Plan of Action for Promoting and Implementing Technical Co-operation among Developing Countries, approved by the United Nations Conference on Technical Co-operation among Developing Countries, particularly with regard to Recommendations 22 and 23 of that document. In noting the comparison between the dynamics of development in Latin America, Asia and Africa, care should be taken not to introduce a new international subdivision of labour that would have an adverse effect on less developed countries or areas, and to avoid the creation of new hegemonistic centres. It is also necessary to make some pronouncement on the feasible and desirable targets of their development, taking into account the features peculiar to their present stage of evolution. Both question should be reformulated in the light of the characteristics of current technological dynamics at different levels.

56. 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 rate of development 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. All the foregoing

/determines

determines a structural heterogeneity of the demand for technology, both in its characteristics and the sources required to supply it.

57. These and other circumstances impose multiple requisites on the preparation of national and regional scientific and technological policies, and those for application vis-a-vis third countries, which should also possess the necessary flexibility to adapt to a milieu whose production universes and institutional structures are changing very rapidly.

2. The conformation of scientific and technological development

58. The general characteristics of the development described influence the form in which technological innovations are effected in the region. It was apparently considered that technological change represented an exogenous variable, independent of the economic policy, while at the same time it was assumed that the processes of accumulation and industrialization would spontaneously in due course generate local capacity to absorb, disseminate and create technical know-how. The results did not completely fulfill these expectations. Although it is true that manifestations of the scientific and technical revolution taking place in the industrial centres were transplanted through migrations, trade, investment and credit, this was only so to a limited and not very selective degree; the internationalization of technology was frequently accompanied by a regressive income process, and a favourable climate was created for luxury consumption supported by technologies which barely contributed to generating the necessary changes in production.

59. In the general context of limited dissemination and absorption, technical progress has been incorporated at very different rates, in accordance with regional heterogeneity in production and society. Generally speaking, the urban sectors linked to services, the industrial process and external trade, have adopted forms of conduct more or less modelled on those predominating in industrial societies; but in the strata which have evolved aside of the process of growth, technical change has emerged in an irregular form, producing instability in living and working habits.

/58. Comparative

60. Comparative studies show that these developments formed an indispensable part of economic growth and may be excused if it is borne in mind that even the currently industrialized countries only became aware of the scope of technology as a variable and mechanism of growth during the Second World War. Previously, awareness of the importance of this factor was merely intuitive.

61. Industrialization based on import substitution followed its upward progress, encouraged by regional transactions, the expansion of the domestic market and by external trade, without giving free rein (or only moderately) to the group of policies, measures and institutions which technological development required. Furthermore, owing to the increasing influence of the transnational corporations in dynamic activities, the machinery and the consequences of technological maturity took shape outside the realm of public policies. The basic reason for the lack of a relationship between the technological learning process - which includes all the elements of scientific and technological supply: academic and research centres, extension services, consultants and engineering firms and measures of legislative, financial and institutional support - and the evolution of the technical requirements associated with industrial development can be found in these facts.

62. On the other hand, the group of basically short- or medium-term instruments which make up the economic policy, have not had positive effects in achieving technological development with a higher level of autonomy. The limited foresight of the effects of industrialization based on import substitution (to some extent linked to excessively formal planning), the scope and nature of the changes and the development style suggested by these effects and the relative conformity vis-a-vis a development process which has been successful in terms of growth, led to the encouragement and prolongation of the application of these economic policy instruments. It may be argued that the measures of industrial protection - those which affect the relative price of the factors and the allocation of public expenditure, and those which encourage primary exports - have not contributed to the systematic

/stimulation

stimulation of the domestic supply of knowledge. This moreover required basic investment and long-term planning which the economic policy has apparently not been able to provide.

63. This discussion on the contradictory and inadequate nature of these instruments is more plausible if its scope is not restricted to the domain of the economy. After all, mistakes have also been made in the attention given to the scientific research system, to modes of investment in human capital and, generally speaking, to the educational and university field. These errors have affected national scientific and technological capacity, although in some specific sectors they may in fact have had constructive effects.[12/]

64. The complexity of the process described above is also influenced by the circumstances which adjust the transnationalization of the Latin American economy and society to the impulse of their own technical progress. The initial disadvantages created by substitutive industrialization lacking internal technical change and the ambivalent effects of the economic policy instruments are accompanied by a new set of factors (the industrialization of scientific research, oligopolistic competition between industrial centres and the transnationalization of the economic cycle and of the centres of decision) which have found a receptive milieu in some countries of the region which are at this stage of development.

65. In the Latin American discussion of this topic three interpretations would seem to exist: (a) the first is that only the technological options of the processes and products corresponding to the predominant line of the major economic centres, where scientific and technological research is intensive, exist in the region. Although there is a large-scale local learning process, it would seem to restrict itself to the passive or peripheral absorption of the prevailing technical and economic modules, or else to minor innovations which do not remedy the basic dependence;

12/ For this see A. Nadal, Instrumentos de política científica y tecnológica en México, el Colegio de México, Mexico 1977, and F. Sagasti, Ciencia y Tecnología para el Desarrollo: Informe Comparativo Central del Proyecto STPI, International Development Research Centre, Bogotá, 1978.

/(b) the

(b) the second is that there is a structural deficiency in national policies in this respect, which are forced to lag behind the orientations which the industrial laboratories of the major enterprises stamp on the rate and content of the innovations; while (c) the third bases itself more on real recent Latin American experience, and considers that if the predominant technical style were capital-intensive, and if this implied for some groups patterns of consumption similar to those observed in the industrial countries, the restrictions of this type of development would be magnified in the course of time, and the transnationalization of decisions, relations and innovations would increase this syndrome of initial and accumulated disadvantages.

3. Diversity and Common Actions

66. The degree of technological progress in the region varies from one country to another. Historically speaking, these differences originated in the specific situation of each country when it begun to emerge from the stage of primary exports. In the course of time, the differences were accentuated by the dissimilar stock of resources, institutional and political development and the course of the economic policy. A further contribution to these differences was that the major currents of modern thinking which supported the emergence of scientific awareness in society, had arrived and were absorbed in varying degrees by the different countries of the region.

67. These events are particularly significant in the domain of technology because the existence and organization of local resources and the characteristics of the intellectual movements condition the absorption and dissemination of technical changes to a large extent.

68. In order to establish a typology of national conditions, some criteria have been suggested which may better illustrate the form in which policies for science and technology should respond:

(a) In the first place, size (from the standpoint of demography, per capita earnings, and even size of territory or magnitude of resources) would appear to be an important variant in long-term national options.

/Historical

Historical and comparative analysis shows that size affects the structure of production, the ability to contribute and mobilize resources and the degree of complexity of the economic system. Size is a parameter of technological development, not only at the microeconomic level but also in the broader plane of national policy.

(b) Secondly, the industrial stage is important. In general terms, the contribution of secondary activities to the product has increased in all the countries of the region, but the degrees and trends of this growth are different. The relatively more developed countries have reached a level of semimaturity characterized by a large contribution by industry (more than 30% of the product), a considerable diversification which lately has stressed capital goods, and an orientation towards exports and increased spending on the learning process and industrial extension activities also related to the volume of qualified human resources available; these characteristics have placed them in a different situation to that of the less developed countries. Their semimaturity has made it possible for them to begin to obtain accumulative advantages at the technological level which, with an adequate regional technology exchange could be of great use to the relatively less developed countries.

(c) Thirdly, access to and share in the subregional integration systems have conditioned the development of the member countries by neutralizing to some extent the limitations of size and the current stage of industrial development. As a result of this system, complementarity and co-operation agreements have been reached, as has been seen in the experiences of the Central American, Caribbean and Andean Group countries.[13/]

(d) Fourthly, the degree of development of the educational system, its coverage and qualitative features and progress in scientific research activities constitute another element which permits the countries access to different possibilities in their scientific and technological progress.

13/ Mainly, with reference to decisions 24, 84 and 85 of the Cartagena Agreement, concerning the machinery for the transfer of technology, industrial property and trademarks to benefit the recipient countries.

/(e) Lastly,

(e) Lastly, the rate and nature of economic internationalization also represent factors of differentiation between national situations. It is not the same thing if this process affects strategic or marginal sectors, if it concentrates on the production stage or the marketing stage, if it is linked to forms of ownership or not, if it forms part or otherwise of oligopolistic relationships, or if it shows a tendency to grow or withdraw into itself.

69. The elements responsible for this diversity in the region constitute an incentive to enrich its capacity in the aim of developing societies that are in different stages of development, a prospect that is particularly valid for launching technological programmes and projects that require economies of scale of some magnitude. As may be seen, there are wide possibilities for co-operation and reciprocity in research, in the joint use of infrastructures (including industrial laboratories) and in information and the training of human resources.

/C. POLICIES

C. POLICIES FOR SCIENCE AND TECHNOLOGY. INSTITUTIONAL ARRANGEMENTS AND NEW FORMS OF INTERNATIONAL CO-OPERATION

1. Scope

70. The governments of Latin America and the Caribbean have been able to substantiate the importance and the multiple repercussions of scientific know-how in their respective countries. For this reason, they have set up specialized institutions and machinery with the task of structuring and promoting the science and technology system as far as is possible.[14/] The research centres which deal with sectoral aspects and train experts in specific matters have thus multiplied.[15/]

71. The institutionalization of certain policies is a process which has begun to acquire impetus during this decade in nearly all the continent although it began earlier in some countries. The aims of these policies were first of all to encourage scientific and technological research, secondly, to pave the way for a rational selection of imported technologies and counter the imperfections of the technological market, thirdly, and more recently, to encourage innovations and adaptations in the national context, particularly to benefit the least protected sectors of the population and the smallest production units; and lastly, to disseminate applications of science and technology to solve the most important problems of the countries (food, health, housing, employment, energy, exports, etc.) and at the same time

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14/ For further information, see Considerations on some recent experiences in the promotion of scientific and technological development in Latin America (ST/CEPAL/Conf.53/L.4) November 1974, and the report of the UNESCO Standing Conference of Directors of National Councils for Science Policy and Research of Latin American and Caribbean Member States (fifth meeting), op.cit.

15/ In the Dominican Republic, for example, more than half of the specialized institutes were established after 1962. University bodies were expanded and diversified during the same period, particularly in Mexico, Central America and Peru. See OAS, Inventario del potencial cientificotécnico de la República Dominicana, Washington, D.C., 1974.

/encourage the

encourage the absorption of scientific culture, i.e., a collective awareness of the importance of developing and stimulating the capacity to create.

72. This process of institutionalization should give attention to the social effect of technological change and proceed in keeping with the social and economic development of the countries. In order to carry out the priorities established by these policies, and in particular progress towards a greater degree of technological autonomy, account should be taken of: (i) factors of an internal order, such as local legal and financial conditions, and (ii) at the international level, activities aimed at changing the institutional framework containing the scientific and technological development process; these include the adoption of a New International Economic Order, the Lima Programme (United Nations Industrial Development Organization), the Charter of Economic Rights, and Duties of States, the international code of conduct being prepared by the United Nations Conference on Trade and Development (UNCTAD) for the transfer of Technology, the Paris Convention revised by the World Intellectual Property Organization and other instruments of technological co-operation, of a multilateral and bilateral nature.

73. One of the basic problems arising in the management of science and technology, is that present practices of economic appraisal do not give objective consideration to the economic viability of investment for scientific and technical development; although methods have been evolved for making an economic and social appraisal of the positive results of science and technology, the effects of the preponderant uncertainty of this activity often constitute a restriction on its financing in developing countries. National and international financing machinery frequently make use of this ommission in order not to accept projects with a high content of scientific and technological research, even when they are clearly viable.16/ For the same reason, the appraisal and follow-up of national efforts in science and technology - in the few cases in which they have been made - lack solid bases.

16/ There are, however, some exceptions, such as the loans by the Inter-American Development Bank (IDB), earmarked for expanding the infrastructure of research, and the group constituted jointly by IDB and CEPAL for research on the technological development of the region.

/Consequently, the

Consequently, the pertinent decisions are difficult to take, and frequently are not taken among other reasons because the techniques and criteria of appraisal have not been adequately developed. It is therefore considered a matter of urgent necessity to make changes in the traditional finance systems, so as to achieve adequate support for the efforts being made nationally, regionally and internationally in scientific and technological research. One of the basic problems arising here is the need for this financial contribution to absorb the risk implicit in any technological research, as well as that implied in the use of technology arising out of these research activities.

74. With reference to this, and considering the Declaration on the Principles of Scientific and Technological Policy,17/ and resolution 87 (IV) of UNCTAD, on the scientific and technological capacity of developing countries, an awareness that scientific and technological development in Latin America and the Caribbean constitutes a dynamic variable, without which it would be impossible to achieve the targets of economic, social and cultural development which the countries of the region have set themselves, is desirable. It is also necessary to identify the bases of scientific and technological policy which, according to the consensus arrived at in the Quito meeting referred to, are essential if science and technology are really to be projected successfully at the economic, social and cultural levels.

75. In an endeavour to achieve these aspirations, institutions have been set up (science and technology councils, industrial information centres), laws and rules have been adopted, as well as standards for regulating foreign investment, and even patents and trademarks, and other provisions have been made, including scholarship programmes, stimuli to local engineering and consultants' firms, etc. The activities of the public sector have also been expanded to deal with new types of problems and

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17/ Adopted at the UNESCO Standing Conference of Directors of National Councils for Science Policy and Research of Latin American and Caribbean Member States (fifth meeting), Quito, Ecuador, in March 1978.

/procedures, relating

procedures relating to technology. More effort has also been put into expanding expenditure earmarked for scientific and technological research, and at present an effort is being made to give the different instruments of technological policy a more organic structure. Monitoring mechanisms have also been set up (such as technology registers) but their application has come up against numerous problems which must be analysed in order to make the necesaary rectifications.

76. Initially, the institutionalization of scientific and technological policies took its inspiration from the efforts made by the industrialized countries to regulate the rate and trend of scientific and technological activities. In certain industrialized countries, institutions and programmes for these purposes already existed in the 1920s; this activity acquired greater impetus during the Second World War, when specific experiences and detailed studies showed the economic, social and military importance of scientific research. However, scanty attention was given in the region to different contexts in which such policies were applied. In these countries, scientific and technological research leads directly to the development of production techniques, while in the region this is not the case, since stress is laid on the incorporation of foreign technology.

77. Various external circumstances influence the determination of the guidelines adopted by science and technology in Latin America; for example, the interdependence which has existed among the industrialized countries in recent decades has given impetus to a great technical progress, which on some occasions has been determined by abundant investment in basic and applied research,[18/] and on others by the unparalleled expansion of world production and markets. The industrialized countries of market economy in their turn have been engaged in a genuinely oligopolistic struggle among themselves, the result of which has been that some countries

18/ Expenditure on research and development by the industrialized countries expanded considerably after the last war, at annual rates of more than 20%, while it reached more than 2% of the gross domestic product in all these countries; it should, however, be borne in mind that in some of the countries the proportion earmarked for war research is very substantial.

/are disposed

are disposed to negotiate with third countries under more favourable conditions. Linked to the above, there has been the growing influence of the transnational corporations in the region which usually impose their criteria with regard to the production and marketing of goods and services, and also frequently hinder the transfer of technology.

78. Sales of technology by these corporations grew outstandingly during the first five years of the 1970s, increasing from 2,700 to 11 billion dollars. Although the developing countries only accounted for 10% (and Latin America 5%) of this figure, it is estimated that if present trends are maintained, purchases of technology by this group of countries from the corporations in 1985 could amount to 6 billion dollars.[19]

79. The availability of researchers in Latin America is notably limited (one per ten thousand inhabitants, compared with the United States and Western Europe, where the proportions are 40 and 30 respectively while the investment earmarked for these activities varies patently. For example, in the United States around 115 dollars per person is spent on scientific and technological research (including defence research), while in the Latin American countries, this figure fluctuates between 40 cents and 2 dollars.[20] The same difference exists in all aspects. The expenditure of the industrialized countries over an extensive period constitutes an accumulated stock, which in addition to the volume of the expenditure places the industrialized countries in a position in which they are very difficult to overtake.

80. There are also disadvantages of a local nature. The increased responsibilities which the public sector is required to take on in this

19/ See United Nations, Transnational Corporations in World Development: a Re-examination, New York, April, 1978.

20/ The lack of proportion is still very considerable if expenditure on armaments research is excluded in the case of the United States.

/field come

field come into conflict with a situation which, until recently, underestimated the importance of technological factors in solving the region's basic problems (the slowing down of industrialization because of technological barriers, unemployment and underemployment accentuated by the lack of technical training and by the indiscriminate use of technologies, and an agriculture lacking in secondary inputs). Owing to this, they have barely been taken into account in defining the economic policy and in global planning.

81. It should be added that these discrepancies do not only reflect a defect or gap among the many to be seen in planning in Latin America, but also that the economic policy is out of step with technological policy as an endogenous variable. A more deep-seated phenomenon explains the lack of decision in the public sector in opting for the decided encouragement of endogenous scientific and technological development. An undertaking of this kind by the state would involve for the public sector a new statement of aims and the use of different instruments. It would be of very little use, for example, for scientific policy to be aimed at the formation of resources and the study of technical requirements to produce capital goods if the economic policy continued to be oriented towards imports of these goods. This shows that one of the central problems is the handling and promotion of the demand for local scientific and technological activities, in such a way that the economic development process will reinforce this activity and at the same time benefit from it.

2. The role of science and technology in development

82. Despite the fact that different approaches exist in Latin America as in the rest of the world for describing the role of science and technology in development, the ideas that have been presented and

/discussed in

discussed in various intergovernmental forums[21/] and in studies by regional experts[22/] coincide in indicating three large areas deserving of attention: the pluralistic nature of the technological process, the role of science within this process and the development of this process within overall national and regional development plans.

83. The pluralistic nature of the technological process. The evolution and development of the technological process within national and regional contests are of a pluralistic nature that is manifest in the use of intermediate technologies to solve radical and transitory problems in certain fields of production and in the use and incorporation of advanced technology of strategic significance in national and regional economic development. In this context it is considered that national technological systems should investigate and apply different options on several levels that will not only resolve transitory deficiencies but also provide a wide range of technological solutions in accordance with the complex realities of the countries of the region.

21/ These forums represent an awareness and a weighing-up of ideas for action. The presidential meeting of Punta del Este (1957), the Conference on the Application of Science and Technology to the Development of Latin America (CASTALA), held in 1965, the Conference on the Application of Science and Technology in Latin America (CACTAL), in 1972, and the CEPAL Meeting on Science, Technology and Development in Latin America in 1974, may be recalled, as well as the specialized meetings of directors of scientific policy and experts in the different aspects of this topic sponsored by UNESCO, UNCTAD, WIPO, the Organization of American States (OAS) and others.

22/ Apart from the studies quoted in the CEPAL document, see Considerations on some recent experiences in the promotion of scientific and technological development in Latin America, op. cit. The Regional Plan of Action on Science and Technology for Development prepared by the experts of the Advisory Committee should be recalled. Also see the different documents drawn up by the joint IDB/CEPAL Technology Programme, and the research carried out under the project for scientific and technological policy instruments, sponsored by the International Development Research Centre (Canada); see Ciencia y tecnología para el desarrollo: Informe comparativo central del proyecto STPI, Bogotá, International Development Research Centre, 1978.

/82. The role

84. The role of science in the technological process. The role that should be played by science in the technological process has been widely discussed, and although such discussion is still characterized by radical positions, a generalized consensus exists that science in the region has at least two functions - albeit of varying nature - that are mutually helpful and complementary. These functions are: (a) the generation of "pure" scientific knowledge without immediate relation to the technological process, but as a necessary element and as a particular contribution to universal scientific knowledge; and, (b) serving as an input for the technological development process in its explicit function as a generator of ideas and methodologies for practical application. It is obvious that the proportion in which these two functions manifest themselves depends to a large extent on the relative stage of development of national science and technology systems.

85. Development of the technological process within overall national and regional development plans. The problem of development of the technological process within overall national and regional development plans includes the following elements: human resources, the production infrastructure and general development policies.

(a) Human resources. The problem of training resources for generating, adapting, managing and marketing technology is at the very base of the process of technological development, and within this problem are included the solidity of national educational systems and the link between higher education systems and the production apparatus.

(b) Production infrastructure. The extent and solidity of the production apparatus are a determining factor in the style of national technological development, since to a large extent they determine if a given style will incline towards one of the options offered by such development. It appears evident that such infrastructure, in conjunction with the availability of human resources, the specific possibilities for autonomous development, interdependence and regional co-operation.

/ General

(c) General development policies. There is generalized concurrence that the world economy is initiating a process of complementarity and interdependence. This situation implies various national and regional policies and strategies, such as:

(i) Orientation of national economies so as to benefit from this situation by identifying some subsector, branch or activity as an axis for their development in which factors of size and geo-economic location are not an obstacle to the development or adaptation of specific technologies;

(ii) Gradual detachment from the hegemonic centres of technology as an incentive for endogenous development of technology; and

(iii) Rectification of the patterns prevailing in international technology transactions to bring them into line with the principles of the New International Order.

86. Nevertheless, the strategy selected notwithstanding, countries should adopt national, regional and international policies that take into account the situations existing in the various areas mentioned that lead systematically to the achievement of specific goals. Only continued efforts in this sense will ensure surpassing present stages of development. The most urgent difficulties will be able to be eliminated by applying a general economic policy if such a policy, in addition to long-term objectives, takes into account the immediate needs involved in technological development.

87. The lively debate on these topics in Latin America has filtered through to a large part of the developing world and has also illustrated the main concerns of regional scientific and technological policy.

3. The problems

88. Science and technology in Latin America are facing extremely complex problems. Human, scientific and technological resources on the academic level are insufficient and unevenly trained; investment is limited and lacking in well-defined criteria; marked dependence on the

/technologies

technologies of transnational corporations prevails; the use of international co-operation is defective and irregular; and there is a significant amount of emigration of skilled professional personnel.

89. In many cases the number and academic training of Latin American researchers is below what international competition and the State might require. The majority only possess a first academic degree, and less frequently a master's degree and doctorate, either because the post-graduate institutions are few or non-existent, or because local demand has still not had need of this academic level.

90. The scarcity of these graduates is due in second place to the fact that research as an exlusive occupation is not a generalized phenomenon; part-time work is common and this more than proportionally reduces the productivity of the scientists. Thirdly, the researchers normally do not respond either to the specific demands of the public or entrepreneurial sectors, but to individual interests which do not always coincide with the country's collective interests. For example, in one country in the region, two-thirds of the projects prepared by research institutions were not covered by external contracts nor had any direct application to any industry.[23/]

91. Generally speaking, researchers work in small groups; this explains why the projects prepared by two or three researchers have a limited scope and are aimed at problems of little magnitude; cases occur in which the number of projects is greater than the number of researchers. These circumstances aggravate the difficulties and detract substantially from the impact which the researchers could have in the scientific and economic sphere.[24/] It cannot be ignored,

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23/ See OAS, Ciencia e industria. Un caso argentino, Washington, D.C., 1974.

24/ A rough indicator of scientific margination is the fact that only two Latin Americans have received the Nobel Prize for Science out of a total of 313 awards.

/however

however, that in some circumstances these small groups (of less than the critical mass) constitute nuclei of "cultural catalysis", essential for initiating the process of getting off the ground at a later stage.

92. In Latin America, the funds available for research and scientific and technological development are insufficient for the needs of the region; furthermore, they are used mainly to cover current costs and their allocation is selective to a very small degree.

93. The financing of research presents aspects of particular interest: first, with regard to the mobilization of additional resources;[25/] secondly, with regard to organization and budgetary programming;[26/] thirdly, with regard to the criteria applied in the selection of projects (for example, in programming and investment, linked to science and technology, the criteria for selection should be different from those which apply to the physical infrastructure); fourthly, with regard to methods for evaluating expenditure, which involve very complex methodological questions. Specific studies on the subject should have top priority in the future. Both with regard to the training of human resources and in matters of financing, the central problem is to have access to a critical mass of resources which will ensure their self-supported growth.

94. It has already been observed that the relations existing between the main actors of technological change (universities, scientific and technological research institutes, the production sector and the government) suffer from defects. There are also difficulties of communication in the different phases of the development of research, ranging from

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25/ Argentina, Peru and Brazil have put into practice original formulae, such as the allocation of a certain percentage of the credits granted by the industrial and development banks to technological research work, the constitution of rotary capital risk funds and the earmarking of a percentage of the profits earned by the enterprises for technological research.

26/ See an essay on this subject by COLCIENCIAS, with the co-operation of UNESCO: El proceso de programación presupuestaria para ciencia y tecnología en Colombia, Bogotá, 1977.

/basic

basic and applied research to technological innovation in experimental plants. The inadequate co-ordination existing between ministries of education and labour, and between these ministries and the academic centres is well known, for example. Owing to this, a scientific and technological policy has to deal with separate units which respond to their own traditions and interests, although all independently influence the accumulation and dissemination of technological change.

95. On the external front an additional group of problems is to be observed deriving from the manner in which transnational corporations operate when they act as vehicles for the transfer of technology. Independently of the effects which they produce, there would appear to be a consensus from the economic standpoint that these corporations, with the advantage of their technological and integration-oriented dynamics, of the innovations which they handle in the general context of the enterprise transfer those of lesser importance. Apart from this, their influence is usually counterproductive in other senses: they frequently impose restrictive practices with regard to the supply and marketing materials; they affect consumer patterns, inducing an artificial differentiation of supply, and consequently influence the pattern of the demand for technology.

96. On the other hand, international public and private co-operation in this matter often give very debateable results, especially because of the lack of clarity with which national requirements are defined. External co-operation can only be a valuable instrument in so far as the scientific and technological policy determines and selects the true areas of national interest.

97. It is, however, necessary to stress that even if national priorities are defined clearly, international technical co-operation for the development of investment projects, especially bilateral and private investment, frequently introduce an element of predetermination with regard to the choice of technology, in terms of the country of origin providing the assistance. This restricts the technological self-determination of the countries of the region.

/96. It is

98. It is also necessary to stress the problem of the movement of trained personnel across national frontiers, as closely bound up with internationalization and local inadequacies. Information available in this respect is not consistent; it usually refers to a single country (the United States), mentions "professionals, technicians and similar workers" and does not indicate cases of return to the country. With these reservations, it should be observed that the total number of migrants for the period 1960-1970 was close on 47,000.[27/] More accurate estimates referring to a country and in particular to its scientific resources show that the emigration has a wide compass; in some countries it is caused by economic factors and should be attributed to a fuller awareness of certain merits and to political circumstances.[28/] In recent years the migratory flows of scientists within the region would appear to have become more intensive.[29/]

99. It is of particular importance for developing countries to have their own personnel trained in science and technology. They are an indispensable vehicle for the assimilation of the benefits contained in the transfer and adaptation of imported technology, and for the progressive development and utilization of national technologies. The efforts and resources which these developing countries put into training this personnel are affected by the reduction of their scientific and technological stocks, as a result of the drain of their professionals

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27/ OAS, II Seminario Metodológico sobre Ciencia y Tecnología, Bogotá, Colombia, 1972.

28/ See UNCTAD, Major issues arising from the transfer of technology to developing countries, a case study of Chile (TD/B/HC.11/20), May 1974.

29/ See UNESCO, Colombia, Informe Nacional, presented at the Standing Conference of Directors of National Councils for Science Policy and Research of Latin American and Caribbean Member States (fifth meeting), Quito, March 1978, and R. Brezzo Paredes, La problemática de la transferencia de tecnología en el Uruguay.

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towards developed nations. This phenomenon in fact constitutes an inverse transfer of scientific and technological know-how and human capital.

100. Among other problems which merit attention in the Latin American context mention may be made of: (i) the scanty attention which has been given to the development of science and technology from the standpoint the requirements of the sectors of production, and in particular, the lack of directives with regard to the adaptation of imported technology, while the lack of support for the minor innovation activities of the enterprises slows down the absorption of technical know-how by the sectors of production; (ii) the lack of promotion given to the use of local technologies and lastly, (iii) the absence of links between the activities for the generation of scientific and technological know-how and the evolution of production technologies, which leads to the relative isolation of the creators of know-how on the one hand and users on the other.

4. The instruments

101. Among the developing countries those of the region have accumulated wider and more diversified experiences in the formulation of various instruments of scientific and technological policy. Some of the instruments, of national and regional scope utilized are well-rooted in the past, since they are founded on initiatives undertaken by academies of science, universities and certain government bodies; others are new, having emerged from critical revision of a legal ordinance and practices that have governed the transfer of technical and scientific knowledge.

102. In order to facilitate the analysis of instruments of scientific and technological policy, a distinction will be made in following paragraphs between those intended for policy formulation, those which promote the production of technologies, those applied to regulate technology imports, those

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directed at the adaptation and incorporation of technology in the production sector, those which motivate the demand for locally-generated technologies, those destinated for dissemination and information, and those concerned with the training of human resources.

103. Among the instruments for the formulation of policies, mention should be made of the establishment of national science and technology councils or of national institutions for scientific and technological planning and research. The aims of such bodies are to formulate science and technology policies and implement development plans and programmes in this field. For example, the setting up of a council of this type by a country in the region[30/] brought about a large-scale structural modification of the national science and technology system[31/] without affecting the autonomy of its different components. The new organization assumed the task of identifying and indicating the priority of objectives, targets, policies and programmes for the scientific and technological development. The national research councils of several countries of the region forming part of the Office of the President of the Republic are also organizations for co-ordination, promotion and aid in this field. One country has a specialized organization at the ministerial level[32/] that is in charge of directing, co-ordinating and regulating the application of State policy in science and technology. Among its activities it includes questions of industrial ownership and the national scientific and technological information system.[33/]

104. One of the national science and technology plans presently under way in Latin America[34/] provides a good example of the accuracy with

30/ The National Council for Science and Technology (CONACYT) of Mexico, established by presidential decree in December 1970.

31/ See Mexico: National Report, presented by CONACYT at the Latin American Regional Preparatory Meeting for the United Nations Conference on Science and Technology for Development (Panama, August 1978).

32/ State Science and Technical Committee (CECT) of Cuba.

33/ See M. A. Fernández Finalé and others, Resumen de la política e instituciones relacionadas con la planificación y transferencia de tecnología en la República de Cuba (UNCTAD/SIDA/III/DT.22), April 1978.

34/ Second National Science and Technology Plan of Brazil (1975-1979).

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which the objectives and instruments must be defined so as to obtain the greatest possible benefit from international scientific resources. This plan stresses import substitution in basic inputs and capital goods, constraint on and substitution of demand for some petroleum products (use of alcohol of vegetable origin to complement gasoline) and the diversification of imports.[35/]

105. The aim of these institutions responsible for formulating and setting in motion scientific and technological policies could be summarized as: co-ordinating and interrelating the different components of the scientific and technological systems; strengthening the infrastructure and general supporting services; mobilizing internal and external resources; expanding the programmes for the training of human resources through scholarships; and disseminating the important results of basic applied research and technological innovation. Latterly, a special effort has been observed directed towards establishing priorities - an essential requirement for the integration of technology to the strategies and plans for socio-economic development.

106. Another type of instrument for policy formulation consists in setting up liaison units between the ministries of finance and the science and technology councils, to reach agreement on the amount of the expenditure and criteria for distribution. In Mexico, for example, progress has been made in this direction, with the proposed establishment of an interinstitutional commission on science and technology, composed of various government bodies that analyses the financial aspects of the science and technology development programmes, including the draft federal budgets, so as to improve the coherence of the process. In the same area, Colombia is setting up a mechanism for programme budgets, financed from the general budget; this mechanism

35/ See Consejo Nacional de Pesquisas del Brasil, Country Report of the UNESCO Standing Conference of Directors of National Councils for Science Policy and Research of Latin American and Caribbean Member States, Quito, 1978.

/is applied

is applied in two phases: in the first phase, the science and technology activities to be carried out by public institutions are identified on the basis of the draft budget forms; in the second phase, the targets and programmes are established, the executing institutions designated and the agreed resources allocated.

107. The instruments which promote the production of technologies include the creation of industrial and agricultural and technological research institutes which provide specialized sectoral services, in some cases to solve immediate problems and in others to provide the advisory services and training required by the production units.[36/] Recent efforts to create new technologies in the region in keeping with specific needs should also be recalled, (for example, the production of rubber from "guayule", steroids from yucca, pharmaceutical products from corals); an improved use has been made of sugar cane bagasse, and alcohol (methanol) used as a source of energy. Furthermore, financial machinery has been designated to foster the production of technology in the countries of the region.[37/]

108. The instruments to regulate imports of technology assume different patterns in the region. In several cases they have taken the form of national registers, and in others they constitute royalties committees. The objectives are the same: the standardization of royalty payments, the suppression of restrictive clauses in technology sales purchase contracts

36/ For example, the National Institute for Industrial Technology (INTI) of Argentina and the Institute of Industrial Technology and technical Standards (ITINTEC) of Peru; the network of sectoral technological institutes set up in Brazil and the Institute of Technological Research of Colombia, the research units of the Academy of Sciences of Cuba, the technological research intitutions created in Paraguay and Chile, the Central American Institute for Research and Technology (ICAITI), the Nutrition Institute of Central America and Panama (INCAP), the Inter-American Institute of Agricultural Sciences (IICA) and the Caribbean Industrial Research Institute in Trinidad and Tobago (CARIRI).

37/ Mention should be made of the funds set up by Brazil (FUNTEC and the National Fund for Scientific and Technological Development), the sectoral funds for industry, mining, fisheries and telecommunications, set up in Peru, and the fund managed by CONACYT in Mexico and linked to the indicative programmes.

/and advice

and advice to local entrepreneurs in their negotiations with the suppliers of technology. These agencies act within the context of the general policies which rule industrialization, external trade and foreign investment, and are usually subject to contradictory orientations in keeping with the conjunctural changes which usually emerge in these policies.

109. Activities to regulate imports of technology are backed up by legal instruments that define objectives and areas of action 38/ and are aimed at avoiding excessive costs or harmful restrictions in contracts for the transfer of technology and regulating the granting of invention patents and the registration of models, trademarks and indications of origin. In this respect it is appropriate to mention the different provisions adopted by the Board of the Cartagena Agreement. Decision 24 of the Agreement, complemented by other instruments concerning questions of industrial property and technological activities which include trademarks and subregional co-operation, constitutes one means of an integrated endeavour to deal with the different machinery to strengthening the bargaining power of countries receiving technology.

110. One mechanism that has aroused great interest in the region in recent years and regarding which significant experiences have been reported within the context of the Andean Pact is the breakdown of the "technological package" which, while making it possible to select imported technology more rationally, also provides greater opportunities to the supply of endogenous technology.

111. The instruments directed at the adaptation and incorporation of technology in the production sector endeavour to mobilize resources in

38/ For example, the Law on Intellectual Property of Costa Rica and the Law on Inventions and Trademarks of Mexico, which regulates the granting of invention and improvement patents, invention certificates, the registration of industrial models and designs, and trademarks and indications of origin.

/the enterprises

the enterprises themselves. For example, in one country relatively small percentages - although in some cases they are fairly sizeable - are deducted from the net income of the enterprises to support research and development projects which the enterprises themselves cannot undertake. In two other countries of the region special lines of credit are set apart to promote scientific and technological activities of the enterprises. It should, however, be noted that, as was said earlier, sufficient attention has not been given to the creation of machinery to motivate the adaptation and absorption of technology by the production sector.

112. Although various instruments exist in the countries of the region that motivate the demand for locally-generated technologies (for example, industrial development institutions, the use of State purchasing power, and fiscal-type incentives), in practice their effect is very limited for different reasons; these include a lack of acquaintance with the local options existing, the risk, the lack of confidence in local technologies and the pressure of the international financing agencies. However, there is at least one example in the region where the modes of industrial financing and State purchasing power are oriented towards greater utilization of national technologies and engineering firms.

113. A great variety of instruments exist in Latin America and the Caribbean with regard to information and dissemination to convey to enterprises the knowledge they require for technological decision-making. At times special organizations have been set up for this purpose;[39/] and in other cases the institutes for technological research or industrial promotion themselves exercise these functions.[40/]

39/ Trust for Technical Information for Industry (INFOTEC-CONACYT) of Mexico. Domestic regional centres for technological research and assistance (CREAT) are also being set up in this country as part of a joint programme with UNDP and UNIDO, two of which are already in operation in Guanajuato and Guadalajara.

40/ Institute of Technological Research (INTEC) of Chile, and Institute of Industrial Technological Research and Technical Standards (ITINTEC) of Peru.

/In addition,

In addition, the Board of the Cartagena Agreement has undertaken activities to set up a subregional information system, and the Latin American Economic System (SELA) is setting up the Latin American Network of Technological Information (RITLA).

114. The instruments for the training of human resources are of fundamental importance in all aspects of scientific and technological matters. Interest exists in the region in encouraging greater participation by universities, technical institutes and training centres in the activities of technological research, control of the transfer of technology, technical information and the like, and in establishing ties between the educational system and the organizations responsible for implementing national scientific and technological policy. Furthermore, in the aim of increasing skilled human resources in accordance with national development needs and plans, fellowship programmes have been set up in several countries, and impetus is being given to practical training through the direct participation of technicians and professionals in these activities, particularly with regard to those involving the negotiation of technology and breakdown of the technological package.

115. It is evident that the analysis and appraisal of each of the groups of instruments require detailed studies which have not yet been carried out. The project on instruments of scientific and technological policy mentioned previously constitutes a first step in this direction.

5. Final considerations

116. The objections to the idea of guiding scientific and technological development would seem to have been overcome, since time has shown that this development cannot be subordinated to the interplay of external influences and internal pressure groups whose objective is not economic and social development seen as an integral process. The role of the state therefore is at present considered fundamental not only to ensure scientific and technological development, but also to link it with the

/objectives

objectives of economic and social development. State intervention is furthermore justified for strictly economic reasons which stem from the fact that the price mechanisms do not permit the efficient allocation of the necessary resources for creation, adaptation and dissemination of know-how. Hence, the imperfections of the technology market due to an inadequate dissemination of data, the public property aspect of technology as merchandise; the increasing returns to scale in the production of know-how, and the inappropriability of the results of investment in the creation of know-how are some of the reasons for requiring state participation in the orientation of scientific and technological development in Latin America and the Caribbean.

117. Generally speaking, it can be said that the guidelines and instruments for the promotion of scientific and technological development existing in the countries of the region are not on a par with the magnitude and urgency of the problems. In many cases, the creation of new institutions (councils, registers, research centres) would appear to have responded to partial demands from academies of science, to protectionist trends in industrial policy and to the accidental influence of some groups of scientists and civil servants. Despite recent progress towards a more accurate conceptual view of the phenomenon, it has not been possible to structure an overall long-term view of scientific and technological development, nor has it been possible to manufacture easily the corresponding policy tools. It is also true that the lack of a clear idea of the type of development which would be desirable, in addition to these substantive and instrumental defects in overall planning, has in some cases accentuated the difficulties and restrictions with which science and technology policies come into conflict.

118. Existing internal and external conjunctural pressures, which are especially vigorous in Latin American context, has meant that less attention has been given to long-term measures. For example, investment

/in scientific

in scientific and technological research has not been considered independently of the restriction on resources from which public finance usually suffers, and has frequently been cut back in keeping with the uneven evolution of the latter. The intensification of domestic capacity to develop research and development activities is usually at loggerheads with the liberal policies for the import for equipment and technical assistance. This leads to out of step situations which tend to be perpetuated.

119. It should not be ignored that the group of instruments which make up technological policy should converge towards achieving the endogenous development of science and technology, in such a way that the generating flow of scientific know-how is organically linked with the evolution of the technological bases of modern production and the systematic and discriminated recovery of the traditional technological base. All this should take place within the dynamic context of the country's socio-economic development.

120. The importance of regional co-operation for the development of science and technology should also be emphasized. This is crucial from several points of view, since valid bilateral and multilateral experiences have been accumulated in the region. The scanty resources that the majority of the countries of the region can earmark for this purpose deprive them of the possibility of significant progress unless they make a joint effort to develop activities for which a minimum critical mass is vital. The spontaneous evolution of the economic integration processes will not lead to greater autonomy in the development of production activities unless this process is based on the joint development and programming of scientific and technological activities. Lastly, common action would give greater bargaining power vis-a-vis third countries for the acquisition of technology under more favourable conditions. The establishment of the Latin American Technological Information Network (RITLA) would be instrumental in achieving this aim.

/In another

121. In another context it can be said that the budgetary allocations of public spending for the development of science and technology - which have been growing in recent years - have not an accurately defined destination in terms of the priorities of scientific and technological policy. In any case, the growth of public expenditure on science and technology has been inadequate, and although the proportion may vary from country to country, it should increase through the establishment of appropriate financing and co-financing mechanisms in such a manner as to attain the objectives of national scientific development.

122. These reflections are linked to others of a more general nature. Historical experience indicates that technological progress, and the impetus deriving from it, depend very largely on the due surmounting of certain traditional inadequacies. There can be no doubt that scientific and technological research will find its full maturity in an atmosphere of justice and social peace and the affirmation of human rights, that technological innovations to meet the needs of the majority sectors are germinated in regions characterized by a better educational coverage, and that the dynamic entry of the countries into the international markets is in the last instance conditioned by the generalized increase in social productivity. These comments must be borne in mind in the daily exercise of the policies for the development of science and technology, and they should constantly be recalled in the light of the achievements which these policies have brought about, and the inadequacies must still be remedied.

/II. RECOMMENDATIONS

II. RECOMMENDATIONS FOR AN ACTION PROGRAMME FOR THE USE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PROCESS

A. GENERAL CONSIDERATIONS

1. Despite the efforts made by the developing countries to surmount the internal and external barriers to their development, many difficulties still exist that prevent them from putting qualitatively different styles of development into practice. The ultimate goal is not to achieve the type of development of many of the industrialized countries, but rather to achieve a style of economic and social development that is in keeping with the genuine interests and aspirations of the developing countries themselves. Consequently, efforts should be made to seek scientific and technological options that will satisfy the aspirations of the population and attend to its priority problems.

2. The holding of the United Nations Conference on Science and Technology for Development is one of the forms of action adopted by the international community as a means of promoting the New International Economic Order.1/

3. As defined in the relevant General Assembly resolutions and in other United Nations bodies and organizations,2/ the New International Economic Order is a model of international co-ordination whose purpose is to create appropriate conditions for the developing countries to achieve self-sustained and autonomous development, thereby reducing international inequalities, by furnishing the bases for the emergence of individual and collective self-reliance in these countries, and putting an end to their continued dependence.

1/ General Assembly resolution 3362 (S-VII).

2/ General Assembly resolutions 3201 (S-VI), 3202 (S-VI) and 3281 (XXIX) and resolution 87 (IV) of the United Nations Conference on Trade and Development (UNCTAD).

/4. The

4. The model of the New International Economic Order entails the restructuring of international relations in order to bring about changes in the present division of labour and in the relations existing in the present international order so as to transform its most outstanding characteristic, its assymetrical nature, into one of negotiated symmetry by means of greater participation of the developing countries in world industrial activities; the achievement of their self-reliance in the production of food; an increased share in the external trade through an appreciable increase in exports; the strengthening of their local scientific and technological capacity; and greater access of these countries to the stock of financing and scientific technological know-how available in the world.

5. The foregoing also implies a new view of development, conceived as a process that should be:

(a) Of a global nature, whose ultimate purpose is mankind, and which is consequently made up of the entire range of factors to which man aspires;

(b) Endogenous, that is, emerging from all the societies that pursue it as a means of satisfying their needs, goals and objectives;

(c) Self-reliant, since it must first of all have recourse to the resources of each society, although this should not signify autarchy; and

(d) Ecologically appropriate, in order to protect and develop the resources of the biosphere.

6. This new concept of development should be based on recognition of the fact that there are many ways of achieving it and that each country is entitled to find its own way. The new concept should also contribute to ensuring that programmes of co-operation for development genuinely strengthen the creative capacities of peoples and become the foundation for local scientific and technological development. It furthermore implies a change in the centre of gravity of co-operative activities, which should correspond to a greater degree to the requirements specified by each country in accordance with its current realities and its vision of the future.

7. The restructuring of international relations involves a number of structural changes in both the national and the international spheres. The principal internal changes include:

/(a) National

(a) National control over the prospecting, exploitation, production and marketing of natural resources;

(b) Co-ordination, regulation and orientation of the industrial sector, including the activities of transnational corporations;

(c) Articulation of the export sector with the agricultural and manufacturing sectors;

(d) Orientation of technological change towards the requirements of a locally defined model of development and adaptation of social structures were relevant;

(e) Regulation of the transfer of technology in such a manner that it does not create distortions in the internal economy; and

(f) The definition of policies and the implementation of actions and instruments to erradicate obsolete agrarian structures in agricultural production.

8. In the international sphere the principal structural changes should include, inter alia:

(a) Redistribution of the world's productive potential;

(b) Access of the developing countries to the sources of international financing and of generation of scientific and technological knowledge; and

(c) The development of new forms of international co-operation that will tend to strengthen internal efforts to achieve development processes defined within the countries themselves.

9. In the area of science and technology the establishment of the New International Economic Order includes, inter alia, the following changes:

(a) The creation of decision-making capacity in technological matters;

(b) The identification of priority areas in which endogenous scientific and technological development creates favourable conditions for achieving the desired model of development;

(c) The elimination of the factors which create monopolistic and oligopolistic conditions in the international exchange of technology, and

(d) The establishment of new mechanisms for international co-operation that will promote a better distribution of efforts and world production in the fields of science and technology.

/10. Unquestionably,

10. Unquestionably, one of the greatest limitations on the creation of scientific and technological infrastructure is the shortage of financial resources which can be channelled without strings to the developing countries for that purpose. The Conference should take a clear and unequivocal position on the modalities to be adopted in order that those who benefit from international trade with the developing countries should also contribute to the implementation of scientific and technological activities planned and executed in those countries.

11. Attention should also be drawn to the responsibility of the governments of the developing countries and of all sectors involved in their economic activities to make a significant effort to initiate a gradually expanding process capable of strengthening scientific and technological activity and the creation of technology which responds to the fundamental needs of the population of these countries. In a clear spirit of solidarity among developing countries, those nations with greater available capacity should aid the relatively less developed countries in this vital and increasingly urgent activity of generating technology. With the aim of correcting imbalances in international relations, the industrialized countries should compensate the developing countries by contributing more effectively to their technological development. One of the necessary roads is the formulation of specific financing alternatives that will gradually make it possible to reduce the current imbalances.

12. Scientific and technological development should be generated within the framework of integral development and be oriented towards improving the quality of life of the population by satisfying its human, social, cultural, material and spiritual needs. This implies that consumption patterns must be brought into line with each country's real requirements, avoiding the creation of artificial needs and trends towards the consumption of luxury goods. Such development should be endogenous, autonomous, ecologically appropriate and based both on changes in the economic, social and cultural structure and on decisions which take into account the needs of the bulk of the population.

/13. The

13. The common elements characterizing autonomous and self-reliant scientific and technological development are: the necessary participation of State agencies, autonomous decision-making capacity in technological matters, and steady growth of the capacity to produce local technological solutions.

14. The formulation of a scientific and technological policy implies the projection of State action in various fields relating to the functioning of the scientific and technological system. They include:

(a) The creation, co-ordination and internal evaluation of scientific and technological knowledge;

(b) The training of skilled human resources;

(c) The seeking and acquisition of foreign technology;

(d) The management of local demand for technology, especially of the public sector, and

(e) The dissemination of the existing stock of technology among enterprises or branches of industry.

15. The legal and institutional mechanisms for promoting the increasing use of science and technology in the economic and social development process should be strengthened, reinforcing the role of the State and the systems for generating, disseminating and transmitting scientific and technological knowledge. This should be carried out by linking the latter closely to the productive and educational systems.

16. It would be advisable to achieve optimum utilization of the resources of the countries and inject vigour into the development process while at the same time maintaining their social and cultural identity.

17. On both the national and international levels, scientific and technological policy should be oriented towards the creation or strengthening of the capacity of countries to generate and adapt the knowledge and technologies most appropriate to their needs and resources in accordance with national objectives and the principle of self-determination.

18. Since man is both the agent and the goal of the development process, the latter should be founded on the training of human resources capable of generating and transmitting specialized knowledge that will assist in strengthening the scientific and technological development process and ensure the full development of the individual as a member of society.

/19. Over

19. Over the past decades several developing countries have experienced a significant exodus of scientific and technical human resources and of skilled labour attracted by the better salaries and working conditions and the greater professional and social status offered by more industrialized countries that have acted as centres of attraction for skilled labour. Governments should investigate mechanisms and means to counteract that emigration, and give national recognition to the work and efforts of research groups, scientists and specialists in technology by granting them their due social status. In addition, the United Nations system should grant greater attention to this question.

20. External co-operation should contribute to strengthening the local capacity of developing countries, as a complement of, and not a substitute for, national efforts. As far as science and technology are concerned, this co-operation should be diversified in keeping with the needs, resources and capacities of the different societies and communities; it should be developed on a solid scientific basis and ensure a fair distribution of its benefits. For this purpose necessary structural changes will have to be made in the economic, social, cultural, educational and technological fields so that the results of scientific and technological development will fairly benefit all sectors of the population.

21. The need should also be stressed for increasing the economic and scientific and technological solidarity of the developing countries with the objective of increasing their individual and collective store of technology. It will be extremely valuable if the countries of the region adopt joint positions to solve common problems. International scientific and technological co-operation will only contribute to development to the extent that it strengthens the inventive capacity of the beneficiary countries and thereby redistributes world scientific and technological efforts and production.

22. The achievement of a true process of transfer of technology depends on strengthening the innovating capacity of the countries benefiting from international scientific and technological co-operation, and therefore differs in both content and impact from the mere international dissemination

/and introduction

and introduction of productive techniques and processes. Scientific and technological redistribution enteils that the suppliers profit-making criteria governing many international aid programmes should be renounced, and replaced by criteria of international co-operation that will lead to the achievement of international social justice.

23. Attempts should be made to strengthen technological co-operation as a means of generating national and regional capacities for importing, adapting, creating and disseminating technologies and taking decisions on these activities. This process should give priority attention to the needs of the relatively less-developed countries, although this should not signify the establishment of new centres of hegemony to replace traditional ones but rather the harmonizing and fostering of the interests of the developing countries.

24. All activities related to the development of science and technology should be accompanied by intensive efforts to arouse social and cultural awareness in all sectors of the population, particularly the young, of the importance of creation and innovation for development, and to promote the training of skilled human resources for scientific and technological research. To this end, appropriate use should be made of the mass communication media and publicity.

25. Scientific and technological co-operation among developing countries is an urgent necessity, especially for countries which, such as the very small ones, are unable to satisfy certain basic needs without assistance from other States. Such co-operation is not only indispensable for these countries, but generally would make it possible to find just and appropriate solutions for their own development processes and strengthen their individual and collective bargaining power with respect to third-party countries.

26. All efforts to absorb external co-operation undertaken by national authorities in this context should be oriented towards establishing or strengthening the local capacity for scientific and technological development, so that the monopolistic and oligopolistic conditions faced by the countries purchasing technology in the international markets will steadily decrease.

/27. The

27. The developing countries should participate actively in the discussions taking place in different international forums to set up codes of conduct to regulate the activities of transnational corporations and the transfer of technology. In particular, it is necessary to amend the harmful provisions of the Peris Convention for the Protection of Industrial Property and to eliminate other barriers that slow down the transfer of technology towards developing countries.

28. One of the greatest obstacles to the equitable distribution of international efforts in the field of science and technology is the colossal quantity of resources devoted by certain industrialized countries to military expenditures and armaments. The funds squandered in this manner are so huge that these countries should take measures to reduce such expenditures and thereby liberate sufficient resources to eradicate world problems of malnutrition and the scarcity of health services and to promote integral scientific and technological development of the developing countries. In addition, the industrialized countries should orient their scientific and technological policies so that the results of research are not used to develop and perfect tools of mass extermination or systematic harm to mankind or to create means whereby some States can exert pressure on others.

29. Special attention should also be focused on the fact that some developing countries also earmark significant portions of their budgets to military expenditures to the detriment of health and education allocations.

B. SPECIFIC SUGGESTIONS FOR A REGIONAL ACTION PROGRAMME

30. Recommendations follow for the preparation of a regional programme for the use of science and technology in the development process, grouping activities nationally, regionally or internationally, as appropriate, and according to whether they refer to the generation and dissemination of know-how at the local level, the incorporation of foreign technology, or the handling of demand for technology.

/1. Recommendations

1. Recommendations at the national level

(a) Planning and financing of scientific and technological development

31. Governments should formulate short-, medium- and long-term science and technology strategies and plans which ensure the primordial function of the State, are based essentially on national efforts, and are complemented by specific measures and legal and institutional machinery which will ensure their implementation and their permanent evaluation and readjustment.

32. In the formulation of science and technology strategies and plans, the objectives should be aimed towards clear-cut consolidation of integral development; due consideration should be given to the characteristics of each country and its natural resources; and such strategies and plans should be integrated into general economic and social development plans with due regard for the implications they hold for science and technology. These measures, inter alia, should be taken to achieve equitable distribution of the benefits of development among all sectors of the population.

33. The science and technology variable should be included explicitly in national development plans or strategies as a basic instrument for achieving the different objectives and goals contained in them; these plans should also include specific requirements at the global and sectoral level for the generation, transfer, local dissemination, incorporation and utilization of scientific and technological know-how.

34. The links should be strengthened among research and development institutions, the political system, the education system and the production sector; an effort should be made to raise the living standards of the population and increase the productivity of low-income groups, while also taking the necessary measures for integrating them into economic activities. In addition, local capacity to generate, manage, and market endogenous technology and to improve conditions for acquiring foreign technologies for their optimum assimilation and adaptation should be strengthened.

35. In the legitimate exercise of their sovereign rights over their own natural resources, the countries should endeavour to extend the application of science and technology in the exploration, conservation and use of these resources.

/36. Science

36. Science and technology plans should explicitly incorporate objectives, instruments and specific actions in different fields, such as: (i) the development of basic research as one of the links in an integral concept of development; (ii) the generation of science and technological know-how in the local context; (iii) the incorporation of foreign technology; (iv) the dissemination within and among sectors of scientific and technological know-how; (v) the training of human resources; and (vi) handling of the demand for technology.

37. These objectives, instruments and actions should cover the activities both of the public enterprises and enterprises in the private sector, research and university area teaching institutes, ministries and other State offices, and be structured in a coherent and co-ordinated form.

(b) Training of human resources

38. Priority support should be given to the training of the human resources required to generate and implement science and technology plans, programmes and projects, by strengthening local professional and vocational training programmes, and carrying out a training effort in administration and handling of technology.

39. The setting up of institutions for the training of human resources in the scientific and technological fields should be fostered. In addition, centres and programmes for professional and technical updating should be systematically organized on all levels to train specialized personnel to provide satisfactory coverage of all the links in the chain that associates scientific and technological research with the problems of production.

40. Preferably within the framework of an overall national policy on human resources, the countries of the region should establish policies to provide incentive to scientific researchers, and recognize their creative efforts.

41. Measures should be taken to provide due incentives and support to the work of scientists and specialists in technology and give full national recognition to the role they are performing in national development.

/(c) Creation

(c) Creation of scientific and technological know-how

42. Criteria should be established to evaluate the effect of the tax instruments applied by certain countries to motivate scientific and technological research and consideration should be given to the suitability of applying such instruments in countries in which they have not yet been adopted.

43. Governments should strengthen the machinery for identifying, studying, preparing and evaluating scientific and technological research programmes and projects, and ensure that they are closely linked with national development priorities.

44. In the generation of local technological know-how achieved through subsidies to the private sector, State policy should formulate suggestions regarding national priority areas of research to be undertaken by that sector and an explicit pattern of areas of research that must be explored directly by the public sector and by institutes financed by funds from the government budget.

45. In the developing countries the establishment should be encouraged of programme-circuits for technological innovation conceived of as instruments for participation and reciprocal action among all economic and social institutions and agents responsible for developing technologies in specific fields, those who use such technologies and those who are affected in one form or another by such technologies. This requires the maintenance of close and permanent contact among such agents so that their ideas, interests and actions are reflected in all stages of the creation and application of technology.3/

(d) Management of the demand for technology

46. Measures should be adopted to create, stimulate and promote the demand for endogenous scientific and technological activities, and for goods and services containing national and regional technology. In this respect special attention should be given to the adoption of such measures as those

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3/ See CONICYT, Circuitos de innovaciones tecnológicas; Bases para un desarrollo científico-tecnológico autodependiente, Caracas, 1977.

/aimed at

aimed at avoiding the imposition of technologies, including "packages" etc., on public sector contracts and purchases, the establishment of appropriate legal and administrative machinery, and the preferential use of local advisory services in engineering. Policies and legal and institutional machinery should also be promoted that will serve as an incentive to purchase national products as a means of channelling local technological creation and promoting the use of technologies and raw materials available in the country. The effects of patterns of consumption on the demand for national technology goods and services should also be borne in mind.

47. The public sector should attach special priority - either through financial support or direct promotion - to the implementation of scientific and technological research programmes in all fields in which there are a priori grounds for expecting large-scale divergences between social and private benefit, and in which external economies of some size may be expected which would be tapped by the social system as a whole. In nearly all the countries of the region there are deep-rooted problems of unemployment, education, public health, nutrition, pollution, housing, transport, lack of options in the utilization of free time, health of the animal and vegetable worlds, high degree of industrial risk, etc., where the task of creating new know-how and formulating new working hypotheses is required with most urgency. The social return on research expenditure in many of these fields may exceed private return, and this is sufficient justification to encourage activities of this type by the public sector.

48. Agricultural and industrial technical extension services should be strengthened, and the use of the existing equipment and technical resources in research and technology institutions promoted. Researchers and technologists should work directly for certain periods of time in national industry so that those engaged in research and development on the one hand and those engaged in industry on the other may learn from one another and foster mutual understanding and trust.

49. Support should be furnished to national engineering firms in order to compensate for their smaller capacity for absorbing risks and providing guarantees of performance comparable with those that the international

/engineering firms

engineering firms are in a position to offer, which frequently have the direct or indirect support of their governments or of international organizations. For these purposes consideration should be given to direct subsidy activities that will take into account the nature of national engineering as an "infant industry". The creation of risk coverage and financing systems should be studied in particular. The greater degree of competitiveness of national engineering firms because of their ability to carry out projects on the scale required by the developing countries should also be taken into account.

50. Financing by State-associated organizations and other financial promotion machinery should be used to reorient towards local sources the demand for technological services, and engineering and advisory activities, as well as the demand for certain products containing local technology.

51. Strong encouragement and support should be given to the establishment of machinery for joint financing of technological development by the public and private production sectors, whose specific function would be to provide the risk capital required for generating local technological innovation. Such machinery should be constituted by contributions from the public and private sectors.

(e) The search for and acquisition of technology

52. The relevant policy should provide for an active role of the State in establishing regulations in the national interest. The basic objective of such regulatory activity should be to intervene between purchasers and sellers of technology in order to avoid inappropriate or unnecessary purchases, excessive expenditures or clauses harmful to national interests. Certain types of basic activities are called for in this area, such as: (i) the creation of apparatus for administration and negotiation to regulate the fields of external technology in which both the private sector and enterprises in the public sector are engaged; (ii) direct intervention by the public sector as a research agent in the world technological market; (iii) its action as a purchaser of technology in international markets; and (iv) the breakdown of technology in order to determine what may be produced locally. These means of action are justified both from the point

/of view

of view of resource allocation (a centralized search would avoid the duplication of efforts and expenditure here), and in terms of strengthening the bargaining power of the countries acquiring the technology. The possible use of mechanisms already part of the government apparatus for the handling of imports (tariffs, import permitis, etc.) should also be studied, with a view to regulating the acquisition of technology incorporated in goods, particularly intermediate and capital goods.

53. The programme-circuits for technological innovation that form the very basis of local generation of technology should be created or strengthened, both in the area of public sector enterprises and in the area of private enterprises. Support to creative microeconomic groups should be provided by different means, such as the granting of invention patents and registration certificates, prizes and other similar incentives.

54. In cases in which it is decided to grant invention patents, national legislation should be examined, and if it is advisable to adhere to the Paris Convention for the Protection of Industrial Property, consideration should be given to the specific manner of so doing. Special care should be taken so that the Convention: (i) does not create conditions that will harm the development of nationally owned enterprises; and (ii) does not clash with the provisions of the respective national legislations concerning the lapsing of patents that have not been used, or in the validation of those registered only to protect imports blocking the possible development of local enterprises.

55. The possibility should be studied of granting special incentives in the form of patents, invention certificates and the like to university laboratories, research groups, technical schools and other public sector organizations as a means of promoting greater creation and dissemination of technological know-how by the State technological system.

56. In using incentives to promote the creation and dissemination of technological know-how, legal and institutional machinery should be established or strengthened to ensure that transnational corporations adapt themselves to national interests. In addition, national legislation on industrial property should be brought up to date and periodically revised in order to adjust it to the changing conditions of development.

/(f) Dissemination

(f) Dissemination of scientific and technological know-how

57. Scientific and technological information systems should be established or strengthened so as to ensure access to information networks at the local level and an effective link with national users. For this purpose the information available on scientific and technological progress in the developed countries should be taken into account. Among the elements these systems should include are: the identification, characterization and systematizing of technologies generated in the country, in accordance with specific sectoral priorities; the preparation and dissemination of directories of research centres, institutes, and management and engineering consulting firms; the systematizing and dissemination of statistical information on contracts for the transfer of technology and on those offering or acquiring such technology; and the systematizing of information on foreign investment as a channel for the transfer of technology.

58. Machinery should also be set up to translate know-how expressed in specialized language into forms comprehensible to entrepreneurs and personnel who have no special training.

2. Recommendations at the regional level

(a) Planning and financing of scientific and technological development

59. Scientific and technological co-operation should be systematically and permanently oriented towards the elimination of monopolistic or oligopolistic exploitation in regional technological trade.

60. Appropriate measures and machinery to develop regional scientific and technological co-operation should be encouraged. It would be desirable here:

(i) To identify and make appropriate use of the proper machinery for multilateral, regional and subregional relations;

(ii) To foster the machinery for subregional and regional action that the countries may consider of importance for national, subregional and regional scientific and technological development; and

(iii) To promote the marketing or exchange of technology among the countries of the region.

/61. Regional

61. Regional co-operation should give preference to activities related to:

(i) Scientific and technological research for the prospecting, exploitation and conservation by the countries of their natural resources and sources of energy, including marine resources and the prevention of disasters;

(ii) Scientific and technological research related to the problems of education, health, housing, environmental pollution, nutrition and so forth;

(iii) The establishment of co-operative programmes for technological creation in areas such as: the manufacture of pharmaceutical products, medical and hospital technology and equipment, and technology for the control of environmental pollution; and

(iv) Scientific and technological research to attain satisfactory levels of production and in the supply of agricultural and other basic products.

62. Regional co-operation aimed at increasing the scientific and technological capacity of all the countries of a region should take into account:

(i) Co-ordinated training of human resources and training, specialization, updating and ongoing education activities;

(ii) Strengthening of regional and subregional research institutions and appropriate use of sectoral investment programmes deriving from various integration schemes;

(iii) Creation and strengthening of national research institutions and scientific and technological supporting services, including the Latin American Technological Information Network (RITLA), and information service on scientific and technological advances in the developed countries, interconnexion with the world information networks and information on the projections of world scientific and technological development and their application to integral development; and

(iv) Development of regional scientific and technological information systems and services, and use of those already in existence.

63. Co-operation should be carried out in the region taking into account the fact that the island-developing countries are handicapped by limited market size and small economies of scale.

/64. Joint

64. Joint programming of scientific and technological activities around specific projects should be one of the most outstanding aspects of subregional and regional co-operation. It would consequently be necessary to stimulate co-operation among the countries regarding topics and priorities chosen by them on the basis of specific programmes and projects designed and programmed jointly by means of technical meetings financed with international funds. These projects should explicitly include complementarity between the capacities existing in the participating countries and the needs for external participation, particularly with regard to the contribution such participation makes to the development of the technological capacity of the countries.

(b) Training of human resources

65. The necessary policy measures should be adopted urgently to determine the causes, scope and repercussions of the drain of qualified personnel from the developing countries to the developed countries, and the means and measures required to reverse the direction of this flow. The developed countries, and where relevant, the international organizations, should provide co-operation here.

(c) Management of the demand for technology

66. Regional advisory and co-ordination machinery should be strengthened and improved with the aim of obtaining better terms for the acquisition and development of technologies.

67. A system should be established to enable the relatively less developed countries to have access under favourable terms to technologies already existing in other developing countries.

68. The effective joint or individual participation should be encouraged of the advisory, engineering, design and construction services of the countries of the region to deal with the demand generated in the region.

69. In conjunction with financial, international and regional organizations, joint action should be taken to create appropriate conditions for financing scientific and technological development co-operation projects to satisfy the specific needs of the developing countries. Special emphasis should be placed on modifying the criteria for the selection of technologies so that projects with high "technological risk" may be carried out.

/3. Recommendations

3. Recommendations at the interregional level

70. A factor of great importance for the collective self-reliance of the developing countries, as well as a definite step towards the implementation of the New International Economic Order, would be to prepare a set of measures at the interregional level for the application of science and technology for development, with a view to establishing machinery for co-operation between Latin America, Africa and Asia aimed at strengthening their scientific and technological capacity and their bargaining power vis-à-vis third countries or groups of countries, in accordance with the provisions of the Buenos Aires Action Plan in respect of technical co-operation among developing countries. In particular, support should be given to: (i) projects involving co-operation among two or more countries of different developing regions; (ii) the channelling of information on scientific knowledge and technological invention achieved in the developing countries, as well as a better system of information stemming from all the industrialized countries; (iii) the promotion of scientific and technological meetings which can give rise to further action.

4. Recommendations at the international level

(a) Planning and financing of scientific and technological development

To the developing countries

71. In the legitimate exercise of their sovereign rights over their own natural resources these countries should promise scientific and technological co-operation in research, and its practical application in the exploration, exploitation, conservation and use of conventional and non-conventional natural resources and sources of energy.

72. Joint action should be undertaken vis-à-vis the international financial institutions so as to obtain appropriate conditions for financing their scientific and technological development, which will alow them to satisfy the specific needs of their development.

73. They should participate actively and co-ordinatedly in the negotiations on the Code of Conduct for Transnational Corporations. This Code should eliminate the obstacles that the transnational corporations place in the

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way of development of an autonomous and self-sustained capacity for business, financial and technological management in the developing countries.

74. Efforts should be made to continue developing and ensuring the political will necessary to make possible an exchange of experience and co-operation in the use of science and technology in the development process.

To the developed countries

75. Scientific and technological research aimed at solving the problems of the developing countries should preferably be carried out within those countries. Such research should be congruent with national, subregional or regional priorities and should be carried out with the effective participation and control of the appropriate national institutions.

76. They should study and, if necessary, increase their financial contributions to the international organizations and the national science and technology promotion institutions so as to facilitate this promotion and increase its efficiency. These contributions should be exempt from political conditions, pressures or interference in the domestic affairs of the countries or international organizations receiving them. Fuethermore, they should not contain clauses which tie them to a commitment to purchase goods and services in their countries of origin.

77. They should provide the contributions pledged within the United Nations for the development of the developing countries, including their scientific and technological progress.

78. They should adopt an open position towards the aspirations of the developing countries in the negotiations taking place to revise the Paris Convention and towards the formulation of a code of conduct on the transfer of technology.

79. They should recognize the need to pay special attention to the requirements of the landlocked and island developing countries resulting from their geographical status.

To the developed and developing countries

80. Measures should be taken to ensure that financing for scientific and technological development may be based, among other sources, on the funds derived from the reduction in military expenses of the developed countries.

/81. The

81. The adoption should be fostered of a code of conduct on transfer of technology which, in keeping with the aspirations of the developing countries;

(i) Covers all categories of transactions, including the operation of the transnational corporations and other suppliers of technology;

(ii) Specifically provides for the suppression of restrictive practices that have or may have adverse effects on the economy of the recipient country, or impose restrictions or limitations on the development of that country's technological capacity, and ensures that the inclusion of these practices in technology agreements is considered contrary to the objectives of the code;

(iii) Contains the principle that any agreement on the transfer of technology should be governed by the legislation of the recipient country and by the norms and principles of the code of conduct; and

(iv) Provides for institutional machinery that will allow and facilitate the adequate achievement of its principles and objectives, including preferential treatment in favour of developing countries.

82. It should be ensured that in the context of the bilateral machinery, the creation of funds and other means of financing the scientific and technological development of the developing countries will not contribute to increasing the technological dependence of these countries on the transnational corporations.

To the international organizations

83. Support should be given to activities to achieve collective technological collaboration for development through the adoption of measures which will contribute to:

(i) Furnishing the greatest possible support to regional science and technological development programmes undertaken by the developing countries for which purpose the international bodies should restructure their respective organizations, with a view to endowing them with the necessary sectoral consistency to give priority attention to development problems;

(ii) Taking into account, in technical co-operation programmes, the need to strengthen and make use of the capacity of the developing countries to administer and manage the resources resulting from these programmes.

/84. Implementation

84. Implementation of the following structural changes in the United Nations system, taking into account the suggestions on the new concept of development contained in paragraph 5 above, with a view towards promoting the objectives of the United Nations Conference on Science and Technology for Development:

(i) Co-ordination and harmonization of the system's functions as a means of

- avoiding the proliferation of organizations, meetings and reports;
- co-ordinating under a restructured Economic and Social Council the various co-operation activities and programmes in general, and particularly those involving scientific and technical co-operation. For this purpose the activities of UNIDO, UNESCO, ILO and the like should be harmonized and co-ordinated by the Economic and Social Council;
- co-ordinating the planning in the scientific and technological field carried out by Governments and the United Nations.

(ii) The strengthening of regional commissions by increasing their authority and autonomy and providing them with greater resources so that they may function as true instruments of the system for regional development and international co-operation in the countries of the region in which they are established. The existence of a single organization responsible for development and co-operation is also recommended, one which under the auspices of the regional commissions includes only the countries of the region and is assisted by functional or sectoral groups of experts or intergovernmental committees, as required.

(iii) Co-ordination of the restructured regional commissions with subregional and regional organizations for co-operation and integration in fields common to all.

85. The regional economic commissions should periodically review and appraise the Programme of Action to be approved by the United Nations Conference of Science and Technoloy for Development, which should be in accordance with the actions of the Third United Nations Decade for Development, so as to include opportunely in this Programme any adjustments and corrections suggested by such study.

/(b) Training

(b) Training of human resources

To the developed countries

86. The developed countries should help to eliminate the factors which give rise to the drain of qualified personnel from the developing to the developed countries, and take a stand in support of the former in the study of this topic which is being carried out within the United Nations agencies.

To the international organizations

87. The United Nations University (UNU) and the United Nations Institute for Training and Research (UNITAR) should consolidate their training and scientific and technological research programmes, and adjust them to the needs of the developing countries. In addition, existing scientific and technological centres in the developing countries should be strengthened.

88. The organizations of the United Nations system concerned with development and the international specialized agencies, should furnish assistance to the developing countries, at their request, in the formulation of measures to encourage the return of scientific, professional and technical personnel living outside their countries of origin. These organizations should also strengthen the capacity of those countries to promote means of voluntary and planned migration in the interests of their development, to include not only selective migration from the developed to the developing countries, but also between developing countries bearing in mind the relevant resolutions adopted in different forums of the United Nations.

(c) Creation of scientific and technological know-how

To the developing countries

89. The developing countries should undertake the following activities, inter alia, to strengthen their technological capacity;

(i) Establishment, operation and strengthening of the appropriate institutional machinery among the developing countries for scientific and technological development, including interregional, scientific and technological information networks containing systems for the collection and exchange of information on conditions for the transfer of technology and foreign investment;

/(ii) Granting

(ii) Granting of preferential treatment in scientific and technological matters to the relatively less developed countries, particularly island and landlocked countries;

(iii) Strengthening of their bargaining power vis-à-vis the developed countries; and

(iv) Establishment of a system by means of which the relatively less developed countries can have access to technologies available in other developing countries under just and favourable conditions.

90. In the full exercise of their sovereignty, the developing countries should adopt the necessary measures to prevent the activities of the transnational corporations, or any other power source or structure, from contributing to preventing the achievement of the legitimate objectives contained in their scientific and technological development plans, programmes and strategies.

91. The developing countries should identify and adopt the measures necessary for obtaining from the transnational corporations, or any other supplier of technology, technological information, assistance, transfer of technology, and administrative and managerial know-how under just and favourable conditions that can assist the developing countries in carrying out their scientific and technological development plans and programmes.

92. The developing countries should continue the efforts undertaken in international fora to prepare an international code of conduct on the transfer of technology that will establish regulations for exchange and co-operation and will take into account the needs and interests of the developing countries with respect for their sovereignty. In this context special attention should be given to the need for establishing a regulatory mechanism to control the forms of technological transfer and direct investment in the developing countries.

93. They should promote, in conjunction with the appropriate internal measures, the deletion of article 5 of the Paris Convention, which upholds the validity of foreign patenting even when the patents are not used locally and the product in question is imported. It is also recommended that the system of compulsory licenses should not be used to mitigate the failure to use the patents.

/To the

To the developed countries

94. The developed countries should co-operate in the creation and strengthening of the scientific and technological infrastructure of the developing countries, with due respect for their development plans and programmes.

(d) Management of the demand of technology

To the international organizations

95. In the light of the Declaration and Programme of Action on the Establishment of a New International Economic Order,4/ of UNCTAD resolution 88 (IV), regarding the Paris Convention for the Protection of Industrial Property, and also considering the text of resolution 2028 (LXI) of the Economic and Social Council,5/ the international organizations should recommend that the conference held to adopt the new provisions of that Convention should include norms for:

(i) Reviewing the principle of equal treatment with regard to patents, so as to establish preferential non-reciprocal treatment and provisions intended to favour the interests of the developing countries;

(ii) Establishing efficacious provisions with regard to the revocation or lapsing of patents owing to lack of adequate use;

(iii) Reviewing the principle of priority and independence of patents, in particular taking into account the interests of the developing countries;

(iv) Insisting that holders of patents use them in national production;

(v) Establishing that the patent does not confer exclusive rights to import the product or products patented or manufactured using patented procedures. In this context, the importation of the products should not be considered as a use of the patents. The corresponding articles included in the Convention should reflect these concerns;

4/ General Assembly resolutions 3201 (S-VI) and 3202 (S-VI).

5/ This resolution specifies as the objective of the Conference the adoption of concrete decisions on ways and means to apply science and technology in establishing the New International Economic Order, indicating that patent and trademark systems constitute one of the most important elements in the framework within which the process of industrialization - and technology in particular - develop.

/(vi) Modifying

(vi) Modifying the voting system so that amendments can be made in the Convention to ensure the exercise of the rights of the developing countries;

(vii) Laying down special norms that will facilitate the access of developing countries to information on the subject proceeding from the developed countries and making possible and effective exchange of information among the developing countries; and

(viii) Deleting all clauses restricting the development of the innovative capacity of the developing countries.

(e) The search for and acquisition of technology

To the developed countries

96. The developed countries should adopt urgent measures to abolish the restrictive practices governing the current transfer of technology, and establish conditions appropriate for the adoption of guarantee systems by the suppliers of technology.

To the international organizations

97. The international organizations should draw up a list of experts and advisory and engineering enterprises in the developing countries, and make preferential use of their services in technical and financial co-operation programmes.

(f) Dissemination of scientific and technological know-how

To the developed countries

98. The developed countries should provide freer and more complete access to all types of technological know-how and to all technologies, not only basic and conventional ones but also the most complex and advanced technologies, such as nuclear technology for peaceful uses, microelectronic technology and space technology, under just and equitable conditions acceptable to both parties and with due consideration to the specific development needs of the recipient countries in the interests of promoting the welfare of the majority sectors of the population.

99. The developed countries should contribute to redistributing world scientific and technological efforts so as to carry out a genuine transfer of resources and know-how to the developing countries and the elimination of the ties which traditionally burden international co-operation.