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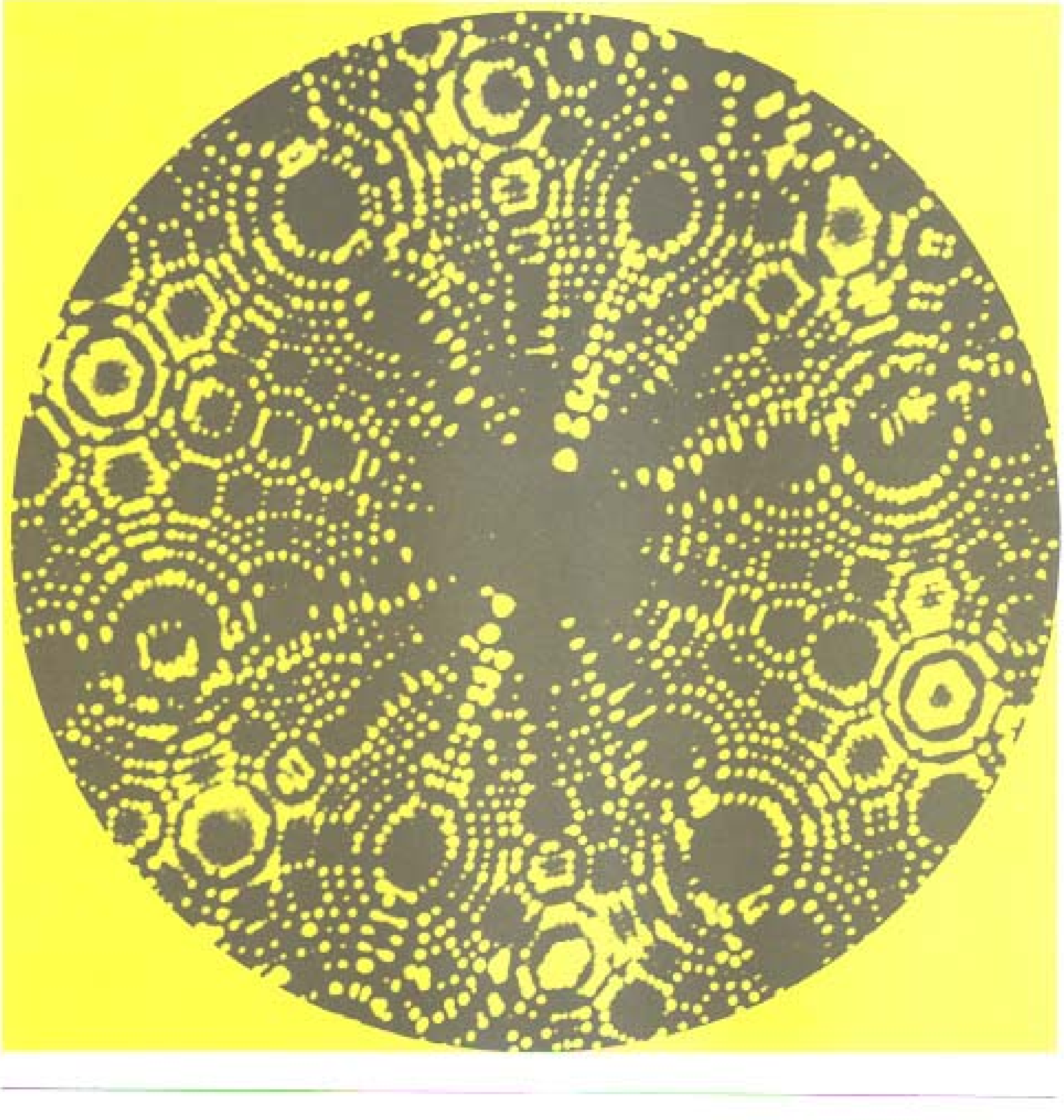
Science, Technology and Development in Asia and the Pacific
- CASTASIA II -

Science policy studies and documents



Unesco

Science, Technology and Development in Asia and the Pacific
- CASTASIA II -

Analysis of trends, issues and prospects and report of the conference

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PREFACE

The Unesco series 'Science policy studies and documents' forms part of a programme initiated by the General Conference of Unesco at its eleventh session in 1960, which aims at making available factual information concerning the science and technology policies of various Member States of the Organization as well as technical studies of interest to policy-makers and managers.

The country studies are carried out by the government authorities responsible for policy-making in the field of science and technology in the Member States concerned.

The selection of the countries in which studies on the national science and technology policy are undertaken is made in accordance with the following criteria: the originality of the methods used in the planning and execution of such policy, the extent of the practical experience acquired, and the level of economic and social development attained. The geographical coverage of the studies published in the series is also taken into account.

The technical studies cover planning of science and technology policy, organization and administration of scientific and technological research, and other questions relating to science and technology policy.

The series also includes reports and other related documentation of Unesco international meetings on science and technology policy, in particular regional ministerial conferences which the Organization convenes regularly in the different parts of the world.

The latest regional ministerial conference was held in the Asia and Pacific region. The 'Second Conference of Ministers Responsible for the Application of Science and Technology to Development and Those Responsible for Economic Planning in Asia and the Pacific' (CASTASIA II) took place in Manila, 22-30 March 1982. The first CASTASIA had been held in Delhi in August 1968.

The present publication contains the proceedings and the main working document of the conference. Two other publications in the same series contain information compiled prior to the conference: one which describes Unesco scientific and technological co-operation programmes in the Asia Pacific region (No. 51 in the series), and one which contains the country reports of the region's Member States on the state of, and national policies for, science and technology (No. 52 in the series).

In addition to these three publications, two reference documents, published in the series of conference papers, complement the entire set of documentation available: (1) 'Science and Technology Statistics in Asia and the Pacific--Selected Data' (SC-82/CASTASIA II/Ref. 3) and (2) 'Science, Technology and Development in Asia and the Pacific--Progress Report 1968-1980' by A. Rahman and S. Hill (SC-82/CASTASIA II/Ref. 1).

Together, these documents constitute the most up-to-date, comprehensive and accurate information that could be assembled and analysed on the subject of science, technology and development in the Asia Pacific region.

The conference itself, attended by some 150 participants from 23 countries, afforded a major opportunity to take stock of recent developments in the region and internationally, and to make recommendations on priorities for regional co-operation in the 1980s.

In its Manila Declaration, the conference called on 'the states and citizens of Asia and the Pacific to unite their will, and pool their abilities, so that science and technology may serve the progress and prosperity of all, and combine with the rich heritage of the region in facing present and future challenges'.

It is hoped that the present publication will help to spread this noble and vital message.

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Science, Technology and Development in Asia and the Pacific

Trends, issues and prospects

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FOREWORD

1. The present text constitutes the main working document of the Second Conference of Ministers Responsible for the Application of Science and Technology to Development and Those Responsible for Economic Planning in Asia and the Pacific (CASTASIA II). This Conference, convened in pursuance of resolution 2/01 adopted by the General Conference of Unesco at its twenty-first session (Belgrade, October 1980), is being organized with the co-operation of the United Nations Economic Commission for Asia and the Pacific (ESCAP). It is part of a series of regional ministerial conferences on science and technology organized by Unesco in the past fifteen years.(1)

2. The first CASTASIA Conference was held in 1968. Since that time several Member States have been included in the region, now known as Asia and the Pacific. The Member States concerned are Australia, New Zealand, Western Samoa, Tonga, Maldives, Papua New Guinea and, more recently, Turkey.(2)

3. Pursuant to the decisions taken by the General Conference of Unesco,(3) CASTASIA II will examine in particular: (i) trends in the countries of the region in respect of scientific and technological development since the first CASTASIA Conference in 1968; (ii) obstacles in the way of this development, and the means of increasing the scientific and technological potential of the participating countries; (iii) problems involved in the direction and organization of research and of scientific and technological facilities, due in particular to changes in employment policies; and (iv) the prospects afforded by regional co-operation.

4. This working document deals with the following items of the provisional agenda, set out in the same order:

Provisional agenda item	Theme	Working document
7	Science and technology in Asia and the Pacific--A review	Chapter 1

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(1) CASTALA (Santiago de Chile, 1965), CASTASIA (Delhi, 1968), MINESPOL (Paris, 1970), CASTAFRICA (Dakar, 1974), CASTARAB (Rabat, 1976), MINESPOL II (Belgrade, 1978).

(2) Member States of Unesco belonging to the Asia and Pacific region: Afghanistan, Australia, Bangladesh, Burma, China, Democratic Kampuchea, Democratic People's Republic of Korea, India, Indonesia, Iran, Japan, Lao People's Democratic Republic, Malaysia, Maldives, Mongolia, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Socialist Republic of Viet Nam, Sri Lanka, Thailand, Tonga, Turkey, Union of Soviet Socialist Republics. Territory enjoying autonomy in the areas to be covered by the Conference: Hong Kong.

(3) Approved Programme and Budget for 1981-1983, paragraph 2057.

Provisional agenda item	Theme	Working document
8	Major science and technology policy issues in Asia and the Pacific in the 1980s	Chapter 2
8.1	Build-up of a science and technology capacity	Section 2.1
8.2	Science and technology for development	Section 2.2
9	Prospects of international and regional co-operation in science and technology	Chapter 3
10	Conference follow-up	Chapter 4

5. In Chapter 1, a succinct review is made of developments that have taken place in the decade 1970-1980 in terms of changes in capability levels, opportunities afforded by the latest advances in world science and technology, and the policies adopted by governments to build up the local capacity and draw benefits from scientific and technological innovations. These three facets are treated in the context of the regional development scene, which is briefly described in the introduction to the chapter.

6. Chapter 2 deals with certain basic issues arising in connection with efforts to develop the scientific and technological capacities of the countries in the region. These include making use of national scientific and technological activities for development and the problems presented by the integration of science and technology into society.

7. Chapter 3 is devoted to the prospects for subregional, regional and international co-operation. Particular consideration is given to three aspects of the question: fields of priority for collective undertakings, modes and mechanisms for co-operation, and financing arrangements.

8. Chapter 4 is devoted to an examination of possible mechanisms designed to monitor and review progress in the implementation of the recommendations that might be adopted by the Conference.

9. The subjects dealt with in this working document are considered with reference to a region of the world where political, socio-economic, cultural, demographic and other conditions vary to a greater extent than elsewhere. For that reason, this document cannot claim to be exhaustive. It is intended, more modestly, to highlight the main problems arising in the region with regard to the development of science and technology and, thus, to provide assistance to the participants in the Conference when they come to discuss the various items of the agenda.

10. Account was taken in the preparation of this working document of the findings of seminars, meetings and conferences organized by Unesco in the region in the last few years,(1) those of studies of a more general nature conducted by Unesco

(1) Asian Seminar on Science and Technology Policy (Jakarta, 1974)
Meeting of Directors of National Councils for Science Policy and Research in Asia and Oceania (Kuala Lumpur, 1975)
Asian Workshop on Science and Technology Policy-Priorities for Regional Co-operation Programmes (Bangkok, 1978)
Fourth Regional Conference of Ministers of Education and Those Responsible for Economic Planning in Asia and Oceania (Colombo, 1978).

but of particular relevance to the region,[1] as well as those of the United Nations Conference on Science and Technology for Development (UNCSTD, 1979), as recorded in the Vienna Programme of Action and its operational extension, the 'Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development'.

11. The country reports[2] prepared for CASTASIA II provided one of the major sources of information, complemented, as required, by those prepared by the Member States of the region for the Vienna Conference, and by the regional paper presented by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) at that Conference.[3]

12. In addition to this main working document and the country reports[2] submitted to the Conference, a number of reference documents,[4] prepared by the Secretariat, will be made available to the participants.

13. A summary of the main issues to be discussed by the Conference, which takes into account the comments made thereon by the preparatory meeting of experts for CASTASIA II (Bangkok, 16-18 December 1981), also appears in document SC-82/CASTASIA II/4, entitled 'Points for discussion'. The participants may also usefully refer to the final report of that meeting of experts, the conclusions of which, presented in the form of comments on the various sections of the annotated agenda, constitute an essential adjunct to the present document. The experts attending that meeting will find here an expression of gratitude for their valuable contribution.

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(1) Working documents of the first (Paris, 19-22 May 1981) and second (Paris, 31 August-3 September 1981) meetings of the Advisory Panel on Science, Technology and Society.

(2) The reports of the following countries were received by the Secretariat before this document was finalized: Afghanistan, Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Mongolia, New Zealand, Pakistan, Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, USSR, Kazakh SSR and Socialist Republic of Viet Nam.

(3) ESCAP document IHT/PRE-CSTD(II)/16, 14 July 1978.

(4)

Reference number	Title
SC-82/CASTASIA II/Ref. 1	Science, Technology and Development in Asia and the Pacific --Progress Report 1968-1980-- (by A. Rahman and S. Hill)
SC-82/CASTASIA II/Ref. 2	An Overview of the Economic and Social Situation in Asia and the Pacific (Prepared by ESCAP Secretariat)
SC-82/CASTASIA II/Ref. 3	Science and Technology Statistics in Asia and the Pacific --Selected Data-- (Prepared by the Unesco Office of Statistics)
SC-82/CASTASIA II/Ref. 4	Unesco Science and Technology Activities in Asia and the Pacific

CHAPTER 1

SCIENCE AND TECHNOLOGY IN ASIA AND THE PACIFIC

A REVIEW

CHAPTER 1 - SCIENCE AND TECHNOLOGY IN ASIA AND THE PACIFIC: A REVIEW

INTRODUCTION: REGIONAL DEVELOPMENT SCENE

1. One of the main challenges facing the countries of the region derives from the magnitude of the needs to be met. The Asia and Pacific region accounts for nearly three-fifths of the world population, or 2.7 thousand million people. The population growth rate remains high in the developing countries of the region (1) (2 to 3 per cent for the period 1970-1979 for most of them, 1.9 per cent for China and 2.1 per cent for India). Demographic pressure has had, and will continue to have in the coming years, a definite impact on development and on the likelihood of being able to meet the aspirations of the peoples who want to see an improvement in their living conditions.

2. In 1976 two-thirds of the world's 186 million unemployed people were in the Asia and Pacific region. Associated with the factors of unemployment, under-employment and high population density, which characterize some countries in the region, is the problem of poverty. According to the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), 82 per cent of the population of Burma were living below the 'poverty line' in 1976, 75 per cent in Bangladesh, 63 per cent in Afghanistan, 50 per cent in Indonesia, 36 per cent in India, 34 per cent in Pakistan, 27 per cent in Thailand, 22 per cent in Sri Lanka, 16 per cent in the Philippines, 15 per cent in Papua New Guinea and 10 per cent in Malaysia.(2)

3. In the developing countries of the region, agriculture continues to be the mainstay of the economies and accounts for 25 to 60 per cent of their GDP (Table 1). Although these countries accounted for more than a third of the world's production of cereals,(3) they were still among the major importers of food grains throughout the 1970s. The share of manufacturing industries in the GDP in the region averaged between 10 and 20 per cent and is showing an upward trend. All but four countries (China, Indonesia, Iran and Malaysia) were importers of petroleum. They depended upon imports for a large part of their total energy requirements, even though their combined energy consumption represented only 10 per cent of that of the world total. They accounted for 8 per cent of the world's imports and 8 per cent of exports.

4. There are still extremely large disparities in income in the region, the per capita gross national product (GNP) (1979) ranging from $100 to $9,000 (Table 1). The per capita GNP in ten countries was lower than $400, in ten other countries it ranged between $400 and $4,000, while in the four industrialized countries in the region it varied between $4,000 and $9,000.

5. The illiteracy rate decreased in all countries but still poses a problem in a number of them. The most recent estimates,(4) relating to 1980, show that four countries had an adult literacy rate lower than 40 per cent (Afghanistan, Nepal, Pakistan and Bangladesh) and in seven others the rate varied between 40 and 70 per cent (Burma, Indonesia, India, Iran, Papua New Guinea, Lao People's Democratic Republic and Turkey). In several developing countries universal primary education appears to have been achieved, as is the case in Indonesia, Iran, Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Philippines, Singapore, Sri Lanka, Thailand, Turkey and the Socialist Republic of Viet Nam). According to

(1) See Table 1.
(2) Source: 'Development strategies in the 1980s in the ESCAP region', Table 10, note by the Secretariat, ESCAP, Bangkok, 1 August 1979. The 'poverty line' is defined there as the minimum per capita income needed to meet basic human needs--mainly food, clothing and housing.
(3) Statistical Yearbook for Asia and the Pacific 1979, ESCAP, Bangkok.
(4) 'Estimates and Projections of Illiteracy', Office of Statistics, Unesco, 1978; and Unesco Statistical Yearbook for 1981, Table 13.

TABLE 1 - Basic indicators

Country	POPULATION: Number of inhabitants (millions) mid-1979	POPULATION: Average annual growth rate (1970-1979)	GROSS NATIONAL PRODUCT: GNP per capita ($US) 1979	GROSS NATIONAL PRODUCT: Average annual growth rate (1979-1978)	GROSS DOMESTIC PRODUCT: Distribution of GDP (%) 1979: Agriculture	GROSS DOMESTIC PRODUCT: Distribution of GDP (%) 1979: Industry (total)	GROSS DOMESTIC PRODUCT: Distribution of GDP (%) 1979: of which the manufacturing sector accounts for:
Afghanistan	15.5	2.6	170	2.7	-	-	-
Australia	14.3	1.5	9,120	1.5	5 (1)	32 (1)	19 (1)
Bangladesh	88.9	3.0	90	0.2	56	13	8
Burma	32.9	2.2	160	1.7	45	14	10
China	964.5	1.9	260	-	31	47	-
Democratic Kampuchea	-	-	-	-	-	-	-
Hong Kong	5.0	2.6	3,760	6.9	2 (2)	31 (2)	25 (2)
India	659.2	2.1	190	1.6	38	27	18
Indonesia	142.9	2.3	370	5.3	30	33	9
Iran	37.0	2.9	-	-	9 (2)	54 (2)	12 (2)
Japan	115.7	1.1	8,810	7.8	5	42	30
DPR Korea	17.5	2.5	1,130	3.8	-	-	-
Rep. of Korea	37.8	1.9	1,480	8.1	20	39	27
Lao PDR	3.3	1.4	-	-	-	-	-
Malaysia	13.1	2.2	1,370	4.8	24	33	16
Maldives	0.2	-	200	-2.1	-	-	-
Mongolia	1.6	2.9	780	3.1	-	-	-
Nepal	14.0	2.2	130	0.3	58	-	-
New Zealand	3.2	1.5	5,930	0.9	11	31	23
Papua New Guinea	2.9	2.3	660	0.2	37	-	8
Pakistan	79.7	3.1	260	1.5	32	24	16
Philippines	46.7	2.6	600	3.7	24	35	24
Samoa	0.2	-	-	-	-	-	-
Singapore	2.4	1.4	3,830	6.6	2	36	28
Sri Lanka	14.5	1.7	230	1.9	27	31	21
Thailand	45.5	2.4	590	4.5	26	28	19
Tongo	0.1	-	-	1.2	-	-	-
Turkey	44.2	2.5	1,330	4.1	23	29	21
USSR	264.1	0.9	4,110	4.3	16	62	-
Viet Nam	52.9	2.9	-	-	-	-	-

Sources: 'World Development Report 1981', World Bank, August 1981; 'World Development Report 1980', World Bank, August 1980; 'World Bank Atlas 1980'.

Key: - Data not available

Notes: (1) figures for 1978
(2) figures for 1977

ESCAP,[1] the infant mortality rate in most developing countries in the region ranged from 3 to 13 times the average in industrialized countries, while the population per physician ratio[2] varied from 300 in the USSR to 35,210 in Nepal (21,600 in the Lao People's Democratic Republic, 19,890 in Afghanistan, 14,580 in Indonesia and 11,800 in Papua New Guinea).

6. The structure of the population has a direct bearing on the educational services to be provided. In 1975 in the 26 developing countries of the region, 40 per cent of the population was under 15 years of age, in contrast to the four industrialized countries (Australia, Japan, New Zealand and the USSR) where only 26 per cent was in this age-group.

7. A significant factor in the demographic scene is the accelerating pace in the growth of urban populations. United Nations projections show that the urban population, which accounted for 25 per cent of the total population in East Asia and 18 per cent in South Asia in 1960, should rise to 33 and 25 per cent respectively by 1980 and by the year 2000 to 45 per cent for East Asia and 37 per cent for South Asia. Though the rural population will, then, still be in the majority by the end of this century, the urban population will have increased to a very large extent. The high-growth areas of urban populations are the large conurbations which will create new industrial growth centres and, under these circumstances, the widening of the industrial sector seems to call for an intensification of the domestic R&D effort as well as increased attention to the choice and adaptation of technologies.

8. Over the past 20 years the developing countries in the region have sought to develop their industrial sectors, despite the fact that agriculture remains the mainstay of the economies. Most of these countries feel that by exporting their products they will be able to improve significantly their balance of payments and that this is bound to have a favourable effect upon the living conditions of their populations. The increase in the relative share of industrial production in the GDP during the period 1960-1978 was highest in the middle-income countries: Iran (+21), Indonesia (+19), Singapore (+17) the Republic of Korea (+17), Malaysia (+14), Papua New Guinea (+13), and lower than 10 in all the other countries. In the cases of Iran and Indonesia this is largely attributable to the role played by the oil industry, while in the case of the Republic of Korea and Singapore, this growth is primarily due to the development of high technology industries. In other countries whose average income is lower, the relative share of the industrial and services sectors in the GDP has continued to increase; such is the case in India and Pakistan.

9. In other countries again the relative share of industry in the GDP has increased at the expense of the tertiary sector; such is the case in Sri Lanka and Bangladesh in particular. Burma, on the other hand, has increasingly depended upon agricultural production, the share of which in the GDP has increased (at the expense of the services sector), while that of the industrial sector has remained unchanged.

10. The considerable variation in industrial growth strategies in the developing countries of the region reflects first the differences in their existing basic industrial infrastructures, established in order to meet the domestic demand and/or to conquer the export markets. These strategies also depend on the development goals that the countries set themselves and the paths chosen to achieve these goals.

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(1) Revised paper prepared by ESCAP for the United Nations Conference on Science and Technology for Development, Bangkok, 1979.

(2) World Development Report 1980, World Bank, August 1980, Table 22, data for 1977.

Development, generally, depends on the transfer of foreign technology and capital and the use of national scientific and technological capabilities. However, the relative emphasis laid on these two types of technical input varies from one country to another and largely depends on national development policies.

11. In low-income countries (India, Sri Lanka and Bangladesh) stress is laid on the necessity of meeting the needs of the most deprived sectors of the population for food, housing, clothing, water, health, education and employment, and of achieving the greatest possible degree of self-reliance in order to do so. Whilst Bangladesh, Sri Lanka and Nepal hope to attain this end by improving agricultural production, Pakistan assigns priority to industrial growth, particularly in agro-based industries and heavy industries, without, however, disregarding the production of essential consumer goods. Modernization, industrial growth and the improvement of economic and administrative efficiency are in the forefront of Afghanistan's concerns.

12. In middle-income countries the elimination of areas of poverty remains a priority goal, together with more rapid and sustained economic growth (Malaysia, the Philippines, Thailand). The elimination of regional inequalities and the equitable distribution of the benefits deriving from growth are also major goals (Indonesia).

13. Those countries that are the most competitive internationally have already acquired an industrial base as well as technological capabilities and are gradually developing technology-intensive industries and exports. Those countries that lag behind on the path to industrialization sometimes offer their cheaper labour to foreign firms that have decided to transfer their production locations and thus they attract capital to stimulate their manufacturing sectors.

14. In the relatively more industrialized middle-income countries--the Republic of Korea and Singapore--there is a stronger emphasis on high technology, with energy savings and the rational utilization of natural resources being the key concern of the Republic of Korea, and diversification of industry being that of Singapore.

15. In the industrialized countries of the region, the goals of development are of another kind, e.g. quality of life, lower inflation and a reduction in unemployment in the case of Australia; and living conditions and workers' health in the case of Japan. Whilst Australia is trying to become more competitive internationally--by improving its export products and developing its industrial and mining base--Japan and New Zealand place more emphasis on the rational utilization of their natural resources, and in particular on becoming less dependent on fuel supplies. Japan seeks agricultural self-reliance, and New Zealand more effective use of its agricultural resources for export. As for China and the USSR, they both consider modernization of the economy to be a key development objective. In the USSR modernization is aimed particularly at industrial production to serve the welfare of the people through an increase in consumer goods, housing and services; in China modernization is aimed more particularly at agriculture and light industry in order to improve the production of staple consumer goods.

16. To sum up, the low-income countries in the region stress the satisfying of basic human needs; the middle-income countries stress the reduction of inequalities through accelerated industrialization or, if they are already relatively industrialized, the intensification of this process through the use of higher technologies; and the industrialized countries in the region assign priority to social welfare and the rational use of the energy resources necessary for their industrial power.

Industrialization strategies

17. Amongst the low-income countries, Bangladesh assigns priority to rural development which it views as having a high potential for generating wealth and employment and as providing the key to national self-reliance; however, it prefers to base such development on activities with a low capital/output ratio. India proposes to follow a mixed agriculture/industry strategy as a way of achieving self-reliance and satisfying basic human needs. Its industrialization strategy consists in setting up a considerable variety of industries--large-scale as well as small-scale, centralized as well as decentralized, and capital-intensive as well as labour-intensive. Sri Lanka considers it important to create an industrial base and to seek to remove the economic obstacles that have prevented it from developing an adequate irrigation and power infrastructure. Sri Lanka's industrialization strategy therefore promotes incentives for industries--particularly those which are small- or medium-scale and labour-intensive--through the creation of industrial promotion zones and the removal of import restrictions to attract export-oriented private industries utilizing both local and foreign capital.

18. Pakistan is seeking to develop both heavy industries, such as steel, cement and fertilizer production, and agriculture-based industries. Pakistan's emphasis is on modernization (in agriculture as well as industry) and on higher production levels in order to be able to provide the range of consumer goods needed by the people. Afghanistan considers that modernization based on industry is the key to building the capacity to provide better services to the mass of the working people and that industrialization must depend on the exploration and exploitation of all the nation's natural resources. Afghanistan's commitment to develop industries is evidenced by the fact that over 50 per cent of its public sector investment is assigned to industry, whilst agriculture and social services receive only 25 and 15 per cent respectively.

19. The middle-income countries place much emphasis, in general, on the creation of the conditions for accelerated, endogenous economic growth. Energy is among the main concerns of Malaysia, the Philippines, Thailand and Indonesia. This is on account of the importance of energy supply, and above all its cost for the industries of those countries. Indonesia is placing major emphasis on oil prospecting and production as well as shifting to a diversified economy. The building up of foreign exchange is a key concern of all countries. Malaysia and Thailand wish to move past import substitution to export, particularly of processed primary products. Indonesia wishes to use its energy reserves to improve its balance of payments. These countries share a determination to increase the production of food items and/or to develop their food-processing industries in order better to feed their populations, but the paths they wish to take towards industrialization and modernization are faily different.

20. Indonesia sees its immediate need (as expressed in the 1979/1980-1983/1984 Plan) as being to develop an industry to process raw materials, particularly using 'appropriate technology'; this would be followed (under the 1984/1985-1988/1989 Plan) by core industrialization to produce machinery for light and heavy industries. It therefore has a policy to develop both capital-intensive industries, based on the use of high technology, and less capital-intensive small-scale industries. Thailand's Fourth Five-Year Plan (1977-1981) lays equal emphasis on building its basic industrial infrastructure and decentralizing industrial development by establishing small-scale industries. The Philippines is committed to building cohesive, diversified and more productive economic structures and generating employment, but emphasizes productivity increases rather than the development of small-scale, less capital-intensive industries. Malaysia wishes to develop the use of sophisticated technology to accelerate the further development of existing industries, and through trade and tax incentives

is seeking to attract foreign capital to this end as well as to enhance the export potential of primary product processing, particularly the production of articles manufactured from latex.

21. The differences in the industrialization policies followed by high-income countries are no doubt due to the fact that the resources they can use on the international market are different--science and technology for Japan, mineral resources for Australia and agricultural produce for New Zealand. The fact that Japan's modern industrial base has been progressively introduced since the 1960s and that it has well-developed science and technology resources and skilled and diligent workers means that it is increasingly becoming an exporter of high technology. The shortage of energy and resources is nevertheless a matter of fundamental concern to that country. Australia is seeking to produce goods which are more competitive on the export market but lays its main emphasis--as evidenced by the subsidies granted by the government--on the large-scale exploitation and export of its energy, mining and mineral resources. New Zealand appears more conscious of the need to defend itself against the increase in the cost of imported articles by altering the structure of its economy so as to reduce its dependence on imports of fuel and other goods, whilst increasing the export potential of its main fields of activity, particularly agriculture.

22. China is pursuing a diversified strategy of industrialization emphasizing automation and mechanization at one level, semi-mechanization and the use of manual labour and labour-intensive technologies at another. Agricultural development, including the production of raw materials for light industry and the building up of foreign exchange reserves, is its first priority whilst the further development of light industry both to meet domestic needs and to provide a source of export earnings is its second.

23. The USSR, for its part, is endeavouring to extend the modernization of its agricultural and industrial sectors, chiefly through the introduction of new machinery, materials and processes that increase the ratio of machinery to manpower, culminating in the attainment of higher productivity levels and product quality. Advanced industries have been established in the field of electronics, microbial synthesis, nuclear engineering, and synthetic materials such as the artificial diamond. Appreciable progress has been made in the mechanization of agriculture, chemical fertilizers, and the industrialized processing of crops and the products of stock farming. The Asian part of the country is expected to assume a growing role in the country's overall economy, in particular through the establishment of industrial complexes in the Urals, Siberia, the far eastern region of the country, Kazakhstan and Tadzhikistan. These various industrial complexes have played a leading role in increasing the country's production of petroleum, natural gas and coal. The construction of the Baikal-Amur railway will soon be opening up vast new prospects for development in these Asian regions of the USSR. It is to be pointed out, lastly, that the industrialization of these regions is bringing about considerable social changes and a substantial improvement in the standards of living and life-styles of the populations.

24. To sum up, although the low-income countries are endeavouring to increase their potential for processing their agricultural products, there are differences in the strategies they are adopting in order to expand their industrial sectors, ranging from a considerable increase in the number of labour-intensive, small-scale industries in Bangladesh to a combination of activities based on advanced technology and labour-intensive industries in India. Middle-income countries tend more to emphasize rapid economic growth and building more diversified industrial infrastructures: more concern is expressed amongst these countries and those that are at a more advanced stage of industrialization about reducing the dependence on foreign oil supply. There is generally a greater emphasis on using more sophisticated

technologies than is evident in the low-income nations. The high-income countries have already set up their industrial bases and are seeking to develop those national resources likely to bring about an increase in their export earnings--industry for Japan, minerals for Australia, processed agricultural products for New Zealand, capital goods and natural and energy resources for the USSR.

CONCLUSIONS OF PARTICULAR RELEVANCE TO LOW-INCOME COUNTRIES

25. It can be said that, on the whole, the main problems facing the low-income and the least affluent middle-income countries in the region are as follows, although they are not set out here according to any degree of priority:

(a) reducing unemployment and underemployment, and raising the real incomes of the poorest classes by creating and strengthening appropriate rural and urban industries;

(b) increasing and diversifying nutritional and food products through biotechnology and promoting their acceptability;

(c) developing forest and marine resources;

(d) expanding the range and quantity of energy resources for agricultural, industrial and domestic uses in rural areas and developing means for more rational energy utilization;

(e) improving the health of the people, and their living conditions;

(f) protecting and developing water resources, soils and other environmental resources;

(g) bringing about such social and economic changes as will stabilize population growth and keep it at the desired level; and

(h) developing transportation facilities and improving vehicles used for transport.

26. Research in science and technology can be directed towards the practical, effective solution of all these problems.

27. The growing disparities of wealth, demographic factors and their implications for the provision of food and shelter, the magnitude of the need for raw materials and energy resources which in the final analysis are limited, threats to the environment--these are all problems that concern not only individual nations but the world as a whole. They demand a concerted national, regional and international effort if the inhabitants of the region are to be able to live with dignity and in reasonable material conditions. Their interrelations are such that they have to be tackled together.

28. Whatever the case may be, it is by means of a more integrated approach to the use of science and technology and, in particular, the building up of a national capacity for such activity that the developing countries in the region will succeed in reaping the full benefits of science and technology and thereby achieve greater self-reliance in this regard.

1.1 NATIONAL CAPABILITY LEVELS OF MEMBER STATES OF THE REGION IN THE FIELDS OF SCIENCE AND TECHNOLOGY

29. The scientific and technological capacities of the countries of the region can be gauged by studying figures on their science and technology manpower, scale of research and development infrastructure and funds allocated to science and technology. The total data for each country give an overall picture of the region's scientific and technological input, and a rough assessment can be made of its achievements and common problems.

30. The great diversity of the region known as Asia and the Pacific is particularly clearly reflected in the comparative intraregional analyses of science and technology resources. These analyses point up the need to qualify certain generalizations so as to take account of the differing situations prevailing in the various countries, and particularly in those which, by virtue of the sheer size of their contribution to the region's overall resources, call for special consideration, namely, China, India, Japan and the USSR.

31. The conclusions put forward in this section are based essentially on the statistics collected by the Secretariat when conducting periodic surveys among Member States and summarized in a reference document(1) and on the reports prepared for the Conference by individual countries.(2)

Science and technology manpower

32. If the evolution of the countries' capabilities is considered in terms of human resources specialized in science and technology, a number of fundamental questions are bound to be raised. These concern, for example, changes in the quantity and quality of total manpower resources, their ability to match up to national needs and the potentialities of the labour market, and their distribution in the various sectors of the economy.

33. Overall manpower resources have increased to a remarkable degree over the past ten years (Table 2 contains all relevant data for countries in which such data were available). The total number of scientists and engineers has increased at an average annual rate of approximately 6 per cent, with peaks exceeding 10 per cent (Republic of Korea) and minimum percentages of 0.4 (New Zealand) and -1.3 (Sri Lanka). The data for the USSR as a whole reveal an annual rate of increase of 6 per cent; however, it is worth noting that this increase rises to 9 per cent in the case of the Kazakh Soviet Socialist Republic.

34. Data concerning numbers of technicians are too scanty for any firm conclusions to be drawn. However, such information as is available suggests that numbers of technicians tend to vary, by and large, with those of scientists and engineers. Some country reports, too, note that technical personnel are too few and of too low a standard.

35. With regard to higher education,(3) there has been a steady increase in enrolments in universities and schools of engineering throughout the 1970s. At the same time, the number of persons with higher qualifications has risen at a remarkable

(1) Document SC-82/CASTASIA II/Ref.3: 'Science and Technology Statistics in Asia and the Pacific--Selected data--'. In the following pages, this document will be referred to simply as 'Ref.3'.

(2) Please refer to the Foreword for the list of countries which had submitted reports to the Secretariat at the time of drafting the present document.

(3) Ref.3, Table 10.

rate, training being provided essentially by establishments in the region itself, since the percentage of students abroad has been relatively small (under 5 per cent) in relation to the percentage of those studying locally (Table 3). Exceptions to this rule have been those countries of the region whose university infrastructure is not yet sufficiently developed.

36. The quantitative increase in the capacity of higher education gives little insight into some of its other important aspects, such as the distribution of enrolments among the various education sectors, the system's capacity to meet development needs and the needs of the economy, the quality of teaching, etc. For example, it should be noted (Table 3) that enrolments in the social sciences and humanities generally account for 50 to 70 per cent of the total, whereas enrolments in the various branches of engineering, for example, generally represent no more than 10 to 25 per cent of the total.

37. The number of scientists and engineers engaged in research has also risen. However, the region's share of the world total remained stationary between 1974 and 1978 (Table 4). The research capacities of the developing countries in the region in terms of manpower showed a relative increase, rising from 23.8 per cent to 29.1 per cent of the regional total.

38. It should be borne in mind, however, that the ratio of researchers to population remains extremely low in the developing countries of the region, as compared with the industrialized countries of this and other regions. According to Unesco estimates(1) relating to all the developing countries of the region with the exception of China, the Socialist Republic of Viet Nam, the Democratic People's Republic of Korea and Mongolia, the average number of research scientists per million inhabitants was 74 in 1974 and 99 in 1978, showing a marked increase over four years, but one which still remains very modest compared with the USSR (5,024 per million inhabitants in 1978), Japan (3,548 per million inhabitants in 1978), Australia (1,617 per million inhabitants in 1976) and the west European countries and North America in general (1,200-1,800 per million inhabitants, and 2,685 in the case of the United States of America).

39. In short, in purely quantitative terms, substantial progress has been made in the region in channelling human resources into research work.

40. It remains to be discovered whether the various countries of the region have in fact acquired the technical expertise needed to make practical use of research findings in the various productive sectors of the economy. One way of gaining an insight into the potential impact of R&D upon the production of goods and services is to consider how many researchers and research engineers are working in each sector of activity (general services, higher education, production enterprises). The figures(2) show that in several countries the proportion of researchers assigned to the production sector is very small, since most scientific researchers enter the higher education and general services sectors. It is accordingly understandable that, without the support of locally conducted R&D, such countries' industrial enterprises should experience some difficulty in adjusting their production activities according to the results of research carried out elsewhere, or even in assimilating the technologies that they import.

Financial resources

41. Funds spent on research in the region have considerably increased since the end of the 1960s, at least in absolute value (constant currency value). However, considered in relation to national wealth, which has also increased over

(1) See Ref.3, Figure 2.
(2) See Ref.3, Table 5.

TABLE 2 - Increase in the overall numbers of scientists and engineers

Country	Year	Number (000)	Year	Number (000)	Mean annual increase (%)
Australia	1971	120	1976	185	9.0
Bangladesh	-	-	1980	10.3	-
China (1)	1960	1,969	1979	4,705	4.7
India	1965	261	1979	626	6.4
Republic of Korea	1967	18.0	1979	91.8	14.5
Japan (2)	1965	149	1979	341	6.0
New Zealand	1975	21.7	1979	22.0	0.4
Pakistan	-	-	1973	111	-
Philippines	1965	81.6	1979	129	3.3
Sri Lanka	1973	6.8	1977	6.5	-1.3
Thailand	1973 (3)	18.8	1979	28.2	7.0
Kazakh Soviet Socialist Republic(4)	1965	3.5	1979	11.5	8.9
USSR	1965	4,891	1979	11.100	6.0

Source: Country reports

Key: - Data not available

Notes:
(1) Total number of scientists, engineers and technicians
(2) Number of scientists and engineers engaged in research only
(3) Unesco Statistical Yearbook 1975
(4) Number of scientific workers possessing a higher education diploma

TABLE 3 - Enrolments in tertiary education

Country	Year	Number of students enrolled in the country's institutions (latest year available)								Number of students enrolled abroad (1972)
		TOTAL	Distribution by discipline (in percentages)							
			Total	SC	ENG	MED	AGR	SOC	OTH	
Afghanistan	1978	21 118	100	7	20	13	9	51	–	1 527
Australia	1979	317 496	100	12	10	7	2	67	2	3 336
Bangladesh	1978	154 496	100	20	3	5	2	67	3	1 818
Burma	1978	121 609 (1)	99	53	2	3	1	41	–	176
People's Republic of China	1978	856 322	100	8	4	13	7	67	1	21 039
Democratic Kampuchea	1972	9 988	101	11	11	22	1	56	–	1 121
Hong Kong	1978	52 961	100	8	38	2	–	52	–	22 141
India	1976	4 555 001 (2)	100	21	7	3	1	67	1	13 311
Indonesia	1976	296 326	101	3	11	5	6	56	20	8 523
Iran	1977	155 811	101	16	19	14	4	39	9	67 900
Japan	1978	2 432 052 (1)	101	3	17	5	3	66	7	14 399
Republic of Korea	1979	509 308	100	7	35	8	7	42	1	6 438
Lao People's Democratic Republic	1974	828	100	–	–	41	–	59	–	2 073
Malaysia	1978	37 862 (3)	102	25	21	5	5	45	1	22 324
Mongolia	1979	11 826	100	5	24	14	13	25	19	–
Nepal	1978	31 942	100	9	5	5	4	77	–	1 452
New Zealand	1979	85 075	100	9	9	5	3	51	23	1 243
Pakistan	1977	148 451	101	14	13	15	5	54	–	4 458
Papua New Guinea	1979	2 883 (4)	100	8	23	5	9	45	10	306
Philippines	1978	1 229 056	100	10	31	8	6	39	6	3 046
Samoa	1978	425	100	–	–	–	–	100	–	302
Singapore	1978	24 114	100	6	45	4	–	44	1	3 619
Sri Lanka	1978	17 485 (5)	100	12	19	9	3	57	–	2 772
Thailand	1977	216 876 (6)	101	5	5	5	2	84	–	10 243
Tonga	1978	128	101	31	8	–	6	56	–	349
Turkey	1978	319 715	100	6	18	8	2	66	–	11 889
USSR	1978	5 109 800 (7)	100	–	46	7	10	37	–	1 224
Socialist Republic of Viet Nam	1978	137 002	100	4	24	9	9	52	2	15 158

TABLE 3 (continued)

Key:

SC: Natural sciences

ENG: Engineering sciences and technology

MED: Medicine

AGR: Agricultural sciences

SOC: Social sciences and humanities

OTH: Other or unspecified disciplines

All percentages have been rounded off to the nearest whole number; hence the totals may be slightly more or slightly less than 100 per cent.

Source: Ref.3, Table 8

Notes: (1) Including correspondence courses

(2) Including intermediate and pre-university courses

(3) Malaysian peninsula only

(4) Universities only

(5) Excluding enrolments in courses not leading to a diploma

(6) Including enrolments in the Open Admission University

(7) Including evening classes and correspondence courses. Enrolments in the natural sciences have been included with those in the social sciences under the latter heading

TABLE 4 - Research scientists and engineers throughout the world

	1974	1978
Total number	1,826,600	2,131,500
Asia and the Pacific region's share in the world total	26.9%	27.0%
Developing countries' share in the regional total for Asia and the Pacific	23.8%	29.1%

Source: Ref.3, Figure 1; (the above estimates do not include the following countries: China, Democratic People's Republic of Korea, Mongolia, the USSR and the Socialist Republic of Viet Nam, for which comparable data were not available) the same period, the trend appears comparatively moderate. Whereas the developing countries of the region were earmarking between 0.1 and 0.3 per cent of their gross national product to research in 1965 or thereabouts (figures dating back to the first CASTASIA Conference), they today allocate between 0.2 and 0.4 per cent of their GNP, with a peak percentage of 0.6 per cent in the case of India and the Republic of Korea (see Table 5). One per cent of the GNP, as advocated by the first CASTASIA Conference, has not been reached, and even the more modest target of 0.5 per cent of the GNP proposed by UNACAST in its World Plan of Action at the beginning of the 1970s has yet to be achieved by the vast majority of the countries.

42. In most countries, the state budget--as distinct from that of private enterprises--remains the major source of financing, while foreign sources play only a marginal role (Table 5). According to the estimates for 1978[1] (see Table 6), the developing countries of the region (excluding China, the Democratic People's Republic of Korea, Mongolia and the Socialist Republic of Viet Nam) allocated some US $1,900 million to research, including approximately US $600 million allocated by India.

TABLE 5 - R&D expenditure in Asia and the Pacific

Country	Year	as a percentage of GNP	Percentage financed by the state budget
Australia	1976	1.0	78
Bangladesh	1974	-	85
Burma	1973	0.1	-
India	1979	0.6	86
Indonesia	1979	0.4 (1)	100
Iran	1972	0.3 (1)	99 (1971)
Japan	1979	2.1	29
Republic of Korea	1979	0.6	52
Mongolia	1980	0.13	49
New Zealand	1977	0.7	85
Pakistan	1974	0.14	100
Philippines	1979	0.17	59
Samoa	1978	-	60
Singapore	1978	0.2	38
Sri Lanka	1978	0.17	54
Thailand	1979	0.26	92
USSR	1979	4.6 (2)	46
Socialist Republic of Viet Nam	1979	-	100

Source: Ref.3, Table 2 and country reports

Notes: (1) Data relating to state financing only
(2) As a percentage of the net material product

(1) Ref.3, Figure 1.

TABLE 6 - Research expenditure worldwide

	1974 (in 1,000 million US $)	%	1978 (in 1,000 million US $)	%
Total	79.2	100	127.7	100
Asia and the Pacific region	11.5	14.5	23	18
Developing countries within that region	0.84		1.9	

Source: Ref.3, Figure 1 (the above estimates do not include the following countries: China, Democratic People's Republic of Korea, Mongolia, USSR and the Socialist Republic of Viet Nam, for which comparable data were not available)

1.2 RECENT ADVANCES IN SCIENCE AND TECHNOLOGY

43. Science and technology develop in close interdependence on each other. A scientific knowledge of the materials and transformation processes used in modern technologies creates a potential for change along an enormous variety of fronts especially in industry. The nature and extent of the impact on society depend, naturally, on the nature of the advances, the implications of the resulting applications and how widely they are disseminated, and the specific circumstances prevailing in the societies concerned.

44. The extent to which recent advances in science and technology are applied in practice varies considerably depending on the degree of technological development in the countries of the region. Some of them have already reached a high degree of sophistication in the manufacture of heavy equipment (e.g. India) or shipbuilding (e.g. the Republic of Korea). Others lag behind in terms of technological achievement, and even lack the facilities and personnel required for the maintenance of agricultural implements.

45. Most countries in the region have to contend with rapid population growth, scarcity of resources, a pressing need for rural development, and unemployment. Under these circumstances, reliance on labour-intensive technologies may be seen as the only way of alleviating the situation, provided that the potential of certain sophisticated technologies as accelerators of development is not overlooked as a result. Examples of these new technologies (which might lend themselves to various forms of regional co-operation) are given below.

Use of remote sensing for natural resources surveys

46. At least ten countries in the region (Australia, Bangladesh, India, Indonesia, Iran, Japan, Pakistan, the Philippines, the Republic of Korea and Thailand) have set up special institutions or centres for using remote-sensing techniques by satellite to carry out rapid surveys of natural resources. These techniques can be employed in surveying agricultural and mineral resources, petroleum and offshore prospection, ground and surface water studies, oceanography, ecology, etc. The training of personnel to interpret data using computerized techniques and to develop indigenous technology for the equipment of ground stations is a vital prerequisite for the exploitation of these new techniques, and an area where regional co-operation

is highly desirable for optimum utilization of the technology; it also appears to be an area in which the industrialized countries could assist the developing countries.

Micro-electronics

47. Man has been processing information since time out of mind. But the advent of the first all-electronic calculator, ENIAC, in 1946, marked a decisive turning-point in this domain.

48. The mass-produced microprocessors of today make possible applications ranging from everyday domestic chores to the most complex cybernetic functions performed in real time. The accessibility of data-processing techniques and devices, and their ubiquitous use, imply mutations in practically all fields of human endeavour. The fabric of society will be affected by the proliferation of links and transfer mechanisms between individuals and groups. Communications and access to information no longer require direct interpersonal contact. The time thus gained, and the higher productivity of human labour, can lead to a considerable increase in the economic growth of all countries. It is clear that major economic and social changes, especially in the occupational structure of the working population, are therefore inevitable.

Ecology and the environment

49. Initially, environmental research was conducted mainly in the industrialized countries because of the need to combat industrial pollution. The developing countries have not yet reached the intolerable levels of atmospheric, river or sea pollution experienced by the industrialized countries which failed to take preventive action in good time. Unfortunately, we are now witnessing the transfer of pollution-generating products to developing countries (for example mercury cells, pesticides based on polychlorobenzene and hexachlorocyclohexane, and vinyl chloride). However, industrialized countries such as the United States of America, Japan and the Federal Republic of Germany are developing technologies which produce effluents that are either not harmful or can be converted into useful by-products.

50. A mastery of non-polluting technologies should enable the developing countries in the region to avoid the accidents experienced by industrialized countries, especially since the cancer-producing or other harmful effects of most industrial effluents are now known.

Biotechnology

51. Biology-based technology promises to have far-reaching repercussions on living conditions, perhaps even on individual behaviour, hence also on the traditional characteristics of societies. No one can yet assess the scope of the ethical issues likely to be raised by the mass application of genetic engineering.

52. Agriculture is possibly the most obvious field for the economic application of biotechnology, in view of the possibility of developing strains exhibiting desirable characteristics in terms of yield, adaptation to specific environments, resistance to aggression from external agents, nutritional value, etc. But the outlook for new applications is promising in all fields relating to molecular structure: disease control, the production of hormones and antibodies, the processing, by means of specialized bacteria, of materials which, owing to their dispersion, are difficult to treat by conventional methods (for instance pollutants from oil spills or chemical waste, the extraction of minerals dispersed in water bodies or in geological formations, etc.), not to mention the renewal of interest in such age-old activities as fermentation and biomass conversion processes.

53. This area, unlike some others, is accessible to developing and highly industrialized countries alike. The adoption of application policies, the choice of lines of research, the development of the appropriate human resources and the dissemination of knowledge among those in authority and potential users are all fundamental factors for participating in the forward movement of biotechnology, a field which is evolving rapidly in terms of both theory and practical applications.

New materials

54. The gradual exhaustion of some mineral resources and the concentration of others in a limited number of countries is a matter of concern to many users, who fear that political and economic changes may prevent their having access to these resources. This concern, combined with the search for competitiveness and for marketable innovations, provides incentives for the development of new or substitute materials. Synthetic chemistry is a constant new source of tailor-made products capable of replacing traditional materials, inter alia petrochemicals. Although recent advances in this field have been less spectacular than the breakthroughs in information technology or biotechnology, the creation of synthetic materials or the replacement of raw materials has a perceptible impact on the economy of developing countries, whose prosperity depends on marketing a single product or small number of products, which puts them in a vulnerable position. Synthetic fibres and elastomers, plastic materials and artificial leather (to mention only a few well-known examples) are witness to this. It is not a matter of setting up defences in each country against progress elsewhere, as recognizing the need to understand the situations and problems that such progress is likely to entail, and acting accordingly, for instance by directing research towards improving the materials or processes on which the country's economy depends, making them more competitive and enhancing their value through new applications.

Energy

55. New and renewable energy sources are now of central concern to most countries; and a clear polarization is noticeable between two types of solution: those requiring large energy-producing units, and more individualized solutions.

56. Nuclear fusion holds out the possibility, perhaps in the span of a generation, of producing massive amounts of energy. But the pattern of distribution of the power thus generated would not differ greatly from the present one, with a large generating station and interconnected distribution networks. Practically inexhaustible and non-polluting, the nuclear fusion option will doubtless require considerable investment, not to mention the very long time-span between decision-making and implementation. Furthermore, it is a well-known fact that complex and large-scale man-made systems occasionally prove dangerously vulnerable, both at the generating station and in the increasingly highly integrated distribution networks.

57. At the other extreme, a variety of factors work in favour of developing small-scale sources of energy: the trend away from developing rural areas on urban patterns; the present incentives encouraging decentralized and non-industrial exploitation of non-conventional sources of energy and the biomass; the high cost of branch networks to distribute centrally generated power, and the new concern to preserve the energy balance in agricultural activities. Research into possible energy sources--solar, wind, biomass, etc.,--and into processes of converting various types of energy into electricity seems to be of clear interest to the developing countries: the sources are easily accessible, as are the techniques and mechanisms for exploiting innovations, and highly flexible composite solutions may be devised to meet the needs of different cultures and environments. The number of lines that may be followed is not restricted to the cases mentioned here:

photo-decomposition of water, use of photo-voltaic cells and batteries, conversion of geothermal energy, utilization of saline ponds to absorb solar energy, not to mention solutions requiring extensive research and costly installations, such as the exploitation of tidal power or ocean temperature gradients. In the case of energy, the impact of innovations on society can be measured in terms of national and local self-reliance, if the solutions adopted are geared to the specific problems of dispersed rural populations.

Satellite technology(1)

58. Multiple uses of satellites for communication, weather-monitoring and resources survey have assumed importance for the developing countries. In Indonesia and the South Pacific islands, satellite communication has provided the solution for rapid communication in isolated areas. Since 1971, Singapore, through its satellite earth station at Sentose, has direct links with two-thirds of the world via two communication satellites. Such systems are particularly useful during national calamities. Typhoons and cyclones have caused considerable damage to life, property and ecology in a number of developing countries (India, Philippines and the Pacific islands).

59. The fruitful co-operation between developing and industrialized countries in weather forecasting for agriculture and in surveying natural resources should be further strengthened through the training of local personnel and the indigenous development of modern ground facilities. This is another field for fruitful technical co-operation amongst developing countries (TCDC).

60. The Space Applications Centre in India conducted a satellite broadcasting experiment in 1975-1976, based on satellite ATS-6 provided by NASA, the ground segment being completely developed by Indian scientists. Programmes on education and development were broadcast from earth stations in two cities, Ahmedabad and Delhi, and retransmitted using the high-power transmitter and large antenna aboard the satellite. These programmes were received by television sets in 2,400 villages in India. One and a half hours of broadcasting in the morning were devoted to schoolchildren, and two and a half hours in the evening to rural audiences in villages.

61. A survey of children exposed to these programmes showed positive gains in the areas of oral expression and their attitude to seeking knowledge and information. There was also conclusive evidence of new practices adopted and even innovations triggered by the farmers: 50,000 rural teachers benefited in this way from a new type of training in the teaching of science subjects. The experiment was most successful in attracting poorer sections of rural society and female audiences.

62. Indonesia also intends to use satellite technolgy for science education and the popularization of science in remote areas; it might be possible for a group of countries to benefit jointly from satellite technology for rural development and education.

Nutrition and development

63. Malnutrition, which affects large sections of the population in most developing countries in the region, is known to be a serious factor in permanent physical disability. But the fact that it can also cause irreparable brain damage in young children is frequently overlooked.

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(1) This section is based in part on the revised draft paper prepared in 1978 by the Economic and Social Commission for Asia and the Pacific (ESCAP) for the United Nations Conference on Science and Technology for Development, reference IHT/PRE-CSTD(II)/16, dated 14 July 1978.

64. The major direct or indirect cause of child mortality below the age of five in the region is related to malnutrition of the mother during pregnancy or to nutritional deficiencies of the infant or young child. The full impact of malnutrition on children surviving to adulthood is more difficult to assess. It is known, however, that many of them suffer irreversible impairment such as defects of vision, hearing or body control, and that they have a higher than average incidence of certain disabling illnesses such as cerebral palsy and epilepsy. Early malnutrition can affect physical and mental development in many other less evident ways, such as absence from school due to illness, or apathy and diminished physical activity which curtail the child's interchange with his environment, thus depriving it of stimulating experiences and learning opportunities.

65. Numerous research projects have already been conducted throughout the world in an attempt to resolve the problem of nutritional deficiencies in developing countries. Many of these efforts were frustrated for a number of reasons:

(a) the proposed solutions were based on imported technologies, the presence of foreign experts and methodologies developed outside the local context;

(b) the fact that the local population was not closely enough associated with the project and was unable to use all available local resources led to a collapse of activity once the project was terminated;

(c) the measures proposed were on too limited a scale to deal with the complex issues involved.

66. Any project designed to counter malnutrition in a developing country requires a multidisciplinary approach using all available resources and applying the methodology of numerous disciplines, such as nutrition, biology, chemistry, genetics, neurophysiology, sociology and cultural anthropology. In addition, emphasis should also be laid on research and training at local level and the utilization of local human resources. Given the crucial role of education in this respect, a comprehensive integrated educational programme will probably be necessary in order to make communities aware of their capabilities for nutritional improvement and help them to make the most of them.

Marine sciences and technology

67. The oceans are vitally important for a wide range of human activities. They provide food and natural resources, carry international trade, act as both a source and a sink of energy and affect atmospheric and climatic conditions. They are the final repository of most of the waste resulting from world population growth and higher living standards.

68. Large sections of the population of Asia and the Pacific are economically dependent on some aspect of marine activity. The list of potential users of improved ocean services is long, and the range of possible applications wide.

69. Ocean data are of direct use to commercial fisheries in a variety of ways. Oceanic fronts often act as environmental barriers to horizontal fish movements, with some shoals of fish congregating along fronts where planktonic foods are concentrated. The thermocline layer depth can act as a top or bottom barrier in trawling and net-setting operations. Changing bottom temperatures on the continental shelf affect distributions of bottom-dwelling seafood populations. Thus the analysis and prediction of ocean frontal locations and surface and subsurface temperatures can be an important asset in commercial fishery operations and in warning systems predicting natural disasters, such as tsunamis, which can inflict terrible damage in terms of human life and property in the Pacific.

70. The safety and efficiency of commercial shipping can be enhanced in several ways. More accurate and longer-term forecasting of marine weather conditions requires improved input of the oceanographic observations on which atmospheric models are based. Local forecasts of fog and iceberg conditions can also be improved with real-time ocean data. Several studies have shown that in some areas substantial savings in ships' fuel costs can be realized through radio broadcasting of real-time positions of major ocean currents. When a disaster occurs at sea, the efficiency of a search and rescue effort can be increased if accurate temperature and ocean current data are available.

71. Tourism-based local economies might benefit from ocean services in support of pleasure boating and fishing activities. All maritime nations will require a whole new range of oceanographic instruments and equipment to conduct offshore exploration and exploitation in waters under their national jurisdiction. The effect of human activities can be evaluated by marine polution monitoring programmes.

72. Most countries in the region could doubtless benefit from the regional and worldwide marine science programmes implemented with the assistance of Unesco and its Intergovernmental Oceanographic Commission (IOC).(1)

73. Finally, the need to strengthen the marine sciences and their related technologies is borne out by recent events which confer new responsibilities on Member States in respect of extensive maritime areas placed under their individual national jurisdiction (an exclusive economic zone of 200 nautical miles) following the deliberations of the United Nations Conference on the Law of the Sea. In this context, Unesco is involved, through its Intergovernmental Oceanographic Commission in preparing a detailed plan of assistance designed to strenghen Member States' capacities in the field of the marine sciences.

Systems analysis

74. Systems analysis, first developed to solve military problems was rapidly turned to advantage by business and industrial firms and economic and social planning agencies. Although until recently it was used mainly by industrialized countries, particularly the United States of America, it is now beginning to be applied by developing countries, especially those in Asia and the Pacific. For example, the Ministry of Science and Technology in the Republic of Korea has recently established a Bureau of Information Industries, which is responsible for directing policy and encouraging the universal adoption and use of this method of forward management.(2)

75. Systems analysis has been described as the integration of scientific methods developed in business and industry planning, together with the logically similar but more precise methods of design and operational development of complex technological devices and systems. The introduction of large digital computers has made possible the wider application of systems analysis, because they perform on-line and off-line computations that would otherwise be difficult to execute. New technological approaches related to systems analysis are being developed to aid those in positions of responsibility in developing countries to evaluate the consequences of various decisions in sectors such as agriculture and industry, or as regards the development of the economy as a whole. However, the lack of qualified personnel is a major impediment in applying systems analysis to planning problems in developing countries, since systems analysis is an interdisciplinary subject

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(1) See 'Unesco Science and Technology Activities in Asia and the Pacific', document SC-82/CASTASIA II/Ref.4; and Sections 3.1 and 3.2 of Chapter 3.

(2 See 'Guidelines for the Development of Industrial Technology in Asia and the Pacific', ESCAP, 1976, Bangkok, p.35.

calling for the participation of mathematicians, system theorists, computer scientists, economists and engineers.

Impact on development

76. The advances briefly discussed in the preceding sections--and also many others--can clearly contribute to development: they have an impact on agriculture and industry, communication, the organization and functioning of society, the availability of energy and the more effective management of natural resources. But how and to what extent can they be applied? The answer depends on a close examination of the conditions prevailing in each country and factors of a specifically local nature. It lies beyond the scope of this paper to consider all the factors involved. However, some of the essential prerequisites for effective exploitation of scientific and technical advances should be noted, for instance improving local capabilities through more relevant infrastructures, co-ordinating research efforts with the overall plan of action adopted, improving the management of the science and technology system as a whole, including production activities, seeking complementarity with other countries in order to increase collective self-reliance, etc. All these areas appear appropriate for international co-operation, but the question of procedures for action remains to be solved.

77. One aspect seems particularly worth study. Current trends in technological progress make it possible to adopt and implement new patterns of development which take into account the differences between the contexts prevailing in, for instance, predominantly urban areas, dispersed rural populations, areas of extensive agricultural exploitation, coastal environments, etc. In particular, the advance in telecommunications and the emphasis on small-scale sources of energy make it possible to envisage forms of development other than the present system of outward radiation from advantaged centres towards regions which lie outside urban or industrial contexts and cannot be integrated into their development system. Although the philosophical basis for a break with this 'centrifugal' pattern was laid many years ago, a number of technological advances now make it easier to proceed to action. Certain questions have to be considered in each case, such as the specific steps to be taken, changes in outlook, complementarity between some of the old lines of action and possible new approaches (for example, telecommunications and surface transport, centralized networks and autonomy, standardization and differentiation, mass production and local variants).

78. Scientific advances have a momentum of their own because of the growing interaction between scientific and technical knowledge and its application, a process that is stimulated by incentives of all kinds. Underlying forces are conducive to further development in the industrialized countries. How can the developing countries in Asia and the Pacific advantageously participate in this forward thrust and integrate it into existing patterns in each country or group of countries? Would this aim be furthered by systematic analysis of the many studies produced throughout the world on the immediate and foreseeable consequences of major new advances, and by dissemination of the findings? Assuming that this results in a better understanding by the countries concerned of the issues involved, what form of action would help them to participate in overall scientific and technological progress? Is it possible to devise a strategy for international co-operation which would be on two separate components:

on the one hand, promoting approaches which seem to be the most promising for an improvement in the human condition throughout the world;

on the other, making every effort to help the countries concerned to catch up in certain fields of knowledge and applied science?

79. If this is possible, what technical areas and practical procedures are best suited to the attainment of this dual objective?

Some of these problems will be considered in Chapter 3.

1.3 SCIENCE AND TECHNOLOGY POLICIES

80. Government decisions which affect, directly or indirectly, the conduct of scientific and technological activities can be subsumed under the generic term of 'policy'. At the time of CASTASIA I, many countries developed and developing alike, appeared to lack any explicit policy for science and technology, having rather a number of implicit policies, sometimes uncoordinated, in the form of industrial, commercial, education and other policies. The countries in the Asia and the Pacific region have gone a long way since then in establishing the mechanisms required for developing integrated science and technology policies. How adequate are these mechanisms? What are the various trends in national policies in the region towards technology transfer, development of indigenous technologies and towards international scientific and technical co-operation? While these questions will be taken up below, it would be advantageous at the outset to define what we mean by a comprehensive science and technology policy as it has evolved since CASTASIA I.

Definition of a comprehensive science and technology policy

81. Science and technology policy will be taken here to mean that part of development policy relating to the planning, organization and conduct of scientific and technological activities considered as instruments of the intellectual and material development of a country. The experience gained over past decades leads to the conclusion that a comprehensive science and technology policy embraces the following elements, this enumeration not being exhaustive, moreover:

(a) formulation of science and technology plans and programme budgets with specific targets; determining of research priorities arising from national development goals in every sector of the national economy; assessment of the conformity of science and technology plans to the goals pursued;

(b) mustering of the resources essential to the implementation of national plans for scientific and technological development, namely:

training of highly qualified scientific workers and of the laboratory technicians whose task it is to assist them. The key to this problem is to be found in higher education of excellent standard in the basic scientific disciplines;

adequate financing on a stable basis to maintain the continuity of the country's science and technology effort;

establishment or strengthening of the institutional infrastructures for fundamental research and for research applied to the solution of development problems, and the related scientific and technological services;

development of all scientific and technological information media;

(c) setting up of the legal, administrative, financial and institutional machinery required to carry through scientific and technological development; and training of the administrators required for its smooth running;

(d) increasing the effectiveness of the national effort in science and technology, in particular by promoting managerial ability in research and development (R&D) and fostering a balanced development of fundamental research, applied research and experimental development activities;

(e) making the results of scientific and technological activity known in all sectors of the economy; continuing review, appraisal and adjustment of R&D programmes at the macro-economic and at the micro-economic level;

(f) promotion of communication and co-operation among government agencies, research institutions, professional societies and the users of scientific and technological research findings with a view to stimulating a demand for scientific research among the productive sectors of the economy;

(g) setting up of national machinery for the assessment, selection, acquisition and adaptation of foreign technology and know-how, full consideration being given to economic, social, cultural and environmental conditions and to the traditional empirical knowledge existing in the country.

82. The mobilization of the country's scientific and technological capacities with a view to development also involves the adoption of measures such as will bring about a constant increase in the well-being of the entire population on the basis of its full participation in the development process. This calls for special efforts on behalf of rural communities, which only too often are left out.

83. Science and technology policy covers basically three major groups of scientific and technological activities:

(1) research and development (R&D);

(2) technology transfer and technological innovation;

(3) scientific and technological services (information and documentation, instrumentation services and quality control, environmental services such as geological, hydrological, meteorological services, metrology and standards, science museums and other science popularization activities, agricultural extension services, etc.).

84. In addition, science and technology policy is closely connected with the production of goods and services (downstream linkage) and with education (upstream linkage), although the importance of its links with other sectors is not to be minimized. It is also incumbent on science and technology policy to contribute actively to the various aspects of the training of scientists, engineers and technologists, especially in regard to curricula and the lines of emphasis of academic research.

85. The activities mentioned above are carried out in a set of institutions (university laboratories, technical schools and firms, institutions providing support services for research and the transfer of knowledge in production) which, together, with the appropriate policy-making, planning and co-ordinating bodies, constitute the 'science and technology system' of a nation.

Institutional framework for science and technology policy

86. Generally speaking, it is over the past decade and following the first CASTASIA Conference that the subject of science and technology policy has begun to receive the attention it deserves in the Asian countries, governments

being increasingly aware of their responsibilities in this sphere. The institutions and mechanisms for science and technology policy-making and the systems for the management of research and development are still rapidly evolving. There are signs that even countries with a weak science and technology policy-making structure still appreciate the significance of science and technology for their economic development--in particular, for effectively guiding national research activity and the development of the necessary human, financial and institutional resources.

87. To give an overall view of the national institutions currently existing in the region and playing a part in the preparation and implementation of science and technology policies, succinct information regarding each country has been put together in Table 7. This table is supplemented by the following description, which is not exhaustive, of the institutional framework for science and technology policy in a limited number of countries in the region. Fuller information may be obtained by consulting the national reports prepared by the countries for the Conference.

Australia

88. Until recently the major body for implementation and innovation in science was the Commonwealth Scientific and Industrial Research Organisation (CSIRO). A Department of Science and Technology, formed in 1980 and stemming from the former Department of Science and Environment, today has science policy and planning as one of its major functions. It shares some of these functions with the CSIRO and with a statutory body, the Australian Science and Technology Council (ASTEC), established in 1977 to advise the federal government on the role of science and technology in the formulation and achievement of national goals. In particular, this Council identifies priority fields for Australian research.

89. A number of departments in the federal government have interests in science and technology matters and some of them conduct and/or finance research and development work. Consequently development policy and science and technology policy meet at the federal level. This applies equally to the governments of the various states of the Commonwealth. The funding of public sector scientific and technological activity directed to development goals is primarily through the federal and state governments. The stimulation of research and development within Australian industry is an important element of the government's long-term industry policy aimed at the development of a stronger and more specialized manufacturing base in Australia. The innovation potential of science and technology research results is taken into account in the setting of development goals by each department, which considers such results in the light of its own responsibilities for development.

Bangladesh

90. A National Council for Science and Technology (NCST) was established in 1975. Its long-term objectives are to promote development and the advancement of science and technology and to co-ordinate the research and development programmes implemented in the country.

91. Members of this Council act in an advisory capacity to determine national policies on science and technology relating to national development goals. The Council prepares plans, co-ordinates research activities for the effective use of science and technology in the various sectors of the economy, develops policies concerning the specialized personnel required and promotes scientific information and extension services.

TABLE 7 - Asia and the Pacific: National bodies responsible for science and technology policy(1)

Country	Policy-making	Planning, co-ordination and evaluation	Implementation	International co-operation
Afghanistan	National Commission of Science and Technology	Science and Technology Department of the State Committee for Planning	Academy of Sciences, Science Centre for Ministry of Education, Kabul University Research Centre	Science and Technology Department of the State Committee for Planning
Australia	Australian Science and Technology Council, Department of Science and Technology	Australian Science and Technology Council, Department of Science and Technology	Commonwealth Scientific and Industrial Research Organization (CSIRO), Australian Atomic Energy Commission, specialized research councils (health, agriculture, energy, defence), Tertiary Education Commission, relevant ministries	Department of Science and Technology, Department of Foreign Affairs
Bangladesh	National Council for Science and Technology	National Council for Science and Technology, Division of Science and Technology of the Office of the President	Relevant ministries, Atomic Energy Commission, Council of Scientific and Industrial Research, Museum of Science and Technology, specialized research councils and institutes (jute, agriculture, health, space, environment)	

(1) The classification of the bodies by type of function is only approximate, the information available not always making it possible to identify their function unequivocally. A blank indicates not the absence of organizations, but a lack of information.

Burma	Research Policy Direction Board	Research Policy Direction Board	Ministries of Agriculture, Health, Industry, Education, research units of ministerial departments and of corporations	Research Policy Direction Board
China	State Scientific and Technological Commission	State Scientific and Technological Commission	Chinese Academies of Sciences and Social Sciences, specialized research institutes and sectoral academies	State Scientific and Technological Commission
Democratic Kampuchea				
Hong Kong				
India	Cabinet Committee on Science and Technology, Advisory Committee to the Cabinet, Department of Science and Technology	Department of Science and Technology, relevant ministries departments and agencies, planning commissions	Council of Scientific and Industrial Research, Indian Council of Agriculture Research, Indian Council of Medical Research, Department of Atomic Energy, Defence Research & Development Organization, Department of Environment, University Grants Commission, relevant ministries and departments	Department of Science and Technology, Ministry of Education, Council of Scientific and Industrial Research Department of Atomic Energy, India Meteorology Department
Indonesia	Ministry of State for Research and Technology, Planning Ministry (BAPPENAS), Indonesian Institute of Sciences (LIPI)	Ministry of State for Research and Technology, Planning Ministry (BAPPENAS), Indonesian Institute of Sciences (LIPI)	Indonesian Institute of Science, National Co-ordination Body for Survey and Mapping, National Institute for Aeronautics and Space, National Atomic Energy Commission	Ministry of State for Research and Technology

Country	Policy-making	Planning, co-ordination and evaluation	Implementation	International co-operation
Iran				
Japan	Japan Science Council, Council for Science and Technology, Science and Technology Agency (STA)	Japan Science Council, Council for Science and Technology, Science and Technology Agency (STA)	Science and Technology Agency, other relevant ministries, Ministry of Education, Science and Culture, Ministry of International Trade and Industry (MITI)	Ministry of Foreign Affairs, Ministry of Education, Science and Culture, Japan International Co-operation Agency (JICA)
Democratic People's Republic of Korea	State Committee for Science and Technology			
Republic of Korea	Ministry of Science and Technology	Ministry of Science and Technology, National Council for Science and Technology	Atomic Energy Commission, Korean Advanced Institute of Science and Technology (KAIST), specialized research institutes, relevant ministries	Ministry of Science and Technology
Lao People's Democratic Republic	National Commission for Science and Technology			
Malaysia	National Council for Scientific Research and Development, Ministry of Science, Technology and Environment (STE)	National Council for Scientific Research and Development, Ministry of Science, Technology and Environment (STE)	Specialized research institutes, relevant ministries	
Maldives				

Mongolia	State Committee on Science and Technology	State Committee on Science and Technology, in collaboration with the Academy of Sciences	State Committee on Science and Technology, Academy of Sciences, relevant ministries	State Committee on Science and Technology
Nepal	National Council of Science and Technology (NCST)	National Council of Science and Technology (NCST)	Relevant departments/ ministries and the universities	
New Zealand	Minister of Science, National Research Advisory Council	National Research Advisory Council	Department of Scientific and Industrial Research relevant departments	National Research Advisory Council
Pakistan	Ministry of Science and Technology, National Science Council (to be replaced by the National Science and Technology Council)	National Science Council	Specialized research councils (agriculture, irrigation, health, defence), Pakistan Science Foundation, Atomic Energy Commission, Appropriate Technology Development Organization	
Papua New Guinea			Departments of Education, Agriculture and Public Works	
Philippines	National Science Development Board (NSDB)	National Science Development Board	Research institutes of the NSDB, of government departments and of universities	National Science Development Board
Samoa				

Country	Policy-making	Planning, co-ordination and evaluation	Implementation	International co-operation
Singapore				
Sri Lanka	National Science Council, Ministry of Industries and Scientific Affairs	Ministry of Industries and Scientific Affairs	Relevant ministries and agencies	
Thailand	Ministry of Science, Technology and Energy, National Research Council	Subcommittee for Science and Technology Planning, under the National Economic and Social Development Board (NESDB)	Relevant ministries and agencies	Department of Technical and Economic Co-operation (DTEC)
Tonga				
Turkey	Scientific and Technical Research Council of Turkey (TUBITAK)	Scientific and Technical Research Council of Turkey	Turkish Atomic Energy Commission, research institutes of the TUBITAK, of government departments and of the universities	Scientific and Technical Research Council of Turkey
USSR	USSR State Committee for Science and Technology, USSR Academy of Sciences	USSR State Committee for Science and Technology, USSR Academy of Sciences	Research institutes of the USSR Academy of Sciences and of the academies of the Union Republics, universities, research institutes of ministerial departments, research units of production enterprises	USSR State Committee for Science and Technology

Viet Nam	State Commission for Science and Technology	State Commission for Science and Technology	Ministry of Education, Ministry of Technical and Higher Education, Commission on Social Sciences, Scientific Research Centre of Viet Nam

92. The Council acts as the highest advisory body to the government but has no direct authority in the administrative control of the programmes, which effectively rest under various ministries.

93. The setting up of this Council and a new Ministry of Science and Technology has been an important step for the development of science and technology in Bangladesh. The secretariat of the Science and Technology Division of the Ministry of Education was moved in 1979 to the newly created Ministry of Science and Technology. In his capacity as Minister of Science and Technology, the President of Bangladesh appointed a Minister of State in 1979 to head this Ministry.

China

94. The State Scientific and Technological Commission is the body responsible for preparing the country's national scientific and technological development plan and supervising the formulation of its overall policy for science and technology. The Commission is assisted in this task by a hundred or so 'academic groups', which are responsible, more especially, for advising it concerning the allocation of funds to the research projects submitted to it for approval.

95. The Academy of Sciences is responsible for fundamental research and high-level applied research. For this purpose the Academy has its own 'academic groups' and operates its own institutes. China's science and technology policy took a decisive turn in 1980 and it was reviewed at two conferences of national scope in 1981. As a result, China's sixth five-year plan(1) for scientific and technological development was embarked upon on the basis of the following guiding principles:

(i) integration and close co-ordination of China's five-year plan for scientific and technological development with the national plan for economic development; definition of a far-reaching 'technological development policy' in the fields of agriculture, energy, machine-tools, transport and communications, the transformation of equipment for the purpose of modernizing industry and reafforestation;

(ii) assignment of priorities in respect of the technologies to be applied, namely: agricultural technology, consumer goods, the furniture industry, electrical equipment, building materials;

(iii) stepping up the scientific and technological potential of the enterprises engaged in production;

(iv) support for fundamental research ($\pm$ 5 per cent of national expenditure on R&D);

adaptation and assimilation of foreign technologies.

96. In the scientific and technological research plan the following tasks may be distinguished:

(a) the tasks required by the ministers responsible for the various economic sectors or the State Scientific and Technological Commission;

(b) the optional tasks selected for carrying out by the research institutes and researchers;

(1) This is no longer a fixed-horizon plan, but a 'rolling' plan subject to annual adjustments.

(c) the tasks stemming from production needs and carried out under contracts or with subventions from the ministries responsible for the various economic sectors or the State Scientific and Technological Commission.

97. It is for the Commission to approve the allocation of funds from the overall state budget to the various ministries responsible for the supervision of scientific and technological activities, to the provinces and to other authorities in charge of China's scientific and technological institutions.

98. These funds cover solely the costs of implementing the research projects. The general expenses of the research institutions are covered by the respective ministries to which they are answerable. For this purpose the ministries receive the necessary funds direct from the state budget. As for capital expenditure on R&D, the State Scientific and Technological Commission covers this solely in respect of projects launched on its own initiative or on its behalf.(1) Otherwise, such expenditure is covered by the ministries responsible for the scientific and technological institutions.

99. China's R&D priorities stem directly from the main lines of the 'technological development policy' adopted by the country. The following are some of the outstanding features:

(a) In agriculture, emphasis is laid on the development of crops diversified in accordance with the physical features and human potential of the different regions.

(b) In energy, more emphasis will be placed on the conservation of energy (i.e. savings) and the campaign against wastage, particularly in the chemical industries and the manufacture of steel. The use of coal will be encouraged, although 75 per cent of China's energy production already comes from this source. An impetus will be given to studies on the liquefaction of coal and research connected with offshore oil production, especially into the major deposits recently discovered. Hydroelectric power, which accounts for only 3 per cent of the power consumed in China, will also be assigned high priority. In addition, emphasis will be laid on the use of the biomass, on small-scale hydroelectric installations and on the development of small coal mines, while research into aeolian, solar and geothermic energy will not be neglected. As for nuclear energy, its development will be continued despite the high cost, because of the special importance of this form of energy for the eastern and central regions of China.

(c) In industry, high priority will be given to machine-tools, chiefly to their qualitative improvement and the manufacture of their key components. In so far as consumer goods are concerned, priority will go to the textile production line (25 per cent of the incomes of families is spent on clothing). The manufacture of synthetic fibres will be developed, but also that of natural fibres (cotton, silk, wool). Textile chemistry (dyes, organic silicones for fabric finishing) will also be developed, as will the clothing industry. Attention will also be given to the furniture industry and the production of domestic appliances and building materials.

The degree of mechanization and automation of industry will be graded depending on the place in which it is established and the type of product. Special emphasis will be placed on increasing the productivity of the 380,000 or so small- and medium-size undertakings in the country.

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(1) As in the case, for example, of institutions serving several ministries, provinces, localities, etc.

India

100. The organization of science in India has a long history. Before the country became politically independent, several bodies and councils for co-ordination of research and surveys existed, but only for certain specific fields in science. The need for multidisciplinary co-ordination and the importance of technology for national development were increasingly recognized and in the last two decades the existing structures have evolved into a complex and highly organized entity.

101. The National Council for Science and Technology (NCST), set up in 1971, has been the main body with specific responsibility for preparing, evaluating and updating national science and technology plans. The NCST has now accomplished its task. Meanwhile a Scientific Advisory Committee to the Cabinet and a Cabinet Committee on Science and Technology have been established. The Department of Science and Technology, under the Prime Minister, acts as the secretariat to these two Committees. Science and technology programmes are carried out through the Council of Scientific and Industrial Research (CSIR), the Indian Council of Agricultural Research (ICAR), the Indian Council of Medical Research (ICMR), the Defence Research and Development Organization (DRDO), the Department of Electronics (DOE), the Department of Atomic Energy (DAE), the Department of Space (DOS) and the Department of Science and Technology (DST).

102. An illustration of the progress made in bringing science and technology policy into line with overall development goals is the manner in which India's latest Five-Year Plan has been drawn up. In March 1980, when the government decided to embark on the formulation of the Sixth Five-Year Plan, the Planning Commission set-up working groups to examine the plans of the various agencies and ministries, including those of the Department of Science and Technology. Representatives of the Department and of the Council of Scientific and Industrial Research were invited to participate in these meetings. The science and technology component of the Sixth Plan was thus discussed at various meetings and by working groups in which scientists and technologists were represented before it was incorporated into the final document and adopted by the National Development Council. The object of the procedure followed is to ensure that science and technology activities are duly linked with overall development goals and that the scientific and technological potential of the nation is taken into account in the formulation of overall socio-economic goals.

Indonesia

103. In Indonesia the Ministry of State for Research and Technology takes charge of the planning, co-ordination and assessment of scientific and technological activities, with the help of a number of supporting bodies responsible for administrative and analytical tasks, the chief of which is the Indonesian Institute of Science (LIPI). The national planning agency, BAPPENAS, co-operates closely with the Institute and the Ministry in the formulation, review and updating of the national plans.

104. What is clear at the present stage of its evolution in this respect is that the country is now building up a base from which science and technology policies can be developed and priority goals ascertained. In this it relies on the activities of the Indonesian Institute of Science, which concerns itself with institutional development, information and analyses of the scientific and technological potential.

Japan

105. One of the main characteristics of the Japanese structure is the existence in several ministries of planning units for science and technology. A number of these come directly under the Prime Minister, namely:

the Council for Science and Technology provides advisory services to the Prime Minister and deals with the comprehensive development of science and technology policy. Co-ordination with the other bodies concerned is effected through the Prime Minister;

the Science and Technology Agency is a body which directs the government's efforts in the fields of science and technology so that they may serve to increase national prosperity. A large number of research councils are placed under its authority;

the Japan Science Council is responsible for promoting the development of science and seeing that national activities as a whole reflect the benefits of that development. It consists of 210 research scientists who are specialists in a wide range of fields. It has no administrative or financial powers, but simply makes recommendations to the government.

106. Japan's overall policy for science and technology is initially worked out by the Council for Science and Technology on the basis of reports prepared by the Science and Technology Agency in consultation with the ministries and government bodies concerned. Since the same ministries and government bodies also participate in the formulation of social and economic policy, co-ordination is maintained between the latter and the policy for science and technology.

107. The Education Ministry also plays an important role in science policy, being responsible for science teaching in the schools and universities and for a number of scientific research institutes attached to universities.

108. The objectives of Japan's new Seven-Year (1979-1985) Plan with respect to science are to promote the contribution of scientific and research activities to the solution of certain major problems (the development of new energy sources, space exploration, the exploitation of marine resources, the development of prediction techniques in respect of earthquakes and volcanic activity, medical treatment for hitherto incurable diseases), to improve research institutions and to train researchers.

Pakistan

109. The principal body concerned with the formulation of national policies for science and technology and the promotion and co-ordination of research and development throughout the country is the Ministry of Science and Technology. Linked to this Ministry are two important autonomous organizations, namely, the National Science Council (NSC) and the Pakistan Science Foundation (PSF). The major functions of the Council are to advise the government on science policy and matters relating to the promotion of science in the country, to review the work of the research councils and to ensure the necessary harmonization of scientific activity and national development plans. The Foundation is primarily a financing agency whose function is to promote fundamental research which might contribute to the meeting of the country's socio-economic needs.

110. Scientific and technological research work is carried out: (i) in autonomous or semi-autonomous institutions linked with federal ministries or the President's Secretariat; (ii) in institutes and field stations (not autonomous) attached to the federal and provincial governments; (iii) in small scientific and technological R&D units in private industry.

Sri Lanka

111. The Ministry of Industries and Scientific Affairs has under it a number of corporations and statutory bodies, among which there are six organizations

dealing with major scientific activities of national importance. These are the National Science Council (NSC), the Ceylon Institute of Scientific and Industrial Research (CISIR), the Industrial Development Board, the Bureau of Ceylon Standards, the Atomic Energy Authority and the National Engineering Research and Development Centre. The National Science Council, whose members are appointed by the Minister of Industries and Scientific Affairs, has the task of advising the latter. The Council may, on its own initiative, examine any scientific or technological issue which seems to it to be of national concern and report on it to the Minister of Industries and Scientific Affairs. If the question raised concerns another ministry, the report is communicated to that ministry, either directly or through the Office of the President. In order to overcome the difficulties encountered by the Council in framing an overall policy covering scientific and technological activities coming under a variety of ministries, a proposal was made recently to replace it by a new body under the direct authority of the President which would thus be able to advise on the full range of science and technology issues.

Thailand

112. In Thailand two government agencies take part in the framing of science and technology policy. The National Research Council, which comes under the recently established Ministry of Science, Technology and Energy, has the task of working out research and development policies and supervising their implementation through research projects carried out by various universities and government agencies. The Division of Technology and Environment Planning, under the National Economic and Social Development Board (NESDB) set up in 1976, works out policy for science and technology as a component of overall development policy. These two agencies call on a great number of eminent persons, mainly from universities and other government or private agencies, to take part in the work of their various subcommittees.

113. The establishment of the Ministry of Science, Technology and Energy is the culmination of the action taken under the impetus of the National Research Council to reform the science and technology policy-making machinery of the country. The establishment of the National Research Council in 1956 was an important first step towards the promotion of science and technology in Thailand, although its function, as its title implies, was limited mainly to the broad area of research and development.

114. The financing of research and development and scientific and technological services is provided mainly by the institutions engaged in project execution from the budgets of the ministries responsible for them. The National Research Council plays a supporting role by financing research projects contracted out to one or another of the institutions on a competitive basis. Recently the Council has also been encouraging research and development activities through the granting of annual subventions for research.

115. Although the National Economic and Social Development Board and the Ministry of Science, Technology and Energy work in close co-operation with each other at various levels, complete co-ordination in the formulation of a science and technology policy does not yet exist in Thailand. A proposal is being considered for the establishment of a Science and Technology Council presided over by the Prime Minister and with key ministers, scientists, technologists and development planners as its members. This Council would be responsible for framing an overall policy and supervising its implementation in respect of all science and technology activities, regardless of where they were carried out.

Goals for science and technology policies

116. The recommendations of CASTASIA I concerning policy-making and decision-making were aimed at:

(1) the setting up of solid government structures for the working out of science and technology policy, planning and co-ordination and the carrying out of research work, technological development and related activities;

(2) the integration of science policy with the overall development policy.

117. It was emphasized that national science policies should be aimed above all at ensuring 'endogenous development'. Almost all the countries in the region have since then set up national bodies with specific responsibility for the development of science and technology. In most of the countries such bodies also fulfil the functions of planning and co-ordination. There are separate agencies for the implementation of science and technology programmes in certain sectors - natural resources, agriculture, health and industry. The environment, however, has not received all the attention it deserves, although India, Japan, the Philippines, Singapore and the USSR inter alia have agencies specifically for the planning of environment programmes. International collaboration in science and technology seems to have been given high priority. With few exceptions, the national policy-making bodies are the focal points of international co-operation. Table 7 lists the institutions responsible for framing science policy in the countries in the region and classifies them according to their main role. In almost all the countries an organizational base for policy-making has been established--either an agency with specific responsibility for the planning of science or a section for that purpose in the appropriate ministry.

118. One may well wonder how effective these mechanisms are and to what extent they co-ordinate with the national development planning bodies, which often determine plans and programmes. The decisions made by interministerial bodies concerning the allocation of national budgetary resources or resources proceeding from programmes for international co-operation for development often enable one to know whether scientific and technological development is receiving the attention it deserves. In government administrations it is well known that the final decisions concerning major policy issues and the budget are often determined by the cabinet. So during the 1970s two trends could be seen to emerge in the various countries. The first trend consisted of demanding ministerial rank for the highest official responsible for the co-ordination of scientific and technological activities and, as a corollary, demanding that he be made a member of the cabinet if he was already a minister. The second trend consisted of setting up intersectoral units for the co-ordination of scientific and technological activities within the Plan bodies, or intersectoral councils answerable to the prime minister or the Head of State. The sharing of responsibilities between these intersectoral bodies and the ministries of science and technology where these exist gives rise in practice to certain problems of co-ordination, and dovetailing them is a delicate matter.

119. Purely institutional factors apart, political will and continuity in action play an appreciable role, though it is difficult to weigh. In the absence of a deliberate effort to make science and technology a component of development planning, the goals of science and technology are not clearly enough defined and programmes for research, training and the setting up of science and technology services are difficult to link up with development programmes.

120. Emphasis on science and technology as factors in development and as an integral part of it is reflected in the establishment of separate sections relating to scientific and technological development programmes as a whole in national development plans. This is a trend which emerged in the 1970s (India, Republic of Korea, Indonesia) but which remains to be confirmed in a large majority of the developing countries in the region.

121. Although--at least in its formulation--government policy in matters of science and technology has made the concern to develop national capacity sufficiently clear, there is another aspect, one that is crucial for the integration of science and technology into development, which has been more difficult to grasp comprehensively and translate into well-defined policies. This is the problem of technology transfer. The difficulty arises from the fact that this question is not exclusively a question of science and technology policy, but rather of overall development policy, involving just as much the country's commercial policy, its industrial policy, etc., although it has major implications for science and technology.

122. In so far as coherent policies with regard to technology transfer can be distinguished, these range from a position of strict control to relatively open attitudes to international technology. If trends in the region in this regard must be indicated, it might be said that there is undoubtedly keen awareness of the servitudes involved in opening the door wide to international technology, and of the need for rigorous selection in regard to the techniques to be imported. Centres of technical information on technology transfer have accordingly been set up in a number of countries and others are at the planning stage.

123. Finally, the question of goals to be set for the allocation of resources to research (R&D) does not seem to have been the subject of any definite commitment on the part of the governments. It will be recalled that the delegations present at CASTASIA I recommended in this connection that the countries in the region aim at assigning around 1 per cent of the GNP to R&D in 1980. As mentioned in Section 1.1 above, this aim was not achieved.

CHAPTER 2

MAJOR SCIENCE AND TECHNOLOGY POLICY ISSUES IN ASIA AND THE PACIFIC IN THE 1980s

CHAPTER 2 - MAJOR SCIENCE AND TECHNOLOGY POLICY ISSUES IN ASIA AND THE PACIFIC IN THE 1980s

124. Many questions arise when one considers the growth of science and technology and their potential or actual impact on development. There can be no doubt that this process is profoundly influenced by the as yet undefined internal dynamics which govern the growth of knowledge, and any authoritarian interference from outside would be likely to jeopardize the quality of research results. At the same time, however, it is clear that science and technology are externally driven by economic and social needs. These twin driving forces behind scientific and technological progress and its applications for development are worthy of careful study. This agenda item is therefore broken down into two sub-items, one on issues relating to the quality of research (section 2.1) and the other on its utility for development (section 2.2).

2.1 BUILD-UP OF A SCIENCE AND TECHNOLOGY CAPACITY

125. Scientific and technological potential may be defined as a community's ability to take advantage of scientific and technological advances and use them for its own autonomous, endogenous development. This section will examine the chief components of that potential, i.e. the education and training of specialists, research and experimental development, and scientific and technological services.

2.1.1 Education and training

126. Despite the remarkable progress made over the last ten years, most of the countries of the region now face problems on a scale merely hinted at in previous sections, which oblige them to be resourceful and inventive. They must take urgent measures in response to rapidly changing situations.

127. The simultaneous use of both advanced and traditional, labour-intensive technologies is justifiable in view of the need to achieve the development of rural areas and the exploitation of new energy sources. And of all the resources brought to bear on these problems, skilled manpower is undoubtedly the most decisive in ensuring that science and technology are applied effectively to every area of the national economy. Science teaching continues to be a major concern in the Member States of the region, which see it as a top priority. They have allocated a by no means negligible proportion of their scarce resources to its development and improvement in the belief that such an investment would yield dividends for the implementation of national development programmes. At the same time, they have been motivated by the idea that particular attention should be paid to science and technology in national education, not only because of the contribution they make as academic subjects and fields of specialized training, but also because of the growing role played by their products in everyday life. An additional factor is the impact of science and technology as integral parts of culture and as indispensable components of rationality and a consistent view of the universe.

Science teaching in schools

128. In quantitative terms, science teaching has grown more rapidly than have total enrolments. In virtually every country of the region, some form of science is now compulsory at primary level, and remains so during the first years of secondary education. Subsequently, science subjects generally become optional, although there is a recent trend towards making science a compulsory part of every pupil's education.

129. In many countries of the region, by far the most significant departure has been the establishment of a special institution to work out science curricula. This has given specialists from widely differing professional backgrounds, both inside and outside education, a voice in the development of new curricula and an opportunity to share the benefits of a number of original experiments.

130. Throughout the region, efforts to update science teaching have hinged upon curriculum reform. In the early 1960s, science curricula were put together by adopting or adapting models borrowed from the developed countries. But during the 1970s, there was a noticeable tendency to build national curricula on the basis of local experience. This trend led to on-the-spot manufacturing of new teaching materials that drew on the pupil's natural and man-made environment, so as to give him a more direct knowledge of the practical uses of a scientific background. Furthermore, most of the activities organized by Unesco, at regional or subregional levels, as part of its Asian Programme of Educational Innovation for Development (APEID), are intended primarily to relate the study of sciences to real situations and the rural environment.

131. Admittedly, the traditional tendency to teach science as a body of knowledge is still predominant in many cases. None the less, a marked change is starting to be seen in the new curricula, which are now intended not to pass on established facts through very direct teaching methods, but rather to provide an understanding of phenomena and processes taken from real-life situations. Greater importance is attached to experiments carried out by the pupils themselves. Clearly, too, there is greater interest, particularly in primary education, in giving pupils a grounding in scientific methodology rather than having them memorize masses of facts.

132. Given that the vast majority of pupils in the region leave school at the end of basic education, whether it lasts for four or five years, or eight or nine, the curriculum content taught to them in the various scientific disciplines must be characterized by a consistent, unified approach, at any rate at the most elementary level.

133. Science curricula should, furthermore, be designed as units with three components: teaching materials, textbooks and guides; improvised or low cost scientific apparatus; and in-service retraining courses for teachers. The countries of the region are leaning, particularly where basic education is concerned, towards curricula that offer valid learning experiences even where traditional teaching equipment is unavailable. This development reflects several important intentions: to link science teaching and experience of working life; to combine cognitive knowledge and its various practical applications; and to make use of resources available in the environment and the community.

134. Every effort is therefore being made to gear basic education to the purposes of society as a whole, or, in other words, to improve its relevance. At present, this 'basic functional education' gives priority to health and nutrition, to the acquisition of useful, practical knowledge and to rural development. As one component of this kind of education, science teaching therefore aims to prepare the pupil to cope with real-life problems, and more especially those caused by the impact of technology on his physical, cultural and socio-economic environment.

135. In order to reform science teaching more quickly, almost all countries have recently, in conjunction with the general reform of their basic education systems, launched far-reaching programmes of in-service training for teachers. The usual strategy is to train staff in key posts, who then provide retraining for teachers. Distance teaching and 'teach yourself' methods of learning are also encouraged. This is because teachers' initial vocational training has proved inadequate for the needs of the new curricula, and therefore requires revision: when the introduction of the new science curricula in schools during the 1960s and 1970s was reviewed, it became clear that efforts to improve teaching methods alone cannot guarantee educational efficiency. Gaps in the teachers' own knowledge were and have remained a major problem, even when they have been taught elementary science at their training institutions.

136. The major difficulty in giving teachers proper training is that they must have sound knowledge both of their specialist area and of appropriate teaching methods. Moreover, in most countries of the region, both initial and in-service teacher-training courses need to raise their sights beyond the changes brought in by any given curriculum reform. By its very nature, the content of science teaching is not static: it changes and evolves. The teacher must therefore be given the necessary facilities and opportunities to adapt to this constant evolution of knowledge. Exploration, research and discovery are as important to him as they are to the young pupil.

137. Together with decentralization of curriculum planning, several countries in the region are beginning to decentralize the assessment of educational achievements as well. If, by the techniques and methods employed--such as performance tests to estimate _inter alia_ the pupils' ability to solve specific problems--this kind of appraisal corresponds to the educational objectives of the new science curricula, then the new examination systems thus established will in all probability encourage teachers to provide an operational kind of education whose purposes are not confined to the memorizing of facts.

Education and training of technicians

138. Technical education and training for technicians have reached various stages in the various countries of the region. Some of them already possess well-established systems in this sphere, while others have recently set them up. Such training, as practised at present in some programmes used in the countries of the region, is not invariably characterized by desirable features; for example:

education and training should not be provided on a full-time basis only, nor exclusively in traditional institutions;

curricula should not tend to remain unchanged over long periods of time; they should be constantly adapted to advances in technologies and the industrial processes based thereon;

curriculum development should draw less heavily on what was done in the past, and much more heavily on analysis of the qualifications required for specific occupations;

the teaching staff should be able to acquire enough suitable experience in industry or in the field;

teaching materials should not be confined to conventional printed matter; at the same time, qualitatively suitable materials of that type should be available in adequate quantities;

the methods of testing and assessing knowledge should not be used exclusively for purposes of awarding certificates, but should also be geared to the permanent improvement of the teaching and learning process.

Education and training curricula

139. Education and training curricula require periodic revision so that they can be adapted to the needs of the various sectors of the economy. This calls for effective machinery for obtaining and processing information about the needs of industry so as to adapt curricula accordingly. Systematic evaluation of curricula once they have been established and brought into force is also essential. When curricula are revised, pupil success rates and subjective opinions are sometimes the deciding factors, and steps should be taken to avoid this danger.

140. There can be no doubt that in technical education there are many drop-outs, repeats and failures. A number of explanations have been suggested for this wastage, including the inflexibility of curricula which leaves no room for consideration of the pupils' different abilities and learning speeds, the fact that all pupils must enter and leave school at the same ages, and the fact that there are no transitional or remedial courses.

Teaching staff and resources

141. There can be no effective training of technicians without sufficient numbers of competent staff. In this area, most of the countries in the region suffer from major shortages. Corrective measures should include better recruitment policies, salary scales and incentives, but also the availability of initial and further training opportunities for teaching staff.

142. Resource management seems to present problems in some countries. Planning, assignment, purchasing and use of these resources (equipment, expendable commodities and buildings) should be carried out systematically. Lack of information, the adoption of standards and equipment which are sometimes quite inappropriate, rigid procedures and a shortage of experts trained in resource management are among the sources of difficulty which have been encountered.

143. Technical schools generally operate on inadequate budgets. Sometimes, the rapid progress of technology should obviously be reflected in curricula as quickly as possible. But much time, many staff and large sums of money must be invested in order to obtain and make judicious use of the educational resources required by an updated system. Lack of technical information, limited experience of developing teaching aids within the country itself and a lack of textbooks and other materials in the local languages are the major problems usually encountered in efforts to adapt technical education to the advance of progress.

Recent innovations

144. Despite the constraints imposed by the scarcity of resources, most of the countries in the region have succeeded in making innovations. Those innovations concern certain aspects of curricula, educational resources, initial and further teacher training, pupil assessment and vocational and educational counselling, in addition to improvements to the organization of teaching. New institutions have been established--curriculum development centres, media centres, teacher-training units for technical education and pilot production centres. Efforts are being made to train the supervisory staff required to manage these institutions. Here, in brief, are some of the major innovations:

certain trends are emerging, albeit on a limited scale, that foreshadow a gradual shift in the direction of a systems approach to the management of technical education at the national level;

rural technical schools are increasingly called upon to play a more important part in integrated rural development programmes;

resolute efforts are being made to enable pupils to obtain industrial training and in-service training courses in industry, thanks to the co-operation of public authorities, teaching institutions and the industrial sector;

surveys of jobs available to graduates and analyses of the corresponding tasks are used as the basis for defining curricula;

the trend towards increasing teacher participation in the preparation of curricula and in development activities is very marked;

there is growing emphasis on the provision of initial, in-service and regular further training for staff employed in technical education, so as to increase their skills;

teaching equipment centres are being set up in technical schools so as to facilitate the development and use of a complete range of educational programmes;

pilot production centres are being established in certain technical schools to meet multiple objectives: providing pupils with practical training opportunities; increasing institutions' resources; and enabling the staff to keep abreast of modern industrial techniques;

linking of the content of scientific education more closely to the particular area of technological and vocational studies in which it is used;

increased emphasis on practical work in technical and vocational education (learning to manipulate electrical circuits or bricks and mortar, or to grow crops on plots of land attached to the school) as an additional way of helping pupils to acquire basic practical skills.

Higher scientific and technological education

145. In most countries in the region, the training of scientists and engineers is still beset by a number of problems, although considerable progress has been made over the past ten years.

146. The most urgent problems include:

the excessively slow adaptation of scientific and technological curricula to economic needs;

the unduly heavy work-load borne by teachers;

the shortage of adequate premises and teaching materials;

the fact that not enough technicians are trained, in comparison with the number of higher level professionals.

147. Since the CASTASIA II Conference is more particularly concerned with matters of application, this section will concentrate primarily on the problems involved in the training of engineers.

148. The availability of well-trained design and execution engineers, able to work effectively under local conditions, is one of the key factors in attaining economic development objectives. They are essential wherever science and technology are used in the production of goods and services--in the development of new energy sources, transport and communications, urban and rural development, civil engineering and housing, the mining and manufacturing industries, agriculture, forestries and fisheries, etc.

149. In most countries of the region, the institutions responsible for the education and training of engineers have grown rapidly over the past 25 years. Shortages do indeed still exist, but the institutional infrastructure has been established and should in due course enable enough engineers to be trained to meet development needs. Unfortunately, teaching staff are often in short supply, sometimes lack the necessary theoretical knowledge and--still more importantly--have only limited practical experience. Co-operation between engineering schools and local industry is sometimes inadequate, and some of those schools are rather out of touch with the real circumstances of the country and not sufficiently responsive to local needs, particularly in rural contexts. In some cases, research facilities are inadequate and little used because of shortages of teaching staff capable of conducting research.

150. However, some of the developing countries in the region already have engineering schools which, with skilled staff and advanced activities and equipment, seem capable of playing a leading part in applied research and experimental development, and this enables them to promote industrial modernization. There is every reason to encourage these engineering schools to continue to work towards that end.

Scientific and technological manpower: mismatches in supply and demand(1)

151. Imbalances between the supply of and demand for scientific and technological manpower affect the different South-East Asian countries in different ways. Some countries, such as Singapore or Brunei, have a shortage of all kinds of qualified personnel in higher education; others, such as Malaysia, suffer from shortages in engineering, medicine and the natural sciences which are relatively less acute. Others again, like Indonesia or Thailand, have both a shortage of qualified personnel in certain areas--generally speaking, science and technology--and surpluses in others, chiefly the arts and humanities. Lastly, there are countries like the Philippines which by and large have too many diploma holders for the employment opportunities available, rather than not enough.

152. The causes of graduate unemployment in the region are many. Firstly, higher education is growing far more quickly than employment opportunities. Secondly, in certain countries such as Indonesia and the Philippines, the authorities have given the private sector a free rein, not to say help and encouragement, in higher education. As a result, the growth of private higher education has sometimes been too rapid, and its objective has not always been primarily to train highly skilled manpower.

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(1) For lack of detailed information about all countries in the Asia and Pacific region, this section will deal, for purposes of illustration, with those South-East Asian countries for which a certain amount of data is available.

153. Thirdly, in some countries of the region, the development of higher education has been based less on long-term projections of manpower needs than on inadequately informed social demand. For that reason, there are too many graduates in some fields and not enough in others. The strong social demand for higher education is due to the fact that even in countries where graduates do not always find jobs, higher education is still a sound investment, its cost to the individual being low because of the scale of public subsidies (social cost), while individual dividends, once one finds a job, are relatively high. Further, in most South-East Asian countries, as, indeed, in many industrialized countries, secondary education is not a goal in itself but merely a preparation for higher education. Consequently, pupils obtaining their secondary-school certificate are not sufficiently equipped for work in productive sectors of the economy, and prefer to enter a higher educational establishment. Since those of an age to enter higher education account for a large proportion of the total population in South-East Asia, the demand for higher education is still rising swiftly, as is the number of graduates. On the other hand, even when education is developed to match government projections of national needs for qualified personnel, graduate unemployment cannot be avoided entirely, because those projections cover a period of four or five years, or the duration of a national development plan. Unfortunately, the economy does not always follow the expected growth pattern--hence there prove to be fewer job opportunities than had been estimated.

154. There is also uneven distribution of graduates within a country, causing surpluses in some provinces and shortages in others. In Indonesia, for instance, there is a surplus of graduates in Java and a dearth of them in the outlying provinces. This also holds true for the states of Sabah and Sarawak in eastern Malaysia. Unemployment also occurs when certain graduates refuse jobs which they regard as unworthy of their qualifications. Nor is the quality of education always uniform within the states of the region, which does not facilitate the mutual recognition of diplomas. This places an unfortunate constraint on the regional mobility of surplus graduates. For instance, it would be virtually impossible to make good the shortage of science teachers in Singapore by recruiting science teachers from the Philippines, which at present has too many.

155. This problem of uncoordinated supply and demand where South-East Asian graduates in higher education are concerned is very complex and cannot be solved by isolated measures. It requires consistent government action through combined policies for education and for the employment of highly qualified personnel, in addition to economic measures designed to prevent rather than to cure.

Science and the non-school population

156. The countries of the region, particularly over the last decade, have given a substantial boost to their non-formal education programmes. Most of these, especially in the fields of health, nutrition, sanitation and improved agricultural productivity, include some scientific components. In most cases, however, science teaching does no more than impart facts, even though the desire to teach something of scientific method, such as empirical observation, generalization, analysis and synthesis, is beginning to emerge in a few countries through the use of teaching materials of up-to-date design. Certain countries have even attempted to mobilize the press, radio, television and other media to this end.

157. The inclusion of a measure of environmental education in programmes for the non-school population should be a means of widening the scope of the general public's knowledge of science. Here, greater use could be made of the media, by expanding their contribution to the debate on the problems of science, technology and society to include more than mere factual reporting.

158. When science is to be taught to the non-school population, the choice of vocabulary to convey scientific ideas often poses a problem. How far the use of esoteric or over-specialized scientific terminology is essential, and whether it is not an obstacle to the effective popularization of science in the particular cultural context of the countries in the region may be given some thought.

159. The way in which the media are currently used to popularize science raises a further problem: very seldom are deliberate attempts made, for educational purposes, to single out different target groups among the general public. Whereas advertisers are extremely good at this, the few popular science messages that the media carry seem to overlook this possibility.

160. Other difficulties reduce the efficiency with which the major media put scientific knowledge across. For example, the fact that the target groups consist, by and large, of adults is not always taken adequately into account. The image of man and the world, in the light of up-to-date scientific and technological knowledge, which should constitute the background for the message proper, is sometimes not distinct enough to be clearly perceived by the public. This shortcoming consequently reduces the desirable impact on people's behaviour.

161. Generally speaking, governments in the region have not underestimated the importance of the economic impact of science. In this field, they rightly proceed from the hypothesis that they cannot modernize their countries or integrate science and technology into the culture of their peoples without massive national support. This latter preoccupation has in fact been the mainspring of the rapid expansion of science teaching in the countries of the region. The originators of the popular science programmes for the region's developing countries might, in their turn, give more thought to this question, including the matter of the conceptual basis of science and technology within the socio-cultural environment of the populations concerned.

Science teaching materials

162. While it is true that all the countries of the region have equipped themselves with units for the design and manufacture of science teaching materials, only a handful of them have established large-scale production systems capable of satisfying national demand. In some countries, the public bodies in charge of teaching materials make only prototypes, granting permission to the private sector to manufacture their designs. In others, they are also responsible for production proper. Contracts are then concluded by the state in response to demand from schools. Rarely does any country's programme for the manufacture of teaching materials include arrangements for quality control, and the degree of suitability of the materials supplied is consequently extremely variable. The lack of funds to equip educational establishments properly poses a constant problem, despite the decision taken by governments to provide science teaching for far broader sections of the population than during the 1960s. In many countries, the situation is further worsened by the low capacities of local production units, which make it necessary to increase the already limited resources assigned to science in education budgets, so that foreign materials may be bought.

2.1.2 Research and experimental development (R&D)

163. Research activity is at the root of all innovation and thus constitutes the core of a nation's science and technology capacity. It usually requires the setting up of highly specialized organizations. Scale effects inevitably come into play in countries which are small, in terms of area or population, and thus have small scientific communities. Accordingly, it is necessary to determine the minimum quantum of efforts and resources required for the development of the various branches of science and technology, while a rigorous selection must be made of the fields of research in which a country can afford to specialize and make an effort which will generate original results. In addition, the extent to which countries should devote human and financial resources to basic research is still a controversial question, which, as we have seen, it is difficult to consider in isolation from policy concerning the expansion of higher education. Another question of importance is that of the respective roles of imported technology and local research in solving socio-economic problems.

164. There is no doubt that research and development has an important role to play in effecting an improvement in the people's standard of living. However, a great deal could be achieved in that direction by putting the already existing pool of knowledge to the best use. Furthermore, research may be sterile unless the funds devoted to it lead to practical applications, preferably capable of being translated into commercial operations after tests on a semi-industrial scale and market research with future users. This process of experimental development and preparing to apply research findings involves many more scientists, engineers and technicians, to say nothing of managers and sales personnel; it also requires much more capital investment than research as such.

165. The initiation and conduct of research activity in the region are sometimes hampered by administrative practices or policies. This situation is damaging to otherwise very substantial intellectual and financial efforts by competent and dedicated people. The factors governing the productivity and effectiveness of research groups(1) in the region thus need to be carefully analysed so that the main obstacles can be identified. Examples of such obstacles are the operation of research institutes as bureaucracies, using managerial methods developed for purely administrative services; outside pressures which hinder the smooth running of operations; the selection of projects without first consulting industry and other research users; the lack of adequate funds; people combining several jobs because of insufficient remuneration; the lack of team spirit among researchers; the lack of status and officially recognized careers for professional scientific researchers,(2) etc.

166. Much remains to be known in regard to most of the problems raised above, although certain remarks touching upon some of them can be safely made on the basis of the data already available.

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(1) In this connection, see Scientific Productivity which was published in 1979 by Cambridge University Press and Unesco and which gives the findings of an in-depth study conducted by Unesco in six European countries. Two countries in the region, India and the Republic of Korea, have now joined the project, and the findings of these new studies are expected to be available by the autumn of 1982.

(2) See Unesco's 1974 Recommendation to Member States on the Status of Scientific Researchers.

The R&D base

167. One of the main recommendations of CASTASIA I was that Member States should endeavour to raise their total national expenditure on R&D to a minimum of 1 per cent of their GNP by 1980. In retrospect, it would seem that the conference was somewhat too optimistic in setting its sights so high, in view both of the low level of national R&D expenditure in the region at that time and the modest total of such expenditure in absolute terms. While this target was virtually unattainable, it had at any rate some incentive value. Two years later, the report of a group of experts on the second development decade endorsed this proposed objective in the 'World Plan of Action' of the United Nations Advisory Committee on the Application of Science and Technology to Development, which recommended that by 1980 the developing countries should aim at raising their R&D expenditure to a minimum of 0.5 per cent of GNP, but at the same time suggested that the same percentage (0.5 per cent of GNP) should be devoted to related scientific and technological activities.[1] Section 1.1 above (Table 5) records the latest available data from the region, which indicate that apart from three industrialized countries (USSR, Australia, Japan), expenditure on R&D in the strict sense has remained stagnant around 0.2 to 0.4 per cent of GNP, except in the case of India, the Republic of Korea and New Zealand, which have achieved 0.6 per cent of GNP.

168. In most countries, the main source of funds for R&D has been government finance. Japan, Singapore, the Republic of Korea and Sri Lanka constitute exceptions: in these countries production firms have contributed substantial support (see Section 1.1, Table 5). The same is true, albeit to a lesser extent, of Australia, India and the Philippines. There is virtually no direct funding of national research from foreign sources.

169. As shown in Section 1.1, the numbers of research personnel rose substantially during the 1970s, but these increases tended to occur in the general government or higher education sector, depending on the country; they very seldom occurred in the production sector (i.e. in agricultural or industrial firms). It is characteristic that it has generally been the industrialized countries (with some exceptions, such as Australia) in which the main thrust of applied research, and particularly experimental development, has been most closely associated with production, and hence has occurred in individual firms. While the government is still the main source of research funds in a number of these countries, it is still in a subordinate position in comparison with business enterprises and institutions of higher education as regards the execution of research work. In most developing countries, the government is still, for all practical purposes, the sole source of funding and the agency which executes most research work. This has led to the well-known situation of two worlds cut off from each other: the research systems, subject to government administrative rules, and the production system subject to the forces of international economic competition.

Resources for fundamental research

170. The percentage of the national budget devoted to fundamental research is a question of particular importance, for experience shows that the more industrialized a country becomes, the less money--in relative terms--it devotes to it. There is a paradox here, since it is sometimes wrongly asserted that 'fundamental research is a luxury which only wealthy countries can afford'. There are two reasons for this situation. First, both industrialized and developing

(1) World Plan of Action for the Application of Science and Technology to Development, UNACAST, New York, United Nations, 1971, p. 55.

countries accord very great importance to the training of scientists and engineers; but in so far as any higher education worthy of the name is based on research, it so happens that in the most disadvantaged countries university research is the only R&D field which the exchequer can afford to finance. Second, the industrialized and scientifically advanced countries are at present the main producers of new technologies, and it is principally these countries which develop and exploit discoveries. Now applied research and experimental development (which are both for particular purposes) are much more costly than the fundamental research carried out in universities. This explains the relatively low proportion of expenditure for fundamental research in high per capita income countries; hence their experience in this respect cannot be deemed to be of any relevance to the developing countries.

171. At the same time, fundamental research cannot be justified solely by the requirements of university teaching. Provided the means are available, the habit of being on the look-out for new discoveries which are apparently devoid of immediate practical utility is an attitude which always pays dividends in the long run. This, however, is more a matter of firm belief, or even opinion, than of economic reasoning. In addition, it is a question which is related to the internal dynamics of the development and dissemination of knowledge within the scientific community.

172. With the statistical data currently available, it is difficult to estimate how great an effort is being devoted to fundamental research in the region. It should be noted that India, the Republic of Korea and the Philippines devote approximately 15 per cent of their total expenditure to fundamental research, and Japan 35 per cent (an exceptional case, as the corresponding figures for other industrialized countries range from 15 per cent to 25 per cent; but the disparity may be the result of differences in the interpretation of definitions for the collection of statistical data).

173. It is also difficult to assess the quality of fundamental research in the region. The only indicator available--and a debatable one at that--is the extent to which a particular national scientific community is recognized by the international scientific community, that is, the extent to which its members' work is published and read by their colleagues elsewhere.

174. According to recent statistics,(1) the numbers of scientists in the region who published articles in specialized journals in 1978 were as shown in Table 8. It appears that the USSR, Japan, India and Australia alone accounted for 94 per cent of all publishing scientists in the region, New Zealand 3 per cent, and all other countries together the remaining 3 per cent. Another study(2) indicates that the numbers of publications by country of origin, in 1973, was as shown in Table 8. The distribution is virtually identical.

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(1) WIPIS: Institute of Scientific Information, Philadelphia, United States, 1978.

(2) 'The Distribution of World Science', by D.J. Frame et al., in Social Studies of Science, Vol. 7, 1977.

TABLE 8 - Volume of research publications and numbers of authors

Country	Number of authors (1978)	%	Number of articles (1973)
USSR	23,581	41.1	24,418
Japan	14,783	25.8	14,265
India	8,498	14.8	6,880
Australia	6,889	12.0	5,341
New Zealand	1,636	2.9	
Iran	402	*	174
Turkey	227	*	
Malaysia	185	*	138
China	137	*	
Pakistan	133	*	
Philippines	120	*	
Singapore	119	*	120
Papua New Guinea	93	*	
Republic of Korea	85	*	
Sri Lanka	76	*	
Bangladesh	58	*	
Indonesia	53	*	
Viet Nam	20	*	
Burma	16	*	
Nepal	10	*	
Afghanistan	4	*	
Lao PDR	1	*	
Samoa	1	*	
TOTAL	57,127	100	

* (Under 0.5 per cent)

175. These few observations suggest that the local scientific communities in most countries of the region participate only to a very modest extent in the mainstream of world research. Unless adequate measures are adopted to create an appropriate climate for research, unless action is taken to optimize the factors governing research effectiveness, and above all unless researchers are provided with the necessary resources, there is a danger that their efforts may be unproductive.

Effect of the import of technology on local research

176. Countries which are excessively dependent on the import of foreign technologies frequently condemn their national research institutions to play a marginal role in the development process. Furthermore, where the transfer of technology is viewed as an operation affected only by the technical requirements of specific projects, its overall repercussions on the national economy are neither perceived nor evaluated, for example in terms of their social cost. Unfortunately, these repercussions can be much more extensive and durable than the effects initially envisaged for a given development project. Uncoordinated technology-transfer projects can therefore lead to contradictory or even chaotic patterns of scientific and technological development.

177. A fragmentary approach of this kind has, amongst other things, the drawback of implicitly detracting from efforts to establish an endogenous R&D potential. For if more store is consistently set by imported technologies--as reportedly having more immediate impact on the development process--local research rapidly becomes an abstract exercise, if not a costly option which developing countries can hardly afford.

178. In order to avert the damaging consequences of such an attitude, decision-makers would be well advised to bear the following three criteria in mind whenever the question of technology import comes up for consideration:

(a) the opinions of local specialists responsible for national science and technology policy: their participation will be an advantage in the identification and choice of technologies to be imported (which in most countries represent an overwhelming proportion of technological application in the productive sectors of the economy);

(b) local research should be viewed as complementary to the import of foreign technology, and should be preferred to it wherever possible--though this does not mean that it will be necessary to redevelop technologies which could be acquired from other sources on reasonable terms; and

(c) the judicious combination of local research and imported foreign technology should be regarded as one of the most important decisions to be taken in connection with the implementation of plans for social and economic development in conformity with national science and technology policy.

Research management(1)

179. In the industrialized countries, industrial research is carried out mainly in production firms, not in state-owned laboratories. This is not generally the case with developing countries, whose industry has not as yet reached the size

(1) This section draws extensively on the ESCAP publication Guidelines for Development of Industrial Technology in Asia and the Pacific, Bangkok, 1976, Chapter IV.

to be able to carry out its own R&D. Consequently, the bulk of the R&D effort in the developing countries is not only financed by governments but also carried out under their direct responsibility, as noted above.

180. In India and the Republic of Korea, industry funded only 14 per cent and 40 per cent respectively of total R&D expenditures in 1979; in other developing countries in the region the percentages were generally much smaller.

181. In view of all the above, it is easy to see why the governments of developing countries have taken the lead and established national industrial research institutions.

182. These may be of three types:

(a) R&D organizations coming directly under ministerial departments, in the form of scientific and industrial research councils or departments, such as BCSIR in Bangladesh, CSIR in India and PCSIR in Pakistan;

(b) independent but government-aided applied research institutes such as KAIST (Republic of Korea), ISIRI (Iran), SIRIM (Malaysia), SISIR (Singapore), CISIR (Sri Lanka) and ASRCT (Thailand);

(c) industrial research units which are an integral part of the civil service (for example, the Department of Industry in Indonesia).

183. A typical example of the first type of research institution is India's CSIR, with 34 research establishments, including national laboratories, institutes and organizations and regional laboratories. These establishments carry out research ranging from fields basic to industrial advancement to specific problems with respect to food, fuel, buildings, roads, industries (such as electronics, glass, ceramics, leather, minerals, marine chemicals, drugs, scientific instruments, etc.), mechanical engineering, aeronautical engineering, public health engineering, electrochemistry, geophysics, oceanography, experimental medicine, toxicology and others. The CSIR is a body registered under the Registration of Societies Act, with its own governing body, even though it is funded mainly by the exchequer.

184. The best example of the second type of research institution is the Korea Advanced Institute for Science and Technology (KAIST), which is similar in constitution and method of working to the independent, non-profit contract research organizations in the western world. KAIST was initially financed from grants and loans from the Governments of the United States and the Republic of Korea. It operates mainly on the principle of contract research, and research is carried out by independent laboratories which function as the Institute's basic organizational units.

185. Because of their autonomous nature, these two types of research institutions are capable of producing results if they function well (which is not always the case). The third type, on the other hand--the government-controlled research institute--appears to have certain shortcomings built into it by the very nature of things. Such institutions are managed by civil servants who do not always possess the necessary scientific and technological competence; their administrative practices thus tend to be similar to the official routine of the civil service, whereas their work is creative in nature and in most instances is carried out in laboratories; the result is that individual initiative and the spirit of discovery may be discouraged.

186. The issue of research management was discussed at CASTASIA I and a number of recommendations were made, essentially directed towards the improvement of the working conditions and social status of scientists, the development of scientific capabilities, the training of scientists and the provision of adequate infrastructure and facilities. In spite of the fact that the level of investment has risen in almost all the countries of the region, and infrastructure and supporting facilities have also improved to a certain extent, the status of scientists and the use of research institutions by society have not kept pace with these improvements.

187. Research institutions in many of these countries are faced with two basic difficulties. First, their research programmes are, in some instances, not directly related to the real needs of the country; the direction and scientific goals of research are set by the trends of research and overall thinking in the industrialized countries, rather than by local needs. Some of the projects selected tend to be purely theoretical and devoid of immediate practical interest to the productive sectors of the economy, notably industry. Secondly, the organization and management of these institutions are frequently modelled on those of government departments; their behaviour patterns, norms and standards of efficiency conform to those of a purely administrative type of public service. In particular, decision-making tends to be centralized.

188. Administrative practices, the archaic methods of assessment of merit, working conditions which are poorly suited to scientific research and even more unsuited to experimental development, the low salaries of scientific researchers by comparison with those in the industrialized countries--these are the main factors which have caused a certain degree of frustration in the scientific communities in the developing countries of the region, impelling a number of their members to seek employment in industrialized or oil-producing countries. The emigration of highly qualified scientists, particularly those who have leadership qualities, deprives the scientists working in R&D institutions in the countries of the region of the leadership and expertise which might have served to guide and motivate them. Some scientists are also lost to other professions such as the civil service, marketing and business administration, etc.

189. If R&D institutions in the developing countries in the region are to be able to carry out work of eventual practical relevance to industry and other productive sectors of the economy, the following steps should probably be taken, not one after the other but more or less simultaneously, because of their interrelationships:

(a) a structural reform of industrial research institutes (IRIs), by restoring full autonomy to those which are in theory autonomous but are in fact run and supervised like purely administrative public services;

(b) improving the management of IRIs by providing their managerial staff with training in the management of such institutions or with in-house training in industry; placing the management of IRIs in the hands of scientists or engineers, rather than of civil servants, first making certain that those selected for such responsibilities are fully familiar with national development goals;

(c) integrating the R&D efforts of IRIs with national plan requirements, objectives and priorities: even with institutions directly administered by governments there appears to be a lack of co-ordination, but in cases where they are fully autonomous, co-ordination may be even more conspicuous by its absence;

(d) committing IRIs to a policy of developing indigenous technology and adapting imported technology to local conditions;

(e) forging communication links with industry: this means that IRIs should establish the necessary contacts with industrial production units, both public and private, and that the latter should be made fully aware of the capabilities of IRIs and the services they are able to render;

(f) limiting research projects to the optimum number, or in other words, avoiding an excessive proliferation of projects, which usually results in resources being thinly spread and the quality and intensity of the entire research effort being compromised;

(g) selecting research projects in consultation with the industrial production units that will eventually be the users of the findings of the research;

(h) providing proper research facilities and the corresponding scientific and technological supporting services (information, libraries and documentation facilities, workshops, pilot plants and instrumentation, etc.);

(i) ensuring a team approach to research problems in contradistinction to the individual approach which scientists in developing countries often tend to adopt;

(j) developing technological delivery systems: in other words, commercializing research findings by taking adequate follow-up action and 'selling the idea' to industry, once a research project brings out results of practical relevance; and

(k) granting adequate governmental financial support to industrial research institutions in order to enable them to manage the research projects for which they are responsible under conditions making for optimum effectiveness.

2.1.3 Scientific and technological services

190. Scientific and technological services (scientific and technological information and documentation, standardization, maintenance and repair of scientific instruments) play a key role both in research and in practical application. Scientific and technological information and documentation, which are of considerable importance, were found to be wanting in most Asian countries at the time of CASTASIA I, for example, the building up of bibliographical data bases which takes many years and is costly. The problem is further compounded in some countries by translation requirements. Engineering consulting services also play a highly significant role. It is through them that countries acquire the capability to upscale, design, and construct plants, thus lessening their dependence on foreign firms.

191. At CASTASIA I, several recommendations were made for strengthening institutional infrastructures and public services in the field of science and technology. These recommendations related to the setting up of documentation and information services, the exchange of information between industrialized and developing countries, the development of basic industrial standards, and the improvement of instrumentation facilities.

192. Since that time, a real effort has been made to strengthen these services. Countries like Australia, India, Japan, New Zealand and the USSR have highly developed infrastructures in this field. Most other countries have strengthened or established one or more institutions. Table 9 gives a country-by-country list of known service institutions.

Scientific and technological information

193. The publication of scientific and technological serials in most countries in the region is a relatively small-scale activity. With a few exceptions, countries continue to depend on serials from developed countries as their main source of up-to-date information on science and technology. Table 10 shows the numbers of periodicals published in various countries in different disciplines. The numbers of scientific and technological periodicals produced in the USSR, India and Australia are comparable with those in most industrialized countries. The other countries in the region which produce sizeable numbers of scientific and technological journals are Japan, the Republic of Korea and Thailand.

194. Since CASTASIA I, the countries in the region have thus taken steps to strengthen their documentation and information services catering for the needs of industry and research institutions. Some developing countries such as China, India, Pakistan, the Philippines and the Republic of Korea have achieved significant progress in this area.

195. In Australia, the National Library of Australia (NLA), a statutory authority, comprises three specialist divisions one of which is the Australian National Science and Technology Library (ANSTEL). The NLA is responsible for co-ordinating information systems and services and has initiated the development of resource-sharing networks, in the absence of any formal national machinery for the systematic organization and co-ordination of scientific and technological information services.

196. Library-based services for scientists and engineers are provided by the National Library of Australia, the Commonwealth Scientific and Industrial Research Organization (CISRO), the libraries of the various Commonwealth countries, municipal libraries, and libraries operated by tertiary institutions and industrial organizations.

197. In Australia, computer-based information systems offering bibliographical services are being increasingly established. Numerical data bases are not so common but recognition of their relevance to practising scientists and to science and technology policy-makers is increasing. The most important organizations in this field include the Australian National Science and Technology Library; Federal Government departments and agencies (Defence, Science and Technology, Australian Bureau of Statistics, Australian Atomic Energy Commission, CSIRO, and others); and industrial firms and organizations sponsored by them (ICI Australia Ltd., Australian Paper Manufacturers, Australian Mineral Foundation). Nationwide information services are provided by CSIRO to industry and the general public. International linkages to overseas data bases have been established by several organizations.

198. In Sri Lanka, the major components of science and technology information activities are located in the libraries of various R&D institutions. The majority of these libraries specialize in specific areas and cater for the persons working in the institutions. Other science and technology information centres exist such as public libraries in urban areas and university libraries. Since its establishment in 1975 the Sri Lanka Scientific and Technical Information Centre (SLSTIC) of the National Science Council has acted as a clearing-house for science and technology information and activities. The Industrial Development Board with its specialized library and documentation centre provides an Industrial Information Service (IFS) to firms and institutions. This is possibly the only information unit in the country which prepares packaged information on technology, on request, to particular groups of users.

TABLE 9 - Science and technology services in Asia and the Pacific

Country	S&T information and documentation							Standardiza-tion	Instrumen-tation
	General	Sectors							
		Agriculture	Medicine	Nuclear energy	Environment	Industry	Energy		
Afghanistan									
Australia	X	X		X	X		X	X	
Bangladesh	X	X		X	X			X	
Burma	X							X	X
China	X				X			X	
Dem. Kampuchea								X	
Hong Kong									
India	X	X	X	X	X	X		X	X
Indonesia	X	X		X	X			X	X
Iran	X							X	
Japan	X	X	X	X	X			X	X
Korea (DPR)				X				X	
Rep. of Korea	X		X	X	X	X		X	X
Lao PDR									
Malaysia		X		X	X			X	
Maldives									
Mongolia	X				X			X	
Nepal									
New Zealand	X				X				
Pakistan	X	X		X	X			X	
Papua New Guinea									
Philippines	X	X		X	X			X	
Samoa									
Singapore								X	
Sri Lanka	X	X		X	X			X	
Thailand	X	X		X	X			X	X
Tonga									
Turkey									
USSR	X	X		X	X			X	
Viet Nam									

Note: Incomplete information. X indicates institutional infrastructures listed in the following indexes: AGRIS (FAO) and INIS (IAEA), and that of UNEP (New Delhi, Department of Science and Technology).

TABLE 10 - Number and distribution by subject of scientific and technological journals in selected countries

Country	Year	Number of journals	Journals devoted to science and technology		Subject distribution of journals				
			Number of journals	As percentage of total	Mathematics	Natural sciences	Medicine	Industry	Agriculture
Afghanistan	1977	23	5	21.7	1	1	1	1	1
Australia	1976	3,575	985	27.5	7	65	152	437	324
India	1975	7,542	1,324	17.6	0	147	688	219	270
Iran	1974	119	34	28.5	1	1	16	6	10
Japan	1977	1,412	356	25.2	0	38	90	201	27
Rep. of Korea	1976	814	248	30.4	2	34	80	101	31
Malaysia	1975	611	82	13.4	1	7	11	16	47
Nepal	1976	88	18	20.5	1	1	3	10	3
Papua New Guinea	1977	72	11	15.2	0	0	2	7	2
Singapore	1977	1,148	162	14.1	8	18	69	59	8
Sri Lanka	1977	432	69	16.0	19	18	13	19	0
Thailand	1975	930	218	23.4	3	24	88	56	47
USSR	1977	4,669	2,071	44.3	38	414	185	1,175	259
Viet Nam	1977	173	29	16.8	2	3	7	11	6

Source: Unesco, Statistical Yearbook, 1980, Paris, 1980.

199. In Indonesia, the National Scientific Documentation Centre (PDIN) is the agency that collects all documentation on scientific literature, excluding books. An 'Index of Indonesian Learned Periodicals' is available indicating the author, subject and periodical. The Indonesian authorities have pointed out that the information available from PDIN is neither comprehensive nor systematically compiled or processed, although most of the existing literature can be identified through catalogues. The national documentation system in Indonesia consists of the PDIN, the Information and Documentation Centre on Biology and Agriculture (Bibliotheca Bogorienses) and the Information and Documentation Centre on Health.

200. In Bangladesh, the Bangladesh National Scientific and Technological Documentation Centre (BANSDOC) attempts to give all scientists and engineers in the country access to the literature in their particular subjects, whether they be employed in government services, universities, or industry. The fields covered by it include engineering, agriculture, medicine and others.

201. BANSDOC endeavours to obtain a selection of microfilms or photocopies of published scientific or technological papers, on receipt of an order giving the fullest available bibliographical details. On request, it compiles a short list of references to the published literature on any special subject of a scientific or technical nature, including the industrial field. It also undertakes the translation of scientific or technological papers into English from a number of languages such as German, French, Russian, Spanish, etc., and makes slides of scientific drawings and illustrations.

202. Scientists wishing to know who else is working on their special subjects may apply for a list of such persons to be compiled by BANSDOC. BANSDOC is equipped to deal with written inquiries relating to published scientific literature, and considers requests to compile comprehensive bibliographies relating to topics covered by symposia.

203. These are only a few examples of information systems which are being developed in the region. Most countries possess similar services, and in the course of the past twenty years Unesco has had occasion to collaborate with several of them, in India (INSDOC, Delhi), Pakistan (PANSDOC, Karachi), Thailand (National Documentation Centre, Bangkok), and the Republic of Korea (KORSTIC, Seoul).

204. In sum, the available evidence allows us to draw the conclusion that most of the countries in the region now possess a basic infrastructure in respect of scientific and technological information and documentation.

205. However, an important constraint in establishing effective science and technology information services is the lack of trained manpower. Unesco has assisted many countries in the establishment or strengthening of S&T information infrastructures and the training of personnel through courses and seminars (examples are a nine-month regional postgraduate training course for specialists in South-East Asia which has been held since 1978 at the University of the Philippines, and a regional training course on the management of science and technology documentation centres for the managers of such centres, held in 1981 in Delhi).

206. In 1966 Unesco, with the assistance of the International Council of Scientific Unions, undertook preliminary studies on a world science information system. This programme, known as UNISIST, has since been expanded to include the social sciences and the humanities. It envisaged the establishment of an international network of scientific and technological information services, open to all interested organizations. The programme is concerned with compatibility among the information-processing systems developed in different countries, and it lays emphasis on the

need for information which is accessible, reliable and adapted to development needs. It appears that the capabilities in most member countries for acquiring, processing and disseminating information are still inadequate and require further strengthening. In addition, it would be desirable to make a special effort to improve machinery for linking national and international information systems, and also to increase the financial resources devoted to the acquisition of documentation from foreign sources and to the translation of essential science and technology publications.

207. There is one particular major field in which very little has been done in the region, and which requires particular attention: the establishment of an information base for S&T policy-making. At present there is only one country in the region, namely India, which in co-operation with Unesco has initiated the setting up of a Science Policies Information and Exchange System (SPINES).

Standardization

208. Most of the developing countries in the region manufacture the same or similar industrial and engineering products based on imports of technology and equipment from more than one source. The Regional Paper by ESCAP(1) refers to the case of a developing country forced to import technology from more than a dozen foreign companies for the manufacture of tractors. As stressed in that paper, such an approach leads to fragmentation of the market and creates difficulties in the manufacture of spare parts and components on a sufficiently large scale to be profitable.

209. Standardization also assures users of the quality of products, particularly in the engineering and consumer industries. It also leads to better utilization of indigenous raw materials in manufacturing operations. At the regional level, it could lead to an increase in intraregional trade.

210. As Table 9 shows, most countries have national standards organizations, but research on the development of standards is of marginal importance. Australia, Japan and the USSR are exceptions in this respect. China, India, Indonesia, Malaysia, Pakistan, the Philippines, the Republic of Korea and Singapore have also gone a long way in the development of standards for their products. India and Malaysia support a certain amount of research on standards.

211. Previously, only the industrialized countries were members of the International Standards Organization (ISO). During the last few years, the developing countries have started producing exportable commodities, with the result that their national standards have to compete with already existing international standards, and this has made it necessary for them to become members of ISO. Many countries require a great deal of assistance for the standardization of products manufactured from locally available raw materials, and the assistance of standards organizations needs to be made available to them.

Scientific instrumentation

212. Instrumentation facilities such as calibration, quality control, repair and so on are of considerable importance in virtually all areas of science and technology. Scientific equipment generally becomes obsolescent at a very rapid rate, and the developing countries are in no position to keep pace in renewing the equipment or instruments which they use for scientific research and for other activities such as industrial development, since they must import the equipment or instruments in question. The USSR and Japan are already self-reliant in the production of

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(1) Regional Paper for the United Nations Conference on the Application of Science and Technology to Development, ESCAP, July 1978, Bangkok.

scientific instruments. It is to the credit of some of the developing countries such as China, India, the Philippines and the Republic of Korea that they have developed competence in manufacturing a variety of instruments but they continue to depend on the industrialized countries for a large number of the more advanced and sophisticated instruments.

213. Large numbers of sophisticated and costly scientific instruments are lying idle in developing countries in the region because of the lack of both repair and maintenance facilities and ready availability of spare parts. Unesco assists countries in the region by funding projects designed to develop local capabilities for the repair and maintenance of instruments, thus increasing their utilization rate. However, there appears to be a substantial continuing need to organize national and regional repair and maintenance services and train instrumentation technicians with assistance from international agencies or industrialized countries.

214. In many cases an effort should be made to design instruments which could be manufactured locally and to produce prototypes which could be mass produced by local industries. Such a plan would be feasible provided it was given priority, for local maintenance and repair require the same facilities and the same skilled manpower; initially, therefore, a choice will generally have to be made between them.

Technology delivery systems

215. If the fruits of research are to be exploited economically, it will be necessary to provide for the inevitable connecting links of market research testing on a semi-industrial scale, consumer testing, and the establishment and servicing of production units. Any decision of a commercial nature requires ready access to technical and economic data and information on prospective markets, so that the services of national and foreign consulting engineering can be used to good effect. While there is scant information on this subject, it seems that the majority of developing countries in the region lack engineering design consultancy services capable of undertaking the design, development and construction or commissioning of plants. In India, the National Research Development Corporation assists entrepreneurs in the transfer of technology, in particular by advancing funds to them; the Republic of Korea has also established a similar corporation. Pakistan is contemplating the establishment of a research development corporation to finance the construction of pilot plants and field-scale trials of new technology; Nepal and Bangladesh are planning to set up similar organizations. Nevertheless, it is quite clear that most developing countries in Asia require external assistance for the building of pilot plants and the marketing of their technologies. Furthermore, every encouragement should be given to the regional efforts being made by developing countries to pool engineering design consultancy services by order of importance and field of specialization, and to make the information thus obtained available to all governments, R&D organizations, industries in developing countries, and national or international financial institutions.

2.2 SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

216. Since 1966, conferences of ministers responsible for the application of science and technology to development, under the acronym 'CAST', have been sponsored by Unesco at fairly regular intervals in different regions of the world in turn.

217. The main purpose of these conferences was to draw the attention of Member States to the key role of national science and technology policies in the process of endogenous and self-reliant development which every country was striving to set in motion. Many governments in Asia and the Pacific have in the meantime set up the necessary machinery for the preparation and implementation of integrated and/or sectoral science and technology policies, based inter alia on the relevant recommendations of the CASTASIA I Conference (1968).

218. A recent event has been the United Nations Conference on Science and Technology for Development (UNCSTD, 1979), which provided an opportunity for an international debate on the subject, with the Vienna Programme of Action as its outcome.

219. Three types of problem in the region should be considered in any discussion of the role of national science and technology policies and their application to economic, social and cultural development: first, the general problem of how to integrate science and technology in the development process; secondly, strategies and lines of approach to the application of science and technology to development; and lastly, the necessary conditions for working out and implementing national science and technology policies.

2.2.1 Integration of science and technology in development

220. The prerequisites for the effective use of science and technology for development now exist in the countries of Asia and the Pacific to a much larger extent than in 1968, when the first CASTASIA Conference was held. Facilities for training scientists and engineers, research and development institutions, government science and technology services and structures for science and technology policy-making have developed rapidly, as moreover have development planning institutions and techniques. However, there is still much to be done to co-ordinate the operation of these various institutions. The majority of the countries of the region remain at a relative disadvantage in the international world of science and technology in that they are subject to international rather than domestic pressures and demands, and that they still occasionally suffer manpower problems such as the 'brain drain'. Furthermore, national science and technology systems are in some cases administered by public authorities which are not sufficiently in touch with the production system or capable of satisfying the aspirations of national scientists and engineers.

221. Confronted with these problems, the governments of the region have shown considerable pragmatism in their policies for the application of science and technology to development. This pragmatism, which has characterized all these policies, has taken various forms at different stages of the development process. It was the hallmark, for instance, of the policies adopted in the initial period of development, when the free flow of imported technology was encouraged in order to stimulate growth in key areas. Similarly, it influenced the assumption that the building up of national scientific and technological potential would play a major role in economic growth after this initial stage. Pragmatism was also shown by governments in offering preferential treatment to industries capable of marketing their research and development know-how quickly, for immediate benefit to economic growth. This practical approach to the use of science and technology was the guiding factor in the establishment of science and technology infrastructures in many countries of the region.

222. However, while the many problems of science, technology and development were tackled on a pragmatic and sectoral basis, no close attention was paid at the outset to the question of whether science and technology were in fact promoting development as a whole. Even when it became apparent that science and technology were not fulfilling expectations as quickly or as fully as anticipated, the hopes placed in them were not called in question. These hopes, and continuing investment in the build-up of a science and technology infrastructure, were based on the deep-seated conviction that science and technology would produce the same modernization in developing countries as they had in industrialized countries and that, ultimately, the advantages of economic take-off would filter down to all members of society. Fully occupied as they were with setting up national science and technology infrastructures, developing countries had little time to consider whether the experience of the industrialized countries could guide them in their own efforts. While highly pragmatic in their approach to the use of science and technology for development, most countries were too much taken up with this task to reflect on whether science and technology were genuinely universal and transferable from one socio-cultural system to another, or on the justification for considering that the type of development resulting from them would ultimately be of benefit to all.

223. Quite apart from the problem of creating a science and technology infrastructure, most developing countries clearly experienced all kinds of difficulties in harmonizing their science and technology programmes with their national development efforts. These so-called 'problems of integration' are today widely recognized, but their scope, nature and implications are such that they should be carefully examined before policy conclusions can be drawn. Some idea of the range and magnitude of these problems can be gained by considering the difficulties of setting up research and development (R&D) establishments and orienting education towards development objectives, the inability of science and technology to penetrate all sectors of the economy that contribute to development, and the social conflicts and costs that have resulted from the introduction of science and technology in the region.

<u>Links between researchers and users</u>

224. The establishment of research and development (R&D) bodies, and attempts to combine the various national scientific and technological activities in an organized system to be used as a whole to promote development, have encountered typical obstacles. As a rule, the science and technology system has been set up by the government rather than by the sector that could have put the findings of scientific research to immediate use. Science and technology institutions are therefore frequently modelled on government or university lines and practices, and copy government or university standards and systems of management. These institutions have been largely insulated from the development needs of the country, and have patterned their research objectives and methods on those of advanced countries. In this way a considerable gap has grown up between researchers and users, which accounts for the limited use made of genuinely national research and development, and the lack of incentive for national scientists to concern themselves with the barriers in the way of applying science and technology to national problems. The centralized administrative structure and excessively hierarchical organization of research work leave little room for individual initiative, and have sometimes prevented direct communication between the scientists and the users who are interested in using and promoting research.

225. Another source of difficulties for R&D institutions is the fact that the standard of science and technology services in the region is seldom comparable to that of their counterparts in industrialized countries. Information and documentation services are often inadequate, and cannot provide scientific researchers with the data that they need, promptly and in usable form; these services seldom work in association with international information systems and institutions. All these difficulties hinder scientific researchers who wish to make use of recent findings in order to solve national problems. When, in addition, information on natural resources and local technologies is not available, any attempt to make effective use of the national science and technology system to attain immediate development objectives has little chance of success.

226. These problems, which have been described at great length, have caused considerable dissatisfaction among scientists in many developing countries. The work of these scientists has seldom any direct bearing on immediate development problems, since the cumbersome administrative machinery of R&D institutions is of little assistance in responding promptly to the needs expressed by the users of research findings. Unfortunately, efforts by scientists and administrators to avoid being caught up in this machinery have not always been successful.

227. Scientific research institutions are relatively easy to set up, but the problem is how to make them work effectively in transferring and adapting science and technology to national circumstances, identifying specific scientific problems and promoting and improving local technologies. It is clear today that the accomplishment of these tasks depends far more than had been thought on social and economic, management and organization factors. Problems of this kind will not disappear overnight, but their relative importance at present in most countries of the region is considerable.

Trends in education

228. The linkage between education and development objectives has also proved to be a major source of difficulties. While industrialization can indeed generate new employment, in developing countries it has not been able to meet the employment demands of the working population. Judging by present figures, it seems unlikely to do so in the future. As a result, graduate unemployment and underemployment are a serious problem in most countries of the region. The reasons for this vary from country to country, but generally there is clear evidence that education has been unable to train the types of personnel--mainly engineers and technicians--needed by the production sector. There are also indications that the vast majority of students take courses that are irrelevant to employment opportunities. This situation is further complicated by the requirements of industry-based development in countries with rapidly expanding populations. These countries have difficulty in creating a sufficient number of jobs for all their educated nationals. Social problems are raised by decisions to employ skilled personnel on jobs which do not accord with their training or expectations. Creating jobs at the desired income level in industry presupposes investment in excess of the economic capabilities of most of the countries considered. Thus, several countries in the region, even if they have succeeded in producing highly educated manpower, can offer that manpower only a limited number of jobs, and have to solve such problems as the unsuitability of curricula, the lure of employment opportunities abroad, and higher economic and social ambitions. These factors often cause disruption; and the expansion of education, instead of ensuring that skilled manpower contributes to sound economic development, becomes in itself an acute problem, combined with political unrest and social discontent.

Choosing priorities

229. Some problems of integration have arisen in part from ill-chosen priorities, as for example in agriculture. Although it became apparent in the 1960s that many countries were not in a position to satisfy the basic needs of their people, and that agriculture should therefore have been given top priority, the promotion of science and technology for rural development was not accorded the attention that the circumstances required.

230. The result has been a grave imbalance between the standard of living of town-dwellers and that of rural populations. In spite of the gains brought by the Green Revolution, agriculture has on the whole failed to attain the growth rates required to keep pace with demographic expansion and development needs. Even where agricultural education and research received encouragement, rural populations benefited little from new technologies which they had neither the financial resources to experiment with, nor the necessary training to appraise and utilize. In addition, agriculturists were usually neither politically nor economically able to influence the direction of agricultural development, with the result that most attempts to modernize agriculture ran into serious difficulties. Where modernization occurred, it often resulted in a concentration of economic power, and tended to conflict with the basic needs of large sectors of the rural population. This meant that the vast resources of science and technology were not directed to the priority of rapidly improving agricultural productivity. Where such an effort was made, clear evidence soon emerged that the use of science and technology could generate social, economic and political conflicts.

What types of science and technology?

231. The priorities of science and technology for rural development have been rearranged in some cases, but unanswered questions still remain regarding the ways in which they are used to that end. Such questions concern not only occasional errors of strategy, but also the very relevance to rural welfare of science and technology as at present organized and conducted in Asia and the Pacific. The issues involved are not merely the advantages of the various financial or strategic options; the question also being asked is how far the existing science and technology infrastructure can help to satisfy the needs and aspirations of the majority of the people. These criticisms are highly relevant to any review of science and technology policies and of the way science and technology are used for rural development.

232. These problems, and the social costs of introducing new technologies for development in both agriculture and industry, were regarded initially as unimportant, because they were thought to be temporary difficulties. Since then, however, a persistent and recognizable pattern has emerged whose salient feature is the necessity of providing for the needs of the population as a whole, and of avoiding extravagant use of natural resources and non-renewable energy, which leads to economic and technological dependence, hence to social inequalities and conflicts. The high social costs implicit in economic development policies will no doubt prompt closer scrutiny of the probable future effects of science and technology on society.

Technology transfers

233. The result has been a gradual re-examination, in government circles and elsewhere, of the social relevance of scientific research, and a questioning of the previously recognized merits of scientific excellence; this wide-ranging debate continues in the developing countries of the region. But the more sustained criticism of the social costs involved in using science and technology for development focuses on technology transfer, which, as things are at present, seems more likely to magnify social problems than to maximize development gains.

234. The reason for this is that technology is produced and shaped by the specific social demands that it is designed to meet. The technology of industrialized countries is designed to satisfy demands that differ markedly from those to be found in most countries in Asia and the Pacific, where, moreover, social needs have not yet been fully or clearly defined. If these needs are to exert a real influence on the policies of R&D institutions and on production, they must have stronger political support; they should not be relegated to the background by more powerful economic forces, or disregarded because of the low purchasing power of the population at large.

235. The innovation chain in the production of goods and services, which derives from consumer demand and economic conditions in industrialized countries, is not well suited to the economic conditions and still less to the social situations, of many developing countries. In some cases technological innovation can also operate against the general socio-economic objectives of national development. In countries that are not highly industrialized, the industrial type of technological innovation is probably not the best means of promoting greater development; it tends to reduce the range of future options and aggravate existing inequalities. It is a well-known fact that once the structures of industrial production and consumption are established, they cannot easily be changed later in the light of social needs. In this way, ill-considered ad hoc technological innovations can cause social tensions which complicate a country's process of modernization as a whole.

236. The difficulties encountered in expanding R&D, orienting education, developing agriculture and preventing social inequalities in the long term have given rise to much debate on the modernization of traditional societies through science and technology. At first, it was thought by some that the cultural patterns of traditional societies were incompatible with the rapid introduction of modern science and technology. However, such false beliefs are tending to disappear as more work is done on both the nature of modern technology and the social impact of technological change. Apart from studies of technological and economic dependence, the clearest evidence of the problems of integrating science and technology in developing countries for purposes of rapid development is to be found in studies on technology transfer.

237. Until they can build up their own science and technology capacity to the present level of the industrialized countries, many countries in the region will continue to be faced with the crucial problem of how to acquire and use technologies in such a way as to meet their social and economic needs while at the same time keeping undesirable psychological, social or cultural repercussions to a minimum. It should also be remembered that these countries are subjected to technology-transfer pressures which are often beyond their control and which do not reflect the needs of the majority of their inhabitants. Large-scale, capital-intensive and sophisticated technologies have accordingly been deliberately introduced into socio-economic and cultural systems without due consideration, and without any knowledge or understanding of their possible effects, still less of how to control them. This policy soon proved to be costly in terms of foreign currency, energy-dependence and indebtedness. Yet it is only recently that its social consequences have received serious attention, and have been the subject of many studies, concentrating mainly on the industrial and agricultural sectors, which have revealed the irremediable damage caused by this policy of importing technologies from industrialized countries. These critical studies, combined with pressure from the supporters of appropriate technology, have highlighted the practical difficulties and long-term costs involved in using certain modern technologies to make a rapid breakthrough for the future benefit of the majority of people living in the region.

238. Emphasis has been placed on the social consequences of introducing sophisticated technologies into socio-cultural systems which differ from those that first produced them. Furthermore, technologies of this kind are usually incompatible with the pre-existing technological level, and, ultimately, either they displace the former production system, or they themselves deteriorate for lack of adequate technical support. The introduction of sophisticated technologies of foreign origin has varying consequences for employment and economic structures depending on each case, but the result is always a state of technological dependence on foreign suppliers, nearly always followed by a period of economic and social uncertainty and instability.

239. The question has been raised, on occasion, whether the countries of the region might not be in danger of paying for their industrialization policy with increased dependence in respect of technology and resources. The question of the social price of the rapid introduction of new foreign technologies into societies unequipped with the necessary machinery to integrate them with their social objectives has, however, received little attention. The problem is particularly acute when the technology transfer is part of a package deal which does not envisage the transfer of new skills to the recipient country. In cases of this type, the cost of introducing imported technologies is not offset by the economic advantages that such an operation might have to offer; as for the social cost of absorbing these new technologies, it is nearly always quite simply ignored.

240. The lesson to be learned from studies of transfer phenomena is that the difficulties are inherent in the very nature of the technology to be transferred. When recipient societies are unable to take full control of new technologies acquired in this way, the social goals that motivate national economic development are seriously threatened.

241. In short, it would appear that in many countries of the region science and technology applications are often of foreign origin, and have not been adapted beforehand to respond to the real needs of developing societies. It is therefore as difficult to build them into the composite process of decision-making in the economic sphere as it is to make them socially acceptable. The countries of the region are reconsidering their policies and priorities in this field, so as to ensure that the integration of science and technology in national development takes place with a minimum of economic and social disruption.

2.2.2 Strategies and orientations for science and technology-based development

242. Since the 1960s, ideas have changed on the right strategy to strengthen the role of national science and technology in development. Decision-makers in developing countries now pay closer attention to the world science and technology co-operation system, which is still greatly influenced by the industrialized countries. Similarly, greater account is now taken of the social effects of the utilization of new technologies on life-styles, the reduction of inequalities, the creation of employment, resources management and the ecological balance. The problems arising in these various spheres increase the difficulties that governments have to face in their efforts to integrate science and technology in national development in a given society. For all these reasons, and because of the general failure of the efforts made to hasten the stage of self-reliance in national development, this more critical attitude has led governments to concern themselves not only with increasing the resources allocated to scientific institutions (manpower, funds and facilities, including information facilities), but also with the practical problems of the efficiency of effort, the relevance of objectives, and at the

national level the integration of the science and technology system with the education system (upstream) and the production system (downstream).

243. While these problems were emerging and attracting more attention, the countries of Asia and the Pacific were working to attain the development objectives that they had set themselves. These objectives, like the strategies adopted to achieve them, varied considerably. Some states have had to concentrate mainly on satisfying the basic needs of the population, while striving to develop their agriculture and to attain minimum industrial self-reliance. Other countries have been able to look towards the goal of increased industrialization as a means of generating further employment and reducing social inequalities. A few relatively industrialized countries have set out to develop high technology-based industry, while an even smaller group of developed countries are aiming at increased social welfare, energy conservation and environmental management as their industrialization goals.

Practical strategies

244. The strategies used to attain these various goals are more widely divergent. While some countries of the region have concentrated their efforts on rural development based on the promotion of labour-intensive, low-capital industries, others have opted for simultaneous agricultural and industrial development as a means of meeting consumer needs while providing a certain amount of industrial growth. In some instances these strategies differ in the degree to which they promote the rapid development of a modern industrial base. For example, countries with relatively well-developed industrial infrastructures and no urgent problems of natural resources or population have adopted industrial diversification as their main strategy, whereas countries less rich in resources, or grappling with population problems, have gradually progressed from establishing heavy industries to a programme of import substitution and export promotion. The approaches adopted by the most industrially advanced countries in the region also vary according to whether they possess a strong high-technology infrastructure and whether they are net exporters or importers of energy, factors which have proved decisive in determining the choice of national strategies.

245. Goals and strategies for industrialization have encountered several obstacles. When the initial period of capital importation, which was to be brief and to result in economic take-off, continued well beyond the predicted time, most countries of the region experienced a considerable rise in their external public debt as their industrialization programmes proceeded. This indebtedness has been aggravated by the increasing cost of energy, which has entailed a rise in capital expenditure and in the cost of spare parts and imports for countries seeking foreign technology for development. Furthermore, industrialization has not produced enough new jobs to meet the needs arising from population growth and the requirements for retraining agricultural labour. Urbanization and the patterns of consumption associated with it have further hindered the promotion of widespread economic benefits and the higher standard of living which should have resulted from industrialization. Wherever industrialization has taken off and begun to meet the demands of the more affluent consumers, the result has been only to highlight social and economic inequalities. Lastly, experience of industrialization in the region has led to a questioning of strategies based on the example of the industrialized countries, which often result in over-exploitation of natural resources and non-renewable energy sources, and in serious damage to the environment, and which, in the absence of corrective legislation, scrupulously enforced, usually lead to an unequal distribution of the benefits of development.

246. Thus, while industrialization has helped to increase national wealth, it has aggravated the external debt and increased the dependence on imports of many countries in the region. On the whole, it has not solved unemployment problems, and it has made those of urbanization more acute. Moreover, the fact that in many cases industrialization has generally been directed towards satisfying the consumer demands of the urban population has called in question the adoption of an economic development strategy based on this type of industrialization. Past experience indicates that certain aspects of this strategy should be reconsidered in order to make it feasible to attain development objectives based on the principles of national self-reliance, the satisfaction of human needs, and equality.

New strategies

247. All these problems call for careful thought by those responsible for framing policy in respect of science and technology for development. Development goals have changed little over the years: they are still centred on the abolition of absolute poverty and the reduction of economic inequalities. But the strategies adopted to attain them through industrialization have in some cases occasioned so much criticism that science and technology, and their role in development, have been called in question. Rapid increases in population have made the problem of food supplies more acute; for the same reason, more attention is now paid to establishing labour-intensive industries than to decentralizing industrial development with a view to attenuating the problems of urbanization. The need to reduce energy consumption has done much to change economic thinking on industrialization programmes, while the rise in interest rates, the higher cost of spare parts and escalating inflation in the industrialized world have complicated the development process in the less developed countries.

248. These facts are causing the countries concerned to examine the problems of development in greater detail. They are attempting to explore new paths to development which, while still science and technology-based, should make it possible to satisfy the needs of the population without creating more social tension or undermining political stability. This quest has led them to devise a strategy for the application of science and technology to development which strikes a balance between strengthening national science and technology capability and importing packaged or front-line technologies from other countries. Meanwhile, they must also tackle a number of new and fundamental problems concerning the uses of science and technology for development in the region, such as raising agricultural productivity, improving basic health and sanitation, more effective management of the environment, control of population growth, increased employment, natural resources management, the conservation of non-renewable energy sources and the development of renewable sources of energy.

Trends in scientific and technological research and in the uses made of its findings

249. A fresh look is being taken at the ability of scientific and technological research, as it is organized today, to make an effective contribution to national development. This reappraisal has come about partly at the prompting of those who question the relevance of science and technology to the social and economic development objectives of the various countries concerned. One of the most important of these objectives is to improve the welfare of the population in general, and of the least privileged in particular. The advances to be made in this sphere will be influenced by respect for the sovereignty of each country and for its fundamental choices in the economic and social fields. This approach to development will be responsive to both the aspirations of the people and requirements for the conservation of natural resources and the protection of the environment.

The impact of the economic recession and the cost of energy

250. Widespread disillusion among development planners and scientists is due not only to slow growth, the gradual dwindling of foreign aid and increasing technological and economic dependence, but also to the twofold problem of the recession and the rapid rise in the cost of energy. The last two factors in particular have added fuel to the debate, which began with questions of social welfare before concentrating on the role of science and technology in development strategy.

251. Energy costs, and the likelihood of shrinking markets for both traditional and modern manufactured goods in the industrialized world, have made hopes of economic or technological self-reliance seem more remote for many developing countries. This has raised the question of national priorities, and the contribution made by the national science and technology system to development goals has in some cases been harshly criticized. The immediate consequence of this state of affairs had been considerable pragmatism, and inconsistency, in the adoption of tactics to attain long- and short-term goals for the application of science and technology to development. As a result, there has been some questioning of policies for technology acquisition, with some countries postponing the date for the attainment of self-reliance and others being induced by circumstances to set out resolutely along this path without delay.

Action to be taken at the national level

252. The countries of the region will no doubt wish to learn from this experience, while without thereby undermining the science and technology basis that they have been at pains to construct. By way of preparation for major decisions of this kind, each country needs to have access to more social data concerning both the influence of exogenous science and technology and the needs of endogenous R&D activities in science and technology. At the higher administrative level, the need to improve the efficiency of the institutional machinery for co-ordinating plans for socio-economic development with those for the development of science and technology calls for a clearer insight into, and greater control over, the functioning of government services in each country. Without such co-ordinated action, the problems involved in the role of science and technology for development in the region are unlikely to be better understood or rapidly overcome.

253. The work that lies ahead is complex, and it will probably be necessary to strengthen decision-making machinery and procedures in respect of priorities for applying science and technology to development. Furthermore, by establishing without delay a capability to manage not only research and development but also the promotion and integration of new technologies in the production sectors of the economy, each country in the region can hope successfully to smooth over the inherent contradiction between the twin aims of technological change and social peace.

2.2.3 Policy requirements

254. The capacity for policy-making and policy implementation depends on a number of prerequisites, the first of which is the existence of a government body whose task is to formulate that policy. It is obviously of the first importance that, in the interests of efficiency, this body should be soundly organized and run, and geared to the governmental planning and budgeting mechanisms. The participation of working scientists, engineers and above all researchers in the policy-making process also plays an important part, as does the competence of the specialists responsible for analysis and the preliminary scientific work required for decision-making within the government body in question. In this connection, modern techniques for determining priorities and for planning, programming and budgeting in the field of science and technology are also particularly useful. Lastly, while the Asian countries have often reached a satisfactory standard in the formulation of science and technology policy, they have sometimes fallen short of that standard in applying and evaluating it. As a result, the policies may be well formulated and endorsed, but are hardly implemented and there is sometimes considerable delay in carrying out priority programmes. The lack of monitoring and feedback then prevents governments from taking corrective action. These problems are the subject of this section.

Policy-making bodies

255. A review of the various forms of mechanism for science and technology policy-making in Asia and the Pacific points to certain general conclusions which, although of varying applicability to any particular case, are none the less useful in outlining what improvements should be made in the countries concerned. These conclusions fall into two categories: those concerning the functions of the central bodies for science and technology policy-making, and those concerning the conditions which will ensure that these bodies will be able to perform such functions effectively.

256. Bearing in mind that the central science and technology policy-making body may be supported by several advisory committees, it appears that its essential functions should include:

establishing an adequate and effective national capability for science and technology;

preparing manpower development plans;

informing planners as to the country's scientific and technological capability, possible alternative solutions and the opportunities deriving from the application of the new knowledge to development;

determining the ideal balance between basic research, applied research and experimental development;

co-ordinating the programmes of different agencies involved in scientific and technological activities;

preparing the overall budget for all scientific and technological activities carried out under the auspices of government or with its financial backing;

studying long-term trends in scientific and technological progress;

formulating guidelines for the selection and local application of foreign technologies; and, in particular, ensuring the organization, co-ordination and direction, in every aspect, of the processes involved in technology transfer so as to attain the objectives of the development plan;

developing the relationship between producers and users of science and technology, more especially by establishing units with responsibility for specific tasks in that connection.

257. If science and technology policy-making bodies are to be able to carry out their tasks, a number of conditions must be met. Firstly, they must co-ordinate their policies with, inter alia, those for education, employment, industry, the environment, culture, etc. Secondly, they must have the necessary resources and authority to decide priorities in scientific and technological development and to influence the decisions of other ministerial agencies involved in the allocation of budgetary funds to science and technology. Thirdly, they must be able to monitor, on a continuous, periodic or ad hoc basis, the execution of the programmes they recommend, to maintain contacts with the competent ministries and the national planning body, and be authorized to report the progress of those programmes to the agencies instructed to apply them. Lastly, they must enjoy sufficient stability to enable them to discharge their functions and attain their long-term objectives regardless of any political or administrative change that may occur within the country.

258. The precise form of the central body differs markedly from country to country, according to political structures, administrative practices, socio-cultural situation, etc. Some countries may need a body, such as a science council or a committee of ministers, primarily concerned with creating a scientific and technological capacity, while more industrialized countries, having created that capacity, may need a body more concerned with establishing effective relationships between the producers and users of science, protecting man and nature against certain dangers stemming from technology and, lastly, ensuring the advancement of knowledge as such.

259. The composition of that central body must reflect the wishes, aspirations and capabilities of the country. It is, however, important that it include a team of specialists, backed up by advisory committees specializing in various fields of science and technology. The permanent members of the central body and its committees should be drawn from government institutions, science centres and planning services, from the users of science (such as industry) and from the universities and learned societies. The committees should also include working scientists, particularly in the younger category.

260. Decisions concerning science and technology, regardless of the structures adopted by the various countries, are taken at three levels, for each of which implementation machinery must be established.

261. At national level, i.e. that of the body in charge of the government's science and technology policy, general strategy is formulated in the light of the country's overall objectives, and priorities are established for the various R&D sectors. At this level, too, the plans of the different agencies are co-ordinated and the necessary resources are allocated in accordance with the priorities of the national science and technology system, the needs of the different sectors of the country's economy, the availability of funds and such scientific and technological potential as exists or must be created.

262. According to the country in question, it is also at the level of the central science and technology policy-making body (centralized system) or at that of the technical ministries and their research councils (sectoral system) or even of the major research institutions, that national socio-economic development plans and objectives are 'transformed' into scientific and technological programmes. Ideally, these various authorities should request and take account of projects submitted to them by the research establishments, laboratories and units that are administratively and/or financially dependent on them.

263. At the third level are the specialists who carry out research and provide scientific and technological services, and this is where research projects properly speaking are most often given their final form.

264. Table 11 shows which bodies are responsible for science and technology policy-making in a number of countries in Asia and the Pacific, and what their relations are with the organizations responsible for overall development planning.

TABLE 11 - Policy-making bodies for science and technology in a number of countries in Asia and the Pacific

Country	Agency responsible for S&T planning	National advisory committee for S&T planning	Mechanisms for establishing linkage between S&T plans and overall development plans
Australia	Department of Science and Technology	Australian Science and Technology Council	Through ministerial advisory bodies at federal and state level
Bangladesh	Ministry of Science and Technology	National Council for Science and Technology	Through the President who acts as the Minister of Science and Technology, and through the Planning Commission
China	State Scientific and Technological Commission	Academy of Sciences and many specialized advisory committees of the State Scientific and Technological Commission	Through the State Planning Commission and the national economic development plan
India	Department of Science and Technology	Scientific Advisory Committee to the Cabinet	Through the Planning Commission and the National Development Council
Indonesia	Ministry of State for Research and Technology	No specific body	Through the Planning Ministry (BAPPENAS)

Japan	Science and Technology Agency	Japan Science Council and the Council for Science and Technology	Through the Economic Planning Agency, the Economic Council and the Council for Science and Technology
Pakistan	Ministry of Science and Technology	National Science Council	Through the National Science Council and the National Planning Agency
Sri Lanka	Ministry of Industries and Scientific Affairs	National Science Council	No formal arrangement; currently done through the Cabinet
Thailand	Ministry of Science, Technology and Energy	National Research Council	Through the National Economic and Social Development Board

265. The great majority of countries in the region have already set up machinery for science and technology policy-making and planning more or less along the lines indicated above. None the less, the status, functions and responsibilities of these bodies, and to some extent, the concept of science and technology policy itself, differ considerably. More often than not, the science and technology policy-making structures are recent creations and, although it is acknowledged that these policies must be co-ordinated with national development policies and plans, in many instances effective co-ordination has been difficult to achieve. Broadly speaking, there are two types of problems here, depending on whether a centralized approach is or is not adopted.

266. In centralized structures, the entire system of science and technology and its functioning are supervised by the Minister of Science and Technology, or by the Prime Minister or one of his deputies, who presides over an interministerial committee representing the various departments that use R&D--industry, agriculture, public health, transport, communication, energy, etc. This system is designed to relate R&D activities to national objectives, and allocations are made from the science and technology budget to the various sectors--industry, agriculture, public health, etc. In this case, decisions are sometimes taken without the active involvement of R&D practitioners.

267. In some countries that also have centralized structures, the formulation of overall science and technology policy is entrusted to advisory councils that have no executive power. However, such bodies have sometimes proved ineffective because they lack authority, particularly with regard to the allocation of budgetary resources.

268. In a decentralized system, there is no ministry or interministerial committee for science and technology; each ministry allocates funds for R&D activities falling within its jurisdiction. In this case, scientific and technological activities may not entirely correspond to overall national objectives or to the respective priorities assigned to them, or may not be completely co-ordinated.

269. There can be no model for the elaboration of science and technology policies. However, each country's experience may be of interest to others: the experience of India and the Republic of Korea, for example, includes valuable findings in the area of planning techniques, the role of the different organizations and their mutual relationship within an operational network of scientific and technological institutions. To consider only the developing countries of the Asia and Pacific region, the science and technology policies pursued by the Republic of Korea seem to have given a great impetus to its economic development. India, for its part, already has long experience in the application of science and technology policy, especially with regard to the analysis of its results and the identification of difficulties involved in planning and decision-making concerning technological matters. Indeed, India's first general science policy objectives were determined by a parliamentary resolution in 1958. There are other developing countries in the region (China, Indonesia, Malaysia, Pakistan, the Philippines and Thailand) that have science and technology planning machinery, but their experience is more recent and hence less conclusive. This section will therefore refer, by way of examples to India and the Republic of Korea, whose extensive experience in this field is more fully documented than that of other countries.

270. In both countries, five-year economic plans are drawn up by the national planning bodies and arrangements are made to ensure that science and technology plans form part and parcel of those economic plans. The science and technology plans are drawn up in India by the National Committee on Science and Technology (NCST), which comprises ten heads of technical ministries and twelve independent members, and in the Republic of Korea by the Ministry of Science and Technology (MOST).

271. The science and technology plans themselves are established in both countries on the basis of detailed studies carried out by sectoral working groups made up of non-governmental specialists. Whether in the Republic of Korea or India, the plans take about one year to prepare and they are revised and updated every year.

272. In India, the NCST set up 27 sector panels and 253 planning groups, consisting of scientists and technologists and advised by economists and administrators, to suggest plans for the following sectors: (1) family welfare and health; (2) natural resources; (3) fuel and energy; (4) heavy industry; (5) chemical industries; (6) machine-tools; (7) mining and metal industries; (8) agricultural equipment; (9) transport; (10) agriculture; (11) meteorology; (12) defence, space and aeronautics; (13) electronics and atomic energy; (14) consumer industries; (15) housing, urban development, etc.; (16) mineral resources; (17) employment of S&T manpower; (18) environmental quality; (19) research support, education; (20) new materials; (21) co-operation agreements; (22) instruments; (23) utilization and recycling of wastes; (24) Khadi and village industries; (25) small-scale industries; (26) refrigeration, etc.; and (27) information.

273. In the Republic of Korea, the MOST draws up five-year S&T plans on the basis of recommendations submitted by 11 committees which include representatives of industry, the universities, financial establishments, etc., but no government officials. Appointed by the Minister, these committees are responsible for advising on (1) co-ordination; (2) manpower--supply and demand, education, training; (3) basic science--university research, the national science foundation project; (4) industrial technology--the Korean Advanced Institute for Science and Technology (KAIST), industrial technology strategy and technology transfer; R&D in the private sector; (5) agricultural development; (6) the environment; (7) resource development--energy, ocean

resources; (8) nuclear energy; (9) international co-operation in S&T; the brain drain; (10) information systems--electronics, computers, information services; and (11) creating a favourable climate for scientific and technological development--public relations, scientific associations, etc.

274. In India, the science and technology plan drawn up by the NCST must be approved by the Cabinet Committee on Science and Technology, while in the Republic of Korea, only particularly important plans and policies need the prior approval of the National (Ministerial) Council for Science and Technology.

275. In both countries, responsibility for the application of S&T plans rests with the technical ministries concerned. However, they are co-ordinated by the MOST in the Republic of Korea, and in India by the NCST and the Department of Science and Technology.

276. As already emphasized, most of the countries now seeking to establish policy-making machinery for science and technology appear to be aiming at a judicious blend of the wholly centralized and the purely sectoral systems. Without going so far as to establish a single science and technology budget administered by a single ministry, it is conceivable that the R&D activities and S&T services of the different ministries might be shown in consolidated form as a single 'functional budget', bringing together the programme budgets drawn up by those ministries responsible for science and technology and thereby highlighting their contribution to national objectives. A national budget for science and technology makes it possible to co-ordinate the S&T activities undertaken by the various ministries and bodies of the public sector, while those carried out in the rest of the economy can be co-ordinated by means of contracts, public subsidies or tax reductions. It also provides governments with a rational basis for deciding on the optimal amount of funds to be assigned to these activities, with the result that R&D would no longer have to suffer--as has often been the case--from the consequences of arbitrary decisions.

<u>The identification and evaluation of S&T projects</u>

277. Methods and techniques for identifying S&T projects are relatively little explored. It would thus be useful for the national community of scientists and engineers and the administrative departments responsible for the establishment of budgets and plans for scientific and technological development to co-operate in the design of any methods or techniques intended to be used for that purpose in the region. This would help to rationalize the process of forming a consensus on complex matters of science and technology policy, by making such a consensus as explicit and objective as possible. It was with this principle in mind that Unesco evolved a method for identifying priority areas of research or the application of existing scientific knowledge.(1) Simple in design, this method uses a set of relatively systematic procedures to involve representatives of the national scientific community and development programme officials in various sectors of the economy. Developed during the 1970s, it has, since 1977, been in full-scale application in a number of countries with very different development levels (Ghana, Morocco, Jordan, Costa Rica, Argentina and, more recently, Portugal; within the Asia and Pacific region, it has been used by Australia).

278. Although this Unesco method seems to offer interesting prospects for the identification of priority areas, it requires supplementing by other analytical techniques in operations following the planning stage. These include various techniques

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(1) 'Method for Priority Determination in Science and Technology'. Science Policy Studies and Documents, No. 40. Unesco, Paris, 1978.

concerning resource allocation, particularly in preparing budgets,[1] and project evaluation by such methods as cost-benefit analysis, since when a decision is being taken consideration must be given to the repercussions of the activities planned on employment, production, consumption, the distribution of incomes, foreign-exchange earnings, social development, the balance of regional development and, sometimes, even the environment--all fields of importance in achieving many national objectives.

279. While a number of analytical techniques are essential to research planning, the latter also calls for precise knowledge of the facts of the situation. Fact-finding and analysis units should be established in governmental science and technology policy-making bodies to gather useful information for the preparation of decisions (inventory of national scientific and technological potential from which it would be an easy matter to extract directories of staff, institutions and research projects in progress, statistics on national S&T activities, education, etc.). Governmental science and technology policy-making bodies in the region have far from adequate services in this sphere, and a particular effort is required.

Monitoring of project implementation

280. The countries in the region generally recognize that scientific and technological projects require monitoring and that this process can usefully be extended beyond the actual period of implementation. It is particularly important to perform checks at the half-way stage, so as to determine whether the results achieved at a given date do in fact correspond with the targets set for that time. On the basis of the available information, it would seem that most of the developing countries of the region have not yet established the machinery needed to monitor the implementation of scientific and technological projects. They are generally carried out by technical ministries (for industry, agriculture, public health, transport and so on), and sometimes co-ordinated by the Ministry or Department of Science and Technology, as in India or the Republic of Korea. However, there is at present virtually no information about the methods of monitoring the implementation of scientific and technological projects in the various countries of the region, or about the working of feedback systems to enable the responsible authorities to take corrective action in time.

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(1) In this context, see the 'Manuel de budgétisation nationale des activités scientifiques et technologiques' produced by Unesco. Science Policy Studies and Documents, No. 48. Unesco, Paris, 1980. English and Spanish versions currently in preparation.

CHAPTER 3

PROSPECTS FOR INTERNATIONAL AND REGIONAL CO-OPERATION IN SCIENCE AND TECHNOLOGY

CHAPTER 3 - PROSPECTS FOR INTERNATIONAL AND REGIONAL CO-OPERATION IN SCIENCE AND TECHNOLOGY

281. Scientific and technological co-operation, both multilateral and bilateral, has made considerable progress in the region since the first CASTASIA Conference. As we have seen in the preceding chapters, the membership of scientific communities and the volume of financial, human and institutional resources allocated to research and to scientific and technological services have increased substantially in almost all countries, enhancing their potential for regional and international co-operation. Beyond these purely quantitative aspects, mention should be made of certain major developments in the 1970s which have had a direct bearing on co-operation in science and technology.

282. In the political and economic fields, the energy crisis triggered off a whole range of research programmes on alternative sources of energy. The United Nations Conference on the Human Environment (Stockholm, 1972) drew attention to the growing problems arising from pollution, and also helped to bring about a marked change of emphasis in research on the natural environment. Furthermore, the United Nations Conference on the Law of the Sea is preparing to establish a new legal order for the seas and oceans, based on the action taken by states and providing new opportunities for utilizing marine resources. It stressed in particular the importance of taking resolute action during the 1980s to develop co-operation programmes in the fields of marine research and exploration and exploitation technology.

283. Science and technology co-operation in the region also underwent a number of changes at the level of regional and international institutions. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) singled out technological co-operation as one of its main fields of activity, converting the Industry and Natural Resources Division of the former ECAFE (Economic Commission for Asia and the Far East) into a Division on Housing, Industry and Technology. This led to the establishment under its auspices of the Regional Centre for Technology Transfer (RCTT), with its headquarters in Bangalore (India), towards the end of the 1970s.

During the same decade, various organizations were set up to provide the necessary framework for regional or subregional co-operation. The Association for Scientific Co-operation in Asia (ASCA), which was founded in the early 1970s, is open, in principle, to all Asian countries. Thailand, Malaysia, Singapore, Indonesia and the Philippines, which had formed an economic association within the framework of ASEAN (Association of South-East Asian Nations) in 1967, subsequently brought science and technology co-operation into sharper focus by setting up a separate Committee of the Association to deal with science and technology (COST--Committee on Science and Technology). Within the ASEAN secretariat itself, a special Bureau (one of three) was established under the Secretary-General to deal exclusively with scientific and technological affairs.

284. Multilateral and bilateral agencies for co-operation and development assistance have adopted policies or set up new structures designed to favour science and technology. The World Bank, the Asian Development Bank and the United Nations Development Programme, to mention but a few, have become increasingly involved in the financing of projects aimed essentially at expanding science and technology capacities: large-scale technical education projects, for instance. Some national bodies have been established for the express purpose of financing research of direct interest to developing countries. One such entity is the Australian Development Assistance Bureau (ADAB), which launched a programme (AUSTREC--Australian Science, Technology and Research Co-operation) in 1979 to co-ordinate all Australian assistance in science and technology. In Japan, the establishment of the Japan International Co-operation Agency (JICA) in 1974 gave a powerful boost to bilateral science and technology co-operation with developing countries. The scale of Japanese co-operation--two-thirds of which is executed by JICA--increased sevenfold in the decade 1970-1980. Other countries (the United States, Canada, the Federal

Republic of Germany, France and the Netherlands) have also stepped up their bilateral financial co-operation--in some cases quite substantially.

285. This growth of regional co-operation in science and technology in Asia and the Pacific must be seen in the larger context of worldwide international co-operation. Given its mission, it was natural that Unesco should be called upon to play a pre-eminent role in this process and to devote a large volume of resources to its furtherance. Thus, the science programme budget rose from 9 million dollars for 1967-1968 (supplemented by an estimated 27.4 million dollars of extra-budgetary resources) to 69.2 million dollars for 1981-1983 (plus an estimated 132.4 million dollars of extra-budgetary resources). This represents an increase of 500 per cent in the size of the budget, or a gross average annual increase of 12.3 per cent (including inflation). It should be noted that the General Conference decided at its twenty-first session (1980) to give marked priority to the science programme by allowing it to grow at a much faster rate than the programme as a whole.

286. The content of the science programme also evolved over the same period, with the launching and expansion of major intergovernmental programmes (Man and the Biosphere, the International Geological Correlation Programme, the International Hydrological Programme, the programmes of the Intergovernmental Oceanographic Commission and the General Information Programme) and the launching of other programmes (science and society, informatics, and new sources of energy). A recent innovation in the science programme was the regrouping of certain activities within major regional projects for the application of science and technology to development. The purpose of these projects is to provide the necessary conditions for endogenous scientific and technological development, while helping to solve practical economic and social development problems by increasing the amount of scientific and technological activity in these fields throughout the national community.

The novelty of these projects lies in their integrated character. They accordingly ensure the convergence of all such activities in Unesco's field of competence as can contribute to achieving their practical objectives: science and technology policy concerning the specific subject under consideration, training at the various levels, various types of research (basic, oriented, applied), information and communication, organization and infrastructure of the various institutions concerned, common services. Furthermore, they aim at giving countries the means of overcoming, in the field considered, all the drawbacks of technological dependence. To this end, they develop not only the research potential of national scientific and technological communities, but also their capacity to evaluate and adapt imported technologies, and thereby to have a say in the technological choices made.

287. Four of Unesco's nine major projects directly concern Asia and the Pacific (see Table 12):

(1) integration of technological research, training and development;

(2) research, training and demonstration aimed at integrated management of humid tropical zones;

(3) research, training and demonstration applied to the integrated management of arid and semi-arid regions;

(4) research and training leading to the integrated management of coastal ecosystems.

288. Unesco's activities are directly in line with the objectives of the new international economic order, and the 1974 Declaration by the General Assembly of the United Nations on this subject was a milestone in international co-operation. The efforts of the international community to bring the new order into being and to

TABLE 12 - Major regional projects for the application of science and technology to development--Asia and the Pacific

Title	Region(s)	Socio-economic impact	Applications	Disciplines
Major regional project for the integration of technological research, training and development	South-East Asia	Development of infrastructures and improvement of living conditions in rural areas Upgrading of agricultural by-products	Habitat, drainage, small local industries Standards of quality of products; universal use of controls; improvement of instrumentation	Civil engineering in rural environments; technologies associated with forest and agricultural products; socio-economic analysis Metrology, applied electronics
Major regional project for research, training and demonstration, aimed at integrated management of humid tropical zones	Interregional	In rural areas, growth of resources through integration of forestry and agriculture and use of forest resources; upgrading of new soils; development of agro-industries	Land improvement; selective clearance, forestry, shifting cultivation; conservation of resources	Ecology of characteristic ecosystems; environmental sciences; socio-economic analysis
Major regional project for research, training and demonstration applied to the integrated mangement of arid and semi-arid regions	Interregional	In rural and grazing areas, improvement of animal and vegetable products through integration of agriculture, forestry and grazing; improvement in standards of food supply	Action to combat desertification; reafforestation; farming systems	Special applied ecology; applied social sciences
Major regional project on research and training leading to the integrated management of coastal ecosystems	Interregional	Growth and conservation of exploitable biological resources (marine and lagoon)	Management of coastal zones and rational use of fishing; control over deterioration of coastal areas	Special ecology (coral reefs, lagoons, mangrove swamps); applied physical and biological oceanography

redress the imbalances of the present order, where science and technology are concerned, culminated in the United Nations Conference on Science and Technology for Development (UNCSTD), held in Vienna in 1979, and the adoption of the 'Vienna Programme of Action'. As stated in the introduction to a recent document prepared for the third session of the Intergovernmental Committee on Science and Technology for Development (ICSTD):(1)

'4. The Vienna Programme of Action seeks to redress the present situation. In order to do so, it has set for the international community three main objectives: the strengthening of the scientific and technological capacities of developing countries; the restructuring of the existing pattern of international scientific and technological relations; and the strengthening of the role of the United Nations system in the field of science and technology, including the provision of increased financial resources.

5. The Vienna Programme, set within the goals of the Declaration and Programme of Action on the establishment of a new international economic order and consonant with the recommendations of the International Development Strategy for the Third United Nations Development Decade for the 1980s, is based on the fundamental premise that the primary responsibility for the development of developing countries rests upon those countries themselves'.

289. The General Conference of Unesco, at its twenty-first session (1980),(2) 'having taken note' of this programme, 'recalling that Unesco, by virtue of its constitutional responsibilities, the vast experience it has built up in the fields of science and technology and the special links it maintains with the international scientific and technological community, has a leading role to play within the United Nations system in furthering the advancement of science and technology and their application to development and, especially, in ensuring implementation of the UNCSTD Programme of Action', and 'noting that the lines of emphasis of that Programme of Action coincide with Unesco's objectives and activities as set out in its Medium-Term Plan for 1977-1982', considered that the current programme (1981-1983) should, in particular, 'contribute, in accordance with the Organization's responsibilities and in co-operation with the Member States and the other organizations, agencies and programmes of the United Nations system, to the implementation of the Programme of Action adopted by the United Nations Conference on Science and Technology for Development'.

290. The countries attending the CASTASIA II Conference will have the opportunity, at this early stage in the decade, to consider the action they wish to take on the recommendations of the Vienna Programme, especially as regards regional and international co-operation. As a guide to discussion, the following three sections will deal in turn with the areas in which co-operation should take top priority and the ways and means and funds required to make it effective.

3.1 PRIORITY AREAS FOR INTERNATIONAL AND REGIONAL CO-OPERATION

291. As resources are limited, the sensitive question of choice arises. Priorities in regional co-operation depend primarily on co-operation policy objectives,

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(1) 'Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development', note by the United Nations Secretary-General, document A/CN.11/12, paragraphs 4-5, United Nations, New York, 1 May 1981.

(2) Resolution 2.01 on the programme for natural sciences and their application to development.

which may vary from country to country. Hence, a list of general objectives should first be drawn up to be used as criteria in the choice of priority areas for co-operation.

292. A number of regional and international organizations and funding agencies in the field of development co-operation have, over the years, defined the objectives of their activities, which reflect their functions, their terms of reference and their membership and inevitably also the common objectives of the countries in which they operate. We may use these objectives as guidelines in considering the general aims of the region under review.

293. The following list, based essentially on the deliberations of a Unesco meeting on scientific co-operation in the region,(1) takes account of statements of principle from a number of other sources concerning the purpose of regional activities. They should:

(1) be of relevance to national requirements and of interest to the largest possible number of countries in the region;

(2) meet the needs of the most disadvantaged and most vulnerable countries and peoples in the region;

(3) encourage wider participation by the public, including women, in the development process and in its benefits;

(4) be action-orientated, with in-built machinery for making use of results and structures designed to strengthen national capacities;

(5) form part of long-term programmes co-ordinated at regional level (thus avoiding the vicissitudes of national programmes covering a period determined in many cases by the length of the sponsoring government's term of office);

(6) focus on areas where a regional rather than a national approach is manifestly desirable;

(7) promote and facilitate mutual awareness, cohesion and understanding among countries;

(8) make full use of existing resources and facilities in the region and support the development of national or regional institutional infrastructures;

(9) be consistent, as far as possible, with major international co-operation programmes in science and technology.

294. It is also useful to bear in mind the areas on which agreement was reached in a number of regional forums during the 1970s.

295. In 1972, the UNACAST Asian Regional Group identified a number of priority areas for scientific and technological development (listed in Table 13), drawn from the UNACAST World Plan of Action, and adapted them to the Asia region. These priority areas reflected the national development priorities of the majority and were therefore of immediate assistance in selecting appropriate areas for co-operation. In 1974, ASCA drew up a list of priority areas selected specifically with a view to co-operative action (see Table 14). There is considerable overlapping between the two lists.

(1) 'Regional co-operation in the basic sciences in South-East Asia', 1975, Final Report.

TABLE 13 - Priorities of the Asian Plan of Action

List of priority areas drawn from the Asian Plan of Action for the Application of Science and Technology to Development (ECAFE, 1973).

Part I. Priority areas for research

1. High-yielding varieties of staple foods
2. Edible protein
3. Fish
4. Pest and vector control
5. Tropical hardwoods and fibres
6. Groundwater
7. Desalination
8. Weather
9. Arid land
10. Industrial research and design
    - A. Metallurgy
    - B. Problems of corrosion
    - C. Industrial chemicals
    - D. Small-scale and cottage industries and handicrafts
    - E. Food industry
    - F. Agro-based industries
    - G. Appropriate technology
    - H. Maintenance, repair and standardization

Part II. Priority areas for the application of existing knowledge

1. Storage and preservation of agricultural products
2. Control of livestock diseases
3. Human disease control
4. Housing construction methods
5. Improvement and strengthening of science teaching
6. Application of modern technology to the development of education
7. Natural resources
8. Human resources
9. Transport
10. Establishment of modern instrumentation facilities for analytical work

TABLE 14 - List of priority areas for co-operation drawn up by ASCA(1)

1. High-yielding varieties of staple food
2. Edible protein
3. Fish (marine resources)
4. Weather modification (monsoon and cyclones)
5. Low-cost housing
6. Non-conventional energy sources
7. Corrosion
8. Family planning
9. Post-harvest technology (storage, etc.)
10. Education technology
11. Upgrading of low-grade ores
12. Medicinal and aromatic plants
13. Pest and vector control
14. Transport
15. Natural resources
16. Water resources
17. Geophysical prospecting
18. Food processing
19. Scientific information
20. Tropical hardwood and fibres
21. Industrial chemicals
22. Agro-based industries
23. Livestock and control of livestock diseases
24. Beneficiation of low-grade coal
25. Modern instrumentation facilities for analytical work
26. High-altitude environmental studies

(1) Report of the Third Meeting of the Association for Science Co-operation in Asia (ASCA), New Delhi, April 1974.

296. More recently, Unesco organized a Workshop on Science and Technology Policy (Bangkok, December 1978) dealing with the question of priorities in regional co-operation programmes. Analysis of all the national reports prepared by the Asian countries for UNCSTD yielded a list of forty-nine development sectors, and seven types of scientific and technological activity were noted by a representative panel of experts from fifteen countries which assessed the relative importance of these categories of activity for national development in each development sector.

297. The appraisal of the Unesco panel of experts based on a survey of all forty-nine sectors indicated that regional co-operation was pre-eminently desirable in the fields of research, professional training and science and technology information. Taking all seven selected categories of activity(1) into account, the panel found that by far the most urgent need for co-operation existed in the field of food and agriculture, followed by natural resources, energy, industry, health, transport and communication and education and training.

298. The most recent effort to provide a basis for the choice of priorities has been the preparation of the 'Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development'. The Intergovernmental Committee on Science and Technology for Development stipulated at its third session (May 1981)(2) that

'the Operational Plan should be conceived as:

(a) a framework that can be used by countries individually or collectively for utilizing the support and experience existing in the United Nations system;

(b) a framework for the scientific and technological activities to be conducted by the relevant organs, organizations and bodies of the United Nations system'.

299. Eight major programme areas have been identified by the Intergovernmental Committee:

I. Scientific and technological policies and plans for development

II. The creation and strengthening of scientific and technological infrastructure

III. The choice, acquisition and transfer of technology

IV. The development of human resources for science and technology

V. The financing of science and technology for development

VI. Scientific and technological information

VII. The strengthening of research and development in and for developing countries and their linkage to the productive system

VIII. The strengthening of co-operation in the field of science and technology among developing countries, and between developing and developed countries.

300. The Operational Plan proceeding from the Vienna Programme provides a general framework which requires adaptation to the specific needs of Asia and the

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(1) R&D, professional training, vocational training, extension services, S&T information and documentation services, other S&T services such as instrumentation and standardization, and feasibility studies.

(2) 'Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development', note by the Secretary-General, ibid., paragraph 15.

Pacific. But it is a useful standard of reference, in so far as it reflects shared concerns--shared particularly among regions--and therefore indicates likely areas of interregional and international co-operation.

301. The region's most urgent development problems have been set out in the introduction to Chapter 1, and broadly correspond to the present aims of scientific and technological co-operation in the region: food production, exploitation of natural resources, health improvement, development of industry, transport and communications, management of the natural environment, and sources and methods of production of energy.

302. The Conference will have to decide, for each of these fields, on the order of priority to be assigned to specific co-operative activities, such as research, training or exchange of information. To assist it in this task, a non-restrictive list of priority areas is given below. The list is based on the meetings of experts held by Unesco in Bangkok in 1978 (1) and more recently in the same city in preparation for CASTASIA II. (2)

Food:	new varieties, pest and vector control, post-harvest technology, food production techniques, fish farming, livestock productivity, fisheries.
Natural resources:	harvesting of forest and mineral resources, resources survey, especially through remote sensing by satellite.
Health:	perinatal medicine, family planning, medicinal plants, pharmaceuticals production.
Industry:	Harvesting of tropical hardwood and fibres, utilization of waste, problems of corrosion; application of micro-electronics; metrology and standardization of materials technology; construction materials.
Transport and communication:	manufacture of motor vehicles or components; space technology (communication satellites).
Natural environment:	groundwater, meteorology, ecology of arid or tropical zones; natural hazards; river basins; oceanography.
Energy:	solar energy, biomass conversion.

303. Science and technology information services or equipment maintenance and repair services are additional prerequisites common to almost all these fields.

304. On another level, the improvement and extension of science education and vocational training constitute additional priority areas for regional co-operation.

305. Two information documents (3) supplied to the participants give an outline of the type of regional co-operative activities under way in Asia and the Pacific.

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(1) Asian Workshop on Science and Technology Policy--Priorities for Regional Co-operation Programmes, Unesco, Bangkok, 11-14 December 1978, Final Report.

(2) Preparatory Meeting for CASTASIA II, Unesco, Bangkok, 16-18 December 1981, Final Report.

(3) Reference document SC-82/CASTASIA II/Ref. 4, Unesco Science and Technology Activities in Asia and the Pacific. Inventory of Regional Co-operative Programmes in Science and Technology--Asia and the Pacific, Unesco, Jakarta, January 1981.

The first document describes Unesco's programmes in the region and the second lists the main regional co-operative programmes in science and technology conducted by all organizations active in the region.

306. As noted in the introduction to this chapter, Unesco's programmes were appreciably expanded and restructured during the 1970s with the express purpose of meeting the needs voiced by Member States and of reflecting more and more faithfully their concerns and development priorities.

307. For instance, the major regional project for South-East Asia (Table 12), which aims at integrating national capacities for technological research and the training of engineers, focuses on the following five areas:

- technology for rural development;
- exploitation of alternative sources of energy;
- construction of low-cost housing in urban and rural areas;
- utilization of agricultural by-products and waste;
- instrumentation and control systems (e.g. development and dissemination of information and models for teaching and training of personnel using control instruments).

308. Priority was also given to geological research of immediate usefulness in evaluating mineral-based energy resources and in studying endogenous or exogenous natural hazards. In the latter case, two main objectives are being pursued: (1) modernization and extension of the seismological network, and (2) establishment of a regional vulcanological institute. The South-East Asian Association of Seismology and Earthquake Engineering (SAASEE) has a special role to play in this field, with Unesco's assistance.

309. Within the framework of the International Hydrological Programme (IHP), the water sciences programme laid down its proposed lines of action at two regional conferences of national IHP committees (Colombo, 1977; Bandung, 1972) and is now concentrating on training and research in hydrological systems of tropical and semi-arid regions.

310. The Man and the Biosphere (MAB) programme is concerned primarily with developing the scientific knowledge required for the rational utilization and conservation of natural resources in the light of man's interaction with the natural environment. The activities of this programme are intimately bound up with two major interregional projects (see Table 12) concerning the integrated management of humid tropical zones, on the one hand, and of arid and semi-arid regions, on the other.

311. The importance of the oceans has been highlighted for several years by the proceedings of the United Nations Conference on the Law of the Sea, and in the wake of the new provisions concerning the limits of territorial waters, maritime countries, particularly those of the region, will most probably embark on large-scale research programmes during the 1980s in order to exploit their marine resources to the full. The major interregional project on coastal ecosystems (COMAR) is specially designed to improve man's scientific knowledge of coral reefs, coastal lagoons, estuaries and mangrove swamps, features which are typical of most of the coastal environment of the countries of the region. Some of the programmes being conducted by the Intergovernmental Oceanographic Commission (IOC) are also of direct interest: for example, the Integrated Global Ocean Station System (IGOSS), sponsored jointly by IOC and the World Meteorological Organization (WMO), and the International Oceanographic Data Exchange programme, both of which involve the collection, analysis and exchange of oceanographic data and the provision of relevant information and services.

3.2 MODES AND MECHANISMS

International scope of science and technology

312. The need for scientific and technological co-operation, at the regional and international level, is commonly acknowledged by the world community today. This need arises not only because of the very nature of scientific and technological knowledge which is universal in itself, but also because of the fact that regional and international co-operation in these fields can usefully contribute to the implementation of national development plans, by strengthening countries' capabilities for the exploitation and management of their resources. Further, going beyond the national context, what is ultimately involved is the well-being of humanity as a whole, since many development problems, such as for example the protection of the environment and the exploitation of natural resources, require a global approach.

313. Scientific and technical co-operation among developing countries themselves and between developing and developed countries is also looked upon as an important means of implementing the new international economic order and reducing the imbalances to be found in the development of science and technology and their applications throughout the world. These two patterns of international co-operation require flexible mechanisms to be able to adapt to new situations and to react in response to events, whether these concern the emergence of new research fields, new applications of technology, or changes in the world political or economic scene (monetary or energy crises, outcome of the North-South dialogue, etc.).

Technical co-operation among developing countries

314. Technical co-operation among developing countries--TCDC--has been developing gradually for many years, partly as a result of Unesco's action in the different regions of the world; the concept was however given official recognition at the United Nations Conference on Technical Co-operation among Developing Countries (1978) in the context of the 'Buenos Aires' Plan of Action. This Plan of Action made recommendations at the national, regional and subregional, interregional and, finally, global level for the promotion, strengthening and implementation of technical co-operation among developing countries.

315. The basic objectives of TCDC, which are interdependent and mutually supporting are, *inter alia*:(1)

to foster the self-reliance of developing countries through the enhancement of their ability to achieve innovative solutions to development problems in keeping with their own aspirations;

to promote and strengthen collective self-reliance among developing countries through the exchange of experience, the pooling of their technical resources, and the development of complementary capacities;

to strengthen the capacity of developing countries to identify and analyse together the main issues of their development and to formulate the requisite strategies for the conduct of their international economic relations;

to increase the quantum and enhance the quality of international co-operation, and to improve the effectiveness of the resources devoted to overall technical co-operation through the pooling of capacities;

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(1) United Nations Conference on Technical Co-operation among Developing Countries, document A/CONF.79/13, 27 September 1978.

to increase developing countries' confidence in each other's technical capabilities, and to achieve better harmonization of their interests so as to take full advantage of their social, physical and economic diversity within the basic context of solidarity.

316. The United Nations Conference on Science and Technology for Development emphasized in its Programme of Action the need for greater co-operation among developing countries.

317. The different types of regional programmes described below (regional co-operation networks, regional centres, regional associations, etc.) are all ways of promoting such co-operation. Co-operation needs to be intensified not only because the technological development problems facing these countries are often similar, but also because these countries offer valuable complementary possibilities as regards their scientific and technological potential. It is a fact that in a number of specific fields many developing countries have reached a sufficiently high level of expertise and know-how to meet the demands of other developing countries. Effective TCDC should therefore result in a decline of the scientific and technological dependence of the developing countries, and ultimately contribute to their achieving individual and collective self-reliance.

318. To achieve this goal, the developing countries, particularly those in Asia and the Pacific, will no doubt wish to strengthen their support for TCDC by creating, where these are still non-existent, national co-ordination and promotion mechanisms to encourage and channel efforts in this respect. This implies *inter alia* the adoption of appropriate legislative and administrative measures with specific budgetary allocations, and the drawing up of bilateral or multilateral intergovernmental agreements creating an adequate political, administrative and financial framework for co-operation at all levels, i.e. institutions, enterprises and individuals.

Existing modes of regional co-operation

319. In the Asia and Pacific region, there exists a wide spectrum of bilateral and multilateral modes of co-operation in the field of science and technology. These forms of intercountry co-operation, the most significant and original of which will be reviewed below, are functioning with varying degrees of success and effectiveness. The CASTASIA II Conference provides a good opportunity for participants to re-examine these forms of co-operation, and express preference for those which seem most promising for national development plans.

(i) Regional networks in Asia and the Pacific

320. The idea, advanced by Unesco, of establishing regional networks in various fields of science and technology has gained ground in the region in recent years. This form of co-operation is considered by Member States and their scientific communities as particularly suitable for strengthening collective capacity in the region, and it is flexible enough for those sharing in regional co-operation programmes to maintain their independence in the organization of their own activities. Generally speaking, a network consists of a group of institutions, laboratories, research centres or individuals located in countries of the region and willing to co-operate in a specific field. It normally functions through a co-ordinating committee which is responsible for the preparation of its programmes and their implementation with the co-operation of national 'contact points'. The co-ordinating committee meets regularly, each time in a different country of the region, where there is a national 'contact point'.

321. One of the main objectives of this form of multilateral co-operation is for the institutions and research teams belonging to the network to share experience

and research and training responsibilities in a specific scientific field. Furthermore, through these institutional linkages, those working in remote and isolated places can maintain close and fruitful contacts with others working on similar problems under similar conditions. Hence the transfer and dissemination of information constitutes the key element in the concept of a network, whether regional or interregional.

322. Over the years Unesco and other international or bilateral organizations have set up a number of such networks in Asia and the Pacific. Typical examples are the Asian Network for Biological Sciences (Unesco/COSTED), two regional networks for the chemistry of natural products and for microbiology in South-East Asia (Unesco/JICA), the Regional Network for Geosciences in South-East Asia (Unesco), the Regional Network for Solar Energy in Asia (Unesco) and the Asian Network for Industrial Technology Information and Extension (International Development Research Centre).

323. Other networks also exist, for example for mathematics, microbiology and medicinal plants. Working groups (on energy, the use of waste matter, low-cost construction, the maintenance and repair of scientific instruments, appropriate technology) set up by FEISEAP (Federation of Engineering Institutions of South-East Asia and the Pacific) and supported by Unesco under its Major Regional Project for the promotion and integration of technological research, training and development in South-East Asia, also provide structural links equivalent to networks.

324. Lastly, Unesco's major scientific programmes, such as Man and the Biosphere (MAB) and the work of the Programme Group for the Western Pacific (WESTPAC), operate in such a way that the result is virtually the constitution of regional co-operation networks.

325. Under the MAB programme mention should be made in particular of the regional networks of pilot projects of research, training and demonstration on the integrated management of humid tropical zones and arid and semi-arid regions, and the network of biosphere reserves for the conservation of natural areas in association with development and with environmental education.

326. These pilot projects are an attempt to surmount the obstacles in the way of the production, dissemination and application of knowledge about natural resources. They are addressed to specific land-use and resources management problems as encountered at local and national levels. The purpose of such projects is to generate information in the fields of the natural and social sciences which can be used directly in solving these management problems. They also make research findings available to planners, managers and teachers, and serve as an ideal means of providing training in the field to local specialists. Pilot projects of this kind already exist in several countries of the region, instituted by the countries themselves under the MAB programme.

327. In the field of energy, Unesco plans to launch three regional pilot projects to handle information on new and renewable energy sources and to keep under review and demonstrate current information technologies, practices and procedures. The aim is to establish an international network of information systems and services relating to new and renewable energy sources, based on concerted action at the national, regional and international levels.

(ii) Regional Centres and Co-ordinating Committees

328. Regional Centres are a different mechanism, since they involve the establishment of a formal and permanent structure, usually with permanent office space and full-time staff. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has promoted this concept with some success, due in particular

to substantial financial support from UNDP. The ESCAP Centres include the Asian and Pacific Development Centre in Kuala Lumpur (Malaysia), which is developing a regional programme in energy planning and management; the Regional Mineral Resources Development Centre in Bandung (Indonesia); the Regional Tin Development Centre in Ipoh (Malaysia); and the Regional Centre for Technology Transfer in Bangalore (India).

329. The Southeast Asian Ministers of Education Organization (SEAMEO) has also set up a number of regional centres working in tropical biology (BIOTROP), agriculture (SEARCA) and science and mathematics (RECSAM).

330. The Co-ordinating Committees for Offshore Prospecting in East Asia and the Pacific have structures which are similar to the Regional Centres and also come under ESCAP. Lastly, reference should be made to the Mekong Committee, which has more limited objectives.

331. The regional committees of Unesco's major intergovernmental programmes constitute another type of co-ordinating machinery. The possibility is at present being considered within the Intergovernmental Oceanographic Commission (IOC) of setting up a working group to be responsible for co-ordinating the special programmes for the study of the Central Indian Ocean.

332. As regards water resources, co-operation is facilitated by the intergovernmental machinery of the International Hydrological Programme (IHP), in particular by the existence of national committees. Regional meetings of these committees are arranged at regular intervals (every five or six years) to update co-operation programmes, which consist, for example, of the holding of training courses, the translation of glossaries and the conduct of specific research projects for the region.

333. A Regional Committee for South and Central Asia (ARCCOH), with its headquarters in New Delhi, has been set up with technical assistance from the Unesco Regional Office for Science and Technology for South and Central Asia (ROSTSCA) with a view to disseminating information and promoting co-operation between countries. The Committee holds regular meetings and publishes a newsletter which facilitates scientific collaboration between its member countries.

(iii) Regional associations, societies and federations

334. Several countries of the region have a sufficient stock of scientists and engineers to form their own national professional associations. For some years now these associations have been joining forces to form a number of regional federations. These provide the institutional framework required for the exchange of information and experience between members from different countries, thus encouraging the development of regional co-operation programmes. Some federations cover the whole region, but generally they are subregional. Examples include the Association for Engineering Education in Central and South Asia, the Association for Engineering Education in Southeast Asia, the Federation of Engineering Institutions of Southeast Asia and the Pacific, the Federation of Asian Chemical Societies, and the Confederation of Engineering Institutions of the Southeast Asian Nations.

(iv) International scientific institutes set up under bilateral or multilateral agreements

335. The need to share expensive equipment and to pool specialized scientific staff from Asia and the Pacific as well as from other regions of the world has led to the creation of a special type of institute, of which two of the most typical examples are the Asian Institute of Technology, in Bangkok, Thailand, and the International Rice Research Institute in Manila, in the Philippines. Consideration is being given to the creation of similar international institutes in other fields of science and technology, such as chemical sciences.

336. In the case of large institutes the problem of sharing costs and benefiting from results is particularly acute. In addition, countries which have a limited scientific research potential are likely to have difficulties in exploiting fully the scientific results obtained by these institutes. Generally speaking, it is therefore in the interest of these countries to study very attentively proposals for setting up new regional institutes, and in particular to assess the possible local repercussions of seconding abroad national experts who are urgently needed in their own countries.

Present arrangements for interregional and international co-operation

337. In this field a variety of arrangements provide a framework for increasingly closer co-operation at the global and interregional levels.

338. The three Unesco major interregional projects cited at the beginning of this chapter (Table 12) provide a framework within which national units which already exist or are to be set up can be integrated as components providing operational or substantive support.

339. The intergovernmental programmes also referred to at the beginning of this chapter likewise provide structures within which national activities receiving interregional or global support can develop on a highly flexible basis.

340. The creation of bilateral institutional links for the 'twinning' of research centres or training institutions in the industrialized and the developing countries(1) might constitute another efficacious approach to promoting the transfer of appropriate advanced technologies and the training of researchers, and avoiding a 'brain drain'. It would help countries to create a closer working relationship between the industrial sector and research and training communities. Another advantage of this strategy is that it would help to build a bridge between the emerging industry of poorly endowed countries and the already established industry of industrialized countries, a context in which the 'twinned' training and research centres would play a key role in communication and harmonization.

341. The TOKTEN scheme (Transfer of Know-how Through Expatriate Nationals) launched by UNDP in 1977, is another original form of international co-operation. It consists of calling upon expatriate nationals with proven professional competence in a specific field to undertake missions of short duration (eight weeks to three months) to their countries of origin. Through this scheme, the visiting consultant transmits his professional experience and know-how to host institutions in his country of origin by means of consultations, advisory services and seminars on problems of national priority. Recognition by the mother country and sponsorship by institutions in the United Nations system have proved to be an extremely motivating force for expatriate specialists to make their expertise available to their countries of origin.

342. This form of transfer of know-how has many advantages:

(i) Expatriate nationals with comparable professional qualifications and experience are usually in a position to operate more effectively because of their intimate knowledge of their home country.

(ii) Expatriates have the same culture and language as their counterparts in the country. This facilitates considerably interpersonal communication at all levels and leads to a better understanding of the specific

(1) See No. 13 in the series 'Science policy studies and documents' and the UNDP document, ref. DP/L.202 of 17 November 1971.

problems of the country. National authorities also accept outspoken, constructive criticism more readily from fellow countrymen than from foreigners.

(iii) Out of devotion to their country of origin, most of the expatriates called upon are ready to do without any remuneration; thus the only costs which have to be borne are travel costs and daily subsistence allowances.

(iv) Once expatriate nationals have returned to the industrialized countries where they are normally resident, they maintain close contacts with their counterparts in their countries of origin and keep them up to date in their field of professional activity. This leads to a permanent flow of information and exchange of ideas between individuals and institutions in the developing and industrialized countries concerned.

343. A number of Asian countries such as Turkey (where the TOKTEN scheme started in 1977), India, Pakistan, the Philippines, China, Sri Lanka and Thailand have recently manifested great interest in TOKTEN. The participants in CASTASIA II might therefore wish to pay special attention to this form of co-operation.

344. There are other forms of co-operation in Asia and the Pacific whose importance should not be underestimated. Unesco and other regional or international organizations organize on a regular basis regional seminars, training courses, workshops, study visits and exchanges of teaching and research personnel. They also award travel grants and research fellowships, and undertake fact-finding and advisory missions at national level. They likewise publish technical reports, newsletters and other documents and thus play an important role as far as the exchange of scientific and technological information is concerned. It is interesting to note here that a very large number of co-operative programmes were launched after the holding of CASTASIA I in 1968. A detailed list of these programmes and the organizations responsible for them will be found in a Unesco publication entitled 'Inventory of Regional Co-operative Programmes in Science and Technology', which was compiled in January 1981 by the Unesco Regional Office for Science and Technology for South-East Asia (ROSTSEA).

3.3 FINANCING ARRANGEMENTS

345. In the 1960s, industrialized countries devoted between 0.5 and 2 per cent of their GNP to research and development with industrialized socialist economies on the high side of these averages. In the same period, Asian developing countries devoted between 0.1 and 0.3 per cent of their GNP to these activities.

346. In the belief that economic progress (with the power it confers) was in some way commensurable with the financial efforts made in respect of R&D and generally speaking, science and technology activities, governments favoured increasing expenditure on research, and set themselves targets to be achieved in this field. Asian governments at the first CASTASIA Conference, in 1968, were no exception to that general trend, and agreed to aim at reaching the figure of 1 per cent of their GNP for R&D allocations by 1980. Given the very limited resources allocated to R&D at that time, the target proved difficult to achieve. Even countries like India and the Republic of Korea, among those with the most energetic policy aimed at creating the scientific base necessary for economic development (albeit through different strategies as concerns technology acquisition), allocated only 0.6 per cent of their GNP to R&D in 1980. By comparison, industrialized countries now devote to R&D some 2 per cent of their GNP.

347. For the decade 1980-1990, the target of 1 per cent would now seem within easier reach for the developing countries of Asia and the Pacific. Aiming at that target would provide at least an idea of the resources likely to be made available by the parties concerned, and allow more co-ordinated and long-term planning by national science and technology policy-makers.

348. The doubling over a decade of the effort in support of R&D, as a percentage of GNP, would imply a growth rate in the funds allocated to these activities of 7 per cent per annum over and above the growth rate of the economy. If the economy grows at, say, an average of 5 per cent per annum, this would mean a 12 per cent annual growth in the allocations to scientific and technological activities. This does not seem beyond reach, but it does imply that science and technology receive priority in overall development planning, i.e. that a deliberate shift of resources is made to the science and technology sector.

349. At the present time, the science and technology financial effort by developing countries in the region represents an annual expenditure of the order of 2,000 million US dollars (excluding China). If, as suggested in the Operational Plan of the Vienna Programme,[1] multilateral and bilateral sources are to be tapped to help developing countries bridge the gap which separates them from the 1 per cent target (a gap which runs into thousands of millions of US dollars), some dramatic changes will have to occur in the North-South dialogue, and major policy readjustments will have to be undertaken in international and regional financing agencies.

350. This increase of resources at national level would also imply considerable realignment, within the countries concerned, of national sources and mechanisms of financing, all sectors of the economy being called upon and national institutions which finance development being requested specifically to allocate funds to scientific and technological activities. The introduction of incentives (and disincentives) to users of technology, through fiscal and monetary policies, might also do much to encourage countries to make use of their own science and technology potential. Such policies ought also to encourage transnational corporations to make use of local resources.

351. If the countries of the region take as their objective a doubling of the resources allocated to scientific and technological activities (which at present total some 2,000 million US dollars, as stated above) between now and the end of the 1980s, the financial resources assigned to regional co-operation programmes in the field of scientific and technological activities might increase porportionately, provided that appropriate policies for budgetary allocations were adopted to this end.

352. Regional activities generally play a complementary role in terms of resources and impact, in relation to national programmes, except perhaps for poorly endowed countries or those with small populations. Scale effects come into play in these countries, which consequently have some difficulty in finding sufficient resources on their own to mount costly programmes; it is therefore in their interest to participate in a regional programme provided with adequate financial and human resources. In other cases, regional programmes are very often the only way to tackle specific problems--e.g. satellites for remote sensing, environmental studies relating to adjacent countries, seismic networks--and are sometimes simply more economical than a collection of national programmes, making it possible to avoid duplication of efforts--e.g. parallel research on problems common to a number of countries.

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(1) Operational Plan, _ibid;_, paragraph 231.

353. Thus regional activities are nevertheless of great significance for the region as a whole, and for its various subregions. However, the financing of these activities raises very complex problems because of the many different partners involved, the variety of their interests, etc. A list of criteria for regional activities is proposed at the beginning of this chapter. The adoption of the first of these criteria as a basis for participation in regional programmes will ensure that these programmes constitute an extension and enhancement of national programmes and that the benefits accruing from them to all interested parties will be apparent.

354. Provided this is the case, one can validly submit that it is in countries' interest to set themselves targets for the allocation of resources to regional or subregional activities, this being fully in accordance with TCDC principles. A figure of 5 per cent of national science and technology expenditure may seem to be modest, but at the present level this would nevertheless amount to committing resources in the range of $50 to 70 million annually (excluding India and China). On the assumption that in the next ten years these resources increase porportionately with overall R&D expenditure, and that the latter doubles (as a percentage of GNP), an idea is obtained of the substantial amounts that might be involved.

355. This global amount of resources would have to be complemented by multilateral and bilateral financing sources. The setting up of a new regional fund is a possibility, although adding yet another funding structure might raise problems of overlapping in view of the relatively great number of funding sources now available, and it might be preferable to set up a body to co-ordinate existing institutions. This function could be entrusted to a regional or international United Nations agency with a central role in scientific and technological co-operation - including its funding.

356. For its part Unesco makes a relatively substantial contribution towards promoting regional co-operation, either directly through its regular programme--and particularly through the participation programme--or indirectly as an executing agency for projects financed from extra-budgetary sources, mainly the United Nations Development Programme (UNDP), but also from bilateral sources constituting Unesco Funds-in-Trust and, recently, the United Nations Interim Fund for Science and Technology for Development. The total cost of projects executed by Unesco and financed from extra-budgetary sources is now some $8,000,000 a year; it should be noted that the bulk of this amount concerns national projects, though extra-budgetary financing is not, in principle, limited to this type of project.

357. Lastly, current national activities should be turned to the best possible account in order to exploit the potential for regional co-operation, avoiding at the same time the administrative complications involved in setting up new structures. A number of national research or training programmes may prove to be of potential interest to other countries in the region. In such cases agreements would be concluded between the countries where these programmes are being carried out and regional or international financing bodies; such agreements would make provision, under procedures to be determined, for any additional financial expenditure consequent on the participation of other countries in the programme in question to be defrayed by the financing body. It might possibly be helpful for the CASTASIA II Conference to decide on the usefulness of this idea, and to attempt to identify national programmes which might be expanded to become regional in scope.

CHAPTER 4

CONFERENCE FOLLOW-UP

CHAPTER 4 - CONFERENCE FOLLOW-UP

358. The recommendations to be made by the Conference will, as usual, be addressed to Member States of the region, United Nations organizations, regional organizations and as the case may be, other international intergovernmental or non-governmental organizations.

359. In formulating its recommendations for action under the various items of the agenda, it is hoped that the Conference will give clear indications for the ready identification of the objectives to be attained, the results to be achieved, the activities to be implemented and the procedures to be followed.

360. In order to enhance the effectiveness of the action taken on its recommendations, the Conference may wish to consider the desirability of establishing suitable machinery to monitor and evaluate such action and to review progress at regular intervals.

361. Past experience has shown that without machinery to carry out these reviews, it is extremely difficult to assess the overall results of initiatives taken in response to Conference recommendations. Some arrangements of this kind have already been set up in the various regions where Unesco has held conferences on the application of science and technology for development (CAST). They are briefly reviewed below to give participants an idea of the options open to the Conference+

362. Following the CASTALA Conference (Santiago de Chile, 1965), a Standing Conference of the Directors of National Councils for Science Policy and Research of the Latin American and Caribbean Member States was established in 1966. This Conference met six times in the period 1966-1981. In the early years of its existence, the Standing Conference had the legal status of a committee of experts, with each expert sitting in a personal capacity and each country represented by one expert. Subsequently, the Conference evolved into an intergovernmental body, with each participant representing his own country.

363. The CASTARAB Conference (Rabat, 1976) decided in one of its major recommendations on follow-up action that:

'(1) there shall be a CASTARAB Standing Conference which shall meet regularly every three years to review and assess the progress which has been made in implementing CASTARAB recommendations, and to determine future policies and programmes;

(2) a CASTARAB Continuing Committee shall be established, composed of four Ministers of Arab States responsible for the application of science and technology to development;

(3) this Committee shall be presided over by the President of the Conference;

(4) for the current CASTARAB session, this Committee is composed of the competent Ministers of Morocco (Chairman), Iraq, Kuwait and Sudan, all the members of the Committee being eligible for re-election at subsequent sessions'.

364. It further requested Unesco to provide the secretariat for the Continuing Committee in collaboration with the relevant regional intergovernmental organization, ALECSO, leaving it to the two organizations themselves to make the necessary arrangements for their co-operation with the Committee. It finally decided that:

'(1) the CASTARAB Continuing Committee, through its secretariat, and with the co-operation of all other institutions concerned, will ensure the follow-up and evaluation of the work of the CASTARAB Standing Conference;

(2) the CASTARAB Continuing Committee, through its secretariat, will communicate with the governments of the Arab States and make preparation for the next session of the CASTARAB Standing Conference'.

365. The two cases mentioned above are examples of follow-up arrangements with wide terms of reference and the capacity to influence government policy, characteristics which presuppose appropriate logistics and adequate financial resources.

366. In two other cases less complex machinery was established in the form of a special co-ordination unit within Unesco responsible for all aspects of co-ordination of conference follow-up activities, and especially for monitoring and reviewing progress. Thus, the European Bureau for Scientific Co-operation was set up as a result of the MINESPOL I Conference (Paris, 1970). Its secretariat is provided by one professional staff member on a full-time basis. The MINESPOL II Conference (Belgrade, 1978) also accorded special attention to reviewing and evaluating activities and recommended Member States:

'(1) to undertake an assessment of the implementation of the MINESPOL II recommendations from the national standpoint;

(2) to communicate to the Unesco Secretariat the results of this assessment and recommendations, if any, for further follow-up action to ensure more complete implementation of the MINESPOL II recommendations';

and Unesco:

'(1) to conduct an internal evaluation of its implementation of such MINESPOL II recommendations as are directed to it;

(2) to submit an interim progress report on the implementation of MINESPOL II recommendations to the twenty-first session of the General Conference;

(3) to collate the national assessments referred to above;

(4) to submit to the member governments, in time for careful study prior to the twenty-second session of the General Conference and on the basis of the national assessments and the Unesco internal evaluation, Unesco's evaluation of MINESPOL II and proposals for further action to implement the recommendations of MINESPOL II as well as recommendations on the appropriateness, timing and scope of future regional conferences of ministers of science and technology'.

367. Following CASTASIA I, a joint Unesco/ESCAP[1] unit for science and technology was set up and located on the premises of ESCAP in Bangkok. This unit, which employed one professional staff member, was dissolved two years later in a move by Unesco to streamline its activities in the field, and its functions were taken over by the two Regional Offices for Science and Technology.

(1) At that time it was known as the United Nations Economic Commission for Asia and the Far East (ECAFE).

368. In the case of CASTAFRICA (Dakar, 1974), general recommendations were made to Unesco concerning programmes it might undertake in implementation of the Conference's decisions, but no precise indications were given regarding the preparation of a periodic review of progress. A UNDP/Unesco project for the establishment of machinery designed to undertake such reviews is at present being submitted to the governments of the region for their approval.

369. The procedures outlined above are offered by way of example. The Conference will no doubt wish to consider still further possibilities - either mechanisms similar to those described above or entirely different arrangements geared to the specific needs of Asia and the Pacific. This vast region, extending from Turkey to Western Samoa and from the Arctic to the Antarctic, is highly diversified and breaks up naturally into a number of subregional groups. Each of these groups has its own set of development problems and its own institutions and co-operative machinery. As a result, whatever mechanism is proposed to ensure follow-up action in regard to the recommendations of CASTASIA II, it will have to fulfil the function of 'inter-subregional co-ordination' in addition to that of regional co-ordination in the conventional sense of the term, as would be the case in more homogeneous regions.

370. In conclusion, it is suggested that the Conference examine the following key questions:

(1) Should a separate mechanism be set up to monitor action taken in application of the recommendations of CASTASIA II and to review progress?

(2) What should the terms of reference of that mechanism be: monitoring, evaluation, co-ordination, information, etc.?

(3) Should the selected mechanism be representative (standing conference of government representatives or a committee of experts) and should Unesco provide the secretariat? Or should responsibility for the follow-up to CASTASIA II be simply left to existing international organizations such as Unesco?

(4) What should the contents form and frequency be of the reports on progress in implementation of the recommendations and to whom should they be submitted?

PART II

CASTASIA II

Second Conference of Ministers Responsible for the Application of Science and Technology to Development and Those Responsible for Economic Planning in Asia and the Pacific

Manila, 22-30 March 1982

Final Report

CONTENTS

I. INTRODUCTION

1. General background

The Second Conference of Ministers Responsible for the Application of Science and Technology to Development and those Responsible for Economic Planning in Asia and the Pacific (CASTASIA II) was held in Manila (Philippines) from 22 to 30 March 1982. Organized by Unesco with the co-operation of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the conference was convened by the Director-General of Unesco in pursuance of resolution 2/01 adopted by the General Conference of the Organization at its twenty-first session. The composition of the conference, which falls into the category of intergovernmental meetings other than international conferences of states (category II), was determined by the Executive Board at its 112th and 113th sessions, held, respectively, in May and September 1981.

2. Purpose of the conference

In accordance with the decisions taken by the General Conference of Unesco at its twenty-first session (Approved Programme and Budget for 1981-1983, paragraph 2057) the purpose of CASTASIA II (see agenda, Annex I) was to examine, in particular:

(i) trends in the countries of the region in respect of scientific and technological development since the first CASTASIA conference in 1968;

(ii) obstacles in the way of this development, and the means of increasing the scientific and technological potential of the participating countries;

(iii) problems involved in the direction and organization of research and of scientific and technological facilities, due in particular to changes in employment policies; and

(iv) the prospects afforded by regional co-operation.

This review was carried out within the general context of the recommendations of the United Nations Conference on Science and Technology for Development (UNCSTD, 1979).

3. Preparation of the conference

The CASTASIA II conference forms part of a series of regional ministerial conferences on science and technology organized by Unesco in the past fifteen years (CASTALA, Santiago de Chile, 1965; CASTASIA I, New Delhi, 1968; MINESPOL I, Paris, 1970; CASTAFRICA, Dakar, 1974; CASTARAB, Rabat, 1976; MINESPOL II, Belgrade, 1978).

A preparatory meeting of experts for CASTASIA II (Bangkok, 16-18 December 1981) was convened by the Director-General in order to identify and define the main issues to be submitted to the conference concerning science and technology in the Asia and Pacific region. ESCAP was associated with the preparation and organization of that meeting. On the basis of the meeting's recommendations and taking into account the findings of other Unesco studies of relevance to the region, and the recommendations of UNCSTD, the following two working documents were prepared with a view to facilitating examination in depth of Items 7, 8, 9 and 10 of the conference agenda: the main working document of the conference entitled 'Science, Technology and Development in Asia and the Pacific - trends, issues and prospects', and the document entitled 'Points for discussion'.

During the two years preceding the conference many preparatory missions were carried out in the Member States of the region. In certain instances and at the request of the Member States concerned, consultants visited the countries in question in order to provide short-term assistance to the authorities responsible for national science and technology policy-making in connection with the preparation of their national reports for CASTASIA II.

Apart from the documents referred to above, a number of reference documents prepared by the Secretariat were made available to participants. The complete list of conference documents is set out in Annex IV.

4. Attendance

The following Member States of the Asia and Pacific region were invited to send delegates: Democratic Republic of Afghanistan, Australia, Bangladesh, Burma, People's Republic of China, Democratic Kampuchea, Democratic People's Republic of Korea, India, Indonesia, Islamic Republic of Iran, Japan, Lao People's Democratic Republic, Malaysia, Maldives, Mongolia, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Socialist Republic of Viet Nam, Sri Lanka, Thailand, Tongo, Turkey, Union of Soviet Socialist Republics. With the approval of the United Kingdom, the territory of Hong Kong was invited to the conference with the right to vote, having regard to the autonomy enjoyed by this territory in the areas covered by the conference. Member States and the Associate Member State of Unesco in other regions of the world could also send observers to the conference.

The Specialized Agencies and other organizations of the United Nations system, and a number of intergovernmental and non-governmental organizations and private foundations, were invited to send representatives or observers.

The conference was attended by 137 delegates representing 22 Member States within the Asia and Pacific region and Hong Kong, observers from 2 other Member States and the Holy See, representatives from 10 organizations of the United Nations system, observers from 2 intergovernmental organizations, from 3 non-governmental organizations and 1 private foundation. Of the 23 countries represented, 15 sent delegations headed by ministers. The complete list of participants appears in Annex V of the report.

5. Opening of the conference

The conference opened on 22 March 1982 at the Philippine International Convention Center, Manila, in the presence of H.E. Mr. Cesar E.A. Virata, Prime Minister of the Republic of the Philippines.

His Excellency Mr. Emil Q. Javier, Minister, Chairman of the National Science Development Board, welcomed participants on behalf of the Filipino people and the Republic of the Philippines. In his address he expressed the hope that CASTASIA II would help to make science and technology serve more effectively the autonomous development of the countries of the region in a spirit of solidarity.

Mr. V. J. Ram read a message on behalf of Mr. S.A.M.S. Kibria, Executive Secretary of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), expressing the hope that CASTASIA II would define the main lines of policies and plans designed to ensure a more vigorous development of science and technology and their wider dissemination, a more equitable access to them and their more effective social integration.

In his address, Mr. Amadou-Mahtar M'Bow, Director-General of Unesco, greeted the participants and thanked the Philippine authorities and leading national figures for their warm welcome and the remarkable effort they had made to ensure the success of the conference. After describing the general context of the conference and its purpose, he reviewed the three main agenda items discussed in the main working document of the conference and drew attention to certain particularly important aspects of these items. Regarding the first item, which related to the general review of the situation, he noted with satisfaction that there had been a significant increase in the scientific and technological capabilities of the countries of the region since the first CASTASIA conference in 1968 in terms of the number of scientists and engineers, the amount of research expenditure and the number of national science and technology policy-making bodies established thereafter. Turning to the second item, relating to science and technology policy, he began by drawing the attention of the conference to the importance of education and training, which constituted a prerequisite for scientific and technological progress. He considered it vital that the conference should examine certain serious problems and challenges that science and technology had to face, notably the food and employment needs arising from the size and rapid growth of the region's population, the drift to the towns and the disparities in income. Mr. M'Bow expressed the view that the solutions provided by science and technology would be appropriate only if the science and technology policy of each country formed part of an integrated socio-economic development strategy that made allowance for the specific traditions, sensibilities and aspirations of its people. Lastly, he hoped the conference would study the prospects of international and regional co-operation - the subject of the third item - with a view to defining the scope of, and arrangements for, such co-operation. Mr. M'Bow ended his address by affirming his belief that the immense capacity for innovation of the peoples of the region would make it possible to bring about the changes called for by the magnitude, diversity and urgency of their needs.

His Excellency, Mr. Cesar E. A. Virata, Prime Minister of the Republic of the Philippines, gave a speech in which he underlined the importance of science and technology for his country and the particular interest with which it would follow the deliberations of the conference. He announced the decisions that his government had taken a few days before concerning the reorganization of the science and technology system in the Philippines. He hoped that the conclusions of the conference would be summarized in a declaration addressed to the Member States.

The full texts of these speeches are reproduced in Annex II.

By the authority of the President of the Republic of the Philippines, the Ancient Order of Sikatuna with the rank of Dato was conferred on Mr. Amadou-Mahtar M'Bow, Director-General of Unesco, by H. E. Mr. Cesar E. A. Virata, Prime Minister of the Republic of the Philippines, during the opening ceremony.

The exhibitions mounted by Unesco and by the National Science Development Board of the Philippines were inaugurated at the end of the opening ceremony.

6. Organization of the work of the conference

At the first plenary meeting of the conference held on Monday, 22 March 1982, in the afternoon, H.E. Mr. Emil Q. Javier, Minister, Chairman of the Philippine National Science Development Board, was elected President of the Conference by acclamation. After deciding to establish two Commissions to examine, respectively, Items 8.1 and 8.2 of the provisional agenda, the conference adopted its rules of procedure and agenda. It then elected, by acclamation, the remaining members of its Steering Committee:

Vice-Presidents

Mr. Jiang Ming (People's Republic of China)
H.E. Dr. M.S. Sanjeevi Rao (India)
H.E. Dr. G.J. Habibie (Indonesia)
Dr. Michio Okamoto (Japan)
Mr. Souli Nanthavong (Lao People's Democratic Republic)
Hon. Stephen Ogaji Tago (Papua New Guinea)

Rapporteur-General

Mr. Hasan Nawab (Pakistan)

Chairman of Commission I

Tan Sri Ong Kee Hui (Malaysia)

Chairman of Commission II

Hon. C. Cyril Mathew (Sri Lanka)

Following the adjournment of the plenary meeting by the President, Commission I elected its Vice-Chairman and Rapporteur by acclamation:

Vice-Chairman

Mr. Mahbub Uddin Chaudhury (Bangladesh)

Rapporteur

Mr. L.G. Wilson (Australia)

Commission II then proceeded to elect, by acclamation, its Vice-Chairmen and Rapporteur:

Vice-Chairmen

Dr. the Hon. Ian Shearer (New Zealand)
H.E. Wing Commander Thinakorn Bhandhugravi (Thailand)

Rapporteur

Dr. Dibya Deo Bhatt (Nepal)

At the commencement of its second plenary meeting, also held in the afternoon of Monday, 22 March 1982, the conference adopted the proposals submitted to it by the Steering Committee concerning the organization of its work, the timetable of plenary meetings, meetings of the Steering Committee and of the Commissions; the establishment of a Drafting Committee for the plenary and a Drafting Committee for each Commission and, lastly, the deadlines for the handing in of draft resolutions.

The Conference devoted four sessions to the discussion of Item 7 of its Agenda, on Monday afternoon, Tuesday and Wednesday morning. The two Commissions then met to discuss Items 8.1 and 8.2 on Wednesday morning and afternoon and Thursday morning. Drafting Committees of the two Commissions met on Thursday afternoon. The Plenary was reconvened on Friday 26 March to examine Items 9 and 10 of the Agenda, for which it devoted two sessions (morning and afternoon).

The two Commissions adopted their recommendations and their reports on Monday morning 29 March, and the Plenary thereafter discussed its own recommendations (on Items 7, 9 and 10) in the afternoon.

In the course of the Conference, the President received a letter from Heads of four delegations expressing their point of view on the presence of a delegation at the conference. He also took note of the fact that all Member States of the Organization belonging to the Asia and Pacific region have been invited to the conference in accordance with the decision of the Executive Board, which in turn was guided by the decision of the United Nations General Assembly.

At the concluding plenary on Tuesday, 30 March 1982, the Rapporteur-General presented, part by part the Draft Final Report for the Consideration of the Conference. On a motion raised by the Philippines and seconded by Japan, Thailand, China, and India, the Conference adopted the Report as a whole.

On behalf of the ASEAN countries, the Delegate from Indonesia expressed gratitude to the President of the Conference, the drafting committee, the Director-General and his staff, and to the Assistant Director-General for Science, the ESCAP, and the Delegates, all of whom contributed to the success of the Conference.

The Director-General then presented the Silver Medal of Unesco to H.E. Dr. Emil Q. Javier, President of the Conference, as an expression of gratitude for his work in guiding the Conference to its successful conclusion.

7. Close of the Conference

The President of the Conference announced that due to pressing unforeseen engagements the President of the Republic, Mr. Ferdinand E. Marcos, and the First Lady, Imelda R. Marcos, could not attend the closing ceremony, and that the President would be represented by his brother, Dr. Pacifico Marcos.

The Rapporteur-General formally read the "Manila Declaration", which the Conference adopted during its eighth plenary meeting.

The delegate of New Zealand read a motion of appreciation and gratitude to President Ferdinand E. Marcos and the people of the Philippines, as well as to the Prime Minister, the President of the Conference and the other officers, the Director-General, and all of the persons who provided supporting services for the successful organization of the Conference.

In his closing address to the Conference the

Director-General commented on the richness and the quality of the debates, the variety and force of the recommendations, and the exceptional importance of the Manila Declaration. He recalled the great importance that the countries of Asia and the Pacific have given to the formulation and the implementation of a science and technology policy integrated with the planning of national development. He pointed out that the strengthening of national scientific and technological potential depends both upon the continuous transfer of knowledge and on a growing development of basic research in each country. In this regard, he noted that basic research influences the capacity to develop applied research, to perfect endogenous technologies, and to select technologies coming from the outside.

The Director-General recalled the importance that the Conference gave to scientific and technological information and to the necessity to apply science and technology taking into account the cultural and economic characteristics of each country. He stressed the need for the promotion of education which at every level impregnates scientific development and familiarizes the population with modern knowledge and techniques.

With regard to regional and international co-operation, the Director-General commented on the diversity of conditions in the region, which can be an enriching factor in development. He recalled the importance that the Conference gave to the creation of centres and regional networks, as well as to the need for better co-ordination of bilateral and multilateral scientific and technological co-operation.

In pointing out the important recommendations of the Conference, the Director-General cited the proposed establishment of a centre or regional network to facilitate the use and integration of science and technology for development; the recommendations concerning scientific instrumentation, experimentation, standards and metrology, the services for popularization, and the services of consultant engineers; and the establishment of a network for scientific and technological information. With respect to the latter he announced that in 1982 he would take the preliminary necessary measures for the establishment of the proposed network. On the subject of the follow-up of CASTASIA II, the Director-General confirmed that he would take appropriate action in line with the Conference's recommendation.

In closing his address, the Director-General observed that Asia and the Pacific has, in a way, all the problems of the world, and in trying to solve these problems the region is asking new questions on the conditions, the significance, and the aims of development. While not ignoring the importance of investments, natural resources, and scientific and technological potential, the Director-General pointed out the need for these means to be joined to a social project, fully assumed by the people, rooted in the spiritual and cultural values which define their collective identity and bear the aspirations by which they can recognize themselves and develop themselves freely in all their possibilities.

At the closing session, H.E. Emil Q. Javier, President of the Conference, made a speech in which he commented on the place of CASTASIA II among the other regional and global conferences on science and technology that have been organized and stressed their interaction and their influence on thinking about science and technology, society and development. He remarked that the Philippines have benefited from the guidance and insights provided by these conferences.

In pointing out the highlights of CASTASIA II, the President of the Conference mentioned the emphasis given to utilization, management, and planning, in contrast to CASTASIA I which emphasized the urgent need for development and the strengthening of basic facilities and programmes. He cited the need for fine-turning the decision-making and institutional mechanisms through which science can contribute to development. With regard to the follow-up of CASTASIA II, Mr. Javier spoke about the need for commitment on the part of the countries themselves and for a mechanism to monitor and evaluate progress.

In his message to the Conference, the President of the Republic of the Philippines, Ferdinand E. Marcos, sensed a greater determination on the part of the representatives of the Member States to grapple with larger issues and problems confronting the region today and a greater resolve to apply scientific and technological know-how in resolving such problems. CASTASIA II has moved into the higher plane of discussing the appropriate application and the impact of new knowledge and technology on member countries, and of evolving a series of important recommendations regarding the role science and technology must play in development plans, as well as proposals for new areas of international co-operation. He congratulated the delegates for adopting the "Manila Declaration" which should in time become a blueprint for the peaceful application of science and technology.

President Marcos stated that science and technology offer the real hope for the deliverance of the human family from hunger and disease. What is left for the authorities to do now is to summon the will and mobilize the resources that would hasten the adoption of new processes and technologies in the critical areas of each country's development plans and programmes. At the same time, the countries of CASTASIA II should now contribute their share towards the realization of co-operative programmes and endeavours. Finally, President Marcos said: "We join you in asking the developed countries to share with us their vast storehouse of knowledge so that we can better provide for the most urgent needs of our people".

The full texts of closing speeches and of the motion of thanks will be found in Annex III.

Following the message of President Marcos, the President of the Conference declared the Conference closed.

II. GENERAL REPORT

1. Science and technology in Asia and the Pacific - a review

The first five plenary sessions were devoted to the review of the development and application of science and technology in Asia and the Pacific (Item 7 of the agenda).

Twenty-two heads of delegations from the following Member States took part in the plenary discussions: Democratic Republic of Afghanistan, Australia, Bangladesh, People's Republic of China, India, Indonesia, Islamic Republic of Iran, Japan, Democratic Kampuchea, Democratic People's Republic of Korea, Republic of Korea, Lao People's Democratic Republic, Malaysia, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand, Socialist Republic of Viet Nam, USSR. The observer from Brazil and the representative of the UNIDO also took part in the discussions.

The national presentations encompassed, in a global manner, the experience accumulated by respective countries, progress achieved since CASTASIA I as well as obstacles and constraints encountered during this fourteen-year period in their scientific and technological development.

A general consensus emerged that the conference provided an excellent opportunity for exchanging experiences acquired in the field of application of science and technology to development.

Delegations participating in the discussion attached great importance to defining the problem areas of application of science and technology to development at national and regional levels with specific reference to the existing economic and social structures and the goals of society.

Several delegations stressed that major changes had taken place not only in the realms of science and technology, but also in the international socio-economic situation since CASTASIA I. The developments that mankind has witnessed during this period have profoundly altered the perspective in science and technology. Concern about the transformations of the social, economic and political situation in the world was reflected in the presentation of several delegations. They pointed out that the economic crisis through which the world was now passing, as well as the pressure imposed by the sharp rise in energy costs and inflation, had disrupted national development and led to a significant reassessment of expectations, which in turn had altered the orientation of science and technology research and application in the region.

The existing patterns of international economic relations in science and technology were also criticized. Several participants in the discussions expressed their conviction that monopoly situations of technology supply should be eliminated so that the developing countries would be free to acquire the technology they needed in their development programmes under fair and reasonable terms. Delegates expressed the view that the activities of international organizations should be better oriented towards the needs of the developing countries, particularly with respect to the development of their indigenous scientific and technological capacities.

The crucial importance of creating the necessary institutional infrastructures for science and technology was recognized. A slow but sustained transformation in this field has been reported by many delegates participating in the conference. Many developing countries of the region have established the requisite governmental machinery, scientific institutions and research centres, thereby gradually bridging the gap in infrastructure and capabilities between developing and developed countries.

Rapid development of such technologies as electronics, informatics, computer application and remote sensing were mentioned as successful examples of the encouraging efforts made by governments towards optimum utilization of scarce resources, appropriate use of technology and reliance on local research and development.

In reviewing the progress made in specific fields, the delegates mentioned the major constraints that were hampering further progress: paucity of funds, lack of training at organizational and management levels, ineffective linkages between industries and research establishments and excessive dependence on imported technologies.

Constraints in skilled manpower and financial resources underline the need for a coherent and comprehensive science and technology policy including a careful selection of priorities according to national development goals.

All Member States participating in the conference have set up national science and technology policy-making bodies responsible for planning, promotion and co-ordination of S and T activities. However, their approaches and attitudes to the organization of science and technology differ widely.

Some countries practise a pluralistic approach in science and technology policies, while the majority of countries in the region have adopted a centrally co-ordinated approach whereby emphasis is laid on an overall view of the national science and technology system, its appropriate linkages with the various economic sectors and a full awareness of long-term development needs.

There was a general consensus among the delegates that science and technology policy of a country should be fully co-ordinated with overall national socio-economic development plans and dovetailed with its cultural patterns.

Many countries reported that specific science and technology plans had been integrated in their overall national development plans since CASTASIA I. In drawing up plans for scientific and technological development, some countries experienced major obstacles due to the scarcity of up-to-date and appropriate information on the application of science and technology for development purposes and the absence of statistical data, particularly relating to S and T manpower.

Extensive programmes for the exchange of this information were proposed by several delegates and some of them offered to share with other countries of the region the available information and the accumulated experience of their own countries. In particular, one of the delegations suggested to host some seminars on the subjects of S and T strategy, training of S and T personnel, development of S and T infrastructure, etc.

Another theme of the discussions was the innovative character of science and technology. The importance of laying a solid foundation of basic sciences was deemed essential for the training of highly qualified specialists who constitute the key factor in technological innovation.

The need was further recognized to promote regional co-operation in various fields of applied research, such as engineering industries, fertilizers, agro-chemicals, energy, chemical industries and in the surveying of natural resources.

Some of the countries, referring to their experiences, were critical about the fast obsolescence of imported technologies and their detrimental effects on the physical and social environment. The criteria for choice of operative technologies should therefore include an assessment of their economic effectiveness, social and cultural costs and environmental effects, before the technologies are acquired. Moreover, every effort should be made to adapt the imported technologies so that they may be readily assimilated and firmly take root in the country. For this purpose, emphasis should be placed on tailoring the educational system accordingly.

Most delegates stressed the necessity of establishing closer links between educational policy on the one hand and science and technology policy on the other. In order to ensure better application of science and technology for national development, radical changes in the social attitudes towards science education were advocated by several speakers.

Concern about the necessity of making a general assessment of the human, and social and cultural implications of science and technology was voiced in the debate. Several delegates insisted that development was to be regarded as a people-centred process and that it called for the promotion of social sciences along with the natural and engineering sciences. Some speakers called upon Unesco to study the socio-economic consequences of science and technology applications on societies and their impact on the culture and life styles of the populations concerned.

While expressing confidence in the overall beneficial effects of science and technology on societies, some delegates referred to the need for a better integration of the scientific attitude with spiritual and religious values.

The delegates participating in the discussion expressed their commitment to promoting scientific and technological co-operation in line with the Vienna Programme of Action. International co-operation in science and technology was seen to be the effective way of solving many global problems, some of which, it was indicated, resulted directly from scientific and technological developments as exemplified by increasing pollution levels, climate changes and depletion of natural resources.

An appeal was made to scientists and scholars, stressing their role and responsibility for preserving durable and lasting peace, putting a halt to the arms race, limiting the use of nuclear energy to peaceful purposes, curbing the development of chemical and biological weapons, and applying the wealth of technological knowledge exclusively to the benefit of humanity.

The following section contains résumés of the oral presentations made during the general debate by heads of delegations on progress achieved in their respective countries.

COUNTRY REVIEWS

Democratic Republic of Afghanistan

The Economic and Social Development Plan (1979-1984) envisages the elimination of economic backwardness, growth of national product, socially progressive changes, raising living standards and building up the country's defence capability.

During the plan period, it is envisaged that national income shall grow by 4.5-5.2 per cent on the average, gross industrial production will increase 1.6-1.7 fold, the agricultural sector will be modernized, the irrigation system and the communication network as well as the water supply system will be improved. Ninety-seven per cent of the total investment will be directed to the public sector activities. Out of the total investment in the public sector, more than 50 per cent will go to the mining and industrial sector, 25 per cent to agriculture and 15 per cent to the social service sector.

Development of the infrastructure for science education and the related research activities will be undertaken: the existing S and T activities will be strengthened and new institutions established to devise policies and monitor scientific activities. Vocational institutions will be created and institutions for higher education upgraded. Although Afghan science and technology are still in their early stages of development, considerable progress has been made during the last four years in terms of consolidation of the existing basis, legislation and organization. The government has established the Afghan Academy of Sciences which has already been able to set up research departments of Natural Sciences, Social Sciences, Languages and Literature. In 1979, the National Science and Technology Commission was established. It is responsible for determining policy and procedures concerning the expansion and popularization of science, research and development activities, and the selection and adoption of appropriate technology. Furthermore, a science and technology unit was established within the National State Planning Commission. Several government departments and institutions are conducting studies and research, organizing conferences and seminars, publishing journals, etc., within their respective fields of competence, such as, for example, the Department of Agricultural Research and Soil Science (Ministry of Agriculture), the Institute of Management (Ministry of Mines and Industries), the Kabul University Research Centre, and the Institute of Pedagogy. Fields of science and technology that promise immediate economic returns are given priority support by the government.

An educational reform took place in 1979: primary education was made compulsory, emphasis was laid on vocational and higher education while due attention is being given to lifelong education.

Australia

Some features of the Australian experience in the application of science and technology are as follows:

(i) In agriculture, a major contribution to the Australian national development has been through research and development. Australia believes that while an indigenous scientific and technological capability is essential to increase productivity and overcome the unique problems of the agriculture sector, international science and technology provides the base on which their indigenous capability rests.

(ii) In the manufacturing industry, research and development gives a capability for innovation. It also gives greater technological choice and facilitates the adaptation of products or processes to local conditions. In the manufacturing sector only 2 to 3 per cent of the firms are engaged in research and development. The remaining 97 per cent of firms must therefore receive due attention within the context of Australian science and technology policies, in order to enhance their capacity for developing innovations. The latter may cover changes of design of installed technologies or in the development of new processes, materials or products. The Australian experience indicates that it is essential to establish close relationships between research agencies and industry.

(iii) Australia's general approach to energy, another area of significant interest, is to seek a diversified energy economy through a National Energy Research Development and Demonstration Programme which is not substantially dependent on R and D from overseas. It also aims at developing a capacity to facilitate the introduction of appropriate overseas energy technologies into the country.

(iv) The Australian experience in the field of S and T manpower training points to the difficulty of matching supply and demand in the professional and technical groups. Australia therefore approaches the problem of training and utilization of qualified manpower in a flexible way, relying in particular on adequate financial incentives.

(v) In the field of land use, Australia strongly supports Unesco's intergovernmental programmes in the ecological, earth, water and marine sciences.

(vi) In policy-making for science and technology, Australia has moved from a pluralistic to a co-ordination model, which emphasizes mechanisms of overview and linkages between sectors, and allows for better awareness of long-term interests.

Two important recent initiatives have contributed to the development of policy machinery. The first is the establishment in 1972 of a department responsible for science in the Federal Government. The Department was given wider responsibilities in 1980, under the title of "Department for Science and Technology". The second is the creation in 1976, of an advisory Council to the Federal Government, the Australian Science and Technology Council.

The Australian Science, Technology and Research Co-operation Programme (AUSTREC) co-ordinates initiatives and provides access to a wide range of research and development capabilities Co-operation programmes are co-ordinated by the Australian Development Assistance Bureau (ADAB) created in 1979. Australia is attempting to make a real contribution to four of the subject areas, i.e. food, energy, trade and international financial relations.

The Australian Government has recently decided to establish the Australian Centre for International Agricultural Research, to be managed by a ministerially appointed Council with a substantial number of its members to be drawn from research institutions of developing countries. The role of the Centre will be to contract agricultural research work to Australian institutions and agencies.

Bangladesh

Bangladesh is one of the most densely populated countries in the world with 90 per cent of its population living in the rural areas. The development strategy is therefore rural and agriculture oriented.

Efforts are being made for increasing crop output, canals are being dug up for rural irrigation, indigenous medicine is being patronized along with modern medicine for rural health. At the same time, nuclear technology is being used in finding high yielding varieties of rice, radiation physics for sterilization of family planning kits, space technology for remote sensing of fish habitats and in forecasting cyclone and tidal surges, and so on. Science and technology in such varied forms is thus finding way in the national development scene, with a definite priority given to the search for alternative energy sources.

There are six universities and a sizeable number of institutions engaged in R and D of various kinds. As per latest figures available, the country has about 30,000 scientists and technologists with post-graduate qualifications, over 100,000 lower level scientific and technical personnel and some 7,000 engineering graduates. The present education and training system and the content of education are being recast to meet the requirements for scientific and technological build-up.

A National Council for Science and Technology has been recently constituted to review and formulate national policies on science and technology including scientific manpower development. It will also ensure co-ordination between research and development activities for the more effective contribution of science and technology to the country's development process.

The energy crisis has crippled the economy of Bangladesh which had to spend 70 per cent of its total export earnings in 1981 for importing oil to meet 20 per cent of the total energy needs of the country. Farmers have to pay substantially more for hydrocarbon based fertilizers, for irrigation by fuel driven pumps and many other uses of commercial fuel. It is, therefore, imperative for Bangladesh to search for useful alternative sources of energy, e.g. solar, biogas, wind, mini-hydro, tidal and even nuclear, energy.

Bangladesh has recently set up an Institute of Appropriate Technology with the primary aim of developing rural technologies related to irrigation and water management, agricultural tools and equipment, post-harvest technology and reduction of post-harvest losses, transport, housing and rural energy, etc.

People's Republic of China

China attaches great importance to self-reliance in the field of science and technology. In its modernization programme during the last three decades, China has firmly established its own science and technology system and has built up a national capability in science and technology. Much progress has been registered in carrying out comprehensive surveying and utilization of natural resources, developing scientific research in industry, agriculture, national defence, health care, promoting new science and technology, emphasizing research in basic and natural sciences, training scientists and technicians. In view of the specific conditions prevailing in China, such as abundant human resources, limited financial means and primitive technology, its approach of, and road to modernization differ largerly from that of the developed countries.

While China's past experiences have proved successful on the whole, to some extent, the development of science and technology was severed from that of the economy. In the past the country had gone in a big way creating new enterprises while neglecting the modernization of old ones. A policy has now been evolved to modernize old enterprises as basic means for expanding production, instead of establishing new ones. In 1981 a new policy for the development of science and technology was formulated. The aim of this policy is to closely integrate science and technology development with the national economic growth and make science and technology serve to the betterment of the nation's economy so that S and T will advance in harmony with socio-economic development.

The necessity of training sufficient numbers of qualified scientists and technicians has been fully recognized and there are over 5 million scientists and technicians, including some eminent, world-famous scientists and experts. But this is hardly sufficient considering the population which is over 1 billion. At present the government is taking measures to solve the problem of shortage of S and T manpower by expanding a large number of key universities, setting up branch colleges, universities on television, correspondence and part-time schools, vocational schools, short-term training courses, etc.

The new policy for the development of science and technology pays due attention to the selection, assimilation and adaptation of foreign scientific and technological achievements. Management studies are undertaken in this connection which bear on financial means, natural resources, technical capability, management, employment opportunities, marketing situations, etc. But the main thrust remains on the self-reliant development of China's own scientific and technological potential, and the application of the results obtained in its own laboratories and pilot plants.

Democratic Kampuchea

Khmer people have one of the oldest and richest historical and cultural heritages. Due to achievements in metallurgy, agriculture, irrigation as well as in trade and art, the Khmer civilization was well known everywhere in the past.

In the twelfth century B.C., they already practised the metallurgy of bronze, later the ferrometallurgy. In the early centuries A.D., the Buddhist University was widely known.

Definite evidence has been discovered in Kampuchea, and in Sumatra in Indonesia, of the earliest use of the symbol zero.

Almost all the irrigation works, industrial undertakings and research laboratories have been destroyed by war, and it is not surprising that the statistics produced by international organizations show Kampuchea as the poorest nation in the world. Most of the scientists, engineers and intellectuals have been forced to flee abroad but will return when peace, independence and national sovereignty have been restored.

Democratic Kampuchea asks the powers that possess a scientific and technological capability and are producing chemical and biological weapons to stop doing so, destroy existing stocks and, above all, refrain from using them, directly or indirectly, against the peoples of the developing countries.

Democratic People's Republic of Korea

The Democratic People's Republic of Korea laid great emphasis on national education and training of national cadres for transformation of the country from backwardness to modern civilization. The country had to develop from scratch as there was no S and T infrastructure. Now it has been possible to train over 70 per cent of the total students as technicians, engineering specialists and in natural sciences for which adequate facilities have been established, such as education and training centres, research institutes in industry, agriculture and medicine. The Academy of Sciences has set up various research centres for training of scientific cadres. A modern library has been established which has hundreds of thousands of scientific and technical books.

The industry is self-supporting and relies mainly on raw materials produced in the country, with adequate fuel and power bases, so that a stable development process has evolved. The ever-increasing demand for fuel and mineral raw materials has been met through intensive research and exploitation of natural resources. In the field of ferro-metal industry, rapid strides were made to make the industry self-reliant.

Through constant research, the textile industry is producing 50,000 tons of vinalon cotton, raw material for which is abundantly available in the country, instead of making cloth from cotton which cannot be cultivated in the vast arable land. Similarly many breeds of grains and vegetables, such as rice and maise suitable for climatic and natural features of the country and with high productivity, have been successfully developed.

Success has been achieved in the manufacture of heavy equipment and machinery needed for agriculture, irrigation, power generation, automobile and heavy industry.

India

The Government of India attaches great importance to self-reliant development and to technical Co-operation among Developing Countries (TCDC) to which it has been contributing 10 per cent of its share of UNDP funds. Specific funds for TCDC have also been allocated in the Sixth Five-Year Plan of the country.

A large number of Science and technology agreements have been signed with the developing countries for sharing information. Over the years, the country has been able to create a solid institutional infrastructure in areas like agriculture, including post-harvest technology, electronics, informatics, remote sensing, water resources, medicine and alternative energy sources, which is open for utilization by any other Member States of the Asia and Pacific region for the training of trainers in a variety of important fields, or by way of participatory research programmes.

Financial constraints still exist in the field of science and technology although the allocation in the Sixth Plan has reached the amount of Rs. 33,670 million for science and technology. During the past years the government has encouraged new areas of scientific research, opened institutes of technology and engineering, created Several national laboratories specializing in a spectrum of areas of science, technology and medicine. The challenges in the field of energy, health, industry, communication and agriculture are being met by wider application of science and technology, and India has now entered into newer technological developments hitherto considered as a monopoly of a few industrialized countries. India has developed scientific and technical manpower of high quality estimated at about 2.5 million.

India has not only been able to make rapid advancement in space sciences, but has also developed the fields of electronics, informatics and computer applications. A National Informatics Centre (NIC) has been established with the assistance of UNDP, comprising a growing network with numerous mini-computer remote job entering stations connected to a powerful central computer system. The NIC is willing to offer training facilities to specialists from other developing countries. Mention was also made of the National Remote Sensing Agency whose data, processed in the form of transparencies as well as computer tapes, are being disseminated to Indian as well as non-Indian users.

Indonesia

Indonesia's annual population growth rate is around 2.3 per cent and its per capita income US$565. The industrial growth rate during the last three years was around 12.7 per cent which is quite high by international standards. The country's labour force absorbed in the agricultural sector is 60-75 per cent whereas in the industrial sector it is only between 8-12 per cent. The projected figure for industrial growth rate between 1985-2000 is expected to be 8 per cent. The major thrust will be to foster industrial development with special emphasis on more equitable income distribution and larger employment opportunities. Value added in manufacturing is expected to grow by not less than 15 per cent annually, and export of manufactured goods by 20 per cent.

In applying science and technology for development, Indonesia gives great importance to defining the problem areas with specific reference to the existing economic and social structure and the goals of the society. Availability of manpower in terms of quantity and quality is the major constraint in the development of science and technology, building national R and D capability and transfer of technology.

The government has formulated a broad framework of national goals and development objectives with a view to enhancing national R and D capabilities, and speeding up the transfer of technology. The national expenditure for R and D was around 0.7 per cent of GDP in 1981. Efforts will be made for building up of research facilities and improving research manpower in order to speed up the process of acquisition and transfer of technology. It should be noted in this connection that a science town is being built at Serpong. The following problem areas were identified:

1. fulfilment of the basic human needs;
2. development of natural and energy resources;
3. development of industry and creation of employment;
4. defence and security;
5. research in social, economic, philosophical and cultural areas.

Environmental factors are nowadays given due consideration in all of these five problem areas.

Within the framework of the National Science and Technology Policy, Indonesia has established co-operation agreements at the bilateral, multilateral, regional and international levels, e.g. with the United States of America, France, Japan, Federal Republic of Germany.

Islamic Republic of Iran

Since the Islamic Revolution in 1979, the country reviewed and decided to make science and technology more relevant and link it with the culture and life of the common man. For creating a harmony between science and technology with the culture of the society, the policy is to expand science and technology in such a way that all the various elements such as Islamic values, natural and social features and infrastructure of national population and their just distribution in the rural and urban areas as well as the experiences of traditional industry are considered. Today's technology has serious effects upon nature, natural resources and wealth, and man should not become subservient to it.

The industry in Iran was mostly dependent upon raw materials, machinery and management personnel from abroad. It has been realized that scientific and industrial growth has to be linked with the available infrastructure and manpower. There is strong consciousness about the culture and value system, and stress is being laid upon avoiding wastes and excessiveness in all aspects of human life.

The government has nationalized large industries, banks, insurance companies and foreign trade. Young entrepreneurs are provided loans, and a widespread movement now aims at using at their best, the potential capacities of people. As a result of which many of the necessary machines and their spare parts are now being built in the country.

The government is paying special attention for development of villages and improving the quality of life in rural areas. With the participation of villagers several construction activities were undertaken, e. g. construction of roads, waterways, electricity, etc.

Until now Iran's economy was based on a single product. Steps have now been taken towards export of non-petroleum products.

One of the important forward steps is the establishment of a planning system for the country. The basis of this system is determined by combining the centralization of decisions made for distribution of natural resources with the decentralization of decisions concerning their utilization for the benefit of the country's regions. This system ensures the participation of villagers in the decision-making process, and in the execution of the decisions.

Steps have been taken to create or strengthen centres for scientific and industrial research, among which are the university Jihad (crusade), the Centre for Communications Research, Scientific and Industrial Research Organization. Among other organizations that have been set up are the Supreme Council in charge of co-ordinating Technical and Vocational Education, the Iran University Press, the Institute for Research and Cultural Studies, the Centre for Scientific and Cultural Publications, the Centre for Technical Information and Research, and the KAFA Educational and Productive Company.

Japan

Scientific and technological activities in Japan are carried out in three different sectors: universities, national and local public research institutes, and private enterprises. Universities conduct a wide range of research under conditions of free inquiry. National and local public research institutes conduct experimental research which involves high risks in terms of success or failure or long gestation periods. Private enterprises undertake research and development aimed at the development of new products.

The total research expenditure, in 1980, exceeded 2.4 per cent of the national income, and the number of scientific researchers was approximately 300,000.

The main characteristics of scientific and technological development in Japan are as follows:

(i) Private enterprise plays a major role in S and T through their central research institutes, which account for 57 per cent of the researchers and 67 per cent of the total national research expenditure.

(ii) Science and technology policy applies to a pluralistic system of institutions comprising universities, national and local public research institutes, and private enterprise research, which are all supported and funded through separate channels.

A Council for Science and Technology, created in 1959, provides overall co-ordination in the government's science and technology policy. It is an advisory organ to the Prime Minister.

(iii) Japanese scientific and technological activities have been given strong impetus by the government's emphasis placed on education and training. It has resulted in 9 out of 10 children finishing high school and 4 out of 10 going to university or college, and one of them taking up science and technology. Private enterprise also provides on-the-job training.

The main reason of Japan's success in modernization was due to the effort made by the country to assimilate and adapt foreign technology so that it successfully took root in Japan. Because of the national emphasis on building up the education system, Japan was also able to disseminate scientific and technological knowledge widely.

Having successfully industrialized, Japan is now confronted with new S and T policy issues such as:

(i) Overcoming the negative aspects of science and technology-based development and reorienting such development towards improvement of the quality of human life. This necessitates a general assessment of the human and social impact of science and technology within a given cultural context.

(ii) Developing original and innovative technology to overcome economic difficulties. This requires a more solid foundation for scientific and technological development resulting from a vigorous promotion of basic science research, and the training of highly qualified scientists and engineers which should go hand-in-hand with widespread popularization of science.

(iii) Meeting the diversifying and more complex needs and aspirations of the people.

In this context reference may be made to the report of the Council for Science and Technology submitted to the Prime Minister in 1977, 'On the basic principles of overall scientific and technological policy in a long-term perspective' which underlined the importance of ensuring a stable supply of natural resources and improving the quality of people's lives. Besides recommending such measures as the promotion of basic sciences, the report insisted on strengthening the links between government, university and industry, and on developing international co-operation in science and technology.

Republic of Korea

Korea has risen from one of the less developed countries to a stable semi-industrialized, middle-income nation during the last 30 years. Initially the activities were highly labour intensive and gradually progressed towards higher technology with modernization of the industrial structure.

With the enactment of a science and technology law a sound basis for infrastructure growth was realized and KIST (Korean Institute of Science and Technology), one of the first modern multidisciplinary research institutes covering a broad spectrum of R and D, was established. Subsequently eight highly specialized industrial research institutes were established. Basic research and high level manpower development was achieved through the establishment of technical training programmes. The Korean experience suggests that the transfer of technology and the development of local R and D capabilities are best pursued not sequentially but concurrently. The other factors contributing to the growth of industrialization is the thinking pattern and attitudes of the public as well as scientific and technological environment and attitude.

The government has set goals for S and T development in the Fifth Economic and Social Development Plan (1982-1986). The demand for high-level technical manpower will be met through reinforcing science and engineering education, on-the-job training in industry and R and D institutes. Research is supported by the government and an effective mechanism is evolved between the R and D institutions.

Large industries are encouraged to establish their own research institutions and small-scale firms to form consortiums. The government undertakes national R and D projects in strategic areas. The government seeks opportunities for joint research with renowned institutes, and industries are encouraged to introduce advanced foreign technologies.

Political consciousness of the vital role of science and technology in development is a prerequisite. Periodic meetings are planned between Cabinet ministers and representatives from relevant segments of the national science and technology system.

Lao People's Democratic Republic

Science and technology constitute an important factor for social, economic, cultural and political development of the country. After the proclamation of the Lao People's Democratic Republic in December 1975, the government defined the major political strategies for the creation of a modern society in Laos. The First Five-Year Plan has been launched in 1981. The main objective of the Plan is to lay the basis for an independent national economy and to improve the living conditions of the people.

In accordance with the Plan, the agricultural, forest and energy resources would be developed on a priority basis in order to make the country self-sufficient in food, and to serve as a base for industrial development.

The development programme for 1981-1985 places implicit emphasis on the necessity of increasing the technological capability of the country, as well as on the need to ensure skilled management of technology.

The government contributed, to a great extent, to the solution of problems confronting the country, e.g. illiteracy, raising the cultural level of the population, training of skilled workers, technicians and engineers. At present Laos has 600 scientists and engineers and more than 3,700 technicians. The objective of the first Five-Year Plan should allow for the following increases in 1985 relative to 1980: 40.3 per cent increase in the number of pupils registered in general education, 59.4 per cent increase in the number of trainees registered in the professional and technical schools of the first cycle, 74.3 per cent increase in the number of trainees registered in the professional and technical schools of the second cycle, and 26.3 per cent increase in the number of students in higher education.

The scientific and technological infrastructure has been developed and the State Committee for Science and Technology was established towards the beginning of 1980, as a planning and coordinating body for S and T activities in the country. But still many problems remain unsolved, e.g. lack of funds, shortage of S and T infrastructure, ineffective enterprises.

The geographical position of the country as a land-locked one, aggravates the situation.

Malaysia

In Malaysia the mobilization of science and technology forms an important part of the strategy for social and economic development of the country.

The scientific research activities began as early as in 1879 with the establishment of the Forest Research Institute and subsequently, in 1900, the Institute of Medical Research, and in 1925 the Rubber Research Institute. Research is also being conducted under various government departments and in the universities. With the launching of the national industrialization programme in the 1960s scientific and technological activities were further diversified.

S and T research is now geared towards the search for new clones, high yielding and fast maturing seeds for various agricultural products. In the field of agriculture, mines and fisheries research institutions were established. In addition, several technical universities and polytechnics were created with a view to ensuring a constant supply of experienced scientists and skilled technicians.

The Ministry of Science, Technology and Environment was entrusted with the task of coordinating, planning and developing all research activities relating to science and technology. Within the framework of the ministry, a National Council for Scientific Research and Development was established in 1975.

The Fourth Economic and Social Development Plan of Malaysia was launched in 1981 for the period 1981-1985 and it foresees a total allocation of approximately 108 million US dollars for R and D. It is envisaged that R and D activities in agro-based industry, the S and T network, technology transfer issues such as the strengthening of the country's ability to select, acquire, adopt and develop foreign and indigenous technologies, will receive a significant impetus. At the same time, emphasis will also be given to applied research on alternative sources of energy, bio-technology, remote sensing, nuclear research and other areas in line with the developmental plan of the country.

Malaysia while recognizing the need to collaborate and co-operate with other governments and international organizations, has been participating in the S and T activities through bilateral, multilateral, regional, inter-regional and international programmes and organizations. At the ASEAN level, various programmes on scientific and technological research are being carried out in areas, such as, protein, non-conventional energy research, climatology, environmental management and the *ad hoc* committee meeting for the formulation of ASEAN Plan of Action in Science and Technology for Development.

Nepal

Nepal, as a least developed and land-locked country, is faced with multidimensional problems of development, including transfer of technology. Lack of basic infrastructure for development, including human and material proves to be a drawback for the country. The situation is further compounded by the population explosion and the oil crisis. In the country's Five-Year Plan a new stage of developmental effort towards laying down the necessary infrastructure and making increasing investments in productive and social sectors has been envisaged. It has been possible to improve the necessary physical infrastructure for development, such as roads, power, irrigation and communication but also in the social service sector, notably, in the fields of education and health.

A National Education System Plan was launched which aims at the expansion of the primary education, as well as creation of new institutions necessary for training of S and T manpower. One of the most difficult tasks for the country is to transform her traditional society into a modern and dynamic one. Since 90 per cent of the population lives in remote hill areas, the immediate need is to impart skill-training on a massive scale to the rural people to generate more meaningful employment opportunities. For this purpose, a number of technical schools are being established in different parts of the country.

Agriculture and forestry have been given highest priority in the Sixth Plan. One of the biggest resources of the country is water and efforts are being made to harness this vast potential for power and irrigation. Build up of S and T capacity in this field is of vital importance and Nepal seeks to exploit this natural resource at the regional level.

Science and technology have now been given due weight in the Sixth Five-Year Plan and a separate chapter has been included. A National Council for Science and Technology was constituted to formulate policies and programmes and coordinate the activities of the R and D institutions in the country. There is a proposal to establish a National Academy of Sciences. Nepal is interested in developing scientific and technological services (S and T information, standardization, instrumentation, etc.) and would like to participate in co-operative regional programmes for sharing of specialized S and T facilities.

The increasing demand for food and energy to meet the growing need of the population has led to an alarming degree of encroachment to forest and marginal land, thus leading to severe ecological imbalance. The country's renewable sources of energy - the forests - are being depleted at a fast rate. While afforestation is being given priority in the national development plans, the alternative sources of energy, particularly solar, wind, biogas are being exploited in the country.

With the shift of emphasis in investment from commerce to industry the country has embarked upon plans for utilization of existing S and T institutions, their expansion and closer integration with the productive enterprises. Nepal seeks increased flow of technology in order to quicken the pace of development through modernization of the economic sectors. It has been realized that agricultural sector alone is not in a position to provide productive employment because of several factors. The Special Economic Programme launched recently has given priority to import substitution industries both in the private and public sectors.

New Zealand

New Zealand's natural resources are inherently different from those of other countries in the region. Because of these differences, New Zealand has different products to export out to different and distant markets and of necessity, New Zealand has developed a range of skills to meet its needs in special areas of science and technology. These skills could be shared amongst other countries of the region through programmes of regional co-operation. New Zealand wants to make available certain skills, such as sheep and cattle production on rangelands, dairy production, pest and disease control in tropical crops and quarantine control.

The National Research Advisory Council comprising representatives from government departments, ministries and the private sector provides recommendations for the orientation and conduct of research and development. About 0.8 per cent of GNP is spent on R and D.

The areas in which scientists from New Zealand have contributed or have been involved in other countries of the region are soil science, water science, plant physiology, metrology, mineral research, seismology and geothermal energy resources.

New Zealand has devoted around 30 per cent of its total bilateral aid to technological assistance (1978). A major part of such assistance is directed to the South Pacific region. Present commitments to the countries of the South Pacific region leave little scope to direct assistance elsewhere at the present moment.

Two of the educational centres in New Zealand serve as training centres for scientists and engineers from other developing countries in Asia. These are the Auckland Geothermal Institute and the Seed Technology Centre.

To make science and technology effective in development it is necessary to have a sound education system to provide a basis of knowledge and skills, a technically strong organization to undertake research and development and an advisory organization which can identify and recommend useful areas of growth and recommend strategies for development. Furthermore, without access to information from a wide range of sources, effective development may not be possible.

Each of the countries of the region has identified for itself its own development priorities and strategies, and to some extent, technological facilities are available to promote research and development. In a limited fashion information services are also available in the region. There is, however, a lack of uniting force in the region to match needs and resources, perhaps in the form of a S and T broker system which would avoid expensive staffing and equipment, and heavy overhead costs.

Pakistan

Since achieving independence Pakistan has made considerable progress in acquiring science and technology capability, especially in building up an institutional infrastructure comprising universities, as well as research institutes and field stations operating under a Council for Scientific and Industrial Research and an Agricultural Research Council.

A Ministry of Science and Technology has been established to promote and co-ordinate scientific research in the country. Linked to the Ministry of Science and Technology are two important semi-autonomous organizations, namely, the National Science Council which advises the government on science policy matters and the Pakistan Science Foundation which provides financial support to basic and fundamental research having a bearing on socio-economic needs of the country. A number of non-governmental S and T organizations exist including an Academy of Sciences. The nation has now reached the take-off stage in S and T capability.

Investment in science and technology has significantly contributed to the modernization and industrialization of the country, particularly in the sectors of irrigation, industries, resources development and transport and communications. The nation has achieved a notable breakthrough in agricultural production as a direct result of which the country is self-sufficient in cereals.

There are, however, some areas of dysfunction and certain real constraints. Amongst such constraints are paucity of funds, lack of training at organization and management levels, ineffective linkages between industries and research establishments and excessive dependence on imported technologies.

Having realized that the pattern of development in advanced industrialized nations is not only alien to the culture of the land and irrelevant to the local needs, but actually untenable in the context of its own socio-economic structure, Pakistan has shifted its scientific and technological efforts in creating endogenous technologies and in meeting the requirements of the common man.

In order to remedy the existing deficiencies in the national infrastructure of science and technology and to orient the entire scientific effort towards the endogenous development of the country, Pakistan has decided to formulate a coherent and comprehensive science and technology policy, which can serve as the model for the development and application of science and technology for the nation. However, in view of the constraints, particularly of funds and trained manpower, it is necessary to select priorities and to concentrate upon providing critical inputs to the S and T system to make it an effective instrument of social and economic growth.

By virtue of science being international, it was stressed that developing countries could reach a level of collective self-reliance through mutual co-operation and sharing of expertise, especially in the field of applied research (e.g. engineering industries, electronics, fertilizers, agro-chemicals, energy, chemical industries) and survey of natural resources. Pakistan would welcome a higher degree of co-operation between its major research organizations and similar bodies within the Asia-Pacific region.

Pakistan attaches a great importance to the possible misuse of scientific and technological knowledge for destructive and exploitative purposes. Science should not be conceived independently and outside the values of religion. Modern science devoid of humanism has brought mankind to the brink of destruction, whereas present scientific and technological knowledge could provide an enormous benefit to the developing countries and could ensure liberation of the masses from poverty; hunger, disease and deprivation. There is a great need for integrating science with culture so that spiritual and religious values could be preserved and enhanced. A conference, such as the present one, should provide guidelines not only for the promotion of S and T but also for their integration with the spiritual, ethical and religious values that strive for good.

Papua New Guinea

Papua New Guinea formulated a strategy for development in 1972 which was promulgated as the National Development Strategy in October 1976. Allocations for various sectoral programmes were made in the National Public Expenditure Plan (NPEP) which came into effect in 1978.

The country does not have a well-enunciated science and technology policy. Scientific and technological activities are subject to the NPEP process and, hence, to broad government development objectives. The government departments and statutory bodies act according to their own perceptions of policy for science and technology in their respective areas of competence.

The linkages between the producers of scientific and technological inputs to the development process and the potential users of these inputs are very weak. At present there is no body, equivalent to a National Science Council, in the country. However, steps are now being undertaken to establish such an organization. After considerable national deliberations and seeking the expert advice from Unesco, it is proposed to establish a National Science and Technology Structure with the task of (a) identifying issues; (b) seeking advice from both inside and outside government; (c) preparing briefs on the issues in terms suitable for cabinet consideration; (d) monitoring implementation of decisions taken; and (e) formulating advice to appropriate bodies.

At the professional level the universities are producing the right number of trained personnel required for the next decade. However, at the high-school level there will be an oversupply.

Application of science and technology in several sectors of the economy, e.g. agriculture, forestry, resource exploration and development, housing, health and nutrition, public works, including development of transport and communications infrastrcture, and energy resources, have been either inappropriate or inadequate to meet the objectives laid down in the National Development Strategy. This is attributable to a number of factors, e.g. insufficiency of skilled and experienced scientific and technological manpower, inadequate facilities for R and D, or R and D facilities used for pursuing inappropriate or irrelevant projects, transfer of inappropriate technologies from industrialized countries to Papua New Guinea, frequent reliance on foreign 'experts', rather than fully utilizing the local expertise, and inadequate communication between the 'producers' and the 'consumers' of science and technology.

In spite of the difficulties, the country, since independence in 1975, has made progress by increasing the S and T manpower, science education in schools, facilities for training and research, and by establishing more positions in the government and private enterprises requiring personnel trained in science and technology.

Philippines

The country is in the process of establishing a national agency to be known as the National Science and Technology Authority under the reorganization order signed by the President. This Authority is to be entrusted with the responsibility of formulating and implementing policies, plans and programmes for developing of S and T capability and promotion of S and T activities.

A comprehensive National Plan for Science and Technology will be prepared in collaboration with the National Economic and Development Authority which will be consistent with the National Economic Development Plan. The aim of the S and T plan is to mobilize and harness all government resources to ensure the effective and co-ordinated implementation of an accelerated research and development programme, and to promote the utilization of the results of such a programme.

The government proposes to establish a career system within the national service in order to attract and retain qualified scientific and technological manpower in government service. Likewise, to promote and encourage the sharing between and among academic and scientific institutions, of libraries, equipment and other facilities and to provide a physical and social environment conducive to scholarship, professionalism and inquiry; science communities concentrated at appropriate locations are being planned by the government.

The agriculture, forestry and fisheries sectors and the local industries in the country require new and improved production methods and facilities to enhance labour productivity, to make more efficient use of energy and to make fuller use of local raw materials. The government is aware of the situation and steps are being taken to acquire these technologies. The S and T organizational structure itself is now re-designed to permit a consultative-planning linkage between industry and the S and T system to harmonize demand and supply of technologies.

A recent feature in the Philippines S and T system is a two-step technology transfer mechanism which facilitates the incorporation of new, improved technologies by cottage, small and medium scale producers which are mostly in the private enterprise system. The process calls for the intervention of a third party in the transaction - the Technology Research Centre - which brings together the supplier of technology, the sources of financing and raw materials, the entrepreneur and even the buyer who will use the technology. This approach provides a very crucial link or bridge by which small producers are able to gain access to new technologies and could very well prove to be one of the many possible institutional answers to the problem of technology utilization and propagation in the country.

Sri Lanka

Since the CASTASIA I, significant developments have taken place in the field of science and technology in Sri Lanka. The four Campuses of the University of Sri Lanka have been elevated to the status of autonomous universities, and at present there are seven universities, two affiliated university colleges, two new medical faculties, one university devoted to technological studies, one post-graduate institute in medicine and one in agriculture.

Over the last one and a half decades the output of science and engineering graduates has been doubled and the present total annual student intake for science-based courses is around 1600.

The R and D infrastructure has been expanded through the establishment of several new R and D institutions and upgrading the capabilities of the existing ones. The R and D expenditure registered a three-fold increase during 1966-1975 which rose from 13 million Rupees to 45.1 million. None the less, the world inflationary trends nullified to a large extent the benefits of this apparently optimistic increase. The financial resources available for R and D activities in the universities are grossly inadequate.

The National Science Council which was established in 1968 and will soon be replaced by a new Authority, is involved in the formulation of science policy, and stimulates and sponsors S and T activities in the country.

Sri Lanka faces considerable science teaching problems in the schools. The main problem is lack of essential items of teaching equipment and supplies. The increase in available resources is neither commensurate with the increase in numbers of pupils nor with the escalation of prices of essential items necessary for the teaching of science.

The country is facing a serious problem of 'brain drain' of technical, skilled and semi-skilled personnel, in addition to elite S and T personnel. These outflows of talent, skills and labour are seriously hampering the progress of major development projects. Sri Lankan secondary science school teachers find lucrative jobs in African countries which has led to a serious depletion of the stock of competent teachers.

In transferring technology from developed countries, Sri Lanka has encountered serious problems. Two examples were mentioned relating to chemical and paper industries, where the technologies have become obsolete and resulted in serious pollution problems. At the time the technologies were acquired the eco-system was unfortunately considered to be capable of withstanding limitless pollution.

Funds for research activities are rather scarce and the present policy is to give highest priority to appropriate research of immediate relevance which satisfies the basic needs of the country. Sri Lanka is in the process of building up its basic research facilities and an Institute for Fundamental Research will soon be established under the purview of His Excellency, the President of Sri Lanka. It is expected that Sri Lankan research scientists of the highest calibre abroad will initiate and contribute much intellectual capital to this institute.

Thailand

Major developments in Thailand since CASTASIA I include the setting up of the Ministry of Science, Technology and Energy in 1979. This new Ministry has included under its jurisdiction the National Research Council (NRC), which was founded in 1956. It has been most active in the promotion of research and development in science and technology. The National Economic and Social Development Board (NESDB) has established a division of Technology and Environment Planning in 1976, which functions as a secretariat for the subcommittee for Science and Technology Planning. Subsequently, Science and Technology plans were included in the fourth National Economic and Social Development Plan (1977-1981), but became explicit as a Science and Technology Plan for the first time in the fifth National Economic and Social Development Plan (1982-1986).

The S and T plan aims at tackling three urgent social and economic problem areas: (i) the application of science and technology for rural development; (ii) the use of science and technology to raise production and efficiency for competitiveness; and (iii) the strengthening of national scientific and technological capabilities. However, a major obstacle has been the scarcity of information on science and technology, particularly concerning S and T manpower, and assistance in overcoming this obstacle is urgently needed.

Thailand has studied S and T planning and organization in other countries and learnt from the experiences of others. As a consequence, a Council of Science and Technology has been established to formulate policy in Science and Technology, and to co-ordinate and supervise the programmes and activities in that area.

Since CASTASIA I, science and technology capabilities have improved. In science education the contents and methods of learning have been completely revised, to assist in the application of science and technology to national development. R and D capacity has increased substantially within the universities. While the virtues of appropriate technology are recognized with respect to rapid material improvement of living conditions, it is felt that such immediate betterment must not be realized at the expense of long-term development of S and T in the developing countries.

Current science and technology development in Thailand has been in keeping with the eight-point operational plan for the implementation of the Vienna Programme of Action. It is felt that a positive role could be played by the country in helping to promote S and T co-operation in Asia and the Pacific, for example by accepting to co-ordinate a number of regional basic science networks operating under the sponsorship of Unesco. These networks have greatly improved mutual information between specialists of the region working in disciplines such as microbiology and applied chemistry. In general, Thailand feels that it has benefitted from, as well as contributed to, the activities under the various regional programmes of scientific and technological co-operation over the past years.

USSR*

The Kazakh Soviet Socialist Republic is one of the fifteen Sovereign Republics of the USSR. It covers an area of over 2.7 million square kilometres and has a population of over 15 million.

Today the Kazakh SSR is a developed republic with a highly diversified industry, large-scale mechanized agriculture, advanced science and technology. The Republic produces iron and steel, copper and lead, oil, fertilizers, metallurgical and farming equipment, precision instruments and different consumer goods. Moreover, it has become one of the primary granaries of the USSR.

Modern Kazakh SSR is a country of universal literacy; practically one-third of the population is benefitting in some way or other from formal and informal education programmes. There are nearly 550,000 students enrolled at 55 institutions of higher education and 238 specialized secondary institutions.

The Republic's steady progress is also seen in the blossoming of science. The Academy of Sciences of the Kazakh SSR is a large scientific centre. A number of scientific institutions are affiliated to it, carrying out research in all branches of fundamental and modern sciences. A large number of scientific research organizations and laboratories carry out applied research for different industries.

Planning the development of science and technology is one of the most important components in the Republic's system of directing scientific and technological progress.

The Five-Year and Annual Plans of economic and social development have combined targets for the development of science and technology in the Republic.

Comprehensive target-oriented programmes have recently been formulated in order to solve scientific and technological problems of importance to the economy of the country. These programmes are of an interdisciplinary and intersectoral character aimed at reducing substantially the lead time for development and application of new technology and strengthening the links between science and production.

The scientific and technological information system occupies an important place in the scientific potential of the Republic. It comprises a Republic Institute and 14 intersectoral territorial information divisions of ministries and enterprises. A network of 400 specialized scientific and technical libraries exists in the Republic.

The Kazakh SSR carries out an extensive economic, scientific and cultural co-operation programme with more than 80 countries all over the world. The Academy of Sciences is engaged in some 46 joint research programmes with foreign research centres.

Socialist Republic of Viet Nam

The Government of the Socialist Republic of Viet Nam pays constant attention to the creation and development of its scientific and technological potential and to the promotion of R and D activities within the country.

The available stock of S and T manpower, at present, is composed of over 260,000 university and college graduates; over 3,000 doctoral graduates; and over 540,000 secondary-level technicians.

The state system of the R and D institutions is composed of 140 institutes, specializing in different fields of socio-economic development. Full-time staff numbers about 15,000. More than 25,000 scientists, engineers and high-level technicians are trained in some 60 universities and technological institutes.

The central government agency responsible for state management and planning of all S and T activities is the State Commission for Science and Technology.

In 1981 the government promulgated the science and technology policy of the Republic, which defines the objectives, principles, and orientations of the activities of research geared to development. The policy foresees the necessary measures for a harmonious development of the Nation's scientific and technological potential, and for its integration with social and economic

*The USSR's experience was represented by the Kazakh Soviet Socialist Republic.

management, while giving due importance to international scientific co-operation.

Viet Nam feels it should make better use of its scientific and technological manpower while improving the national system of research and development in particular by strengthening its institutional infrastructure, and perfecting its managerial techniques.

The role of research in the universities must be strengthened in such a way that each university will be a base for teaching, research and development.

During the period 1981-1990 the efforts of the government are to be concentrated on the solution of the following problems: the production of foodstuffs, raw materials for industry, consumer goods and export production, energy supply, increasing the production and quality of mechanical equipment, metallurgy and chemical industry. The scientific foundations of industry will be developed, while some R and D units will be incorporated in the productive enterprises.

The country will give special attention to scientific and technological information, and the popularization of science, and more generally to a closer integration of scientific and technological activities with the overall national effort of socioeconomic development.

2. Prospects of international and regional co-operation in science and technology, and conference follow-up

The Steering Committee proposed to discuss Items 9 and 10 concurrently, and this was accepted by the conference. Seventeen delegations addressed themselves to these items: Democratic Republic of Afghanistan, Australia, Bangladesh, China, Hong Kong, India, Islamic Republic of Iran, Japan, Malaysia, Nepal, New Zealand, the Philippines, Pakistan, the Republic of Korea, Thailand, the Union of Soviet Socialist Republics and Socialist Republic of Viet Nam. The observers from the United Nations Centre for Science and Technology and the United Nations Financing System for Science and Technology also made statements.

In the debate that followed, mention was made of the recommendations of the United Nations Conference on Science and Technology for Development (UNCSTD) August 1979, and of the activities undertaken in that respect by organizations of the United Nations system. Unesco's regional offices were also mentioned in connection with the implementation of regional programmes, as well as their co-operation with ESCAP.

2.1 Fields of priority

The information on priority areas for regional co-operation contained in the 'Vienna Programme of Action' was generally acknowledged. The participants also noted the work done in this area by ESCAP/ACAST and ASCA.

The overriding need for a system of exchange and dissemination of scientific and technological information as well as a system of training the personnel in this field was almost unanimously recognized. Likewise it was felt that action should be taken to develop national capabilities in the field of information technology. The creation of a regional network of information systems was suggested, based on existing national entities. Unesco's mandate under the General Information Programme was mentioned in this connection, as was the need to harmonize the actions of all United Nations organizations in this field.

Many delegations described the need for more qualified personnel and for more studies in the field of science and technology policy planning and management. A proposal was made for the establishment of a centre for research and training in science and technology policy planning and management. In this regard, the conference took note of the offer made by the delegation of the People's Republic of China to provide host facilities for such a centre. The proposed centre could organize courses, seminars, and workshops, carry out studies, and provide information and forecasts on science and technology policy planning and management.

The setting up of a regional centre for scientific instruments was also suggested, which could assist countries to obtain instruments and spare parts, to train personnel, and even to manufacture instruments.

The other areas of priorities for regional co-operation that were mentioned were:

(i) food and agriculture;
(ii) surveys of natural resources;
(iii) remote sensing;
(iv) health and family welfare;
(v) computer science;
(vi) biotechnology;
(vii) microelectronics;
(viii) marine science;
(ix) forest ecology;
(x) erosion control;
(xi) hydrology;
(xii) metrology and standards;
(xiii) technical and vocational education;
(xiv) literacy;
(xv) formal and non-formal education;
(xvi) seismology and earthquake engineering;
(xvii) new energy sources;
(xviii) informatics;
(xix) environment.

The point was also made that developing countries must not ignore basic research, as it is an important stimulus for innovative thinking. In this context the conference was informed of the proposal for a Giant Equatorial Radio Telescope, which would permit scientists from developing countries to work on many front-line research areas. Such a project could also promote the development of electronics and data-handling industries in developing countries of the region.

The need for meaningful and reliable indicators of scientific and technological development was mentioned.

Regarding priorities, it was suggested that a three-man team could visit the countries of the region and in consultation with national authorities, identify the real needs for regional co-operative action. The two Unesco Regional Offices for Science and Technology in Asia could monitor this exercise and establish links for regional co-operation on the needs eventually identified.

2.2 Modes and mechanisms for regional co-operation on science and technology

The existing mechanisms for the promotion of regional co-operation have to be strengthened and adapted to the current needs, according to the different types of regional activity. In this regard, the conference noted the Vienna Programme of Action and the subsequent Operational Plan which called for the co-operation of all United Nations organizations in the implementation of activities covered by the selected priority areas.

The network concept, which links existing institutions and individuals in collaboration on priority areas for regional co-operation, was frequently referred to and extolled. The existence of national institutions, ongoing scientific research and, above all, active scientific researchers, are fundamental prerequisites to regional co-operation. When their capacity is adequate, scientists can accomplish much more by participating in regional networks covering their respective fields of work. The cross-fertilization of ideas that can result from linking-up existing research projects through network arrangements was greatly appreciated.

The conference recognized that regional institutes might have to be established to perform clearly-defined functions whenever it became clear that existing institutes could not perform them through concerted and systematic regional co-operative arrangements.

In this connection, the conference noted India's offer of the facilities and services of its 'National Centre for Informatics' for organizing regional co-operative activities, in the spirit of TCDC.

Mention was made by one delegate of the need for ESCAP to set up a science and technology unit in order to improve co-ordination of co-operation in the region.

2.3 Financing arrangements

Since new sources of funding seem unlikely to become available in the near future, sustained efforts must be deployed to use existing sources of international financing for building up the national science and technology capacity in the developing countries of the region.

2.4 Measures for monitoring and evaluation of follow-up

In so far as possible, the existing mechanisms of the United Nations system and especially the Unesco Regional Offices for Science and Technology should be used to follow up on CASTASIA II recommendations. The conference noted the suggestion that periodic meetings be held to take stock of progress made in their connection and that ESCAP should be invited to be present at these meetings.

The conference noted the suggestion that the United Nations Intergovernmental Committee on Science and Technology for Development (IGCSTD) consider the CASTASIA II recommendations when the Committee makes its annual system-wide review of United Nations programmes in science and technology. In this connection, the Unesco involvement in the *ad hoc* Inter-Agency Working Group on Science and Technology Policy and Planning was appreciated.

1. Report of Commission I - Build up of a science and technology capacity

The Commission held three meetings on 24 and 25 March 1982. The meetings were chaired by His Excellency Tan Sri Ong Kee Hui, Minister of Science, Technology and Environment of Malaysia. The Rapporteur was Mr. L. G. Wilson, Executive Secretary of the Commonwealth Scientific and Industrial Organization of Australia. In its consideration of Item 8.1 of the agenda the Commission had before it as working documents

1. SC-82/CASTASIA II/3: "Science, Technology and Development in Asia and the Pacific - Trends, Issues and Prospects."
2. SC-82/CASTASIA II/Ref. 1: "Science, Technology and Development in Asia and the Pacific - Progress Report, 1968-1980."
3. SC-82/CASTASIA II/4: "Points for Discussion."
4. Preparatory Meeting for CASTASIA II - Final Report.

The subject matter was discussed under three broad areas:

(a) education and training;
(b) research and experimental development;
(c) scientific and technological services.

In addition the Commission addressed a number of matters relating to these areas but having more general relevance to the work of CASTASIA II. These are considered in this report under a fourth heading: "D. General." Specific recommendations arising from the Commission's work relating to these broad areas were developed by a drafting committee from Australia, Thailand, Philippines, India and Japan under the chairmanship of Bangladesh, based on suggestions from many countries. *

During its work the Commission gave special attention to the Operational Plan for the Implementation of the Vienna Programme of Action on Science and Technology for Development and the work of the Intergovernmental Committee on Science and Technology for Development. Specific actions taken by Member States and Unesco following CASTASIA I were also taken into account.

In its work the Commission did not cover the various matters in a comprehensive manner - time did not allow. Rather in the context of ongoing national development and international action it selected particular matters for attention, looking for new emphases to existing action and possible innovations which had arisen in recent years and which might be adapted to the needs of Member States.

A. Education and training

(a) Science teaching in school

Problems of science teaching at the school level tended to relate to situations in a particular country. There would nevertheless be benefit in educators and scientists identifying common problems for regional collaboration. Examples cited were development of science teaching kits, simple instruments capable of local manufacture and the possible use of modern technologies in the instruction of large numbers of students. Attention was drawn to new methods of teaching science being developed in some countries which give particular attention to national issues, national cultures and the state of development, from the village level to urbanized societies.

There was accord that the introduction to science and technology at primary and through secondary level was an essential prerequisite to subsequent tuition in science and formed a basis for developing an appreciation - no matter how rudimentary - of technology encountered in every day living, particularly in relation to problems of hygiene, population growth and rural development.

Many countries saw that the relatively low priority given to science education at the primary level seriously limited the development of instruction in science and technology at the primary level and called for this problem to be drawn to the attention of international funding organizations.

Among other topics which were discussed, the importance of vocationalization of learning at an early stage was seen as an important developing trend which was to be encouraged in order to

*These specific recommendations were later integrated within draft recommendations considered by the Commission during its closing session.

meet specific national requirements of many countries.

It was also noted that whereas the teaching of science was seen as universal in nature this is not true in the case of technology and attention was seen as necessary in teaching of technologies to meet specific cultural and social needs.

Among problems which were highlighted by delegates, were the lack of special teachers trained in both science and teaching and the problem of curricula and book development for science and technology teaching at all levels.

(b) Education and training of technicians

This was generally recognized to be an area of particular importance which will require continuing attention. The rapid advances being made in scientific and technological development presented special problems in ensuring flexibility and innovation in technician training programmes which were seen generally as being conservative in nature. The special requirement of teacher retraining, possibly through regional technical training institutes was seen as requiring special attention.

There was seen to be an urgent need to give special attention to the training of technicians as there was an expanding role at this level due to the present rate of technological development. This requirement related to all areas of technician training including medicine and health care as well as rural and secondary industry. The use of apprenticeship mechanisms was seen as a means of encouraging collaboration between educators and employers of high level craftsmen and technicians.

(c) Higher scientific and technological education

In most countries in the region the basic facilities for higher scientific and technological education are at or approaching an acceptable level, but there is need for attention in some new and specialized fields. For example, a need for special training in the emerging field of technology assessment was seen as of special importance in relation to choice of technology and the development of institutes of appropriate technology. The need for education and training in relation to science policy and also in relation to the management of research, education and technological development was given special attention.

The establishment of link courses for students travelling abroad for higher education, concentrating on the 'scientific method' was seen as worthy of attention although the desirability of students being trained at higher levels in their own country was seen as preferable to training elsewhere. Other points raised during the discussions included the concept of teachers travelling to students rather than students travelling to other countries. The possibility of forming a pool of those prepared to do so was raised as was the use of retired scientists and teachers - grey power. The balance between science students and arts students at the undergraduate level was seen as requiring understanding in order to attract more students to science.

Science and the non-school population

The development of mechanisms for promoting better public understanding of science and technology, developing an awareness of their importance and encouraging further study in non-school populations was seen as a continuing requirement necessary for development by all countries. In addition to special programmes of instruction, use of the mass media and continuing education programmes, the role of museums, science clubs, science fairs, special exhibitions, quiz programmes, science prizes, open days at universities and research laboratories were all seen as deserving of attention. On-the job training, in-service training and similar mechanisms also required attention as did the development of community polytechnics.

Scientific and technological manpower

The Commission focused special attention on the need to develop techniques of manpower planning and forecasting applicable to the countries of the region in relation to:

(i) the supply of teachers of science and technology at all levels;

(ii) technicians and craftsmen;

(iii) graduate in science, technology, engineering and medicine;

(iv) post-graduate researchers.

There were problems reported in matching supply and demand in a rapidly developing technological world where economic variability on a national and global level had considerable impact on both supply and demand. A country's education profile needs to be matched with that of the economy. The special problems of manpower export were highlighted in this context. Attention was also drawn to the need for a series of workshops in the region to address particular manpower planning problems relating to different science and technology activities.

Other matters

The Commission saw the achievement of national literacy and numeracy as being of overriding importance in the education field as it related to the effective use of science and technology for development. While recognizing the considerable progress made in many countries and the important role played by Unesco to date, the Commission felt that programmes and actions relating to achieving literacy and numeracy might be re-examined in order to achieve new insights in tackling this all-important question.

Special attention was given to the question of the status of teachers at all levels and the need for governments to give special consideration to the development of incentives to attract and retain teachers who were regarded as a basic resource in the development process.

B. Research and experimental development

The R and D base and resource allocation

The development of a national research and development base was seen as a matter of national policy although it was recognized that there were benefits to be gained from studying a diversity of foreign models and experience.

The balance between research and development and between basic and applied research were seen as matters requiring consideration at national levels though speakers agreed that it was essential to allow basic scientific research to flourish not only as a necessary complementary activity to applied problem-solving but because each country had a responsibility to allow for its human resources of creativity to contribute to the world's knowledge. In this connection the long tradition of the region in making such contributions was highlighted.

Funding levels for various facets of scientific and technical activity were seen as questions of national priorities for the use of resources and it was clear that important progress is being made. A number of countries indicated welcome growth in scientific and technological research in terms of expenditure as a percentage of GNP.

The question of effective co-ordination at national, regional and international levels was seen as important in the context of making maximum use of existing and planned institutional arrangements. While recognizing existing efforts towards improved co-ordination at the international level, a number of countries indicated that at the working level existing co-ordination was not always seen as effective and unnecessary duplication of activities was seen to exist. More effective exchange of information was seen as a contributing solution as was action, in relation to international activity, at the national level.

The various network-type structures which have been developed by Unesco and other bodies in the region were seen as a useful regional mechanism for collaborative research and experimental development and were discussed. However it was felt that a study of the effectiveness and interrelationships between networks and the formulation of guidelines for network development would be a useful means of clarifying approaches to the development of networks which were recognized as an important component of the regional science and technology infrastructure.

Impact on technology on local research

The development of links between research workers in universities, government laboratories and private industry on the one hand and users of the results of their research and the resultant technology on the other was seen as an issue requiring attention. The role of extension workers, the use of research workers as consultants to industry, the role of community polytechnics and technology centres in developing a two-way interaction between the three components research, technology and users were seen as techniques which might be explored. The role of the entrepreneur - whether he be at the level of government or private industry - was an aspect of development receiving attention in some countries as was the part played in innovation by scientific societies and associations.

Research management

There was seen to be a need to give attention to the development of a national cadre of research managers and those concerned with policy development in fields related to science and technology. With respect to the latter, the employment of science and engineering graduates in policy departments of government, as was frequent in some countries, was seen as worthy of attention. Several proposals for the development of suitable institutional arrangements for training programme and related workshops were seen as being of importance particularly if conducted in a way to allow for national environments to be taken into account. Reference was also made to an international comparative study of national models of, and arrangements for, science and technology which were in operation and which had jointly been undertaken by a number of countries.

C. Scientific and technological services

Scientific and technological information

During the discussion of the Commission the subject of information received considerable attention. A prerequisite for contributing to any regional or wider information network was seen to be the development of national information services and Unesco was encouraged to continue its long-established work in this area.

It was indicated that considerable progress has already been made in the region in the establishment of facilities at the national level and that the time appears right to actively pursue through existing national, regional and international bodies in a co-ordinated way, the development of regional information networks related to specific areas of activity. Agriculture was seen to be one area requiring early attention followed soon by other areas. Unesco was seen to have a special responsibility in this development.

Other topics which were highlighted during the discussions included: the non-availability, or time gap from publication, of scientific and technical journals and rising costs; the continuing and growing need for assistance in training information scientists and technicians and librarians in which area Unesco was encouraged to enhance its role; the role of the book not only at the school and university level but as a means of contributing to continuing education; and the importance of translation services and translated works which was seen as having special significance in some countries.

Scientific and industrial standards

National metrology services, product standards and certifying services and the relationship of such services to international activities, were seen as important and integral components in the creation of a scientific and technological infrastructure directed towards national development as it related to secondary industry, rural industry and commerce. Developments taking place in the region, particularly the steady development of a metrology network, which was to be reviewed during the later part of 1980, were noted, and opportunities for further regional collaboration in relation to the development of standards and testing services are to be encouraged.

Scientific instrumentation

Particular attention was drawn to problems of most countries in the region with respect to evaluation, purchase, commissioning, maintenance, modification and repair of scientific instruments used in educational, research, and industrial organizations. As a step towards dealing with these problems the possibility of regional instrument centres to provide training and assistance in relation to all these matters and in some cases to act as instrument operating centres for a number of countries was briefly explored. Unesco and Member States were invited to give this matter particular attention as it was seen as fundamental to the development of science and technology and industrial infrastructures.

Technology delivery

Now that the basic problems of staff and facilities have been reasonably dealt with in an increasing number of the countries of the region, the role of managers and the development of managerial capability in the development of technology delivery systems was seen as being important. The chain of processes from basic and pure research through applied research to development, design, production and marketing in the context of social and industrial needs was seen as requiring study in the countries of the region and consideration by appropriate regional organizations.

The role of consultants in the development of production lines and products and in implementing discoveries relating to rural and industrial development was discussed. University staff and workers from government laboratories were seen as having potentially important roles as consultants. There was a call for the preparation of national directories, and for regional circulation of available personnel. The development of research laboratories in particular industries and special industrial research associations was noted as one means of shortening the link between research and its application.

D. General

There was a general recognition of the need for greater attention to be given by Member States and by international agencies to the role of women in research and scientific and technological development.

Attention was drawn to the importance of linking the work of CASTASIA II to Unesco's next Medium-Term Plan and the necessary connection between governments' consideration of the Plan and the forthcoming Meeting of the Intergovernmental Committee on Science and Technology for Development. In the context of the Medium-Term Plan, encouragement was given for the development by Unesco of further broad regional science programmes of special significance to Member States along the lines of those adopted at the last General Conference.

The need for enhanced co-ordination among the various organs of the United Nations and the development of relationships among all organizations concerned with science and technology was seen as vitally important for developing all aspects of science and technology capacity.

The role of national, regional and international societies concerned with specific areas of industry and science and technology was seen as of significance in the promotion of science and technology and Unesco was invited to actively encourage and assist in the formation of such organizations.

Throughout the discussions special attention was paid to the need to identify and apply technologies which are particularly relevant to the rural population, including traditional techniques, and to ensuring that all members of the society have access to the benefits of technology, including the rural and urban poor.

Finally, many speakers drew attention to new technologies such as micro-processor, remote sensing and alternative energy sources and the need for special emphasis on these matters in education and training programmes at all levels in order that they may be rapidly adopted.

2. Report of Commission II - Science and technology for development

The Commission held four working meetings on 24 and 25 March 1982. The meetings were chaired by His Excellency the Hon. C. Cyril Mathew, Minister of Industries and Scientific Affairs of Sri Lanka. The Rapporteur was Dr. Dibya Deo Bhatt, Member Secretary, National Planning Commission of Nepal.

The Commission considered Item 8.2 of the agenda of the conference, namely 'Science and Technology for Development', with discussions of the three items dealing with this area in the Main Working Document of the Conference (SC-82/CASTASIA II/3): 'Integration of Science and Technology in Development'; 'Strategies and orientations for science and technology-based development', and 'Policy requirements'.

Introduction

Since the First Meeting of Ministers of Science and Technology for Development (CASTASIA I) in 1968, there has been considerable change in the Asia and Pacific region. Economic development in the region has, over recent years, been considerably hampered by the price of technology and rapidly increasing energy, material and trading constraints. In addition, there has also been a growing awareness of environmental constraints on development and the need to conserve non-renewable natural resources. With regard to science and technology, science education has made vast progress and science and technology institutions and infrastructure have expanded considerably since 1968. At the same time, public scrutiny of the social impact of technology has increased, and there is also widespread concern to gain immediate social and economic benefits from the application of science and technology to development. Such economic and social factors have changed the role of science and technology in the countries of Asia and the Pacific.

Goals, strategies and problems

As a result, the goals of science and technology in development have changed from a concern with economic growth itself, to a broader social concern for economic and social welfare, equity and the quality of life, with in addition, the necessary economic growth to sustain these benefits. In discussion in the Commission, this concern was evident in the wish to ensure that science and technology satisfied both basic, as well as higher level human needs and aimed at greater human contentment.

The consequences of this greater attention to the goals of development have been seen in all countries, for there is now a greater emphasis on the planning of science and technology as well as a greater emphasis on the integration of science and technology planning with economic and social planning. These consequences were frequently mentioned in the Commission, though there were no clearly generalizable strategies discussed by means of which the countries of the region might best direct their science and technology policies and initiatives so as to ensure the achievement of the balanced goal of economic growth with equity and social welfare.

The reason for this lack of a clear strategy for the promotion of science and technology for development may stem from the nature of the region itself for, while there are common problems in the integration of science and technology with social and economic planning in the countries in the region there is, none the less, clear evidence that the countries of the region differ greatly. The diversity within the Asia and Pacific region is such that many countries may tend to the view that their own problems with science and technology planning, and the integration with economic planning, are unique to their own social and cultural circumstances.

Delegates from some least developed Member States did, however, note that they shared the greatest need for development assistance because they were confronted with the most severe problems of integrating science and technology with social and economic planning. However, even then, it was emphasized that planning must be implemented according to specific local requirements rather than according to a generalized strategy.

Throughout the region, the changed goals for science and technology in development have also been deeply influenced by a recognition of the changing context in which recent national scientific and technological development has taken place. Instances were cited where economic policies such as the heavy reliance on foreign imports had introduced technologies which were incompatible with the resources of the country and exposed the country to the constraints and costs of the international technology transfer system. The result was to both retard the growth of indigenous science and technology in the Member States and to limit the extent to which it could be applied.

Some Member States in the region now view the importation of foreign technology with some reservation, even believing that foreign technology may distort development goals, expose the country to economic exploitation and undermine the technological and economic base of the country. Some Member States of the region reported their strategic response to these negative effects of foreign technology by placing a very strong emphasis, at a policy level, on the need to build up a parallel national ability in science and technology and to retain some measure of self-reliance in science.

It was felt by several Member States that changes in the context in which science and technology operate in the region also flow from the impact of the fluctuations in supply, and increased costs, of energy. The change in the oil-based energy price structure has influenced agricultural and industrial development and is one of the most important contemporary problems facing the application of science and technology for development. Comments by the delegates indicated that the consequence of this for science and technology in the region was considerable, requiring that high priority be given to the promotion of research into various renewable, alternative energy sources.

It was generally felt that the consequence of these changes in the economic and social context in which indigenous science and technology has been evolving in the region has heightened pressures both to plan science and technology in order to maximize their benefits, as well as to integrate them fully into social and economic planning and subject them to the same economic constraints, political parameters and public scrutiny as any other public expenditure.

It was generally agreed by Member States that science and technology must now be closely integrated with development. It was pointed out that this perspective was highlighted by the 1979 UNCSTD Conference. Science and technology policies had been adopted, but it was stressed that the important problem was the lack of adequate financial support to implement these policies. For this reason a request was made to establish targets for the purpose of funding assistance.

Science planning and management

These pressures to plan science and technology have resulted in major changes in the institutional mechanisms for the management of science and technology in the region. The statements by a number of Member States made it clear that high level mechanisms to plan science and technology are now common in the region and these involve, as participants, members of the national science community. It was felt that such mechanisms contribute significantly in directing science and technology toward national goals.

It was pointed out however, that there had been instances where a science and technology system had been established but there had been a failure to integrate this effectively with the productive sector of the economy; an important precondition for it to contribute to development in some Member States of the region. Examples were offered by other Member States where decision-makers, having outlined their socio-economic goals, developed a science and technology which sought to interface all sectors of the society and economy. The important point, it was stated, was to establish linkages between all levels or sectors in order that integration could be achieved.

Statements by several Member States also made it clear that, as a result of these same economic and resource pressures, it is now common for the countries of the region to undertake long-term planning which takes into account the social assessment of technology and which integrates into shorter-term planning projections, the social, environmental and economic consequences of new technologies. It was felt by the delegates that Unesco and other United Nations agencies such as ESCAP could assist in the development of methodologies to foster the linkages between science and technology planning and the social and economic planning process.

Delegates at the conference raised, as an urgent need, the problem of the development of science indicators which could be used to both assess the implementation of science and technology polices and to assist science planners and administrators to assert the priority of the science and technology sector in relation to other public sectors.

An example of an attempt to develop such indicators was given by one Member State where output indicators in key areas of national S and T endeavour were developed to provide some feedback for the evaluation of policy implementation. Indicators mentioned in this regard involved the rate of innovation, patent indicators, trade in R and D-intensive products, technological intensity, and the purchase and sale of technical know-how.

The comment was made that in one case, the absence of such indicators had directly led to a loss of government support for science and technology.

Science, technology and society

Related to this problem of planning science and technology for development is the need to clearly understand how science and technology can meet the needs of the people. In this respect, it was stated that it is necessary that emphasis be placed on the promotion of the social sciences as well as the natural sciences, and that sociological research be undertaken in conjunction with science and technology planning and economic and social planning, in order that science and technology be properly integrated in ways that will benefit all sectors of the society, and not only the elite.

A comment was also added that, in order to effectively achieve this social integration, reference must be constantly made to national priorities, the economic framework, the economic and social viability of scientific and technological innovation, as well as to community-wide policy considerations.

It was also observed that integration of science with other policies of social planning is necessary at a practical level, particularly in the careful planning of education, the utilization of trained manpower for both research and applied development, and in the encouragement of innovation.

An appropriate policy for the promotion of the education system was highlighted as the prime prerequisite for a satisfactory integration of science and technology with the society. It was emphasized that the successful promotion of mass education could also ensure that, ultimately, the whole society could participate in a growing technologically-based economy.

Several delegates emphasized the importance of extension services in integrating science and technology with the society. Without strengthening such services, the planning of science and technology would not, of itself, ensure an adequate link between planned scientific research and the utilization of such research for the benefit of the society.

Research strategies

In this regard, the delegates emphasized that, because some countries of the region suffered from a shortage of research and development personnel, it is even more necessary to ensure that the research effort is oriented more directly towards national needs and developmental goals. As a consequence, the areas of scientific concentration the state chooses to pursue need to be very carefully selected. It was generally felt that such a strategic orientation needs to be supported with appropriate funding and institutional support mechanisms, as well as other incentives, which will sustain and encourage research in areas of concentration.

Absence of effective science policy machinery in less-developed countries limits the development of the most useful areas of research concentration at a second level. One Member State, referring to its experience as an aid-donor, pointed out that they rely heavily on the governments of recipient states identifying their own problems and research needs. While many less developed Member States of the region have difficulty in formulating science policies, and lack the infrastructure necessary to undertake this task, it is difficult for the aid-donors to direct their assistance to areas of greatest need.

Some of the delegates pointed out that even where the resources for research and development are limited, it is necessary to sustain a fundamental research capacity in carefully selected areas. In this regard an outline was given of mechanisms for participation in decision-making by working scientists and of a system for peer review seminars to ascertain priority research areas for financial support.

Such research can have important spin-off effects on the economy and on the development of technology which may not be initially recognized, provided pathways for applied research can be established. For this reason, some delegates emphasized that carefully selected fundamental research is important. Other delegates pointed out, however, that the level of fundamental research a Member State should pursue varies according to its level of economic development. It was felt that whilst a balance must be struck between fundamental and applied research, great caution must be exercised in promoting fundamental scientific research without taking economic considerations into account.

The question was also raised as to whether what was regarded as an articial distinction between applied and fundamental research should be continued.

Discussions, on the problem of determining exactly which science and technology policy should be adopted, once again emphasized the unique circumstances with which each Member State had to contend. Instances were given where different sectors, even within the same state, were so differently structured that the nature of science and technology services needed to assist their growth and improved productivity had to be vastly different. Such circumstances within each country, it was indicated, needed the assistance of a highly developed science policy system to determine these alternative roles for science and technology.

It was recognized that problems presented in identifying technologies, particularly front-line technologies, which could assist nations of the Asia and Pacific region were considerable and the suggestion was made that the development of science policy studies could provide a useful means of evaluating the scientific research potential of alternate areas. It was stated that this was a field which Unesco could foster and one for which it could provide considerable assistance to Member States in the region.

Science and technology infrastructure

Before this level of science and technology attainment can be reached by many of the countries in Asia and the Pacific there must be a considerable improvement in the national science and technology infrastructure. Delegates expressed a clear wish that the S and T information exchange system throughout the region should be upgraded and improved. The TOKTEN programme was mentioned in relation to this. The meeting believed there would be merit in compiling information about existing networks, irrespective of agency sponsorship, and identifying the possibilities for collaboration between them, and asked whether Unesco could take a lead in this by using an existing Unesco regional office with seconded officers from Member States of the region.

However, the capacity of some of the developing countries of the region to benefit from an improved science and technology information system in the region is limited by the inappropriateness of some of the technologies available for such information exchange and communication in the region. For instance, there is a need to tropicalize equipment and to develop regional standards for such equipment.

Similarly, regional co-operation should be promoted to assist countries suffering from an inadequate science and technology infrastructure. In this respect, it was believed that networks should be developed in the region in areas of research and technology which are well developed in some Member States and would be of benefit to other Member States of the region. Another suggestion that was made was for the creation of twinning relationships between institutions in developing countries, as well as between institutions in developing and developed countries of the region.

Within the region a major infrastructural weakness identified by delegates is the widespread lack of a technological capability and the low level of technical skill and training. It was stressed that technical education is a crucial factor in fostering economic and social development and integrating science and technology with society.

It was noted that this weakness is particularly evident in the region at the level of science and technology management and there is a need to raise the level of awareness and managerial capability among decision-makers, as many reports and recent conferences have indicated. For this reason the delegates stressed that there is a particular need for training in the area of science policy-making and the administration of scientific institutions, and there was considerable discussion about how this need in the region could be met on the basis of either a central training facility or by means of more informal networks or workshops.

Factors considered were the costs, the suitability and adequacy of resources to the varied needs of Member States, the emphasis of policy studies and training, and the adequate utilization of existing institutions.

As a model for international co-operation, WHO's approach of utilizing existing institutional mechanisms was introduced to the Commission.

Reference was also made in the discussion to the General Conference in Belgrade which recommended to Unesco to make a feasibility study regarding the setting up of an institute for the planning of scientific and technological development. The progress of this study was reported. It involves a global review of existing facilities in scientific and technological planning. The full report of the feasibility study is to be presented at the twenty-second session of the Unesco General Conference in 1983.

In the meantime this continuing deficiency represents a severe constraint on the educational, research and development, planning, and administrative capabilities of many countries of the region and undermines the considerable efforts presently being made to improve the role of science and technology in development.

The problem of a low level of managerial skill in the area of science and technology policy-making, planning and administration is also compounded by a widespread lack of understanding of the use of science and technology by political leaders, and even the scientific community itself. In some countries in the region it is necessary to undertake programmes for the education of politicians, as well as members of the public, to ensure that they understand how science and technology could contribute to social and economic development.

Conclusions

During discussions in the Commission, delegates deliberated on the implementation of the Operational Plan of the Vienna Programme of Action and were interested in the action which Unesco, regional organizations and national governments might take in this regard. There were repeated requests that agencies of the United Nations system such as Unesco should assist the science and technology policy-making and planning organizations established in nation states by producing methodologies, and providing training in science and technology management.

There was unanimous agreement on the importance of establishing science and technology goals, integrating science and technology planning with economic planning and, through the establishment of such a national managerial capability,ensuring the improved integration of science and technology in social and economic development of the countries of Asia and the Pacific. It was stated that there is still, even among the scientific community, considerable ignorance of the possible role of science and technology for development in some developing countries.

The international economic, social, scientific and technological constraints play a major part in influencing trends in science and technology in Asia and the Pacific, with the result that the science and technology policies of the region, especially in the developing countries, now reflect the national responses to this situation. National science and technology policies are starting now to monitor, assess and control technology transfer and to determine the manner by which specific technological choices can be made, for instance, in preferring unpackaged technologies in preference to any packaged technology. This, it was clear in discussions, is an attempt by many countries to assert their national self-reliance in the face of overwhelming S and T pressures from abroad.

The delegates were aware that, as science and technology contributed to development, there was the possibility that there might be an essential incompatibility between such development and the goals of greater social equity, removal of poverty, full employment and greater national self-reliance. They were, however, inclined to discount this view and to assert that such development could be compatible with the achievement of greater social equity. None the less, studies on the problems of integrating science and society and overcoming incompatibilities which do exist are important and Unesco should undertake action on this regard, bearing in mind the distinction drawn by the OECD Committee on Science and Technology between 'science for policy' and 'policy for science'.

Finally, as the delegates' various statements made clear, in considering action on science and technology for development it is important to remember the great disparities which exist among the countries of the region, some of which are engaged in basic reconstruction while others are among the most developed in the world.

IV. RECOMMENDATIONS OF THE CONFERENCE

Recommendation Number	Source	Discussed under agenda item
1 - Science and Technology Policies		
1	DR. 36	7
2	DR. 28 (I)	8. 1
3	DR. 29 (I)	8. 2
4	DR. 29 (II)	8. 2
5	DR. 29 (III)	8. 2
6	DR. 35	8. 2
7	DR. 6	9
2 - Scientific and Technological Education and Training		
8	DR. 32 (I)	8. 1
9	DR. 32 (II)	8. 1
10	DR. 32 (IV)	8. 1
11	DR. 32 (VI)	8. 1
12	DR. 32 (V)	8. 1
13	DR. 32 (III)	8. 1
3 - Priorities for Science and Technology in the Region		
14	DR. 30	8
15	DR. 33	9
16	DR. 28 (III)	8. 1
17	DR. 2	9
18	DR. 34	9
19	DR. 31	8
20	DR. 28 (II)	8. 1
21	DR. 20	9
4 - The United Nations Systems		
22	DR. 38	9
23	DR. 27	9
24	DR. 23	8. 2
5 - Follow-up		
25	DR. 26	10

1. SCIENCE AND TECHNOLOGY POLICIES

Recommendation No. 1 — Key areas in Research and Development (R and D)

The Conference,

Considering the imperative need for planned and systematic efforts to raise the long-term scientific and technological capability of the developing countries in order to bridge the S and T gap among nations,

Noting the mandate of Unesco and its role in the United Nations system to conduct such long-term activities,

Drawing attention to the critical need in the developing countries to strengthen national capabilities in research and development in order to achieve self-reliance in many areas of science and technology,

Considering that Unesco is one of the major organizations of the United Nations system which is responsible for contributing to the raising of the long-term scientific and technological capability of the developing countries in order to bridge the gap among nations,

Recommends that Unesco undertake special goal-oriented programmes in science and technology with the aim of helping the developing countries to bridge the scientific and technological gap, and

1. To ensure that all programmes are of high efficiency, and with the minimum administrative structure.

2. To obtain a generally agreed upon list of S and T areas where R and D activities in less-developed countries can be of benefit and thereby gradually narrow the S and T gap.

3. To achieve the solution of key problems in S and T as defined above.

Specific objectives

1. To launch initially a number of special programmes concerning key areas of R and D with maximal impact on bridging the S and T gap among nations in Asia and the Pacific.

2. To undertake studies immediately in consultation with the Member States to identify the key problem areas to which research and development efforts should be directed in a planned manner within the framework of the national priorities such as:

   (a) Maximal domestic utilization of natural resources, e.g. mineral areas, metallurgy.

   (b) Maximal domestic utilization of renewable natural resources, e.g. agricultural products, aquatic livestock.

   (c) Establishment of R and D capabilities in the various fields of bio-technology.

   (d) Development of renewable energy sources.

The Conference,

Further recommends that the implementation of these programmes be on the basis of concentrating resources and efforts for maximum impact through key areas, taking care to maximize research and development support at minimum administrative cost.

Recommendation No. 2 — Science, Technology and the Productive Sector

The Conference,

Recognizing the fundamental role of science and technology in the development of national economies and its importance in the achievement of social and cultural objectives, Urges the Member States of the region:

(1) To encourage

a close relationship between industry and research and development bodies;

enterprises with similar problems to support research directed to their common interest.

(2) To promote

greater involvement of industry in research and development;

access to and acceptance by industry of standards and testing services;

(3) To develop

their endogenous scientific and technological capability to increase productivity and to provide national solutions to national problems;

linkages and strong interactions with research and development activities in other countries.

Recognizing that many countries in the region have requisite research capacity but have limited engineering design consultancy organizations capable of undertaking adaptation, design, layout and erection of plants,

Appreciating that endogenous S and T capability depends largely on the ability to transform scientific concepts into engineering devices, processes and systems,

Recommends to Member States in the region to give high priority to the development of endogenous design capability through the establishment and support of design consultancy organizations in their own countries, and to co-operate where necessary with other countries of the region by pooling resources in this area for the execution of major engineering and development projects.

Recommendation No. 3 Promotion of scientific and technological development

The Conference,

Mindful that science and technology play an increasing role in economic development and in the improvement of the people's well-being;

Recognizing that the development of science and technology calls for a special effort on the part of the countries of the Asia and the Pacific region, especially the developing countries;

Further recognizing that such development largely depends on the formulation and implementation of purposeful science and technology policies by the governments concerned;

Realizing the need to integrate policies for science and technology, with national economic policies;

Recalling that national science and technology policies basically aim at achieving:

(i) extensive, effective and timely application of both national and worldwide results of modern science and technology in all sectors of the economy;

(ii) optimal and balanced development of a nation's scientific and technological potential, through national efforts as well as through international and regional co-operation;

Noting that national policy-making for science and technology involves, among others, the following tasks:

(i) selecting long-term and medium-term objectives for the country's scientific and technological activities, consonant with its overall economic and social development goals;

(ii) determining priorities for the progressive build-up of the nation's scientific and technological potential, according to the defined objectives;

(iii) elaborating detailed plans and specific measures for the creation and strengthening of a national capacity in those priority fields of science and technology development;

(iv) improving the organization and management of scientific and technological activities, and the application of the results thereof;

(v) securing adequate financing and other necessary resources for the implementation of the science and technology component of the national development plan;

Recommends that, in view of the current situation with regard to the formulation and application of science and technology policy for development in the region, Unesco and other competent international organizations should, when so requested, co-operate with the countries of the Asia and the Pacific region in drawing up and implementing scientific and technological development plans and programmes; with particular emphasis on the priority areas defined in the overall national development plans.

Recommendation No. 4 — Training and research in the field of science and technology policies

The Conference,

Recognizing the need for trained specialists in science and technology policy-making, planning and management, and the importance of increasing the capacity of countries belonging to the Asia and Pacific region in those fields, including transfer and adaptation of technologies;

Considering that science and technology policy research and R and D management studies, especially adapted to the needs of member countries of the region, should urgently be carried out and the results thereof widely disseminated;

Recommends

(a) that Unesco make appropriate regional arrangements, and assist in national arrangements, including funding support, for the periodical training of key policy-making, planning and management personnel in the field of science and technology and for mutual exchange of experience in this sphere, for example through the organization of workshops, training courses, or rotating seminars. A regional workshop should be planned at RCTT Bangalore to be followed up by appropriate activities as required.

(b) that training courses should focus on subjects of common interest to science and technology planners in the region; particular emphasis would be given to the transformation of economic requirements into science and technology programmes and on the practical application of research results in the development of the economy;

(c) that the national training courses should be held in different countries, the host country providing the necessary facilities and secretarial assistance; the courses should be attended initially by senior policy-making officials from S and T planning and socio-economic planning bodies, with the participation of experts drawn from both developing and developed countries;

(d) that Unesco undertake to strengthen existing national institutions in the region engaged in such training and research and to connect them in an interacting network, while requesting one of these existing institutions to take the responsibility of co-ordinating the activities of the institutions belonging to the network, as determined by a regional co-ordinating body, consisting of the national points of contact from each participating country.

The network would carry out research on theoretical and practical aspects of science and technology policy and on the planning of scientific and technological expansion for development by the interested countries of the region; it would also promote exchanging the research results obtained by its member organizations.

(e) that the proposed regional co-ordinating body should also be entrusted with:

determining selection procedures and substantive content of the training courses;

fixing general policy orientation of the courses; with particular attention to the participating Member States' special needs;

evaluating the effectiveness of the courses and their impact on the planning and management of scientific and technological activities in the region;

assessing future demand for the training courses;

advising Unesco on whatever institutional arrangements may be required for the organization and management of the training courses on a permanent basis, including the possible set up of a regional centre.

Further recommends that Unesco undertake studies on the productivity and effectiveness of scientific and technological activities with a view to constructing performance indicators which could be taken by countries as a common basis for assessing the effects of policies and plans being implemented in their respective countries.

Recommendation No. 5 — Exchange of information relevant for policy-making and planning in the field of science and technology

The Conference,

Recognizing the need for comprehensive information on a wide spectrum of activities which are required for science and technology policy-making and planning on the one hand, and the lack of such data or the difficulties of ready access to them on the other hand;

Noting the need for systematic arrangements designed to enhance exchange of relevant information relating to science and technology policies, training in the field of planning, organization and management of national science and technology policies including technology transfer and adaptation policies;

Recommends that the exchange of documents and/or bibliographic data, especially those relating to science and technology policy development and to the exchange of specialists in the promotion of science and technology, should be promoted by Unesco;

Further recommends to Unesco to provide, whenever possible, relevant studies and documents concerning science and technology policy issues of both worldwide and regional interest, to the national science and technology policy-making bodies of the countries of Asia and the Pacific.

Recommendation No. 6 — Science, technology and development planning

The Conference,

Noting the development of S and T infrastructure in the region,

Mindful of the problems which the countries have in common in harmonizing their S and T programmes with their national development efforts,

The Conference recommends that Unesco assist the Member States in

identifying specific S and T inputs required by various sectors of the economy by sponsoring interdisciplinary studies and the exchange and sharing of the expertise available in the regions.

The Conference further recommends that the Member States strengthen their S and T capabilities and provide an effective mechanism for S and T to be used as an instrument for development planning.

Recommendation No. 7 — Integration of Science and Technology in development

The Conference,

Bearing in mind the serious difficulties of less-endowed small countries (including the isolated island countries) in applying research and development in S and T due to financial, personnel and institutional constraints, Believing that regional co-operation will contribute significantly to solving the problems of integrating S and T in development, arising out of deficiencies in management and administrative practices, paucity of scientific and technological services,

Recommends that Unesco make a feasibility study of appropriate mechanisms for the special purpose of co-operatively assisting the less-endowed countries in meeting their needs for integrating and utilizing S and T in development.

2. SCIENTIFIC AND TECHNOLOGICAL EDUCATION AND TRAINING

Recommendation No. 8 — Forecasting of scientific and technological manpower requirements

The Conference,

Considering that information on S and T manpower is essential for effective social and economic planning and policy-making at both national and regional levels,

Recognizing the need to improve the methodology and capacity for manpower forecasting to facilitate matching the demand and supply of scientific and technological manpower,

Recommends to Member States that they should take steps to establish national agencies for S and T manpower planning,

Recommends to Unesco and other international agencies that they initiate programmes of research and training in the forecasting of scientific and technological manpower requirements on a national/regional/global basis,

Recommends to Unesco that as a first step in initiating such a programme, it should identify a number of key personnel from Member States to constitute a working group to propose specific follow-up action.

Recommendation No. 9 — Science and technology education

The Conference,

Considering the importance of science and technology education in social and economic development,

Recommends to Member States:

1. That they ensure that science and technology education becomes an integral part of the primary and secondary education for all children and that, as a critical step toward ensuring this, adequate facilities be provided for teacher education, curriculum development and improvement of laboratory instruction in the school system.

2. That nutrition and health education should be an integral part of general education at all levels and efforts be made to co-ordinate national activities in this field.

3. That science, technology and culture should be looked at as an integrated system and careful attention be given, especially in developing countries, to the design and development of education in the cultural context of society.

Recommends to Unesco that it assist Member States in the development of science and technology education and promote innovations in this field by collating and disseminating novel ideas to Member States.

Recommendation No. 10 — Education and training of engineers and technologists

The Conference,

Considering the importance of science and technology in economic development, social transformation and human progress,

Recognizing that, unlike science, technology is nation-specific,

Appreciating that engineers and technologists are often required to choose between alternative technologies for a desired solution of techno-economic problems,

Noting that transfer of technology from one socio-economic system to another needs careful and critical evaluation and adaptation to ensure success,

Recommends to Member States that the education and training of engineers and technologists should include courses on technology assessment, and exposure through case studies to the problems of technology transfer,

Recommends to Unesco to co-operate with Member States in this critical area through provision of advisory services, reference materials, and information on relevant case studies.

Recommendation No. 11 — Scientists and technologists in education

The Conference,

Recognizing the fact that in many Member States in the region there is an acute shortage of science and technology teachers at all levels,

Appreciating that opportunities for employment of S and T personnel in activities outside the educational system are numerous and more attractive,

Recommends to Member States in the region that they develop specific policies for attracting scientists and technologists to the education sector through better emoluments, career advancement prospects and respect and status in society, and that they consider innovative approaches in making the teaching profession more attractive.

Recommendation No. 12 — Training of middle-level technicians

The Conference,

Recognizing the extremely important role of the middle-level technicians in the development process, and the dearth of adequate facilities for the training of technicians in the region,

Bearing in mind, that rapid technological advanced require continual updating of curricula for technician training,

Recommends that Member States accord the highest priority to technician education giving emphasis to curricula updating as well as on-the-job training needed to gain industrial experience,

Recommends that Unesco should strengthen and upgrade programmes for technician teacher-training at the national and regional level.

Recommendation No. 13 Out-of-school education in science and technology

The Conference,

Recognizing the importance of science and technology education in building up human resources in the Member States,

Considering that a large number of youth and adults are out-of-school and constitute a major portion of manpower in the developing countries,

Recommends to Unesco that it give emphasis to popularization of S and T to the out-of-school population by assisting the member countries in their efforts in this respect, i.e. the development of science museums, the arrangement of science exhibitions, science fairs and other relevant activities to keep up with the new knowledge of S and T in the world,

Recommends to Member States that they continue to strengthen their efforts to ensure that the large number of members of the population that are not in school, will not be left out of the S and T development scene.

3. PRIORITIES FOR SCIENCE AND TECHNOLOGY IN THE REGION

Recommendation No. 14 Fields of critical importance

The Conference,

Considering the necessity of linking science and technology to development goals,

Noting the prerequisite of strengthening the science infrastructure including fundamental research for enhancing endogenous capabilities for scientific and technological creation,

Realizing the need for advancing international co-operation in scientific research and training including exchange of scientists,

Bearing in mind the importance of science and technology in a regional context,

Noting the existence of various regional networks and the lack of information on their work and effectiveness,

Noting that Unesco is currently in the process of preparing its second Medium-Term Plan for the years 1983-1989,

Recommends:

(i) that Member States, the United Nations system and other organizations encourage the interchange of scientists and technologists between developing countries as well as between developed and developing countries,

(ii) that all Member States should provide support and facilities for the fundamental research necessary for the establishment of a balanced science and technology capacity.

(iii) that Unesco in consultation with Member States take the lead in compiling information about specialist networks in the region. Based on this information, the effectiveness of such networks be determined and appropriate recommendations be made for improvement.

Further invites the Director-General of Unesco:

(a) to take into account the recommendations and discussion of CASTASIA II in the preparation of the second Medium-Term Plan;

(b) within the framework of the Plan to give special consideration to the development of further specific regional programmes in fields of critical importance within the region such as energy, particularly renewable sources of energy; marine science, environmentall quality, micro-electronics, and information science ; biological sciences; natural resources; engineering and management;

(c) to promote research projects with special relevance to the problems of the developing countries in the region.

Recommendation No. 15 — Policy objectives and fields for regional co-operation in science and technology

The Conference,

Recognizing the role of international science and technology co-operation for the progress, improvement and enhancement of the life of human beings,

Considering that Unesco has an important role to play in attaining this goal,

Realizing that the development in the region of strategies for international co-operation would help it have its voice better heard in international forums, especially Unesco,

Affirms the paramount importance of the following policy objectives for regional co-operation:

(1) meet the needs of the most disadvantaged countries in the region for the well-being of the people;

(2) emphasize the fields of activity where a regional approach is more beneficial than a country approach;

Recommends that these policy objectives be used as criteria in evaluating past regional priorities in science and technology co-operation in Asia and the Pacific, and

Further recommends that consideration be given to the following fields of co-operation:

1. Agricultural and food sciences.
2. Educational fields which could be divided into three parts; namely,
    1. Removing illiteracy.
    2. Informal and non-formal education.
    3. Vocational and technical education.
3. Water resources and hydrological programme.
4. Earthquake studies of the region. (Seismological study as well as constructional study).
5. Health programmes.
6. Establishing mechanisms to facilitate the flow of scientific information as well as technical know-how from developed countries to developing countries of the region.

Recommendation No. 16 — New Technologies

The Conference,

Recognizing that the advent of new technologies is having a profound influence in many areas which are critical to the development process,

Appreciating that the engineers and technologists of the region will have to play an increasing role in the application of such technologies to various research, development and industrial activities.

Noting as specific examples of areas in which Unesco has continuing interest,

1. microprocessors which are having a profound influence in information processing, process monitoring and control as well as in design and operation of industrial devices and systems;

2. remote sensing which plays an important role in the collection of resources and environment data much needed for development planning in fields such as oceanography, coastal zone ecology, mangroves, etc.;

3. alternative sources of energy such as solar energy, biogas, wind, mini-hydro power-plants and tidal energy,

Recommends to Member States to undertake the training of teachers in the new emerging technologies so as to enable an early introduction of courses in the relevant fields,

Recommends to Unesco to assist in organizing regional level training programmes for teacher-trainers in, and R and D efforts related to, new fields of technology as they develop.

Recommendation No. 17 Giant Equatorial Radio Telescope

The Conference,

Noting the statement in the Director-General's speech about the Giant Equatorial Radio Telescope (GERT),

Recalling that this project has been initiated by developing countries from different regions of the world and has received the support of Unesco, which helped in the preparatory studies undertaken by eminent scientists,

Considering that this important scientific and technological project will enable the undertaking of extensive frontline research work on the study of the universe from the vantage location of the equator and has the potential of promoting endogenous capability building in areas related to space sciences, electronics, data-handling, systems and communication which are of great importance to social and economic development in Asia and the Pacific,

Invites all countries concerned to actively pursue the study and possible implementation of this project with a view to ensuring that the proposed project would contribute amongst others to the attainment of the objectives of TCDC;

The Conference further

Thanks the Director-General of Unesco for the efficient contribution of Unesco to the study of GERT; and

Invites him to continue to support it.

The Conference,

Appeals to all countries and organizations concerned with scientific and technological development in Asia and the Pacific to support the project.

Recommendation No. 18 International Centre for Integrated Mountain Development in Nepal

The Conference,

Considering the importance of the study of high mountains, particularly the Himalayas, for an understanding of such fragile ecosystems which may be irretrievably destroyed by man's action and thereby seriously affect man's existence, further considering the aesthetic and cultural value of their natural system which has been included in the 'Heritage of Mankind' list of Unesco,

Recognizing that appropriate management and development can be obtained only through a good knowledge of the Himalayas, including its people,

Recalling the recommendations made by the General Conference of Unesco on the establishment of an

'International Centre for Integrated Mountain Development in Nepal',

Further recalling that a protocol to this effect was signed in Paris in September 1981 to which many Member States of Unesco have pledged support,

Realizing that the International Centre would contribute substantially towards finding a practical solution to the multidimensional problems of conservation, rational exploitation and management of the resources,

Noting that the International Centre would play a very important role in integrating science and technology into development.

Recommends that Unesco elicit maximum support and co-operation from the Member States of the region for strengthening and further developing the newly-established Centre.

Recommendation No. 19 Exchange of scientific and technological information

The Conference,

Recognizing that scientific and technological information is essential for the advancement of science and technology and for their application to economic, cultural and social development,

Considering the importance of ready access to relevant information by scientists, engineers and other groups of users,

Recognizing that improved access to scientific and technological information may be achieved by using modern technology for data transmission, as well as the traditional information and documentation services and other personal contacts,

Recognizing that effective information exchange and use must be based on the continuing development of national information systems and services operated by information specialists working closely with the scientific community.

The Conference,

Proposes the creation of a scientific and technological network for Asia and the Pacific for the exchange of information and expertise that should:

(a) concentrate on priority subject areas;

(b) take into account the needs and interest of the region; and

(c) make full use of scientific and technological information systems and services at the national, regional and international levels;

Invites Member States to actively participate in the proposed network, and to establish or re-identify country science and technology point(s) of contact which will undertake to seek and transmit scientific and technological information on request;

Recommends that the Director-General take appropriate action to establish the network, and take it into account in preparing Unesco's draft Medium-Term Plan for 1984-1989.

Recommendation No. 20 Instrumentation and Standardization

The Conference,

Considering that instrumentation and control systems play an essential role in most fields of scientific and technological activity,

Recognizing that the development of an endogenous capability in science and technology depends to a considerable extent on the availability of measuring devices and systems of various degrees of sophistication, Noting that most Member States of the region have limited access to sophisticated instruments and also have limited facilities for training instrumentation technicians and engineers in the whole field of instrument specifications, commissioning and installation, maintenance and repair, modification, design, development and production,

Recommends to Member States that a network of instrument resource centres be established in each country, with help of integrating agencies if necessary, giving S and T personnel access to measurement and instrumentation equipment up to the highest levels of precision available.

Recommends to Unesco and other international agencies that they develop and support appropriate programmes in the region for the training of technicians and engineers in the whole field of instrumentation, including control systems,

Recognizing that metrology, standardization and testing are areas of activity of fundamental and essential importance in the utilization of a nation's technological capability.

Calling attention to the fact that this is an area in which regional co-operation has been demonstrated to be highly effective,

Noting the increase of industrial capability achieved by member countries and the progress made in developing regional co-operation since CASTASIA I, which can be expected to continue significantly in the coming years,

Recommends Member States to:

(1) increase

their efforts to establish regional co-operation in metrology through the Unesco/Commonwealth Science Council Asia-Pacific Metrology Programme;

(2) increase

co-operation in training and in the preparation and adoption of standards including those concerned with structures, commodities, materials, practices and operations;

(3) share

relevant experiences and provide advice on testing methods and services;

Recommends to Unesco and to other international agencies that they increase their efforts to harmonize the programmes and activities of the groups working in the areas of metrology, standards and testing.

Recommends to Unesco and to other international agencies to provide support in respect of scientific instrumentation by aiding countries in need of assistance to:

(1) obtain efficient instruments suitable for their requirements, together with spare parts;

(2) train personnel in the use and maintenance of scientific instruments;

(3) manufacture the instruments required in accordance with each country's technological capacity.

Further recommends to Unesco that new means of long-term support be provided for the purchase and importation of specialized laboratory equipment, including instruments and apparatus for standardization and metrology.

Recommendation No. 21 Scientific journalism

The Conference,

Considering the important role which the communications media can play in promoting the regional co-operation in science and technology for development,

Requests the Director-General of Unesco to initiate a scheme for the exchange of science writers and science features among the countries of the Asia-Pacific region and amongst this and other regions.

Recommendation No. 22 — Financing of science and technology programmes

The Conference,

Appreciating the results already achieved by developing countries in the application of science and technology for the benefit of their social and economic development;

Aware of the contributions made in that respect by the United Nations Development Programme (UNDP) and other development programmes, as well as by financial institutions such as the World Bank, the Asian Development Bank, the Islamic Development Bank and others;

Convinced of the need for additional resources to support the efforts of developing countries for strengthening their scientific and technological potential;

Calls on development programmes and financing institutions to increase their financial support to programmes in science and technology of developing countries.

Recommendation No. 23 — United Nations Financing System for Science and Technology

The Conference,

Noting with concern the large shortfall between the target of US $250 million agreed at the United Nations Conference on Science and Technology for Development in Vienna for the interim period 1980-1981 and the resources actually made available for the international financing of science and technology,

Noting the efficient manner in which the United Nations Interim Fund performed during the years 1980 and 1981,

Reaffirms the determination of the governments of Asia and the Pacific countries to ensure that all measures be taken for the successful operation of the newly set-up United Nations financing system for science and technology,

Urges both developed and developing countries to contribute generously to the financing system.

Recommendation No. 24 — Co-ordination and efficiency of international programmes for the application of science and technology to development

The Conference,

Recalling the United Nations General Assembly resolution 34/218 which requests the United Nations bodies to implement the Vienna Programme of Action on Science and Technology for Development,

Noting the specific co-ordination measures implemented by the United Nations system in the field of science and technology for development as a result of the adoption by the General Assembly of the Vienna Programme of Action,

Recognizing the specific mandates and responsibilities of the various organizations and agencies of the United Nations system as determined by their charters and governing organs,

Appreciating the progress already achieved in the joint action undertaken by the organizations and agencies of the United Nations system to contribute to the elaboration and future implementation of the operational plan adopted by the Intergovernmental Committee on Science and Technology for Development,

Requests the Director-General to strengthen his efforts with Member States, United Nations and other intergovernmental and non-governmental organizations to continuously improve co-ordination and raise efficiency in the programmes initiated for the application of science and technology for development.

5. FOLLOW-UP OF CASTASIA II

Recommendation No. 25 Review process of CASTASIA II follow-up

The Conference,

Noting the various measures adopted by each of the regional Conferences on Science and Technology for Development (CAST) organized by Unesco in Latin America, Africa, the Arab States and Europe and North America (CASTALA, CASTAFRICA, CASTARAB, MINESPOL),

Appreciating that each one of these conferences chose the implementation procedures best adapted to the needs and conditions of the region,

Affirming that the implementation of the recommendations adopted by CASTASIA II is the responsibility of the Member States acting singly, jointly or through their international and regional organizations, as well as of the United Nations organizations having special responsibility for science and technology,

Further affirming that existing mechanisms should be utilized as far as possible for the purpose of the follow-up of CASTASIA II,

Convinced of the necessity of periodic review of the implementation of the CASTASIA II recommendations in particular, and of the progress of science and technology and their applications for development in the region in general,

Aware of the fact that such review requires the collection of information from Member States, the dissemination of such information among them, and the holding of meetings at appropriate intervals,

Requests the Director-General of Unesco to initiate appropriate action in co-operation with ESCAP and other relevant agencies and organizations to ensure the implementation of the review process.

V. MANILA DECLARATION

We, the representatives of the governments of the states of Asia and the Pacific, members of the United Nations Educational, Scientific and Cultural Organization (UNESCO),

Meeting at the Second Conference of Ministers Responsible for the Application of Science and Technology to Development and those Responsible for Economic Planning in Asia and the Pacific, convened in Manila, Philippines, from 22 to 30 March 1982 by the United Nations Educational, Scientific and Cultural Organization with the co-operation of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP),

Hereby declare that:

I

Two-thirds of the world's population live in Asia and the Pacific. As inheritors of great civilizations and ancient cultures, the nations of the region possess capacities for creation, innovation and production which open up to them broad prospects for the future. Today, they are still facing a host of acute problems and, sometimes, grave emergencies.

It is imperative that the countries of the region increasingly apply science and technology as tools for the welfare of their societies. This will help to eradicate mass poverty and endemic diseases, draw rural and urban communities closer together, provide productive employment and educate hundreds of millions of people.

Science and technology can also enhance human lives and happiness by furthering intellectual and material exchange and improving people's chances of satisfying their needs, expressing their talents and fulfilling their aspirations.

WE THEREFORE CALL on the states and citizens of Asia and the Pacific to unite their will, and pool their abilities, so that science and technology may serve the progress and prosperity of all, and combine with the rich heritage of the region in facing present and future challenges.

II

Science and technology are powerful instruments of change, but they are neither autonomous nor neutral. They have great potential for influencing man and society, value systems and physical environments. Their effects can be either positive or negative according to the ways they interact with ethical, social and economic factors. Thus, to be effective, science and technology must be interwoven in the cultural fabric of society, and their applications must be available to, and accepted by, the nation as a whole.

WE THEREFORE INTEND to promote the full integration in our endogenous cultures of the methods, means and tools of modern knowledge and techniques, which are the common heritage of mankind.

III

The progress of science and technology is an integral part of societal development. It contributes to the creation of a better world, combining material welfare and ethical values. To deploy its full potential requires that adequate resources be made available to scientists and engineers working in every country of the world. Determined efforts must also be exerted for the promotion of education, the exchange of information and experience, and the delivery of research results to potential users.

Scientific and technological education, whether intended for the training of specialists or as part of general education, lies at the root of all progress in science and technology and their application to development.

The improvement of the general level of literacy, knowledge and skills and a greater awareness of the potentialities of science and technology among the people, are prerequisites for the development of a nation's scientific and technological capability.

Countries should provide the incentives necessary for promoting the growth of active scientific and technological communities. Such communities can provide valuable assistance to decision-makers and to the general public in reaching appropriate decisions concerning the sometimes difficult choices which must be made in the field of science and technology.

WE THEREFORE INVITE governments, scientific and technological bodies, and the production sector in Asia and the Pacific, to ensure that science and technology permeate all forms of social and economic activity and help to create prosperity which can be shared by all.

IV

The world's scientific and technological potential is still very unevenly distributed among countries and regions. These disparities can lead to great inequality of opportunity for science-based development, and to situations of technological dependence for certain countries.

The countries of Asia and the Pacific include some which are highly industrialized and urban, and many which are less industrialized and still predominantly rural. It is of great importance to the region region - and indeed to the rest of the world - that the already beneficial co-operation that has been established between these countries be further strengthened, with the ultimate aim of ensuring optimum use of science and technology for development in every country in the region.

This will call for measures to ensure unimpeded access to scientific and technological information based on expanded exchanges of experience and ideas between scientific communities and other interested groups. The efforts of developing countries in the region to strengthen their scientific and technological potentials could be significantly enhanced by contributions made by the industrialized countries through their scientific and technological institutions and the organizations of the United Nations system. Such contributions must be made in a spirit of co-operation, transcending political and ideological differences.

WE THEREFORE PLEDGE ourselves to promote international and regional co-operation to ensure that scientific exchange and the acquisition of technology may lead to greater strengthening of the research and production capacity of each country.

V

A considerable proportion of mankind's scientific and technological potential is currently devoted to military ends and to the perfecting of lethal weapons. If that potential were used for peaceful purposes, it could ease social tensions and economic difficulties, and stamp out hunger, illiteracy and diseases, and promote a system of positive health, both physical and mental.

WE THEREFORE APPEAL to the moral sense of mankind: the armaments race must cease; the resources allotted to it must be used for peaceful purposes; an atmosphere of peace and stability must prevail. At no less a price can the welfare of all peoples of the world be ensured.

VI

The United Nations system as a whole, and Unesco in particular, play a major role in the field of scientific and technological co-operation for peaceful purposes. Their efforts can bear fruit only when actively supported by Member States themselves.

WE THEREFORE APPEAL to governments of all countries to contribute, directly, and through the United Nations system, to the attainment of the objectives contained in the present Declaration.

ANNEX I

AGENDA OF THE CONFERENCE

1. Opening of the Conference.
2. Election of the President.
3. Adoption of the Rules of Procedure.
4. Adoption of the Agenda.
5. Election of the Vice-Presidents and Rapporteur-General of the Conference, and of the Chairmen of the two Commissions.
6. Organization of work of the Conference.
7. Science and technology in Asia and the Pacific - a review.

   Capability levels; advances in science and technology; science and technology policies.

8. Major science and technology policy issues in Asia and the Pacific in the 1980s.

   8.1 Build-up of a science and technology capacity.

   Education and training; research and experimental development; scientific and technological information and other scientific and engineering services.

   8.2 Science and technology for development.

   Integration of science and technology in development; policies and strategies; requirements for policy-making and policy implementation.

9. Prospects of international and regional co-operation in science and technology.

   Fields of priority; modes and mechanisms; financing arrangements.

10. Conference follow-up.

    Measures for monitoring and evaluation of follow-up.

11. Adoption of the recommendations and final report.
12. Close of the Conference.

ANNEX II

OPENING SPEECHES

Opening Remarks of His Excellency Dr. Emil Q. Javier
Chairman, National Science Development Board

Statement of Mr. S.A. M.S. Kibria,
Executive Secretary of ESCAP

Address by Mr. Amadou Mahtar M'Bow
Director-General of Unesco

Keynote address by His Excellency the Honourable
Mr. Cesar E.A. Virata,
Prime Minister of the Republic of the Philippines

Opening Remarks of His Exc. Dr. Emil Q. Javier, Chairman, National Science Development Board.

Your Excellencies:
Prime Minister Cesar Virata,
Director-General Amadou-Mahtar M'Bow,
Distinguished Delegates and Participants to CASTASIA II,
Members of the Diplomatic Corps,
the Staff of Unesco, ESCAP and other United Nations agencies,
Fellow Scientists, Administrators, Friends,
Ladies and Gentlemen,

On behalf of the Filipino people and of the Republic of the Philippines, it is my pleasant task this morning to extend a warm and cordial welcome to all of you. We welcome all of you to our homeland with our hands and hearts open in friendship, love and peace.

This conference on science and technology comes at a most opportune time for the peoples of Asia and the Pacific. As each of our countries, rich and poor alike, attempts to cope with the difficulties, challenges and opportunities in a rapidly changing world, which is increasingly getting more populous, getting more and more energy hungry, getting more spoiled and dangerous to live in, and getting more complex and interdependent, we find we have to turn to science and technology as a powerful way of inquiring into and in working out alternative solutions to age-old problems.

The period between CASTASIA I which was held in New Delhi in 1968 and this conference has provided sufficient time for the countries concerned to implement in whole or in part the prescriptions in the New Delhi document.

The time has come to measure the progress of the countries in the region in the field of science and technology as brought forward during that first meeting.

Except for a few notable exceptions, most of the countries which have broken away from colonial rule have had sufficient time to consolidate their freshly worn political rights and now perforce must concentrate on the economic and technological spheres in order to give substance and meaning to their political independence.

The concerns in science and technology remain fundamentally the same, although new parameters have since been introduced principally in terms of the cost and availability of fossil fuels, emerging technologies in biology, space, information and communications and in materials, and in the emergence of Japan as a third regional locus of intense industrial and technological activity in competition with the established centres in Europe and North America.

For the less developed countries, access to the world's pool of science and technology and the their ability to adapt these technologies to suit their particular needs remain as the major issues of concern.

Technologies, which will enable them to clothe, feed and shelter their people better, to process their raw materials into more profitable manufactured products, to generate employment and to enhance productivity, are very high in the priority lists of the developing countries.

Equally important is the realization that technology could be acquired without the country developing an indigenous capability to generate, transfer and utilize technology. This places the country in a totally dependent posture to the suppliers of technology which nullifies their hard-earned political autonomy.

Thus each of these countries must seek to institute policies and mechanisms, and establish domestic organizations and institutions which in time will enable the country to attain a respectable measure of self-reliance in matters of technology generation, transfer and adaptation.

The more affluent nations, on the other hand, have their shares of concern in science and technology, too. Having provided for the basic physical needs of their populace, their concerns focus more on which directions to advance the frontiers of knowledge in order to keep their traditional lead and advantage; to diversify the sourcing of their massive energy needs; and to contain the assault of modernization on the environment and on the social, cultural and political fabric of their national societies.

CASTASIA II therefore will have its hands full in the great task of assessing the state of science and technology in the Member States in the region; in focusing attention and in contributing to the understanding of the issues which have remained unresolved since the last meeting, and of the new dimensions which have arisen since then, and in promoting and mobilizing co-operation in all forms among Member States in the region and throughout the world.

We can only wish that CASTASIA II succeed in the big challenges ahead of it. If the caliber of the delegations in this conference could be used as a gauge of the goodwill and commitment of the Member States to the rational and humane development and application of science and technology in the affairs of their respective states and societies, there is plenty of room for optimism.

With the political will of the Member States and through mutual co-operation and understanding in the spirit of a shared destiny for all, we can still hope to look forward to the dawn of a more prosperous, safe and equitable world.

Statement of Mr. S.A.M.S. Kibria,
Executive Secretary of ESCAP
(Read on his behalf by Mr. V. J. Ram, Chief
ESCAP/UNIDO Division of Industry,
Human Settlements and Technology).

Mr. Chairman,
Excellencies,
Distinguished Representatives,
Ladies and Gentlemen,

I have great pleasure in extending a warm welcome, on behalf of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and on my own behalf, to all the participants in the Second Conference of Ministers Responsible for the Application of Science and Technology to Development and those Responsible for Economic Planning in Asia and the Pacific (CASTASIA II).

We often hear that the world is passing through a period of turbulence - economic, social and political. Behind all these crises, there is a central challenge of finding an orderly accommodation in the changing fortunes of the economic and strategic strength of nations. Science and technology have a vital role in determining the socio-economic development and strength of nations. They alone can help us in solving the problems of hunger, poverty and illiteracy. However, in the pace and pattern of developments in science and technology, there are astounding diversities and inequalities among nations in the world. The entire Third World, while accounting for 75 per cent of the population of the international community, accounts for only a fourth of its exports, a fifth of its imports and GNP, a sixth of its industrial output and less than 5 per cent of its capital goods output. In the sphere of science and technology, this inequality is sharper, with the share of the Third World being only 2 per cent in research and development expenditures, 1 per cent in patent holding and nearly zero in development of frontier science and technology.

Despite all this, it is interesting to remember that only a few hundred years ago science and technology flowed from the East to the West, and Europe was the recipient of the benefits of scientific and technological advances in the rest of the world. This flow has been completely reversed during the last two centuries. The explosive developments in this area, especially since 1850, have radically altered the ability of people to produce more and varied goods and services. In today's industrially advanced countries, productivity per person, which is a good measure of technological transformation, has increased 12 to 15 times during the last 130 years and a veritable treasure-house of technologies has been created during this period. The problems of backwardness and underdevelopment, among vast areas and peoples, especially in this region, are basically due to their being by-passed by these significant developments in science and technology during the last 100 or so years. Therefore, at this juncture, it is imperative for all nations in the world community to address themselves to the task of vigorous and equitable development in science and technology, to ensure greater access to science and technology by developing countries, to strengthen their endogenous capability in this area and to promote the technological transformation of their societies. CASTASIA II, meeting as it does at this juncture, has these historic responsibilities and I attach great significance to the deliberations of this important conference.

The growth of modern science and technology coincided everywhere in the world with the industrial revolution. The growth and spread of technology, which is often described as the 'science of industrial arts', is very relevant in this context. Modern technology is not a simple by-product of science. It has a logic and impact of its own on the socio-economic structure. Without science, technology will degenerate into mere craft, just as science, without its interaction with technology, will become barren. In all projects and programmes for scientific and technological transformation, this complex relationship between science and technology, on the one hand, and the industrial revolution, on the other, needs to be kept constantly in mind. The structure of scientific and technological organizations built in a number of countries in this region is largely based on those in existence in Western Europe during the late nineteenth and early twentieth centuries. Their role and contribution to national goals and tasks have not been uniform. Improved interaction between science and technology, on the one side, and the process of development, on the other, is urgently required.

Carefully prepared and well-thought-out science and technology policies and plans can be very effective instruments in enhancing the capacities of a nation and in achieving greater diffusion of known technological inventions on a wider scale through better integration of developments in science and technology with the production sectors. Therefore, I am confident that the conference will discuss and delineate the contours of such policies and plans as precisely as possible. The United Nations system has assisted and aided significant developments in specific areas of science and technology during the past two decades. However, such developments have been slow in the area of 'industrial technologies'. Therefore, the time is ripe for concentrating on institutional developments and programme support for the growth and spread of industrial technologies in developing countries.

The requirements in science and technology in this region are immense and so are the problems connected with their development and growth. In order to make a perceptible and tangible impact on these needs and problems, a great deal more financial and other resources than are currently deployed by national and international agencies are necessary. Moreover, the international environment in which the developing countries can plan their technological progress has become rigid, favouring developed countries' interests and imposing heavy constraints on 'newcomers'. The conditions for acquiring foreign technology have become more stringent. Technology is being imported without the essential technological experimentation and concomitant training that were characteristic of the pioneer industrial countries. As a consequence, even when some of the developing countries have experienced higher rates of growth, there has not always been a parallel development of their domestic technological capability. It is in this context that a new international technological order, as referred to in the Declaration on the Establishment of a New International Economic Order, is of paramount importance.

A dynamic interpretation of the interdependence of various components of the world economy and devising mechanisms for greater collaboration among developing countries within the region in formulating strategies and planning countries for technological transformation are equally important. It is essential for developing countries to avoid repetitive research and development along identical lines and to co-operate and collaborate on substantial programmes and activities to secure better results from their collective efforts. I hope and trust that the deliberations during this conference will result in such concrete measures of co-operative endeavour.

ESCAP, as the only intergovernmental forum in this region, is increasingly being called upon to play an expanded and unique role in the field of science and technology for development. As a pre-eminent forum for collective action by all governments in this region, it has provided significant opportunities for interaction between policy-makers in the member countries and has assisted them in evolving institutional and policy initiatives for building up their technological capabilities. During the preparations for the United Nations Conference on Science and Technology for Development in 1979, ESCAP supported member countries in formulating their national papers and in evolving the regional contribution and has also been active since then in the implementation of the Vienna Programme of Action. It is closely involved in the preparation and execution of the operational plan for the implementation of the Vienna Programme of Action and in the regional, subregional and national initiatives required for this.

In the spirit of General Assembly resolution 32/197, which envisages the regional commissions as the main economic and social development centres of the United Nations system in each region, ESCAP has been functioning as the regional nodal point for all activities of the United Nations system in the implementation of the Vienna Programme of Action. In co-operation with countries of the region, ESCAP established the Regional Centre for Technology Transfer in order to assist them in all matters concerning technology development and transfer. The Centre functions on the network concept and has proved to be an extremely good instrument in providing back-up support to national efforts and in implementing regional activities in the field of technology. It acts as a regional instrument to further the major concerns of different organizations in the United Nations system involved in the field of technology and therefore is able to stimulate and guide a large spread of activities in our member countries. In keeping with the global plans and the requirements of member countries, a regional operational plan is being evolved by the ESCAP secretariat.

The work programme of ESCAP in science and technology for development is reviewed by ESCAP's Committee on Industry, Technology, Human Settlements and the Environment, which meets annually, and by the Commission itself each year. The Commission has, inter alia, mandated that a biennial survey of science and technology for development should be undertaken in the region, so as to ensure that the crucial elements and critical determinants of scientific and technological progress are periodically highlighted for the operational interest of policy-makers in member countries. The documents, proceedings and final recommendations of CASTASIA II will be very useful in the organization and conduct of this survey. The discussions during this conference will also enable ESCAP to focus upon and pinpoint relevant issues for consideration at the regional meeting of ministers of science and technology for development, which we propose to hold at an appropriate time in consultation with all other concerned agencies. These major initiatives by ESCAP will, I hope, carry forward the momentum generated at this meeting.

In keeping with the central role of ESCAP as the region's main development centre for the United Nations, a great deal of emphasis has always been laid on interagency co-ordination in order to optimize results. It is necessary to co-ordinate the activities of different United Nations agencies in this important area and effectively complement the efforts at the national level. For this purpose, ESCAP has constituted an interagency task force in the field of science and technology, which, through its periodical meetings, is able to synthesize and harmonize the diversity of efforts in this field. The proposed establishment of a regional advisory committee on science and technology for development consisting of a small number of experts serving in their individual capacity at the regional level would also strengthen the work of this interagency task force. I am confident, therefore, that the institutional framework already in position and the mechanisms in existence for interagency co-ordination and inter-country and institutional co-operation will prove useful in the effective implementation of the principal recommendations of this important conference. On this occasion, I should like to commit all agencies and forums of ESCAP to the challenging tasks of carrying forward the basic initiatives and activities in the region arising from your deliberations.

I wish you every success in your deliberations.

Address by Mr. Amadou Mahtar M'Bow
Director-General of Unesco

Mr. Prime Minister,
Distinguished Ministers,
Members of the Diplomatic Corps,
Mr. Representative of the Executive Secretary of ESCAP,
Your Excellencies,
Honourable Delegates,
Ladies and Gentlemen,

It is both an honour and a pleasure for me to open with you this Second Conference of Ministers Responsible for the Application of Science and Technology to Development and Those Responsible for Economic Planning in Asia and the Pacific.

First of all, I should like to thank the Prime Minister, Mr. Cesar Virata, most sincerely for being here with us and for the generous hospitality shown to our Conference by the Government and people of the Philippines.

I also wish to express our deep gratitude to President Ferdinand Marcos, who has always taken a personal interest in Unesco's activities and in the role it plays in international co-operation.

Your country, Mr. Prime Minister, provides by its geographical position and by its historic role a striking illustration of the task of the Conference it is hosting today - that of linking the countries of the Asian continent to the island nations of the Pacific, and also of linking them as a whole to the rest of the international community.

Situated as it is, at this meeting-place of so many peoples and so many cultures, the Philippines has succeeded, while preserving the most characteristic elements of its traditions, in assimilating the many rich contributions it has received from the outside world - thereby becoming a remarkable cultural and intellectual melting pot.

In expressing our gratitude to you, Mr. Prime Minister, may I mention the outstanding efforts made by your country's officials to ensure the success of this Conference. I am thinking in particular of Mr. Emil Javier, Chairman of the National Science Development Board, the National Commission of the Philippines for Unesco and its President Mr. Carlos Romulo, Minister of Foreign Affairs - to whom we send our best wishes for a speedy recovery - and the members of the National Organizing Committee, among whom I should like to single out Mr. Pedro Abella, whose service to his country has for so long been identified with service to our Organization. And, lastly, I thank those in charge of this magnificent Convention Center where we are meeting today and the authorities of Metro Manila.

I should like now to welcome the distinguished representatives of the Member States belonging to the Asia and Pacific region and the observers from other regions. I am particularly glad to see among us the delegates of countries which have come to be included in this region since the holding of the first CASTASIA Conference in 1968: Australia, Bangladesh, New Zealand, The Democratic People's Republic of Korea, Western Samoa, Tonga, Maldives, Papua New Guinea and, more recently, Turkey.

I also greet the representatives of organizations in the United Nations system and observers from international or regional intergovernmental or non-governmental organizations - including the representative of Mr. Kibria, Executive Secretary of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), who, detained in Bangkok by the Commission's annual session, has been unable to join us here and has sent the message which has just been read to you.

May I also extend a welcome to Mr. Ferrari, Director of the United Nations Centre for Science and Technology for Development. His presence here emphasizes the direct continuity that links the United Nations Conference on Science and Technology for Development (UNCSTD), held in Vienna in 1979, with the present Conference.

Lastly, it is my pleasant duty to welcome the journalists and scientific writers who have wished to follow the proceedings of this Conference: their role will be vital in disseminating the results of its deliberations and in bringing the message which it carries to the public throughout the entire world.

Mr. Prime Minister,
Ladies and Gentlemen,

It will soon be fourteen years since the holding in New Delhi of the first CASTASIA Conference, which brought together the Ministers of Science and Technology of the countries of Asia. The second is opening here today, in pursuance of of resolution 2/01 adopted by the twenty-first session of the General Conference of Unesco, which met in Belgrade in 1980. This Conference forms part of a series of ministerial conferences on science and technology organized by Unesco at intervals in the various parts of the world in order to review the state of scientific and technological development in the countries of a specific region, to reflect on their current scientific and technological capability levels and ways of raising those levels and to examine the role regional and international co-operation can play to that end.

The proposed agenda contains, then three essential items.

The first of these items concerns a general review of the situation, with particular reference to the current state of national capability levels and the progress achieved to date.

The study presented in the main working document - 'Science, Technology and Development in Asia and the Pacific' - shows that scientific capability levels have risen considerably since the first CASTASIA Conference.

The total number of scientists and engineers has increased over the past ten years at an average annual rate of approximately six per cent, with a peak exceeding ten per cent in the Republic of Korea and minimum percentages of the order of 0.4 (New Zealand).

As regards higher education, there has been a steady increase in the number of university and engineering college enrolments throughout the 1970s. At the same time, the number of higher education graduates has risen continuously, training being provided essentially by establishments in the region itself and the numbers studying abroad remaining below 5 per cent.

None the less, the proportion of research workers in the population as a whole remains extremely low in the developing countries of the region. According to the Unesco estimates, which cover all the countries except China, the Democratic People's Republic of Korea, Mongolia and the Socialist Republic of Viet Nam, the average number of scientists and research engineers per million inhabitants was 99 in 1978, which is still very modest compared with the figures for the USSR (5,024 per million), Japan (3,548 per million) and Australia (1,617 per million). For the purpose of comparison, the figures for the West European countries and North America range from 1,200 to 1,800 with 2,685 in the United States.

Funds spent on research in the region have increased considerably since the end of the 1960s, but the amount is still small considered in relation to national wealth. Whereas the developing countries of the region were earmarking between 0.1 and 0.3 per cent of their gross national product in 1965, they are now earmarking between 0.2 and 0.4 per cent. The rate of 1 per cent advocated by the first CASTASIA Conference has thus not been reached, and the vast majority of the countries of the region have yet to achieve the more modest target of 0.5 per cent proposed by UNACAST in its World Plan of Action at the beginning of the 1970s.

The attitudes of the governments of your region, however, reflect a general will to overcome the difficulties they encounter and to promote scientific and technological development enabling them to take advantage of the manifold potential of modern knowledge and know-how.

To this end, they have made an effort to set up the necessary decision-making bodies, and the 1970s saw the establishment in almost all countries in the region either of ministries of science and technology or of analogous national councils and committees.

The second agenda item concerns science and technology policy issues. Item 8.1 deals with the means of building up science and technology capacity as such - through education and training, research and experiment and specialized information, while Item 8.2 is concerned with the ways whereby science and technology may most effectively serve the needs of development.

It would seem to be now an accepted fact that science education is, in every respect, a prerequisite for the real advance of science. This education accordingly warrants special attention at the primary and secondary levels, for the quality of studies at the higher level is governed by this. More generally, it would seem useful to pay particular heed to the various problems involved in bringing study programmes into line with the changes that are occurring with increasing rapidity, as well as those concerning the qualifications and status of teachers and the quality of teaching materials. The training of qualified personnel and, more especially, of technicians who can effectively back up the engineers and scientists is also of major importance - the most serious shortfalls are often experienced among the ranks of middle-level personnel or even skilled workers.

Moreover, experience would seem to show that the potential of a country for scientific and technological innovation depends on the general level of knowledge of the population - and, above all on the quality and diversity of the research that it can undertake. This research work implies, in turn, the creation of a variety of highly specialized institutions, the cost of which is bound to raise problems of considerable complexity. Nevertheless, countries with limited means and a small scientific community can also reach a really effective level of research if they concentrate their efforts in clearly-defined fields and take full advantage of the experience acquired in the rest of the world.

Scientific and technological information has an essential role to play in this regard. However, the setting up of bibliographical data bases often demands years of work and, at times, considerable financial resources. Because of this the international community is in duty bound to take special measures in order to give the least privileged peoples access to such information.

The problems concerning the utilization of science and technology for development involve, for their part, several essential aspects which call for examination by your Conference.

The introduction to the review of the situation set out in the Conference's working document quite rightly points out that one of the major challenges facing you is the sheer magnitude of the needs of a region which numbers over 2.5 thousand million people. And the growth rate of this population - 2 to 3 per cent per annum - means that food and employment needs will, in the near future, reach unprecedented proportions.

These quantitative needs are compounded by others - such as those arising from the enormous disparities in income to be seen among the different population groups and the various countries in the region. Moreover, although the economic situation of the countries in Asia and the Pacific has, in general, improved, we cannot overlook the fact that their energy supply problems and their increasing reliance on cereal imports - at a time when the restrictions imposed on their exports are increasing and the general terms of trade are deteriorating - have seriously jeopardized the economic growth of most of them and thus slowed down the effort to reduce inequalities in the region.

At the same time we are witnessing the phenomenon - seemingly inexorable - of migration to the towns. Whereas in 1960 the urban population accounted for 20 to 25 per cent of the total population, we may expect this figure to be doubled, according to United Nations projections, by the year 2000. This gives us the measure of the enormous task of urban development and construction that we must prepare for here and now and the impact that this evolution is bound to have on the organization of urban society and on the national life of every people.

This, then, provides the background for our thinking concerning the role that science and technology could play in determining the future of the peoples of your region.

One of the decisive aspects of the question lies in the smooth integration of scientific and technological progress in the overall national development process. This integration depends, in large measure, on the ability to adapt the methods, means and instruments that modern knowledge and know-how offer us to the traditions, feelings and specific aspirations of each people.

Any use of progress which attempts to bypass the basic realities of the relevant cultural and socio-economic context may produce a reaction of rejection. It is of the greatest possible importance then, to master the necessary adaptation processes. And here the social sciences have an essential role to play in aiding our understanding of such processes. Science education, for its part, can help to make people aware of the benefits of innovations and thus increase their social acceptability.

A deeper understanding of the processes governing the adaptation of scientific and technical means to the needs of development can, furthermore, help to guide policies and organize action. For whereas decisions concerning science and technology are dependent on overall socio-economic development strategies, they tend, in the long run, to influence the ways, means and sometimes the objectives themselves of such strategies.

Your Conference is, lastly, called upon to review the processes for the formulation and implementation of appropriate science and technology policies. This point concerns more especially the government bodies responsible for policy-making, the organization and functioning of these bodies and their relation to national development planning and budgeting mechanisms.

The participation in these bodies of scientists and engineers actively engaged in scientific research and technological innovation is of great importance, as is that of specialists in the analysis of social processes linked to scientific and technological development. Moreover, the work of these specialists demands bibliographical information on studies conducted throughout the world and statistical information on the scientific and technological potential of the country concerned. Finally, the range of analytical techniques used for determining priorities and preparing plans and budgets needs to be further developed, as does the series of procedures that can be used for policy formulation.

The third agenda item concerns the prospects of international and regional co-operation in science and technology. Regional co-operation has developed steadily over the past ten years, and Unesco, for its part, has sought to foster this movement by strengthening or, if necessary, remodelling its major intergovernmental programmes concerning the environment, water, oceanography and the earth sciences, and its programmes of co-operation in many fields such as chemistry, microbiology, computer science and new energy sources. It has also strengthened its Regional Offices for Science and Technology by the inclusion of new functions.

You may perhaps wish to examine the question of priority areas for co-operation in science and technology. The decisions to be taken are not simple, having regard to the magnitude of present-day needs. Here the conclusions of the experts from countries in the region who met in Bangkok last December and whose report forms part of the documentation made available to you could provide you with useful information.

Co-operation can play an increasingly important role in complementing and reinforcing national efforts in many areas. In this context, the regional networks set up by Unesco for the chemistry of natural products and for microbiology are splendid examples of collaboration between the national scientific communities of various countries of the region. In particular, such networks enable the communities concerned to establish the contacts that are essential for their work, to disseminate information and to enhance the collective research potential that exists in your region.

All Unesco's major research projects have been designed with these aims in mind, and four of them are of particular interest to you, namely a major project on the integration of technological research, training and development and three others on research, training and demonstration as applied to the integrated management of humid tropical zones, arid and semi-arid regions and coastal eco-systems. This last project is of particular relevance at this time when the Conference on the Law of the Sea is taking place and when all countries are preparing to take on new responsibilities in the management of their ocean environment and in the use of marine resources.

There are many other areas in which further efforts could be made. I am thinking in particular of the Regional Network for Geosciences and the international project for the construction of a giant equatorial radio telescope (GERT), which is supported by the International Astronomical Union and by eminent scientists from your region. The feasibility study for this project may be carried out by Unesco.

Lastly, with a view to the implementation of your recommendations, you are invited to specify the measures to be taken by your countries and by Unesco or by other international organizations and, in particular, to outline the arrangements that will enable you to assess the efforts undertaken as a result of CASTASIA II and periodically take stock of them. For the purpose of assisting you in this task, the main working document you have been given briefly recapitulates the various arrangements made following ministerial conferences on the application of science and technology to development organized by Unesco in various regions of the world since 1965.

Mr. Prime Minister,
Ladies and Gentlemen,

In the course of the conferences of ministers of science and technology Unesco began organizing in 1965, the conviction has grown steadily stronger that advances in science and technology today hold out immense opportunities to us. If placed at the service of mankind and adapted to the specific aspirations of the individual peoples, science and technology are capable, in the near future, of putting an end to hunger, illiteracy and the major endemic diseases, all over the world. But they can do more than alleviate human misery: they can help to enrich life considerably, to create further contacts between peoples, to bring cultures closer together and to strengthen the bonds of solidarity between nations.

These objectives are obviously not easy to attain, but the new factor in the world of today is that they have become possible. For the promises held out by scientific and technological progress to materialize, everything depends on the will of individuals and on the detdrmination, generosity and imagination of authorities everywhere.

The experience built up so far already points to a number of basic conclusions, the most important of which no doubt concerns the close link that exists between the cultural, economic and social factors of development and its scientific and technological factors.

Although these latter factors are now recognized as a powerful driving force for change there is nothing autonomous or exclusive about this function. They cannot fulfil the hopes placed in them unless they are integrated into each individual context, are accepted, assimilated and developed creatively by each population concerned, meeting its needs and its own particular priorities.

There is no doubt that the Conference that brings us together today will give a stimulus to our general thinking on the conditions that are most conducive to this integration process. It is, indeed, being held in a region which has already made an exceptional effort to place science and technology at the service of development. This effort has led to remarkable successes, to unexpected results and to new challenges; it has enabled us to solve many problems in a great many spheres of activity, at the same time contributing to the emergence of new points at issue which were unsuspected at the outset concerning questions to which no answer has yet been found, even today.

President Ferdinand Marcos aptly described this process of continued renewal when he wrote, in his Notes on the New Society of the Philippines, 'We must, in a realistic manner, recognize this principle - that it is much better to face up to the problems resulting from reform measures than to allow old problems to worsen and to overwhelm us. The solution to one problem tends to raise others. And we must face those which reform gives rise to with vigour and enthusiasm'.

Mr. Prime Minister,
Ladies and Gentlemen,

Although it shares with other regions certain features that are common to the developing world, your region is distinguished nevertheless by certain characteristics which are specific to it - first and foremost, its population density. The immensity of its numbers represents here, at one and the same time, an asset and a challenge. It is an asset because its peoples, the inheritors of renowned civilizations which are the vectors of age-old cultures, possess the capacity for production and innovation which, rooted in loyalty to abiding spiritual and ethical values, opens up boundless prospects for the future.

But these large numbers also represent a challenge inasmuch as the problems arising on this scale have a particular intensity and cadence, and your region is called upon to solve these problems by mobilizing more intensely than elsewhere the whole of its capacity for change.

But this region, with its ancient wisdom and eternal youth, has long demonstrated that it is able to guide the course of progress by its sense of spiritual and ethical values. It possesses, then, the secret of change that is synonymous with progress for all and with development for each individual.

It is with the prospect of such a change in view that I express my wishes for the complete success of this Conference.

Keynote address by His Exc. the Honourable Cesar E.A. Virata, Prime Minister of the Republic of the Philippines

Your excellencies:

Mr. Amadou-Mahtar M'Bow, Director-general of Unesco,
Mr. Ram, Representative of the Executive Secretary of ESCAP,
Dr. Emil Javier, Chairman of the National Science Development Board,
Ambassador Felipe Mabilangan, Permanent Delegate of the Philippines to Unesco,
Distinguished Delegates and Participants,
Members of the Diplomatic Corps,
Staff members of Unesco, ESCAP and other United Nations agencies,
Fellow Scientists, Ladies and Gentlemen, and Friends,

President Marcos, the First Lady, Governor of Metro Manila, the Filipino people and the Philippine Government are very honoured by your presence. We are very pleased indeed that you accepted our invitation to hold the Second Conference of Science and Economic Planning Ministers in Asia and the Pacific in Manila. Since the topic of science and technology is of vital interest to us, as it is I suppose to everybody else, we shall be following with keen interest the deliberations, the resolutions and the outcomes of your conference.

At this point, allow me to compliment the Unesco Organization through the person of its Director-General, Mr. M'Bow, and the staff of the Paris, Bangkok and Jakarta offices here present not only for CASTASIA II but for the many initiatives the Organization has taken in the Asian and Pacific region during the last few years in the fields of science and technology, education and culture. The Philippines have had the privilege of participating in a number of activities and we have benefited greatly like the other participating countries from these regional efforts.

Our congratulations go as well to ESCAP which I understand is Unesco's partner in the organization of this conference, also for its much appreciated efforts in assisting the Member States in the region in economic and social development. As you know ESCAP's annual meeting is also being held simultaneously in Bangkok during this week.

It has been fourteen years since the first CASTASIA meeting in New Delhi in 1968. Since then there have been other global deliberations and negotiations in trade and development (UNCTAD), in science and technology (UNCSTD), and in new and renewable forms of energy (UNCNRSE) which have sought to highlight the problems of mankind in each of these concerns, the opportunities and challenges arising out of these problems, and the initiatives open to the world community of nations acting singly or collectively in addressing these issues.

As we look back to 1968 and observe the present, one begins to wonder how far we have gone ahead in the development and application of science and technology in each of the different countries in the region. This I understand is precisely one of the objectives of CASTASIA II - the review and assessment of developments and trends, in S and T among the Asian and Pacific nations. I am glad this review dwells on the building up of the S and T capacity and the S and T for development unlike the undue emphasis on improvement of technology in weaponry. I was informed that our existing stock of weapons are enough to kill the world's population ten times over but some countries are improving the kill ratio still more.

Obviously there cannot be one, single answer since the countries in the region vary widely in terms of their stages of economic development, their economic and production systems, their initial manpower base, the resources at their disposal as well as the strategies they have adopted for development purposes.

The holding of CASTASIA II in Manila assumes special significance to us because you have come at a point when we ourselves have been conducting an assessment of the status of science and technology in our country, its planning, organization, and governance and strategies and programmes for action. That self-assessment is almost complete now and as a consequence we have made a number of decisions which, with your indulgence I wish to share with you this morning.

Since these decisions were made only recently, I hope you will not mind if I take this opportunity to make formal these decisions which I know the Philippine science community had been waiting eagerly for the past few weeks.

They have participated in the dialogues and consultations which preceded these decisions and are therefore naturally curious of the outcomes.

The New Philippine S and T system

Under a reorganization order signed by President Marcos, a National Agency - to be known as the National Science and Technology Authority, is to be entrusted with the responsibility of formulating and implementing policies, plans and programmes for the development of S and T capability and the promotion of S and T activities.

We shall have a comprehensive national plan for S and T which will be formulated by this Authority and which upon approval by the President will be implemented by all government agencies and instrumentalities.

Such a S and T plan, which is to be developed in close collaboration with the National Economic and Development Authority, will be relevant to and consistent with the national economic development plan, and will mobilize and harness all government resources to ensure the effective and efficient implementation of an accelerated scientific and technological research and development programme and to promote the utilization of the results of such programme. The plan, moreover, will provide guidelines for the role and participation of the private sector in the national S and T effort.

This Authority will likewise prepare and submit to the Office of Budget and Management its annual budgetary requirements and co-ordinate the funding and implementation of the comprehensive national plan for S and T.

Planning, co-ordination, promotion and monitoring at the sectoral level will be accomplished through a system of sectoral S and T councils under the administrative supervision of the Authority.

The council system is to be composed of the Philippine Council for Agriculture and Resources Research and Development (PCARRD), the Philippine Council for Industry and Energy Research and Development (PCIERD), the Philippine Council for Health Research and Development (PCHRD) and the National Research Council of the Philippines.

The Director-General of the Authority sits as chairman in all the councils except in the NRCP which retains its status as a collegial body of scientists.

The NRCP is primarily responsible for research of a more basic or fundamental nature in contrast with the applied research orientation of the three other councils.

Membership of the councils provides for balanced representation from appropriate government ministries and individuals from the private sector who are appointed in their individual capacities.

The other novel features of the new order include the establishment of a scientific career system within the civil service which will provide for parallel career paths that would allow scientists to develop within their respective areas of expertise without having to change their status as scientists and give appropriate incentives to attract and retain qualified manpower in the science career system.

Likewise, to promote and encourage the sharing between and among academic and scientific institutions, of libraries, equipment and other facilities and to provide a physical and social environment conducive to scholarship, professionalism and inquiry, we plan to establish science communities at appropriate locations. These science communities will provide for research and living facilities for scientists and their families.

Demand pull strategy for technological development

A re-examination of our technological needs indicates that for the moment and for the most part, our needs are relatively simple. The agriculture, forestry and fisheries sectors and the local industries, the majority of which belong to the small to medium scale category, need new and improved production methods and facilities to enhance labour productivity, to make more efficient use of energy and to make fuller use of local raw materials. These technologies as a rule are already available elsewhere and therefore need not be invented again.

What we require is ready access to this information and the ability to adapt the technology to local economic, social and environmental conditions.

Technological development is a continuous process which includes the stages of generation (research), diffusion (technology transfer), and application of knowledge (technical innovation). Technological development takes place only when the three stages are harmoniously developed and linked.

Creation of new knowledge constitutes a 'supply' that should be followed by their application.

Ironically it appears that part of our problem had been the tendency to look at our lack of technological progress in terms of insufficient application of S and T. This follows the classical supply-push approach which has dominated science policy thinking in developed countries.

We have tended 'to equate science policies with research policies', the premise being, if we promote research and development, the economy will sooner or later translate and absorb the new knowledge into the production system.

We have for the most part given insufficient attention to the 'diffusion' and 'innovation' stages, much less to the regulation of transfer of foreign technology.

We are proposing, therefore, to take a different tack and aggressively approach the technology issue from the demand side to complement with our present largely supply-push efforts.

It is this assessment of our S and T situation that has guided us in redirecting our S and T policies, programmes and institutional mechanisms towards what we might call a demand-pull strategy for technological development.

We now seek closer integration of the S and T system with the economic production system at the operational level.

The national development plan will now feature a comprehensive, national S and T plan with specific targets and programmes.

The S and T organizational structure itself is now redesigned to permit a consultative-planning linkage between industry and the S and T system to harmonize demand and supply of technologies.

For their part, the research organizations, particularly the ministry R and D agencies, are encouraged to pay more attention to the diffusion and utilization stages downstream activities in the R and D spectrum.

Technology delivery organizations which attend to the needs of the users of technology must now become a significant, integral part of the R and D system.

Acquisition of technologies by both public and private organizations must now be supported, technically and by means of regulations, to assist in the selection, evaluation and negotiations of technological imports.

A recent feature in the Philippines S and T system is a two-step technology transfer mechanism which facilitates the incorporation of new, improved technologies by cottage, small and medium scale producers which as I indicated earlier form the bulk of our private enterprise system.

The process calls for the intervention of a third party in the transaction - the Technology Resource Centre - which functions as a one-stop shop and project syndicator which brings together the supplier of technology, the sources of financing and raw materials, the entrepreneur who will use the technology and even the buyer who will use the technology, and even the buyers who will absorb the products of the enterprise.

This resource centre approach is proving to be a very crucial link or bridge by which small producers are able to gain access to new technologies and could very well be one of the many possible institutional answers to the problem of technology utilization and propagation in developing countries.

International and regional co-operation in science and technology

The Vienna Conference of 1979 called for the establishment of an interim fund for science and technology preparatory to a final decision on a United Nations Fund for Science and Technology for Development.

The agreement for the interim fund lapses this year. This matter is an issue of great importance to the conference. Although the interim fund attracted less than $40 million, the fund has demonstrated its catalytic value in promoting S and T development in many developing countries.

In addition to the usual statements of support for the fund, the conference, through the Member States present, may wish to signal to the developed countries our deep interest in the establishment of such a regular fund for S and T development by way of more than token contributions to the fund ourselves.

Speaking of regional co-operation I wish to call the attention of the conference to the many successful forms of co-operation at the regional level which have evolved since the last CASTASIA meeting. We are in full support of these efforts and we have participated wholeheartedly in many of them.

There are more ways in which we could mutually assist one another. I therefore enjoin the conference to devote sufficient thought to this topic so that we may broaden and deepen further these links among Member States in the region.

I hope you can develop the results of the conference by summarizing them in a declaration of the Manila Conference.

ANNEX III

CLOSING SPEECHES

Motion of thanks

Address by Mr. Amadou Mahtar M'Bow
Director-General of the United Nations
Educational, Scientific and Cultural Organization

Address by His Excellency Dr. Emil Q. Javier,
Chairman, National Science Development Board

Message from the President of the Republic of
the Philippines

MOTION OF THANKS

moved by the Delegation of New Zealand

Appreciation and gratitude expressed by the participants of CASTASIA II

On behalf of all Member States participating at this second Conference of Ministers responsible for the application of science and technology to development and those responsible for economic planning in Asia and the Pacific (CASTASIA II),

Closing its meeting held at the Philippines International Convention Centre, Manila (the Philippines) from 22 to 30 March 1982,

It is my very great pleasure to

1. Express our deep appreciation to Doctor Pacifico Marcos for honouring this Conference with his presence. We wish to express our deep gratitude to President Ferdinand E. Marcos and to the people of the Philippines for their generous and warm hospitality and for hosting this timely and significant Conference in the Philippines,

2. We wish to express our appreciation to H. E. Mr. Cesar E. Virata, Prime Minister of the Republic of the Philippines, who addressed the Conference at the opening ceremony,

3. Conference Delegates and observers also wish to acknowledge their deep appreciation to the Conference Officers and, in particular, to the President H. E. Dr. Emil Javier, Chairman, National Science Development Board, who also presided over the local Organizing Committee for CASTASIA II, and the Rapporteur-General, Mr. Hasan Nawab, Joint Secretary, Ministry of Science and Technology of Pakistan,

4. We wish to express our gratitude to Unesco for convening the Conference and our appreciation to the Director-General for the efficient services of the Secretariat, in particular, the excellent preparation and rapid distribution of Conference and Pre-Conference documents,

5. It is also our wish to record our appreciation of all the supporting staff including interpreters, translators, administrative personnel, secretaries, technicians, assistants, and drivers, whose faithful and untiring services were an essential contribution to the successful organization of the Conference.

Address by Mr. Amadou Mahtar M'Bow
Director-General of Unesco

Dr. Pacifico Marcos, Representative of the President of the Republic of the Philippines,
Mr. President of the Conference,
Your Excellencies,
Ladies and Gentlemen,

As the proceedings of the Second Conference of Ministers Responsible for the Application of Science and Technology to Development and Those Responsible for Economic Planning in Asia and the Pacific (CASTASIA II) draw to a close, I am honoured and delighted to welcome Dr. Pacifico Marcos, Representative of the President of the Republic of the Philippines. The fact that the President of the Republic has sent a special representative to this closing meeting is further proof of the vital importance he attaches to international co-operation and a mark of his commitment, on his country's behalf, to science and technology as a driving force for the progress of his people.

It is my pleasant duty, Mr. Special Representative of the President, to express to the Government and the people of the Philippines, through you, my very deep appreciation of the warmth and friendship with which they have hosted this conference and of the many facilities they have so generously provided in order to ensure its success.

I should like to say, Mr. President of the Conference, how much we have appreciated the skilful and, at the same time, courteous way in which you have directed the deliberations of the Conference, the stimulating effect of your firm guidance as well as the confidence you have shown in the Unesco Secretariat which has had the pleasure of aiding you.

May I also pay tribute to the work of the Vice-Presidents, the Rapporteur-General, and the Chairmen, Vice-Chairmen and Rapporteurs of Commissions I and II who have shared with you the lofty responsibility of bringing the proceedings of this Conference to a successful conclusion.

I am extremely grateful to the Philippine Technical Committee responsible for the organization of the Conference, whose constant assistance has been invaluable to the Secretariat throughout the Conference.

Lastly, I thank all the participants gathered here who, through their contributions, have enriched a debate which, from start to finish, has been of a remarkable calibre.

Mr. President,
Ladies and Gentlemen,

Doubtless it is still too early to make an exhaustive assessment of the results of CASTASIA II. However I believe I am speaking on behalf of all of you when I say that this Conference marks a real turning point in the series of regional ministerial conferences that have been organized by Unesco on science and technology.

As demonstrated by the quality and constructiveness of your discussions, the variety and scope of your recommendations and the exceptional importance, finally, of the Manila Declaration, your countries have shown a determination to master science and technology to an ever-increasing extent in order to serve the development of your societies.

President Marcos summed up this requirement admirably, on the basis of his country's experience, when he wrote in his Notes on the New Society of the Philippines:

> 'We realize only too well that in the quest for progress no nation can do without science and technology. In the Philippines, the reasons for intense research and technological advancement are more compelling today than at any other time in the past. The worldwide food shortages and energy crises, together with the dangers that the future holds because of pollution and population growth, have summoned the nation to maximize its efforts in science and technology as a measure of national survival.'

Ladies and Gentlemen,

You have accordingly reasserted in your discussions the considerable importance for the countries of the Asia and Pacific region of the formulation and implementation of a science and technology policy which is integrated into the planning of national development.

You have recalled the need for each country constantly to strengthen its national scientific and technological potential by means, on the one hand, of its own efforts and, on the other, of regional and international co-operation. Such strengthening can be achieved only by combining two approaches which are indissociable from each other: the constant transfer of knowledge, of course, but in addition the growing development of fundamental research in each country.

Because of the growing interdependence of science and technology, the capacity to conduct fundamental research has in turn a direct influence on the ability to develop applied research, to build up endogenous technologies, to make, whenever the necessity arises, a wiser choice of technologies from abroad and negotiate better terms for their use, and, finally, to adapt such technologies to the particular economic, social, cultural and ecological context. In this connection, I think, as you do, that it would be extremely useful to conduct research designed to bring about a new appreciation of bygone knowledge and traditional technologies.

I welcome, furthermore, the importance that you have assigned to scientific and technological information, to its wide dissemination and to unhampered access by all to it which constitutes an essential prerequisite for the advance of knowledge in the world.

In regard to the application of science and technology to development, current experience in your region shows, in particular, that the most appropriate policies are generally those which enable the needs and aspirations of the population to be met, are based on the active participation of the people in their implementation and, to this end, have the greatest regard for the cultural and economic characteristics of each country.

There is a need, moreover, for consistent measures to promote the kind of education that - at every level - is steeped in the scientific approach and will enable all sectors of the population to have access to the stock of modern knowledge and know-how so that they in their turn may contribute to its enrichment through innovations born of their own experience and thereby become increasingly self-reliant in solving the problems with which they are faced.

The debates of this Conference have centred on regional and international scientific and technological co-operation.

This co-operation, which has already led to important achievements, is of course not without its problems, due to the diversity of conditions prevailing in your region. But such diversity may in itself prove an asset, a source of enrichment for all, if the countries which have the most to offer the others shed all hesitation and contribute fully to the common development effort of the region.

Above all, you have stressed the importance of regional co-operation to be achieved through regional centres or networks whose establishment you have proposed. You have also stressed the need for more effective co-ordination of bilateral and multilateral scientific and technological co-operation, with particular reference to the activities carried out by the various organizations of the United Nations system.

This is an issue of vital concern to Unesco, which intends to pursue even more energetically the efforts it is already making - with due regard for the sphere of competence of each agency in the system.

Your debates have culminated in the adoption of a good many recommendations. I shall mention here only the most important of them, indicating both their scope and the part Unesco can play in translating them into reality.

Your recommendation on the possible establishment of an appropriate mechanism - such as a regional centre or network - to facilitate the use and integration of science and technology for development strikes me as highly interesting and worthy of serious study, because such a mechanism would serve primarily the poorest countries of the region, which is to say those with the most needs and the least opportunity to benefit, in the immediate future, from the advantages of science and technology.

You have also made several recommendations concerning scientific instrumentation, testing, standardization and metrology, popularization services and the services of consultant engineers. The implementations of these recommendations would make a considerable contribution to the region's development drive.

I have also noted the Conference's desire for the prompt establishment of a scientific and technological information network. The Organization is already co-operating with the Member States in the region, under its General Information Programme. A further step forward must now be taken to enable information as such to flow unrestrictedly and to give all countries the means of receiving, storing and using the data that their development demands. In view of the great interest your countries have shown in this, I am pleased to announce that I intend this year to take the preliminary steps needed to set up the network in question as soon as possible.

You have also expressed the hope that the Organization will assume responsibility for organizing the periodical review of the implementation of the CASTASIA II recommendations, and you have asked the Director-General to take appropriate steps for that purpose. I can assure you that Unesco will do its utmost to respond to your expectations in this respect.

Lastly, I welcome your Conference's adoption of a document of the highest importance - which we have just heard read: the Manila Declaration, which reflects both the principles which subtend your recommendations and the spirit that has reigned over all your work.

This historic Declaration is a message of hope, an appeal to solidarity and a firm commitment for the future.

It is indeed a message in which you forcefully affirm that science and technology - providing they are used judiciously, systematically and with due regard for specific cultural, economic and social characteristics - can help to solve the principal problems confronting you, improve the lives of the peoples of the region, reduce the inequalities that exist in this world of ours and facilitate man's all-round development. It is also a resounding appeal to all men of goodwill - and in particular to the region's politicians, educators, scientists, engineers, technicians and industrialists as well as to the entire international community - for a fairer distribution of knowledge and of the power knowledge brings. It is also a commitment marking your countries' resolve to determine their own future and to take up the reins of their own development so as to achieve, together, a general prosperity that draws on the immense diversity of the resources of your region.

Mr. President, Ladies and Gentlemen,

The many problems confronting the states of Asia and the Pacific are in some ways a summary of world problems. Your region includes, in fact, some of the earth's most highly industrialized countries and some of its poorest nations. Most of the great challenges of our time therefore manifest themselves within this region and combine to highlight the dilemmas it shares with the rest of mankind and the contribution it can make to the search for innovative solutions to problems that are common to all.

The proceedings of your Conference have made it clear that, side by side with the magnificent practical results they have achieved, your countries are posing new questions that are of concern to the whole world.

These questions relate to the conditions, significance and goals of development in a world in which nations are increasingly dependent on one another but in which they have not yet established among themselves an ethic of solidarity and co-responsibility that would enable their common aspirations to prevail over certain national egoisms.

Many speakers have, then, brought out the need for the international community to shoulder jointly the burden of solving the problems bequeathed by the colonial era and thereby enable all those countries that are still suffering from the after effects of that era to overcome them as rapidly as possible.

Such countries cannot absorb the principal socio-economic imbalances at present paralysing their autonomous development capability unless international relationships founded on a growing sense of equity are brought into being. The fact is that the established prosperity of many industrialized countries has been based largely on an input of resources drawn from the Third World countries - one that is partly responsible for the imbalances now impeding their present efforts. The latter are therefore legitimately entitled to expect from the former the support they need to reinforce their capacity for development.

Your discussions have frequently highlighted the fact that these capacities were not confined - that they could not be confined - to the material forces of production alone, to nothing more than economic, financial or technical factors. Of course considerable means of investment, abundant natural resources and a modern scientific and technological potential are all essential prerequisites for progress. But they cannot in actual fact lead to progress unless they form part of a blueprint for society accepted wholeheartedly by the populations concerned, based on spiritual and cultural values that define their collective identity and reflecting the aspirations through which they can, together, recognize their common purpose and develop their potential.

Development, then, can be seen as a global social process in which every dimension of human creativity has its place and in which scientific and technical endeavour, a deeply-flowing stream that nourishes the very roots of the many sectors of the economy, is itself directed towards the realization of society's highest aspirations.

And so vital questions arise for each country, whose import concerns us all: what mode of production should be chosen so as to fulfil the hopes of the people as faithfully as possible? What balance should be struck, for that purpose, between ethical and economic issues, between the community and the individual, between society and the environment, between industry and agriculture, between production and consumption?

Answering these questions is also to define both the dynamic link that connects each society to its own particular past, and its relations with the rest of the world - its loyalty to itself and its responsiveness to others. Scientific and technological activity is revealing in this respect: it implies, in fact, not only the constant widening of exchanges of ideas and experiences between all peoples but, at the same time, the creative enrichment by each people, in the light of its needs and in accordance with its own talents, of what it can draw from the universal heritage of knowledge and know-how.

This activity implies, then, forms of international and regional co-operation based not on rivalry but on solidarity.

It implies, more especially, that those who hold leading positions in the world economy must take heed of the alarming situation that exists in many developing countries today. It demands, lastly, that the present arms race - which everywhere fuels aggressive ambitions, arouses mistrust among countries, multiplies local, regional and international sources of tension - must end and that the vast intellectual and material means that are assigned to it today should be redirected towards peaceful co-operation.

Here, science and technology offer immense prospects; they can not only end these world scourges of poverty, famine, disease, illiteracy and helplessness in the fact of natural catastrophes, but they can, in the longer term, give a decisive thrust to progress that will benefit all peoples everywhere and which is synonymous for all with both material betterment and spiritual fulfilment.

The means to achieve such an ambition for mankind already exist. What remains to be done, in order to give them practical expression, is to give substance to the combined will of the governments and peoples of the world. In this sense your Conference represents a new phase. You may be assured that, in pursuing this action, the peoples of your region, in the same way as those in the rest of the world, will always find Unesco by their side, ready to support their efforts and help them to achieve their hopes for progress, justice and solidarity.

Address by His Excellency Dr. Emil Q. Javier, Chairman of the Conference

Your Honour, Dr. Pacifico Marcos,
Mr. Director-General, Your Excellencies
Distinguished Delegates,
Ladies and Gentlemen,

I should like to begin by offering my compliments and profuse thanks to your Excellencies and the distinguished delegates and participants for your magnanimous and enlightened display of co-operation and solidarity during the nine days of CASTASIA II.

The Asia-Pacific region easily spans half the globe, it represents two-thirds of the world's population, and embraces peoples of vastly divergent racial origins, cultures and religions. Moreover, the Member States differ greatly in their populations, physical size and natural resource endowments, as well as in their degrees of material affluence, technological development and politico-economic-social systems.

In the face of such a plurality of concerns, problems and outlooks, and taking into account the sensitivity of the issues under discussion and the deep political differences which still divide some of the Member States of the region, I am deeply impressed by the degree of tolerance, understanding and openness which have characterized your deliberations during the last few days.

As your President or presiding officer, I am indeed most happy and grateful that your Excellencies, showing great statesmanship and the utmost concern for the welfare of the peoples in our region deliberately played down whatever political differences may exist in order that we may all contribute to, and participate positively and expeditiously in, the discussion of the important issues before the conference.

On behalf of the people and of the Government of the Republic of the Philippines, who are the hosts of CASTASIA II, may I therefore express my appreciation to your Excellencies and the peoples and governments you represent for being such gracious guests. Indeed, if only the whole world and her leaders could conduct the world's business and affairs in the manner we have conducted CASTASIA II, we would have good reason to look forward to a bright and secure future for all.

The first task before CASTASIA II was the assessment and review of the progress of science and technology since the first Asian ministerial conference fourteen years ago.

The region includes of course a number of developed countries with well-established scientific and technological infrastructures, but it is very clear however that the developing countries among us have by and large made substantial progress during the intervening decade.

Whether in terms of numbers of students at the tertiary level, of numbers of scientists, engineers and technicians and of kinds and numbers of research institutions and technological support centres, all such indicators point towards a marked increase in the level of scientific and technological activity in practically all countries of the region. And even in the smaller countries which have gained independence only recently, we note with satisfaction that the foundations of a scientific and technological infrastructure are now being put into place.

While at the first CASTASIA the main issues had to do with the installation of an endogenous scientific and technological capability, during this conference, we have deliberated at length on the linkage of the science and technology system with the production system, the integration of science and technology policy-making and planning with national economic and social planning.

At this conference, we have dwelt on the sharing of science and technology development experiences, on information and documentation exchange, and the need to upgrade the scientific and technological policy, planning and management capabilities of the Member States.

All of these shifts in focus and priorities are further indications of the progress, however modest, that we have collectively achieved since CASTASIA I.

The complete absence of recrimination and bitterness in this conference which I mentioned earlier was highlighted by the positive and very concrete offers for regional co-operation from the Member States. Delegation after delegation came forward with generous as well as pragmatic ways by which we could all share experiences, resources and facilities within the limits of our respective capabilities.

Again as your presiding officer I wish to acknowledge the very meaningful and most appreciated, yet largely unnoticed, efforts made by more developed countries of the region like Japan, Australia and New Zealand in building a stronger science and technology base for the countries of Asia and the Pacific.

The widening opportunities for training now being offered by India deserve special mention. Likewise we should point out the expanding bilateral exchanges which the People's Republic of China has undertaken with many smaller, developing countries of the region. We appreciate of course the continuing possibilities for science and technology co-operation with the Soviet Union in the very many fields of science and technology where she excels.

The newly industrializing states such as the Republic of Korea, Singapore and the territory of Hong Kong, in view of the recentness of their modern development could serve as relevant models for scientific and technological development to the less developed Member States. You will recall that the Delegation of the Republic of Korea indeed made such an offer of co-operation.

Even among the developing countries themselves, the possibilities for concerted action are enormous. Among the five small nation-states of ASEAN, co-operative programmes are being implemented in food processing, agriculture, forestry and fisheries research and training.

This brings us to the most crucial point, and that is follow-up for action. The fine prose of the Manila declaration which we have just adopted, the final reports of the two commissions and the plenary, and the conference recommendations, these are all plans, words, and intentions.

The final gauge of the success of this conference will be how many of these plans and intentions are translated into reality. How many of these fine gestures and positive offers of co-operation will be pursued and implemented?

You will recall that one of the major recommendations of this conference is a mandate to the Director-General of Unesco to take the initiative in advancing the various recommendations and ideas put forward at CASTASIA II, in co-operation with other relevant agencies and with the full support of the Member States themselves.

I venture to say at this point that part of that initiative could very well be the convening under the auspices of Unesco of a continuing committee of CASTASIA II which will take upon itself the task of promoting and following up the recommendations and agreements arrived at Manila. Such a continuing committee of CASTASIA II could in the process, and in collaboration with Unesco, prepare the ground work for CASTASIA III.

But in the final analysis, the spirit of CASTASIA II will survive and flourish only if we, the Member States, will it to be so. May I therefore appeal to all those concerned to take individual responsibility for the beautiful and moving spirit of co-operation and understanding which sustained all of us in Manila during CASTASIA II in order that this spirit may influence and enlighten the highest governing, policy and decision-making councils of our respective countries.

In closing allow me, Your Excellencies, to congratulate on your behalf the Director-General, Mr. A. M. M'Bow and the Unesco staff from Paris, Jakarta and New Delhi for the exhaustive and intensive preparations which preceded the holding of CASTASIA II. The documentation, the translation services and the overall organization of CASTASIA II proceeded like clockwork because of this thorough and very professional preparation for the conference.

Allow me also to acknowledge the outstanding services of the Philippine orgganizing committee for CASTASIA II who worked behind the scenes but who made everything possible and looked after the myriad details of hosting this conference. I refer to Counsellor Pedro Abella and Professor Dolores Makalintal of the Philippine Unesco National Commission, and Miss Delia Torrijos and Professor Ifor Solidum of the National Science and Technology Authority.

And finally, allow me to take this last opportunity to thank Your Excellencies and distinguished delegates for the honour and privilege of serving as President of CASTASIA II. It is an undeserved honour which I shall long cherish. I only hope I have met even half of your expectations. Thank you so much for your tolerance and understanding of my limitations.

To Messrs. Kaddoura, Raja Roy Singh and members of the Steering Committee, it was a pleasure to get acquainted and work with you.

And last but not least, a tribute to a great citizen of the world and statesman and champion of the Third World, His Excellency Director-General Amadou Mahtar M'Bow for providing the inspiration and moving spirit to CASTASIA II.

I wish you all a safe journey home.

Address of the President of the Republic of the Philippines (Read on his behalf by Dr. Pacifico Marcos, Chairman of the Philippines Medical Commission)

Your Excellencies,
Ladies and Gentlemen,

The following is the message of President Marcos to this conference:

I had wanted to join you at the Opening of this conference to welcome you in behalf of our country and our people, but as you all know I was out of the country on a most important mission on the day you began your deliberations. I am therefore grateful for the opportunity you have given me to do the next best thing to saying welcome, and that is bidding you all goodbye.

I hope you found our facilities and preparations for this important meeting adequate and suitable to your needs.

This is only the second conference of Ministers responsible for the application of science and technology to development and those responsible for economic planning in Asia and the Pacific. But I can already sense a greater determination on the part of the representatives of the Member States to grapple with larger issues and problems confronting our region today and a greater resolve to apply scientific and technological know-how in resolving such problems in a speedy but prudent manner.

During the first meeting in India, CASTASIA's principal focus was on strengthening the institutions, the facilities and programmes for the advancement of science and technology in individual member countries. CASTASIA II has moved into the higher plane of discussing the appropriate application and the impact of new knowledge and technology on member countries, and of evolving a series of important recommendations regarding the role science and technology must play in development plans as well as proposals for new areas of international co-operation.

I am sure that the sentiments you have expressed and the recommendations embodied in what you now refer to as the Manila Declaration will have a deep and lasting impact on the course of developments in our part of the world. The Manila Declaration does not only reflect the consensus of the scientific community and of the economic planners of the countries represented in CASTASIA II, it also incorporates the hopes and aspirations of the peoples of Asia and the Pacific and their common wish to make science serve the ends of peace, prosperity and equality for all.

Let me therefore congratulate you all for adopting this historic document which should in time become a blueprint for the peaceful application of science and technology. In particular, I would like to mention the leadership and guidance exercised by the United Nations Educational, Scientific and Cultural Organization and its co-sponsor the United Nations Economic and Social Commission for Asia and the Pacific, not only during this conference but also in previous conferences in the past.

During the last few days, you have had the opportunity not only to discuss the state of science and technology in our region but also to dissect in some detail the social, economic and cultural settings in which they are being applied. The review of the situation in our region, I am sure, has clearly demonstrated the pressing need for science and technology to be brought to bear upon the many urgent problems of the region.

Statistics can never fully capture the full dimensions of the problems we are faced with; much less do they project the pains and miseries they merely quantify. The data which indicate the gross disparities in the per capita incomes among the nations of Asia and the Pacific which range from \$100 for the poorest to \$9,000 for the richest are bad enough. But what is even more disturbing is the very real possibility that the situation could turn for the worse in the future since our region's population is expected to double in a few year's time from the estimated 2.7 billion at present.

Poverty we all recognize now spawns a host of problems, such as malnutrition, diseases, and illiteracy. The millions of hungry, sick and uneducated peoples in Asia and the Pacific now look up to their leaders, the scientists and the rest of the human family to help alleviate their misery. Science and technology offer the real hope for their deliverance from hunger and disease. Therein lies the significance of your conference here in Manila.

In the course of your conference, I am pleased to learn that you have succeeded in identifying the priority concerns that science and economic planning must immediately address.

You have defined the modes and strategies for the accelerated transfer of technology. And you have also set priority areas for international co-operation.

What is left for us to do now is to summon the will and mobilize the resources that would hasten the adoption of new processes and technologies in the critical areas of each of our country's development plans and programmes. At the same time, the countries of CASTASIA II should now contribute their share towards the realization of co-operative programmes and endeavours.

We in the Philippines are committed to help in every way and give substance to our commitment in regional co-operative tasks. We are also prepared to implement on our own the relevant recommendations you have suggested. Prime Minister Cesar Virata, I believe, had already outlined for you the measures we have taken to promote scientific and technological research and development, including the creation of a new Philippine Science and Technology Authority which will be responsible for formulating and implementing policies, plans and programmes for the development of science and technology.

We join you in asking the developed countries to share with us their vast storehouse of knowledge so that we can better provide for the most urgent needs of our people.

And finally we are with you in appealing to the superpowers to put an end to the headlong race towards arms superiority and instead devote their immense resources in science and technology to the noble task of combating hunger, disease and the many ills afflicting the majority of mankind. For the cause of peace can be better advanced not through the massive manufacture of weapons of war but through the intensified development of tools for survival for the impoverished millions of the Third World.

Allow me again to congratulate you for a most fruitful conference. You will soon be leaving with our sincere wishes for success in your efforts to put science and technology to peaceful and productive uses for the benefit of the people in our region and the rest of the world.

Thank you and good day.

ANNEX IV

LIST OF DOCUMENTS

Code number SC-82/CASTASIA II/...	Title	Language	
	1. WORKING DOCUMENTS		
.../1 prov.	Provisional agenda	E/F/R/C	
.../1 add.	Annotated agenda	"	
.../2 prov.	Provisional rules of procedure	"	
.../3	Science, Technology and Development in Asia and the Pacific - Trends, issues and prospects - (Main working document)	"	
.../4	Points for discussion (Succinct working document)	"	
	2. REFERENCE DOCUMENTS		
.../Ref. 1	Science, technology and development in Asia and the Pacific - Progress report 1968-1980 - by A. Rahman and S. Hill	E	
.../Ref. 2	Overview of the economic and social situation in Asia and the Pacific (prepared by the ESCAP Secretariat)	E	Cancelled
.../Ref. 3	Science and technology statistics in Asia and the Pacific	E	
.../Ref. 4	Unesco science and technology activities in Asia and the Pacific	E	

3. INFORMATION DOCUMENTS

.../INF.1	General information note	E/F/R/C
.../INF.2 prov.	Provisional list of participants	"
.../INF.3 rev.1	List of documents	"

4. OTHER BACKGROUND DOCUMENTS
(Conference room documents only)

-	Inventory of regional co-operative programmes in science and technology in Asia and the Pacific	E
SC-81/CONF.637/5	Final Report, Preparatory Meeting of Experts for CASTASIA II (Bangkok, 16-18 December 1981	E
-	Country reports	E
-	The Vienna programme of action on science and technology for development (United Nations)	E/F/R/C/
-	Operational Plan for the implementation of the Vienna programme of action (United Nations)	E/F/R/C
-	CASTASIA Final Report (1968) Part I: Conclusions and Recommendations	E
-	Financial Arrangements: Some possibilities in Southeast Asia (prepared by Unesco Secretariat)	E
-	The work of the United Nations University in the fields of science and technology in Asia and the Pacific: concepts, activities and emerging results	E
-	The application of science and technology to development: the IDRC experience	E
-	Background document prepared by the Pacific Science Association	E

ANNEX V/ANNEXE V/ПРИЛОЖЕНИЕ V/附 件 V

LIST OF PARTICIPANTS/LISTE DES PARTICIPANTS
СПИСОК УЧАСТНИКОВ/与会者名单

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III. Secretariat/Secrétariat/Секретариат/秘书处

IV. Local Organization/Organisation locale/Местные организации/地方组织

Names and titles in the following lists are reproduced as handed in to the Secretariat by the delegations concerned. Countries are shown in the English alphabetical order.

Les noms et titres qui figurent dans les listes ci-après sont reproduits dans la forme où ils ont été communiqués au Secrétariat par les délégations intéressées. Les pays sont mentionés dans l'ordre alphabétique anglais.

Фамилии и названия в нижеследующих списках даны в том виде, в каком они были переданы в Секретариат делегациями. Названия стран следуют в порядке английского алфавита.

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Professor Ifor B. Solidum, NSDB	NSDB Special Consultant for CASTASIA II

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Ms. Delia E. Torrijos, NSDB
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