Science and Technology for Development

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Report
on the United Nations
Conference
on the Application
of Science and Technology
for the Benefit of
the Less Developed Areas

Volume VI. Education and Training

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Prefatory note

This eight-volume Report gives a narrative account of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. It is an official report of the Secretary-General of the United Nations, enlarging upon his summary report on that Conference presented to the United Nations Economic and Social Council at its thirty-sixth session (E/3772 and Add. 1). In substance it is comprehensive, embodying both the oral discussions and the contributors' papers. In style it is non-technical: the aim has been to make this permanent record a readable one which will be widely studied and used.

The Report was prepared in the English language with the counsel of an Editorial Advisory Committee, under the Chairmanship of Sir Benjamin Lockspeiser, former Director of the United Kingdom Department of Scientific and Industrial Research, and composed of Ritchie Calder, Professor of International Relations, University of Edinburgh, V. Kovda, Director, Department of Natural Sciences, United Nations Educational, Scientific and Cultural Organization, Georges Laclavère, Secretary-General of the International Union of Geodesy and Geophysics, José Mayobré, United Nations Commissioner for Industrial Development, and J. V. A. Nehemiah, Director, Programme Liaison Division, Food and Agriculture Organization of the United Nations. The editorial staff comprised Gerald Wendt, Editor-in-chief; Leonard Berry, Assistant Editor; Georges Laclavère and Ritchie Calder, Consultant-Editors; Lee Ambrose, Robert Brittain, Peter Collins, J. Avery Joyce, Margaret Stewart and George Symeonides, Writers; John R. Conway, George Goodman, Anila Graham, Sophia Podolsky and Chandler Whipple, Assistant-Writers.

The volumes of the series are entitled as follows:

I. World of opportunity
II. Natural resources
III. Agriculture
IV. Industry

V. People and living—Population: Health, Nutrition, Rural Development, Urbanization
VI. Education and training
VII. Science and Planning
VIII. Plenary proceedings, list of reports and papers and index.

As suggested by its title, Volume VIII includes a complete subject index of the series as well as a complete list of Conference papers and of the reports of the Conference Secretary-General and Rapporteurs for each session. Each of the other volumes includes a subject index and (except Volume I) a list of papers and reports related to its own contents.

Code Numbers, e.g. A/100, are used in the text when referring to Conference papers. The full titles of these papers, together with the names of the authors and of the countries of origin, can be found for each volume in its "List of Papers" and for all volumes in the complete list published in Volume VIII.

The individual papers forming the documentation presented to the Conference are not bound in volumes but are available, until the end of 1964, as photo-offset copies of the papers as submitted by the contributors. They comprise the following:

(*a*) Papers submitted to General Sessions and the reports of the Conference Secretary-General and of the Rapporteur covering these papers and proceedings in English, French, Spanish and Russian;

(*b*) Papers contributed to Specialized Sessions. These papers have been reproduced in the original language of submission. A summary of each such paper, averaging two pages in length, has also been produced in each of the four languages used by the Conference. The report of the Conference Secretary-General on the papers contributed to the Specialized Sessions and the reports of the Rapporteurs on the proceedings of these sessions are also available in all four languages.

The charge for each of these papers is $US0.25, but they will normally be available in folders covering each session of the Conference. The price of the folders will, of course, vary according to the number of papers presented to any given session. Thus, for a folder containing eight submitted papers and two reports, the price will be $US2.50. A fully indexed list of papers, bearing the symbol E/CONF.39/INF.3, which gives an indexed reference to authorship, is available at a cost of $US1.50, in English, French, Spanish and Russian.

Purchases may be made through The Sales Section, United Nations, Palais des Nations, Geneva, Switzerland.

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Foreword

The United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas had been long under discussion and for more than a year in active preparation when it opened in Geneva, Switzerland on 4 February 1963. Other scientific conferences under United Nations auspices had preceded it, notably one on New Sources of Energy in 1961, the two which were convened to discuss the Peaceful Uses of Atomic Energy in 1955 and 1958, and, as early as 1948, the United Nations Scientific Conference on the Conservation and Utilization of Resources. There was also the survey of "Current Trends in Scientific Research" which was undertaken under the joint auspices of the United Nations and of UNESCO in the years 1958 to 1960. In breadth of scope, however, the Conference on Science and Technology was unique. It touched on all the scientific disciplines and almost all aspects of modern society. More than 2,000 papers were submitted. The participants numbered 1,665 and 96 Governments were represented.

There is reason to think that this Conference will go down as an important landmark. In the words of Professor M. S. Thacker, President of the Conference, "The story of how man is remaking his world by a more effective use of human and natural resources would open even reluctant eyes." The United Nations Development Decade will, surely, reflect an ever growing awareness of the practical importance of science and technology for economic and social development. The destructive tendencies of science need not take over nor need its constructive triumphs remain aloof from daily life. Applied science can be the most powerful force in the world for raising living standards if action can be taken to harness it for that purpose—if the Governments and people of the world can find the means and the will.

In its resolution 834 (XXXII) by which it authorized the holding of the Conference, the Economic and Social Council requested me "to circulate for information a report on the Conference to all Members of the United Nations and of the specialized agencies, to the related agencies, and to the non-governmental

organizations in consultative status". At an earlier stage I have given a summary report to the Council itself (E/3772 and Add. 1), and now present in this eight-volume report a full and definitive account, written for wide distribution.

U THANT
Secretary-General

INTRODUCTION

What this book is about

Universal education, which was once a Utopian dream among the social sciences, has today moved into the centre of that earth-wide revolution which is daily transforming man's living conditions on this planet more drastically than the Renaissance, the discovery of America, the Reformation, the Industrial Revolution, and the advent of the Air Age, all rolled into one. It has become the touchstone of every one of the political, economic and social changes of the contemporary scene, both within nations and between nations in a rapidly shrinking globe.

"A large part of mankind is not mentally prepared to assimilate this transformation, to become incorporated fully and vitally in this new type of society which should be built in the countries suffering from under-development," declared Professor R. V. Garcia of Argentina, a Scientific Secretary of the Conference; and he continued: "The very basis of the problems of development, the core of everything related to it, is *Man*. Technology cannot canalize his potential with the same speed as it can canalize, for example, a river. Today we know how to deal with a desert, to turn it into an orchard in relatively few years; but far more time is necessary to train men who are capable of growing oranges in a desert."

A similar warning came from U Thant, Secretary-General of the United Nations, who reminded the Conference:

> "It is often said that development may nowadays be telescoped by applying all the technological knowledge already acquired, that the trials and errors and the turmoil through which industrialization took place in the advanced countries during the nineteenth century may be avoided. There is some truth in this, and this is one of our reasons for hope. But let us not deceive ourselves with the illusion that what is at stake is just a simple transfer of technological devices. Let us be aware of the disruption which may be caused by the superimposition of modern knowledge and techniques on a society whose habits and thinking, methods of work and way of life, are utterly unprepared for them."

In any approach, therefore, to the organization of education and training of the whole of the people, as primary factors in the growth of the less developed countries, piecemeal attempts cannot possibly avail. That fact came out from beginning to end of the Conference. The planning of education must be seen in its planetary context. For so long regarded as, essentially, a local problem—the school, the university, the community—the organization of education has emerged as a nation-wide system almost within the present generation. "Mass education" was a terrifying term which swept into use following the Second World War. Now it has become global and both reflects and becomes an instrument of the scientific transformation of our time. "The cause of development demands a revolution in the methods of education," said Dr. Carlos Chagas, Secretary-General of the Conference. That is where this book begins.

For that reason, Chapter 1, entitled "Education—the prime necessity", has to open with some factual estimate of what is perhaps the major challenge of our time—the appalling disparity which exists between the advanced and what used to be called the "under-developed" countries. The problem of the "haves" and the "have-nots" has been with us for many years; it has been the subject of numerous international conferences held under the auspices of the United Nations and its family of agencies. Yet, in spite of this deepening concern, the gulf between the overfed and the underfed halves of the planet—both in their available resources and their actual standards of living—has tended to widen rather than to narrow. It has become the crowning paradox of today's unprecedented scientific and technological progress in a few favoured countries that it has had only spasmodic or disrupting effects in those wide regions of the world whose need is greatest.

Although the wider implications of this "gap" were dealt with in Volume I of this series, our first chapter will need to sketch something of the background on this earth-wide problem of mounting human need, so as to put in true perspective the universal and many-sided campaign, known as the Development Decade, which the United Nations launched in 1961 in response to it. "In the years following the Second World War," states the United Nations report[1] introducing the Development Decade, "it has generally been recognized in the advanced countries that the new techniques of research and development, coupled with the new resources made available by science and technology, will allow the solution of most problems. However, while research and development expenditures have soared in the industrialized countries, too little effort has been directed to the developing countries of the world . . ."

Such a broad look at the operative principles on which this great international enterprise proceeds is essential in order to understand the significance and longer-term implications of the many educational programmes and projects which emerged from the Conference. It will thus be seen that education, in its broadest sense, is the prime necessity of the Decade and the bedrock foundation on which

[1] United Nations, *The Development Decade—Proposals for Action*, p. 99, New York, 1962, Sales No.: 62.II.B.2.

the economic and social super-structure of the newly developing countries has to be built.

Chapter 2, entitled "National and regional planning", begins with some of the basic principles of educational planning which were accepted at Geneva as the *sine qua non* of all educational advance. A conspectus follows of the regional plans and the special projects which have been sponsored by the United Nations Educational, Scientific and Cultural Organization (UNESCO), as the primary United Nations agency working in this field.

In Chapter 3 a survey is made of some of the basic structural problems facing general education today—primary, secondary and university—with a glance at the relationship between university and research. The chapter attempts a synthesis of the major proposals which emerged from the discussions for implementing the national and regional targets.

Against this background of general educational planning, Chapter 4 takes up the subject of "Training: skills and techniques". It examines some of the specific fields calling for technically qualified personnel capable of handling the multifarious economic and social problems of the developing countries. Some of the problems of forecasting are discussed, together with the creation of training institutes, of which the one at Turin, promoted by the International Labour Organisation (ILO), is an outstanding example.

It became obvious, throughout the Conference, that no scheme for accelerated economic and social development could be formulated in any nation without taking fully into account the quantity and quality of personnel needed to carry out the various stages of such a development. The training of large numbers of scientists, engineers and technicians is a prerequisite of modern science and technology, harnessed to the cause of economic and social progress. "Today," said Professor José Reis, of Brazil, "the destiny of any community is definitely tied to the quality and quantity of the science and technology it cultivates. Science is being heeded not only for its own value as a means of obtaining pure knowledge, but also as a reservoir on which the nations can draw for the necessary elements of their progress."

When, in Chapter 5, we come to consider "Educating the Adult", some readers may be surprised that the subject-matter goes far beyond the frontiers of "adult education", as it has hitherto been normally conceived in Western circles. This chapter deals with some of the new forms which adult education—in its broadest sense—is taking, and will increasingly take, in what are still largely illiterate areas of the globe. Mass-illiteracy is a major obstacle to national development, in any form. So the general education of adults becomes the linchpin of economic and social progress. Certainly, the training of teachers may be looked upon as the most rewarding form of adult education, and training for management as equally vital for the developing countries.

The discussions at the Conference frequently brought out that, unless the citizens as a whole are made aware of the need for the development programmes being promoted by their Governments, no nations or communities can expect to

keep to the objectives or time-tables that they have set themselves. The basic issue here is really one of democracy: how to underpin economic progress by a socially-conscious popular will. "Democracy is sharing," declared Professor B. Schwartz of France. "What can we share better than education?"

The foregoing survey of popular education and training programmes leads to an examination in more detail, in Chapter 6, of "The use of communication media". Spokesmen from the developing areas consistently called for the rapid advance of mass media in their countries. "Communication", they insisted, is a double link—a link between leaders and their peoples and also between all those engaged in the development process itself on the administrative and technical levels. Press, radio, television and the other branches of "mass" information play an indispensable role in the whole communication process. The deliberations of the Conference will be related, in this chapter, to the projects now being promoted by mass-media specialists under the auspices of UNESCO.

Chapter 7, on "International Co-operation", attempts to bring together some of the universalist ideas and trends which came out of the Conference, pointing to the new patterns of international co-operation which science and technology have introduced in the total educational process. For example, the new International Institute for Labour Studies, established in Geneva in 1962, and the International Institute for Educational Planning, recently inaugurated in Paris, are already opening great possibilities for the education leaders of the newly developing countries. How to follow through the results of the Conference has become the first concern of all those who, both in their own countries and by working internationally, are playing their own special part in promoting this world-wide crusade for a better life for mankind.

A brief comment is in place on the nature and programme of the Conference itself, which Volume I in this series discusses in some detail. In meeting its broad objectives there can be little doubt that the Conference succeeded in focusing the attention of the whole scientific world on their obligation as scientists to combat poverty, disease and illiteracy. As Mr. David A. Morse, Director-General of the International Labour Office (ILO), stressed at the opening session "this is not a Conference for the advancement of science or the glorification of technology, but a Conference designed to contribute to ensuring that scientific and technological progress is the loyal servant of human need and not the heartless master of an inhuman destiny." And he continued: "To promote human freedom, to preserve and enhance human dignity, to enlarge the horizons of economic security and equality of opportunity: these are the tasks to which the United Nations family have set their hand; these are the challenges which scientific and technological progress has made it possible for us to master".

Throughout the Conference special emphasis was given to the training of national personnel—in particular, to the provision of cadres of scientists, engineers, scientific teachers and technicians—and to the application of engineering and other professional skills as a basic requirement of all worthwhile development. It is these aspects which form the substance of the present volume, though

it should never be lost sight of that education and training are not ends in themselves, but means to a fuller and richer life for men and nations.

An observation was made by Dr. Aly Shoeb, of the United Arab Republic, that "education and science have a snowball characteristic—as it moves it grows in size". Thus, as it proceeded from topic to topic the Conference itself moved from the day-to-day applications of science and technology to the education of people and the training of personnel to accomplish such tasks. It thus brought to light many different concepts of the underlying psychological and social problems, as well as new ways and means of providing useful employment for the human resources which constitute a nation's true wealth.

The Conference called for new wisdom and new men. The President, in his opening speech, had hinted at the formation of a brains trust or committee of wise men to guide them into the future. In the course of the days which followed, this beckoning challenge was taken up on all sides. Mr. David Morse suggested that the objectives of the Conference were too vast to be entrusted to any one of the existing international organizations. Mr. B. R. Sen, Director-General of the Food and Agriculture Organization (FAO) called for a world advisory panel to carry forward their endeavour, while Mr. René Maheu, Director-General of UNESCO announced the creation of an international institute for the training of technologists and technicians.

The need for education and training at every level ran like a connecting thread throughout the Conference. In his closing address Professor M. S. Thacker said: "No other aspect has been more stressed here. Developing human resources, training of men, training of minds, has emerged as the most pivotal aspect . . . It is human resources, still largely untapped, which constitute man's real hope for the future. For all his inventions and calculating machines, man remains the principal tool of economic development, as his welfare should be its only objective."

CHAPTER 1

Education—the prime necessity

While billion-dollar spacecraft soar majestically towards the stars, grinding poverty is still the lot of the greater part of the human beings on Planet Earth. Two-thirds of them live in the under-developed regions of Africa, Asia and Latin America. Over wide areas wooden ploughs scratch a meagre food supply from worn-out soil; normal transport is by means of bare feet; the simplest health and sanitation services are non-existent. And as for schools? At this moment, 400 millions of the world's children have no school to go to. For the great mass of the earth's population the boundless riches of man's scientific genius have barely touched their primitive economies.

That disparity would intrinsically be disturbing enough to the sensitive conscience. But two related facts make its elimination imperative. The first is that hundreds of millions of hungry, sick and miserably sheltered human beings are no longer content with their lot. The second is that the scientific miracles that have opened up these vast vistas of man's creation are themselves bringing home to peoples everywhere the possibilities that lie before them.

There is no containing the inquisitiveness of the human mind. Both realism and idealism compel the advanced countries to face the fact that science has made the earth too small for its fruits to abound for the privileged few and to be denied to the underprivileged many.

The contrast is too blatant to be ignored even in the backward areas themselves, for modern technology has been infiltrating at a rapid though uneven rate. Two entirely contradictory versions of how people are expected to live in the twentieth century can be seen side by side. Mammoth automobiles and pocket-transistors, tiled bathrooms and refrigerators exist within a stone's-throw of jungle conditions which have not changed from time immemorial.

"Many millions of our farm families have only a small acreage of land, few tools, little equipment and few livestock," said the Minister for Lands and Natural Resources of Nigeria (Hon. K. O. Mbadiwe) recently: "They have learned over scores of years, through experience and trial, how to wrest from the land food, clothing and shelter, but not in amounts and qualities adequate to prevent malnutrition, disease and often early death."

How does the ordinary human being in the under-developed regions view this contra-distinction? He has a life expectancy of only 40 years at best—in some countries only 27—against 63 years in the advanced countries; he has an income of less than one-tenth of that enjoyed in the developed regions, and he must subsist on an average daily diet of only 700 calories above sheer starvation level, or at least 750 calories below that of the fortunate third of mankind.

He is caught in a vicious circle. He lacks bread, yet his primitive agriculture yields him only six bushels of wheat per acre, contrasted with 40 bushels in the "rich" countries. 50 per cent of his fellows are constantly ill; he is himself plagued by ill-health; yet there is only one doctor for each 20,000 persons, while the advanced countries, with planned medical services, have one physician for 1,000 persons. And he cannot read. His children have no schools to go to. They are among the millions of children of school age in the world without classrooms or teachers or books. He cannot break this vicious circle without outside help of a substantial and systematic kind.

THE GREAT PARADOX

This was the great paradox which lay at the heart of the Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, and which, as a principal reason, led the United Nations to its historic initiative. From the outset, speaker after speaker emphasized that the advance of science and technology, by itself, was *not* providing a bridge across the gap. In his opening address, the President of the Conference pointed the warning in the clearest terms: "The wide, and in some cases tragic, gap can easily be gauged when one realizes that one-tenth of the peoples of the world enjoy 60 per cent of the world's income, while 57 per cent of them have less than 10 per cent of that wealth at their disposal. If present trends are to continue, the gulf between the poor and the rich countries of the world will widen still further, and this at a time when great continents have awoken to freedom and their populations are clamouring for certain minimum standards of life."

The voice of Africa was equally insistent. Dr. F. T. Sai, of Ghana, described this scandalous disparity in terms which found their echo in all parts of the Conference throughout its sessions: "We have seen that the two ends of the world's spectra of wealth and health are very far apart. We have used the term 'developed' and 'less developed' to apply to these two ends . . . There are nations with a *per caput* income of $US50 or less whilst others enjoy $US1,000 or more. These differences are not due to national laziness or apathy and they are not due to contentment with their poor lot, on the one hand, as opposed to initiative and hard work on the other."

Mr. Salah el-Din Hedayat, a Vice-President of the Conference, carried the warning further: "Undoubtedly, there is a widening gap between the highly developed and the developing areas of the world, in spite of the great efforts

made in the 1950's. Even a rate of growth of five per cent by the end of the decade, a target set up by the United Nations resolution on the Development Decade, would result only in doubling the income per head in less developed countries in a period of 35 to 50 years."

Of course, this is far from being the full story, and a closer look at the possibilities of the Development Decade comes later in this chapter. Another approach is evident in the words of Academician E. K. Fedorov, of the Soviet Union, who pointed out that "the gulf between the level of production in different countries, the chasm between the level of prosperity in different countries, has not opened up overnight. Neither did it open up because some countries are poor in natural resources or because their peoples are somehow incapable of adapting themselves to science or technology. No, we know that many developing countries possess very rich natural resources and the achievements of their ancient civilizations still fire the imagination. It is clear to us that the peoples of these countries are poor because their natural wealth, and the very labour of their people, have for a very long time been used to serve the interests of other countries, which built up their prosperity on this basis".

As though to make things more difficult for the responsible leaders of the less developed countries, the phenomenon known as the "population explosion" has become a formidable obstacle confronting all economic and social planners. This basic issue is discussed in detail in Volume V of this series, especially from the point of view of the contribution which modern science and technology can make towards resolving it. But here it can be epitomized in the picture drawn by Dr. Ralph W. Phillips, a Conference Scientific Secretary, who visualized mankind eating their meals along a single table. To seat an estimated 3,115 million people in the world last year the table would have circled the globe over 23 times. By the year 2,000, however, at the present rate of population growth, the same table would circle the globe 47 times. To keep up with the number of consumers the table would have to grow 43 miles longer each day. As for the food that goes on to it, a bare 8.35 per cent of the world's surface is the food-producing area on which man depends primarily for his existence. But actual production, even in this limited area, is unequal. Some nations produce ten times more rice per acre than others. As for wheat, production may be even 20 times greater in some countries. There is a similar disparity in the means at the farmer's disposal to help him improve his yield. While in Europe, for example, over 78 metric tons of chemical fertilizers are used on every 1,000 acres, the equivalent is about one ton in Africa.

There are many ways of measuring the gap. One method is by comparing average incomes. In North America personal incomes average $US2,500 a year, while in Europe they amount to $US900 a year; but in most Asian and African countries the figure is between $US50 and $US100 a year. A comparison of incomes (see *Statistics of Hunger*, Food and Agriculture Organization, 1962) gives a clearer picture of how wealth is shared around the world:

Regions	*Per cent of world income*	*Per cent of world population*
North America	39.8	6.7
Europe	37.7	22.2
Far East	12.3	52.3
Latin America	4.7	6.8
Africa	2.2	7.1

The manner in which this imbalance of worldly goods works out in terms of the number of individuals who can read and write was reflected in UNESCO's statement to the Conference. As far as adults are concerned (persons more than 15 years of age), says the Director-General, "We are obliged to make approximations, and in 1957 found that there were approximately 700 million people who are assumed to be illiterate. This represents more than two-fifths of the adult population of the world. The great majority of these illiterates reside in the less developed areas. As regards children (from five to 15 years) in the under-developed regions of Africa, Latin America and Eastern Asia, 47 per cent of the children of school age do not go to school. To take into account the number of those who will relapse into illiteracy—primary school children who will leave before having reached the decisive stage of functional literacy—these regions will have 150 million future adult illiterates. Under present conditions of educational development and population growth in the course of the next six or seven years, 20 to 25 million new illiterates will be added each year to the world's population".

It is the purpose of this chapter to relate such figures as these to the main subject of this volume, namely education. For is it not obvious that the various applications of science and technology which have created this ever-widening gap have themselves depended on the skills of the scientists and engineers, the organizers and administrators, who are themselves in turn a product of the educational systems of the advanced countries, particularly since the Second World War?

The following figures, which characterize the advanced countries, given in a UNESCO paper to the Conference (I/27), bear this out. In the United States, with a population of 185 million, there are 1,000 scientists and 4,000 engineers per million of the population. In the Soviet Union, with a population of 220 million, there are 400,000 scientists of all specialities and levels, and the number of engineers and agronomers, including technicians, is approximately 4,700,000. Thus, there are 1,800 scientists and 20,000 engineers and agronomers per million of the population. In France, with a population of 46 million, there are 17,000 research scientists, and 120,000 engineers; that is, 360 scientists and 2,608 engineers per million of the population.

This inequality, in terms of educational opportunity, raises one of the crucial issues of our generation. A major factor in under-development is, in fact, that a large part of the population does not benefit from even minimum education —let alone the higher education which will make it possible to obtain the scien-

tists, technicians and educators required for our present level of civilization and culture. For it is not merely a question of expertise—of producing enough engineers and technicians—but of educating people. Hence this volume is entitled "Education and training". This education of people as human beings calls for a dual approach: to conquer the curse of illiteracy and then to organize those aspects of higher education which will apply the current advances of science and technology to the social and economic advantage of the particular nation concerned.

An educational problem concerned with under-development of this magnitude cannot, obviously, be studied in isolation, whether in terms of the nation or of the objective. It can be seen only in the perspective of a multidimensional programme of economic co-operation and technical assistance on a world scale—one whose volume has, in fact, been growing so fast in recent years that it has now reached a point justifying the conception of a "Development Decade".

THE UNITED NATIONS RESPONSE

Long before the Conference met in February 1963, this yawning chasm between rich and the poor members of the human race had been recognized as a transcendent issue facing all Governments, and had moved into the forefront of the United Nations programme. The Conference can best be seen as a stage—a vitally important stage—in this expanding programme of international co-operation (see also Volume VII in this series). Experience since the Second World War has again and again shown that no single nation, or group of nations, however "advanced", could deal effectively with the multiplicity of problems involved in such a complex undertaking. Nor could any one international institution, however well endowed with wisdom and resources, tackle more than a small part of it. International co-operation had to be horizontal, as well as vertical, to bridge the gulf. It is essential, then, before proceeding with the actual work of the Conference, to survey something of the organizational framework within which the Conference itself took its historic place. Moreover, the follow-through of the event and of the many practical ideas which emerged from it can have meaning only within the context which brought the Conference together in the first place.

There can be little doubt that what was an experimental and somewhat localized effort, launched by the United Nations and its agencies little more than a decade ago, has since grown into a deliberate long-term programme, whose ultimate goal is the social betterment of all peoples and world peace through international co-operation, in the broadest sense. The legal basis of this expanding development was laid down in the United Nations Charter itself. Article 55 reads: "With a view to the creation of conditions of stability and well-being which are necessary for peaceful and friendly relations among nations, based on respect for the principle of equal rights and self-determination of the peoples, the United

Nations shall promote . . . higher standards of living, full employment, and conditions of economic and social progress and development". The next following Article pledges all members of the United Nations to take action to achieve these purposes. On this solid foundation has been created the operative work of the United Nations family, as it is sometimes called, which can best be summarized in the following paragraphs.

The United Nations began to provide technical assistance as early as 1947, when nine countries were given help and advice in the form of social welfare services. It has long been the practice of international organizations to provide expert aid—generally in the form of visiting specialists—on the request of their Member States. The International Labour Organisation, for example, has provided experts in the field of labour legislation to Member States for more than 30 years.

Direct aid in the United Nations began with the dispatch of individual experts or teams of experts to meet requests coming from individual countries. This system has since evolved into a co-ordinated programme, with which many of the activities of the United Nations and its agencies are now integrated. In the general field of education UNESCO, as the specialized agency primarily concerned, has rapidly shaped its policies to meet the challenge of the gap by giving direct assistance not only in designated fields of education as such, but also in the natural and social sciences, cultural activities and mass communication. Likewise, the services of the ILO have been increasingly put at the disposal of the "new" nations, especially in regard to training programmes affecting the work force as a whole. In the following chapters, therefore, particular stress is placed on the central role played by both these agencies in many of the areas covered by the Conference, although the part played by other United Nations agencies in the programming of technical education and vocational training has not been overlooked.

By 1949 all the agencies had already gained valuable experience in carrying out "technical aid" missions of their own. For example, FAO had provided Governments with specialists in such fields as nutrition, fisheries and animal disease control; and the World Health Organization (WHO) teams had checked an outbreak of cholera in the Middle East and started a world-wide anti-malaria campaign. In June 1950 a United Nations Technical Assistance Conference was convened and a goal of $US20 million was agreed. These were relatively small beginnings, but the course had been set.

Yet this kind of *ad hoc* assistance was soon seen to be totally inadequate to the immense calls on the United Nations system of mutual aid. Ten years later international assistance for economic development took another step forward when the United Nations Special Fund was set up to help needy countries to lay the groundwork of a more effective capital investment. The Special Fund concentrates on getting rid of the obstacles to the progress of a country or region. For example, it makes financially possible the comprehensive surveys of natural resources, manpower, skills and industrial possibilities (described in other volumes

in this series) so that a factual basis can be laid for planned economic advance. The newest link in this chain of financial aid through the United Nations is the International Development Association, established in 1960. The IDA enables large-scale and long-term loans to be granted to increase productivity and thus raise standards of living in the less developed areas.

As the United Nations Secretary-General said recently in surveying this wide network of assistance: "The United Nations system is well placed to undertake this task. It can draw on a world-wide pool of experience and technical knowledge in many diverse fields, and a range of contacts which are unparalleled, if they can be brought to bear upon the problems of each country in a unified and swift manner. The services offered by it are impartial and without political strings or implications. It has no vested interest in specific sectors as against others, or in specific types of development or in specific projects for financing. Yet, while being outside local rivalries and disputes, the United Nations system is not an outside body; it embodies the idea of partnership and the assisted country is itself a Member. By their constitutional procedures the United Nations organizations act only on the request of Governments, although their advice and suggestions are independent of Governments."[1]

The importance of this standing machinery will be more apparent as we review some of the proposals made at Geneva in the special field of education and training, since technical assistance from the United Nations agencies has been more and more sought after by the needy countries. The heart of the technical assistance programme is the Technical Assistance Board (TAB), composed of the United Nations and seven of the specialized agencies. It is responsible to the Technical Assistance Committee, consisting of representatives of the 18 Governments which are at present members of the United Nations Economic and Social Council. It was at the request of and under the direction of this Council that the Geneva Conference was convened and carried through its appointed tasks. The Council will obviously have the major say in how the Conference is to be followed up within the United Nations system.

It should be borne in mind that the Governments desiring help make their requests for technical assistance direct to the agency concerned. These requests are examined by TAB and, if approved, an agreement is then signed between the agency and the requesting country, specifying how the arrangement is to be carried out. The agreement has to provide the money to be used for such objects as the sending of experts in specific fields of national development—of which education is one among many—or for providing fellowships to train men and women sent abroad eventually for work in their own countries. Or, again, it provides for the setting up of demonstration or training centres to meet the needs of several countries in the same region. The Conference voiced the need for a vastly expanded development of these existing procedures, as well as calling for many new ones mentioned later in this book.

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[1] United Nations, *The United Nations Development Decade—Proposals for Action*, New York, 1962, Sales No.: 62.II.B.2.

THE DEVELOPMENT DECADE BEGINS

It was the growing recognition of the limitations of the improvised United Nations machinery, so far described, that led to the decision of the United Nations General Assembly in 1961 to inaugurate what is called the "Development Decade". It is too early yet to assess the total contribution which this all-purpose campaign can make to the fundamental problem raised earlier in this chapter, but it is unquestionably the biggest venture in world economic co-operation ever attempted in man's history.

The Decade aims, in short, at the all-round growth of the economic structure of each under-developed country so as to attain a substantial and continuing increase in the standard of living of its population. Each country has been invited to set its own target or series of targets. The indispensable part played by the Conference was to bring together a wealth of detail as to what those targets were in the different areas of production and administration, and what machinery was necessary to attain them.

As other volumes in this series explain, this over-all effort comprises a range of programmes aimed at increasing food production, exploiting natural resources, promoting industrial development and better housing, developing science and technology, and expanding international trade. The first priority of such a campaign must, therefore, be directed towards improving education and training, for none of these goals can be reached with an illiterate and untrained labour force. Moreover, in order to achieve a minimum annual growth of 5 per cent in the national incomes of the countries concerned, the United Nations system of aid will have to be expanded and intensified on a broad front.

It has been estimated that these all-purpose objectives would raise the flow of capital and assistance to between four and five billion dollars a year above present levels. National income growth, taking all the less developed countries together, is at present about $3\frac{1}{2}$ per cent a year. The immediate task will be to raise this rate of growth, during the next few years, by about $1\frac{1}{2}$ per cent to at least the 5 per cent envisaged, and then to increase this by a further $1\frac{1}{2}$ per cent to over 6 per cent per annum by the end of the Decade. The immensity of this task is seen in a new light when we come to define more closely the specific goals discussed at the Geneva Conference, and also at the earlier conferences of educational ministers and experts mentioned in the next chapter.

The United Nations system of mutual aid has already gained a good deal of practical experience in understanding this development process. It is useful to bear in mind the existing organization as, occasionally, participants from the developing countries have called for the setting up of new agencies or institutions, even where effective use of the existing machinery has not been made. Such instruments of joint action as the International Bank for Reconstruction and Development, the International Monetary Fund, the International Development Association, the International Finance Corporation, the Special Fund and the Expanded Programme of Technical Assistance, as well as special programmes

like the World Food Programme and the United Nations Children's Fund (UNICEF), have thoroughly proved their worth, even where inadequate funds have greatly restricted their operations. Their special contributions to, and close co-ordination within, the Decade are apparent in later chapters, as many participants of the Conference called on them for more extended services.

AN OVER-ALL PLAN FOR EACH COUNTRY

The crux of the problem of stepped-up development on the scale demanded lies in the setting up of clearly defined targets by each individual country. Each Government has to determine its specific national objectives, as well as the difficulties to be overcome, and what it considers its development "potential" to be. Forecasting personnel needs is dealt with in Chapter 3; but, as the Conference showed, all these factors have to be embodied in a comprehensive plan. Such a plan involves, in fact, the mobilization of the human resources of a nation as a whole. This is a precondition for achieving the material aims of the Development Decade. "The unutilized talents of their people constitute the chief present waste, and the chief future hope, of the developing countries," runs the United Nations report;[2] and, as a consequence, "high priority must accordingly be given to establishing educational systems well adapted to the economic and social needs of the developing countries".

"At the opening of the United Nations Development Decade," stated the Secretary-General of the United Nations, "we are beginning to understand the real aims of development and the nature of the development process. We are learning that development concerns not only man's material needs but also the improvement of the social conditions of his life and his broad human aspirations. Development is not just economic growth, it is growth plus change. As our understanding of development deepens, it may prove possible, in the developing countries, to compress stages of growth through which the developed countries have passed. It may also be necessary to examine afresh the methods by which the goals of development may be attained."[3]

This means that new methods of technical co-operation, added to those already well tried, will have to be found in order to take full advantage of the economic and technological procedures which have emerged in recent years. This exploration into fresh territory formed the substance of the Conference and made its discussions so timely. For instance, the main economic objective for the Decade is, as stated above, to create conditions in which the national incomes of the developing countries will increase by 5 per cent yearly by 1970, and continue to expand thereafter. If this can be accomplished—even if the population of the developing countries continues to rise at its present rate of 2 per cent to

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[2] United Nations, *The United Nations Development Decade—Proposals for Action*, New York, 1962, Sales No.: 62.II.B.2.
[3] *Ibid.*, Foreword.

2½ per cent yearly—personal living standards can be doubled within about 25 years. If, however, the growth of population should be more rapid by the end of the Decade than it is now, the raising of living standards will take correspondingly longer. Nevertheless, the Secretary-General's estimate shows that the objective for 1970 is within our reach, given a greater willingness to make the efforts and sacrifices required. If achieved, it would open up for a significant number of less developed countries the prospect of a real improvement in the conditions of life in their peoples. Above all, it offers great hope for the young men and women living today, who will be the nation of tomorrow.

THE RADICAL APPROACH

But the discovery and application of new working methods depends on the adoption of new attitudes by the national leaders. A number of such radical approaches emerged in Geneva. As they have a direct bearing on the later chapters of this volume, they may be summed up as follows:

The concept of national planning. Former objections to planning, largely attributable to a misunderstanding of the role envisaged for the private sector in most developing plans, have almost wholly disappeared. The basic purpose of a development plan is to provide a programme of action for the achievement of specific targets, based on factual studies of the resources available. It is not merely a stating of aims, but translating national objectives into action programmes.

Insight into the importance of the human factor. The most urgent need is to mobilize human resources. Economic growth is nowadays seen to be attributable far more than was previously supposed to human skills, rather than to "capital" in the old sense. Hence, the widening of man's horizons through general education and practical training is the essential pre-condition for long-term national development. For example, the total number of trained people in the developing countries must be increased by at least 10 per cent a year if the economic objectives of the Decade are to be achieved.

The assembling of detailed knowledge of natural resources. The United Nations Special Fund has concentrated its efforts on pre-investment work, giving special attention to studies of natural resources, in addition to technical and vocational training and, establishment of institutions for applied research (see Volume III).

The bringing of highly-skilled personnel from the advanced countries. In fact, the shortage of highly skilled personnel, rather than a shortage of material resources or finance, is now seen as the greatest hindrance of all to national action. In this context, technical field workers are no longer to be isolated; they should, on the contrary, work in constant contact with those of the advanced countries that are best acquainted with the problems under study. Moreover, foreign experts should help set up institutions to take over their own work when they leave.

The principle of outside capital assistance. As one of the essential foundations of planned growth, such capital assistance is also one of the most striking

expressions of international solidarity. If such assistance can reach a level of even 1 per cent of the national incomes of the advanced countries during the Decade—as urged by the United Nations General Assembly—it will represent a major contribution to the success of the Decade.

AN OBSTACLE TO BE CLEARED

The foregoing survey has indicated that means of fulfilling the objectives of the Decade are indeed within our grasp. One further consideration was never absent from the discussion: how much faster would men, money and materials be available for economic and social reconstruction if a substantial measure of disarmament could be carried out during the Decade.

Present expenditures on armaments *are equal to the aggregate national incomes of all under-developed countries put together*, and about ten times their net capital formation. By a unanimous General Assembly declaration, Governments have agreed to devote a portion of the savings achieved through internationally supervised world-wide disarmament to an international fund, within the framework of the United Nations, to assist the development of these countries. The fulfilment of this pledge would in itself go a long way towards providing the external resources required for the goals of the Decade.

Until the Conference, in fact, there had been too little organized effort to bring science and technology specifically to bear upon the particular problems of under-development. But, as several speakers pointed out, this has been due, in part, to the increasing burden of non-economic armaments, which has made it far more difficult to direct scientific and technological leadership and resources to the problems of their countries. Heavy financial aid, modern equipment and skilled personnel, which might otherwise be devoted to their problems, are pre-empted by the arms race between the Great Powers. Yet, even allowing for the research and development, to give higher priority to these objectives than has hitherto been the case.

It has been estimated, for instance, that the required acceleration in the growth of aggregate incomes in the developing countries from 3½ per cent to 5 per cent would result from a halving of armament expenditures.

The United Nations report, cited at the Conference—*The Economic and Social Consequences of Disarmament*[4]—introduced a further point bearing on the less developed areas, namely, that since "the competing claims in developing countries are also urgent, there is a serious possibility that the financial resources released by disarmament might be rapidly absorbed by purely national aims. It is therefore desirable that an appropriate proportion of these resources should be allocated

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[4] United Nations, *The Economic and Social Consequences of Disarmament*, New York, 1962, Sales No.: 62.IX.1.

to international aid in its various forms simultaneously with their use for domestic purposes".

In terms of broader social action, which effective disarmament would greatly enhance, the Director-General of the ILO well expressed this new emphasis: "Economic growth is not an end in itself but an indispensable means towards the real end—a better life in a good society." And he continued: "Economic growth has to be considered as a function of a wider process of social reconstruction. In this there are two other indispensable elements. One is greater material well-being for the population as a whole, and particularly for workers and their families. The other—and perhaps of the three the most important of all—is opportunity for the development of the individual personality and for the growth of institutions through which people can freely and responsibly decide the goals for which they are prepared to work."

It is essential to have such a large-scale chart in mind in order to gauge both the course of educational planning in the years immediately ahead and the types of training needed to translate the scientific programmes of a country into a national programme. The whole United Nations system of international co-operation is now wholeheartedly devoted to the mobilization of each less developed country's manpower and to securing outside co-operation to help that country in every possible way. By focusing effort directly on human resources, needy countries will be able to achieve a better utilization of their labour force and create higher levels of productive employment, while at the same time improving the quality of labour by vocational education and training.

HUMAN RESOURCES THE HIDDEN POWER

It has long been recognized in orthodox economic theory that capital, labour and natural resources are the main factors of production. Each is an essential element in industrial development. But the availability of natural resources varies widely. Some developing countries have abundant supplies of minerals, energy and water; others are less fortunately placed; while, in almost all, there is a scarcity of capital. Yet there is invariably a surplus of unskilled labour. With the pressure of increasing population the danger of unemployment and under-employment is in many of these countries becoming ever more acute. This continual waste of manpower—the greatest potential asset the developing countries possess—leads only to human misery and degradation. Hence, to cite the Director-General of the ILO again, "It is idle to talk of economic progress when large, and in many countries increasing, numbers of workers are either fully unemployed or under-employed".

The transfer of scientific and technological knowledge to the less developed countries has thus been accepted as an essential step towards enabling their peoples to lead a fuller life. In this transfer it is the human being, and not the

technique as such, that has become the centre of the great enterprise. This principle was stressed in the Conference Secretary-General's report on "Human Resources" [GR.2 (B)], when he cited the Economic and Social Council's statement on programme appraisals: [5] "The end may be forgotten in preoccupation with the means. Human rights may be submerged and human beings seen only as instruments of production, rather than as free entities, for whose welfare and cultural advance the increased production is intended."

That principle being accepted as the basis of the considerations which follow, the importance of education in the all-round development of a "new" nation cannot be exaggerated. One major task, for example, is to meet the food requirements of an increasing population and, at the same time, to provide for improved nutrition. Modern agricultural practices are vital if the annual increases in food supplies, envisaged by the Decade at between 3.8 per cent and 4.3 per cent, are to be met. Behind the many new projects designed to open up natural resources (see Volume II) it is necessary to expand cartographic services, prepare surveys of water needs and resources, intensify work on mineral exploration, plan future energy needs, and develop small power units in rural areas. It is evident that none of these tasks can be accomplished by an illiterate and untrained population.

Similarly, manufacturing output in the developing countries will, it has been estimated, have to increase by no less than 130 per cent if the goal of a 5 per cent annual growth in aggregate incomes is to be met. This will obviously entail greater public support of industrial planning, the promotion of small industries, and industrial training on an extensive scale. Here, again, education comes to the forefront. In the field of housing and public health it is estimated that in Africa, Asia and Latin America between 19 million and 24 million dwellings must be constructed annually throughout the Decade in order to eliminate existing shortages within 30 years, as well as to house the increase in the population.

Furthermore, if the proposed health targets are to be met, each country should have, by 1970, one physician per 10,000 persons, one nurse per 5,000, one technician (e.g., laboratory or X-ray) per 5,000, one health auxiliary per 1,000, one sanitarian per 15,000, and one sanitary engineer per 250,000. These are only rough figures, but they give some idea of the social goals set before the basic health service of these countries.

A similar situation prevails in regard to the development of transport and communications, the expansion of international trade, and the many other functions of the Decade. It is not obvious that education, in the broadest sense, has an indispensable role to play in fulfilling each one of the separate efforts which together form the most constructive experiment in world co-operation ever undertaken by man? It is in this context that the agenda of the Conference became, in effect, a road map of man's broadening future, if he had the wit and the will to travel that way.

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[5] United Nations, *Five-Year Perspective, 1960-1964*, Geneva, 1960, Sales No.: 60.IV.14.

NO GROUND FOR COMPLACENCY

The inauguration of the Development Decade thus marked a distinct phase both in the rise of the developing countries and in the functions of the world organization. This phase may be seen as a lessening emphasis on political methods and a growing awareness of actual economic and administrative problems which can only be solved by international co-operation. The Director General of UNESCO told the Conference: "After the great political emancipation movement which has occupied the foreground of history for the past 40 years, and which is now drawing to a close, it is clear for these countries that problems of administrative organization, economic growth and social progress will now become the dominant concern of their peoples and their leaders."

Once the magnitude and the inter-relationship of these problems are grasped it becomes apparent that the methods to be adopted will have to be those of applied science and technology, which, by their very nature, involve planning and organization. With rising populations, all too often on the edge of starvation, erosion of soils, precarious health and rudimentary tools, the manifold problems of the new nations would never be solved quickly enough if the traditional methods of the nineteenth century were to be followed. The call is for large-scale national and international organization, making use of specialized knowledge in many fields—agriculture, industry, transport, finance—and, behind all these, education of the ordinary people to make full use of modern techniques.

This insistence on co-ordinated and effective action was ever-present during the discussions which led up to the Decade and it came out at many points during the Conference. Up to a few years ago it had been virtually taken for granted in the West that, in the modern world, standards of living are, by and large, gradually improving everywhere. This seemed a natural assumption—before the facts (so recently) came to light. The big shock—which gave rise to the Development Decade and later brought the Geneva Conference into being—was the discovery that in wide regions of the world this "natural growth" theory was simply not true. Surveys carried out by United Nations experts and others, since the Second World War, revealed the contrary to be the case. How could it be taken for granted that economic and social progress was inevitable so long as vast areas of the planet existed where population was pressing every year more heavily on diminishing resources? For hundreds of millions of people today standards of living are falling, not rising.

A further obstacle may be briefly mentioned here, though it is fully treated in Volume V on "People and living". Progress towards a higher level of living in the world as a whole is being held back by the higher rates of population growth in poorer countries as compared with wealthier countries. Thus, as the former countries account for a larger proportion of population increases, they offset the improvement in world conditions as a whole. Each year the total number of human beings living in poverty and distress increases rather than diminishes. Even in the field of education—in spite of considerable achievements

in many less developed countries during the last decade—progress has not been enough to justify complacency. In spite of the sustained efforts to stamp out illiteracy (described in Chapter 4), the number of illiterate people still tends to grow, simply as a result of this relentless population expansion. In India, for example, the census figures for 1951 and 1961 disclose an increase between those years of more than 40 million of persons able to read and write; yet this splendid accomplishment was not enough to prevent the number of illiterates from increasing by more than 11 million in the age-group of five years and over.

NATIONAL PLANNING ESSENTIAL

Both in the earlier discussions and in those at the Conference it was realized that the efforts of the developing countries should come to be expressed more and more in comprehensive national plans. It is imperative that the approaches to the various problems of development should be co-ordinated and not be attempted on a piecemeal basis. For this reason special stress has been laid in this opening chapter on the inter-relations which have been steadily built up by the United Nations and its agencies over the years, and which are being consolidated under the Development Decade. The need for systematic and continuous international action at all levels is no longer challengeable. Thus, the various types of functional co-operation which are now proceeding under United Nations auspices occupied a large part of the Geneva discussions, not least in the area of education and training.

Indeed, the increasing realization of the importance of the human factor in economic and technical development brought the issue of education and training to the forefront of the agenda. Since recent research and experience suggest that the contribution of physical capital alone is by no means so dominant a factor as had at one time been imagined, concentration on the human factor has opened up new approaches to the whole strategy of development. Through education and training on a national scale, through community development and the employment of idle manpower, coupled with the eradication of disease, the vast untapped human resources of each developing country can best be directed to the tasks of nation-building.

Yet, in spite of the progress made in reaching agreement on such principles as the foregoing, and in spite of some conspicuous examples of purposeful planning, the general picture presented to the Conference was still one in which many of the "new" countries had, admittedly, either no development plans at all or mere paper plans lacking the machinery of implementation. In many cases the basic factual information required to draw up detailed action programmes was still lacking, as were also the planning skills to interpret and utilize the information.

The importance of the Conference to these countries could hardly be overstated. An effective development plan must cover, for instance, an action programme for both the public and private sectors of the economy and also

offer opportunities for the development of the latent resources of the country. But this kind of plan is still the exception rather than the rule; and some participants at the Conference confessed that their countries had neither the administrative experience nor the skilled manpower nor the budgets to cope with such sweeping changes in their own economy.

It should be recalled that the General Assembly resolution, which initiated the Decade, set out this general aim as follows: " . . . accelerate progress towards self-sustaining growth of the economy of the individual nations, and their social advancement, so as to attain in each under-developed country a substantial increase in the rate of growth, with each country setting its own target, taking as the objective a minimum rate of growth of aggregate national income of 5 per cent at the end of the Decade."[6] It will be noticed that the emphasis was on the individual nation, on "each country setting its own target". The key to the unlocking of accelerating development must be found in each country. Hence, each Government has to determine its specific national objectives, and the conditions and development of its own potential. This is certainly true of education, though it will be observed in the next chapter that the regional plans initiated by UNESCO have considerably facilitated the national process.

In passing, it might be assumed that the 5 per cent growth target, proposed in the General Assembly resolution, would be used at least in part for the benefit of the poorer sections of the population. The degree of social progress compatible with such a rise in the national income would plainly make possible educational facilities never available under the old conditions. In fact, the resolution refers specifically to social advancement and social development, with land reform, with the elimination of illiteracy, hunger and disease, and with improvements in education, thus making it clear that education is interlocked with the whole development process. And when a higher proportion of the increased incomes so induced is saved and spent on education, training and research, as well as on the discovery of new natural resources and similar developmental assets, the need for external assistance can be reduced.

The achievement of the basic objectives of the Decade becomes more realistic as the spectacular progress of modern science is constantly evolving new techniques applying to the expansion of national productivity. Although it is true that this progress has so far been of limited value to the under-developed lands, for lack of specific attention being given to their problems, this very neglect rendered the Conference an historic turning-point, coming, as it did, almost at the beginning of the Decade.

MILLIONS WAITING OUTSIDE

The intimate relation of education and training on the one hand, with science and technology on the other, calls for closer examination. Let us take, as an

[6] United Nations, *Official Records of the General Assembly, Sixteenth Session, Supplement 17, Resolutions* (A/5100), Resolution 1710 (XVI), New York, 1962.

example, the ever-disturbing question of illiteracy. In former days illiteracy did not necessarily imply a lack of "education" in the sense of adaptation to an individual's economic and social environment. If he had the elementary skill, general knowledge and social adaptation were acquired in his village, in the workshop, or on the farm. Today, however, it is a quite different problem. As has been shown above, a great drive has been set in motion for the social and economic application of science and technology to a vast range of human needs. But between the promise of universal literacy and its realization there is a disparately congested bottleneck; the school, the technical college, and the university, where would-be students crowd to learn, and thousands wait outside, lacking even the elementary guidance to know which way to turn. Also waiting outside, in most of the developing countries, are the uninterested illiterates in their thousands, if not millions.

Mr. Paul G. Hoffman, Managing Director of the Special Fund, substantiated Mr. R. Maheu's plea when he pointed out that: "Of the 1,300 million people living in the less developed countries for which the United Nations has some responsibility, almost half cannot read or write. Not over 10 per cent of the children from 14 to 18 are in secondary school and only the thinnest layer are undergoing technical training or taking university work. Today everyone recognizes the intimate relationship that exists between the economic development of a country and the education of its people. Only by giving the highest priority to the development of education at all levels, with particular emphasis on the training of people to make effective use of their natural resources, can there be an adequate response to the revolution of rising expectations. Only through education can the benefits of the revolution of science and technology be realized. Making effective use of human resources is an entirely different task from that of speeding the discovery of physical resources."

Likewise, Professor M. S. Thacker, President of the Conference, urged that the highest priority be given to the development of human resources: "Problems of education in the less developed areas are many. Generally, education is dealt with as a part of the social services. It has still not been adequately realised that investment in education and in the development of skills and capacities among people is investment for economic growth and should really form an integral part of a country's economic plan. The building up of an educational infrastructure is basic to all growth in any economy—advanced or less developed . . . The tremendous growth which we have witnessed in science and technology is the result of one thing—a better use by man of his mental capacities . . . Developing human resources, training of minds, resources still largely untapped, constitute man's real hope for the future."

As we have noted, many different factors have a bearing, directly or indirectly, on the development of a country, such as the existence of a stable political order and administration, internal savings and capital formation, the ability to attract capital from outside, and the availability of basic raw materials. Nevertheless, the development of its scientific and technological manpower is the most crucial

factor of all, because, even if capital and raw materials are physically available, they become productive only if scientists and technologists and other skilled people are available in adequate numbers.

This point has been made several times in the present chapter because it is basic to all that follows. The economic advance of the developed countries, such as the United Kingdom, the United States, Germany and France, was directly attributable to the progress of science and technology—plus the growth, over the years, of a large work force possessing scientific knowledge and trained in technological skills. So it is with the "new" countries today. Mr. R. Prasad, Director of Manpower, Ministry of Home Affairs, New Delhi, made this clear when he said: "The great stride made by the USSR in the course of a single generation of about 25-30 years has been due largely to the advance of science and technology, and to the build-up of a large corps of scientists and technologists" (K/41).

"The huge development of man's reason leads him to create machines and equipment to remedy his deficiencies," stated Academician Nikolai M. Zhavoronkov of the USSR; and he added: "An even greater quality is the fact that the human mind understands the limitations of its cycle as well as its psychic and physiological substitutes, and thus is using electronic computers. But I must say that the possibilities of the human mind have not been exhausted by far. Full use of automation in the industrial process will lead, and is leading, to increased productivity; but there is another more important element. Today, automation allows the processing of a much greater amount of information than could be done by the human mind. This will lead to the elaboration and practical use of intensive processes which could not exist with the more conventional means . . . but man still plays the paramount role—man having the necessary mental equipment to lead technology and make new scientific discoveries. This is why the perfecting of the system of training engineers and scientists should always be the first task alike for developing and for highly developed countries."

To sum up, the feasibility of rapidly transforming an under-developed country into a modern industrial economy—given the right kind of help from scientists and technologists from outside—has been demonstrated beyond dispute. Accordingly, the main hope for the developing countries to attain a rapid rate of economic advancement and to raise the living standards of their people in the foreseeable future lies in their giving high priority to the development of their scientific and technological manpower.

"For many years," declared Dr. Anisio S. Teixeira and Dr. Darcy Ribeiro in a paper submitted by Brazil, "we have been in the condition of our Xavants Indians, who, having learned to use steel axes, could no longer do without them and saw themselves tied to those who supplied the axes. Now that we already produce steel, telephones and penicillin, thereby increasing our autonomy, we risk subordinating ourselves to foreign standards and skills. We will really be autonomous only when the renovation of our factories can be performed by our

own engineers and technicians, according to procedures resulting from our own special conditions. This is the road we must follow if we are to step up the rate of our production and reduce the distance between Brazil and the technologically advanced countries, now ahead of us because of the achievements of their scientists and technicians. They will continue to be ahead of us unless and until we develop a new kind of higher education to produce scientists and technicians of our own; in other words: unless and until we have education for development" (K/19).

PRIORITIES AND TIME-LAGS

But the national supply of scientists and technologists cannot be suddenly increased. The rising demand for their services in a developing economy can be met only by advance thinking and by planning on a long-term basis. In the absence of such planning there is a serious risk of the pace of development being impeded at some point for want of a sufficient number of qualified scientists and technologists. (This topic is expanded in Chapter 3, which deals with some of the problems of forecasting personnel.)

Naturally, the education and training of sufficient scientists and technologists takes time. As Mr. Prasad indicated, in India the degree course in engineering takes five years and in medicine six years, after the completion of higher secondary education; and, normally, a graduate would need two to three years' practical training before he is properly equipped for taking up a responsible position. The formulation of plans and policies and the setting up of additional educational and training facilities may also take two to three years. In certain situations tests may first have to be taken for expanding facilities for science education at the secondary stage before a substantial programme can be undertaken for education and training at the university or professional level. Thus, the time-lag in the expansion of educational and training facilities for scientists and technologists is roughly of the order of eight to 12 years as against three to four years which may be needed to put up a large steel plant or a heavy electrical equipment factory or other similar industries (K/41).

The major barrier to a full use of such challenging opportunities—apart from the will to give the needs of the less developed countries reasonable priority—is the shortage of qualified personnel in the developed countries themselves. This shortage is particularly acute in scientific subjects. New methods must therefore be found to educate and train larger numbers of people in these disciplines in all countries. The problems are, in fact, particularly crucial, not only because competent personnel is lacking, but also because of the lack of special and often expensive equipment. For this reason alone a large proportion of scientists must be trained abroad, at least in the short run. To meet this situation major emphasis must be placed on the building up of regional universities and technical colleges. In addition, advanced countries are urged to take account of the needs

of the developing countries when they make projections of their own needs for certain skills.

As Professor V. Malinschi, of Romania, expressed it: "To put science and technology at the service of progress does not only mean using scientific and technological conquests, but also having the capable and trained personnel and using them as effectively as possible, ensuring their development, their further training, and their continual adaptation." In fact, this is the major premise for the fast development of young states. One of the possibilities open to these young States (continued Professor Malinschi) is the preparation of cadres in the more developed countries. Nonetheless, urgent measures should also be taken to ensure the training of such cadres in their own country; and to start this by preparing teams—basic teams which would ensure the development of all levels of education. Moreover, in the process of forming cadres it is necessary for new technicians to understand as deeply as possible the social and economic situation of the country they are dealing with, because most of these trained people will probably be called upon to play an important role in the public life of their country, since the *élite* is limited. "In my own country," concluded Professor Malinschi, "medium and higher education is closely related to practice and to the real needs of life. In 1962 there were in Romania 45 higher education establishments with 151 faculties, whereas in 1938 there were only 16 institutions with 35 faculties. In the period since 1955 not less than 70,000 specialists have been trained, among them 30,000 engineers or economists. Today my country has six times more engineers than it had in 1938" (C/400).

A NEW ATTITUDE NEEDED

In the gigantic efforts now being made towards economic and social development in all these new countries, the transfer to them of existing scientific knowledge and skills, so that they may themselves control the forces of nature, is of the utmost urgency. As the following chapters demonstrate, some of the older countries of the world, having recognized these needs, have freely opened the doors of their educational establishments to nationals of the developing countries and have often invited their Governments to use the services of their experts. Yet, even so, no Government of an advanced country has so far fully assessed the magnitude of this problem or the degree of its urgency. Although these recent efforts have been helpful in certain cases, it has become obvious that they have yielded only slender results. For this reason the international machinery for the dissemination of intellectual, scientific and technical knowledge and skills throughout the world must be completely revised.

From the Conference there issued a more revolutionary programme than its extensive agenda might have foreshadowed. Henri Laugier, a former Assistant Secretary-General of the United Nations, insisted that "international planners should resolutely undertake a revolutionary re-appraisal of techniques for the dissemination of knowledge". Large educational centres, whether international

or regional, should be set up, he urged, covering every field of knowledge, and new international universities and international or regional centres for technical training should be established. These new centres ought to be truly international in spirit, and in administration and management. They "should not cling to the traditional and obsolete teaching methods of universities in the older countries", but should use to the full all the techniques which modern science places at the disposal of the home student, such as radio, television, tape-recorders, teaching-machines, simultaneous interpreting, and other audio-visual media. (This proposal is further considered in Chapter 5.)

One tacit question remains however—and it was, in fact, one of the chief reasons for calling the Conference. It may be phrased thus: "Can an underdeveloped country really acquire the scientific attitude?" It was Dr. A. Babs Fafunwa, of the University of Nigeria, who gave a suitable answer: some writers, he said, erroneously maintained that the average African was incapable of a scientific attitude or that it would take him countless generations to acquire the logical reasoning involved in that attitude. This spurious argument rested on the belief that the idea of the "wheel", the simplest and oldest scientific device, was unknown to him. "Science and technology, in particular, are products of challenge and response—unlike art and literature, which are products of creative leisure and artistic instinct," said Dr. Fafunwa; hence, "the scientific attitude can be acquired as a way of life in the same manner in which socialism, capitalism, communism and the like are injected into the society as a way of living".

CHAPTER 2

National and regional planning

"The newly developing countries in the world today are in a hurry. They will not be satisfied with the rate of development that has been achieved in the past by the so-called advanced nations. They want," claimed Professor F. H. Harbison, of the United States, "high speed, accelerated growth. Now, I would submit that the purpose of making a manpower assessment is not limited to the development of statistics; it is not research; it is not the making of studies. It is, I submit, the building of a strategy for action—a programme to get on with the job."

It was typical of the variety of opinions which confronted each other in Geneva that "developed" and "developing" countries frequently appeared to switch places. When their respective spokesmen attempted to define educational goals and to lay down a methodology for reaching them, it often happened that the personal quotient, the local problem, the national economy, and the regional or international plan tended to overlap. As Dr. R. D. Loken, of Ghana, expressed it in the same discussion: "I believe that most economists do not give sufficient weight or attention to the human factors. When you present figures, such as I have presented to the economist, he simply looks at these statistics and says: 'Fine—they will take care of themselves'. But, believe me, to institute a programme as described here, takes a lot more than simply saying go ahead and do it! It requires institutions, people, experience, etc."

Acceptance of the need for basic planning in education implied that it had to be envisaged as integrated with the wider economic plans. Because (as Dr. J. W. Corran, of the United Kingdom, remarked), before any idea of the needs in terms of scientists and technologists and technicians can be ascertained, it is essential that the policy-making committee of the Government should consider the development of the country in its broadest aspect. "After all," insisted the speaker, "the provision of enough food is the biggest problem we have before us today." To determine the directions in which food can be produced and distributed on an increasing scale requires the developing countries to base whatever plans they determine on considerations of this nature. Having done that, he said, they will be in a position to define whatever "types of special scientific and

technological requirements are required to fulfil any plans that are conceived".

When Tunisia became independent in 1956 (Mr. B. Jaïbi reminded the Conference) a whole host of concurrent problems confronted its leaders and, in particular, problems of training. Quite soon, planning in education turned out to be an essential undertaking. This requirement arose even before the Tunisian Government had decided in favour of economic planning. The establishment of an economic plan was begun only in 1961, while the first attempt at planning a so-called ten-year plan of schooling was actually drawn up in 1958. "When an economic plan—or rather a ten-year economic prospect—was prepared in 1961, it was necessary," said the speaker, "to revise completely the schooling ten-year plan and adapt it to the conclusions or the indices of the economic plan."

Concrete examples of this kind illustrate some of the difficulties which developing countries are facing in having so speedily to improvise nation-wide educational organization and engage in over-all economic planning at the same time. This problem of co-ordination arose throughout the Conference. It was dealt with in some detail by reference to the experience of Yugoslavia: "However complex and difficult it might be, owing to the deficiency in statistics and research," stated Dr. Miloš Macura, "one should aim at this kind of co-ordination. For it would obviate the wrong use of scarce resources, as well as avert sociological and psychological problems arising from unemployment of skilled labour". The complexity of this co-ordination of production and education lies in the fact that production targets have to be set for the immediate and prospective periods, whereas educational targets are, by their very nature, of long-term character. This dilemma points to the necessity of first working out a long-term projection of economic and social development, to be used for target-setting in education, and then selecting the most efficient short-term methods for training, and meantime finding substitutes for the technical, managerial and other personnel which is immediately needed.

The same speaker stressed that, owing to the scarcity of resources and the great demand for educated people and for programmes of education, both inside the country and abroad, national plans should aim at maximizing output and minimizing expenditures. In addition to regular enrolment at universities and colleges, vocational and similar schools, less costly methods should be adopted, such as evening classes, out-of-door training, in-service training, part-time studies, and so on. Institutions should train people to educate themselves by their own efforts: this would help to meet the growing requirements at lower cost. "I should like to mention that such methods have proved very efficient in my country," concluded Dr. Macura, "particularly during the first years of the industrialization programme, when the enrolment capacity of the universities and the schools was small and the bulk of resources was directed to productive investments. Even now, at least one-fifth of our total number of university and college students are part-time science students. How much less expensive this is than the regular enrolment."

REGIONAL PLANNING THE BASIS

It is time, however, to turn from the individual school and to survey, in the next few pages, the background developments of recent years, during which educational planning has taken firm root in the main regions of the world. As explained in Chapter 1, UNESCO had already, in co-operation with other specialized agencies and with the Regional Economic Commissions of the United Nations, set the stage for a decade of intensive action for the development of education. In this chapter, UNESCO's part in the over-all economic and social reconstruction of the developing countries will be seen in terms of their educational needs. These needs were studied at the national and regional levels and a framework of decisions was agreed regarding the levels of educational development *to be achieved by 1970.* The regional targets on which these decisions were based can be briefly summarized as follows:

In Africa: 70 per cent of the children of age group six to 12 are, by the target date, to be in primary schools—compared with the present level of 40 per cent; 15 per cent of the appropriate age group in secondary schools—now three per cent; and 0.4 per cent of the appropriate age group in universities—now 0.2 per cent.

In Asia: 50 per cent of children of primary school age are to be in primary schools. It is further estimated that 50 per cent of primary school leavers will go to secondary schools, plus a further 20 per cent to trade and agricultural schools. In the area of higher education the present percentage of two per cent is expected to move towards a target of three per cent.

In Latin America: All children of primary school age are to be in six-year primary schools, involving an increase in the primary school population from 26 million children in 1960 to 45 million in 1970; 30 per cent of the appropriate age group in second level schools; and four per cent of the appropriate age group in universities.

These regional plans also call for a substantial enlargement of training programmes and adult education facilities. (Further details of these are given in Chapters 4 and 5.) These specific objectives were carefully worked out at the regional conferences, described below, at which the individual countries of all the regions committed themselves to an annual expenditure of approximately four per cent of their gross national product by the end of the Decade. Periodic conferences of ministers of education are to be held to review progress and plan future developments. It need hardly be emphasized that the attainment of these targets will require, in addition, large amounts of external assistance, which have also been estimated with some precision by UNESCO experts. Substantial financial aid, both bilateral and international, will thus be required to a growing extent for educational developments alone as the Decade proceeds.

Other agencies are just as deeply involved. The Food and Agriculture Organization, for instance, started in 1955 a series of regional studies on agricultural education, beginning with Latin America. Later studies were made for Asia and

the Far East, and for the Near East. These studies are being followed up by meetings of deans of faculties of agriculture and directors-general of ministries of agriculture, in order to revise present training schemes. (Chapter 4 gives further details of such programmes, which are also dealt with in the appropriate volumes of this series.)

AGREEMENT ACROSS THE WORLD

In order to appreciate the terminology used in discussing these plans, the sequence of the regional meetings initiated by UNESCO may be summarized as follows. An epoch-making meeting of representatives of Asian Member States was held in Karachi in December 1959 and January 1960, where they drew up for their own region an outline plan of educational development aiming at *universal primary education by 1980*—the "Karachi plan". A later meeting of ministers of education of Asian Member States was called by UNESCO—in association with the United Nations Economic Commission for Asia and the Far East—in Tokyo in April 1962, to examine the Karachi plan in relation to over-all educational planning and to social and economic development.

About the same time an enquiry was made into the educational needs of the Arab States. These findings were studied at a meeting of representatives of ministries of education at Beirut in February 1960, which urged the introduction of educational planning for the region. These initiatives were followed by a Conference of African States held at Addis Ababa in May 1961, which approved a regional plan, similarly aiming at *universal primary education* by 1980, and a balanced development in all sectors of education. This has been called the "Addis Ababa plan". A meeting of African ministers of education concerned in following up the Addis Ababa plan was held in Paris in March 1962 and reviewed, country by country, separate plans for their own educational development and current budgeting. It is these country-by-country plans which were brought to the attention of the Conference, and to which frequent reference is made later.

As regards Latin America, a Major Project, as it is called, for the extension and improvement of primary education in Latin America has been in operation since 1956. The project has so far been directed mainly towards the expansion of elementary education; but it was considerably widened following a special session of the Inter-American Economic and Social Council at Punta del Este in August 1961. Long-term development goals were then set before the Latin American nations. A further conference on education, to implement the requirements of economic and technical development, was held at Santiago in March 1962. A comprehensive declaration was there adopted setting out the objectives and methods of educational development for Latin American States as a whole, and education ministers of the several nations have since been implementing these decisions as far as their resources have permitted.

It is worthy of note that in all these regional schemes the United Nations and its specialized agencies as well as inter-governmental institutions have been increasingly brought together to work on a common design under the impact of the Decade, as described in Chapter 1. The Conference listened to high expressions of praise for this gathering momentum of technical co-operation, which means so much to the individual countries.

Educational planning on a regional basis has not been confined to the three continents already mentioned. About two years ago—Professor Alves Martins, of the University of Lisbon, told the Conference—six European countries, Greece, Italy, Portugal, Spain, Turkey and Yugoslavia—joined in preparing an assessment of their educational needs up to 1975, and in estimating the investment required to meet such needs. This research project is known as the MRP—the Mediterranean Regional Project—and was initiated by bilateral agreement between the Organisation for Economic Co-operation and Development and the Governments of the six countries. Today, research groups set up in these countries under MRP are working in close co-operation. Their research directors have met several times for the purpose of pooling their experience, affording mutual help in the solution of their difficulties, and combining efforts for the accomplishment of their common tasks.

It is hoped that the final product of this co-operation will be a set of recommendations addressed to policy-makers of their respective national Governments regarding action programmes in the whole field of education. Meantime, the activities of these six teams have already led to one of their consultants writing a valuable book on the "methodological" problems with which they are faced—namely Professor Barnes's *Forecasting Educational Needs for Economic and Social Development*, which was published in October 1962 by the OECD.

FINDING A METHODOLOGY

The need for a consistent "methodology" of educational planning came up at a number of points of the Conference; hence, it may be useful to elucidate this term somewhat further. At the first conference in Karachi, in 1959, a simple regional approach was employed. In other words, educational goals for the whole region were defined as carefully as possible on the basis of the results of national educational surveys. The programme was costed as far as practicable, but without any specific relation to economic resources and the potential educational "investment" of the region. At the second conference, however, at Addis Ababa in 1961, a regional educational-*cum*-economic methodology was introduced. This meant that educational goals were again established, but this time in the light both of the national educational surveys which are being undertaken and of the expected gross national product (GNP), as well as of the estimated educational investment deemed to be possible within the period planned. External aid—essential if the national targets were to be achieved—was also taken into

account. Educational goals were defined for the region as a whole, in relation to the present and future GNP. An estimate of the educational investment and other assistance needed was made for the target year 1980, and then worked *backwards* for an analysis to 1960. The African countries have decided to set up continuing machinery to apply this kind of methodology to each individual country's national plan, and then to work out the annual financial implications of the educational targets for each country.

The third stage in this development was initially proposed at the above-mentioned Latin American Conference at Santiago in 1962. For this purpose the region was divided into three sub-regions, on the basis of the national surveys, and the current second-level school enrolment ratio was taken as the criterion. The first sub-region consists of four countries, where the enrolment ratio is from four to eight per cent of the appropriate age group; the second group consists of seven countries, with a ratio from nine to 13 per cent; and the third consists of nine countries, with a ratio from 14 to 38 per cent. The educational targets covering the "Alliance for Progress" scheme (1960-1970) for each of these three groups are varied in accordance with their current educational achievement and, indirectly, with their educational investment possibilities. The costing of this ten-year educational plan and the estimating of the GNP and educational investment on a continental basis have not yet been undertaken.

The same methodology was adopted at a Conference of Asian Ministers of Education, held in Tokyo in April 1962. It was found to require some four years to apply it to the 18 countries grouped together under the afore-mentioned Karachi plan. Under this procedure, national surveys of educational achievements by levels will be made in each country. From the base thus established projections will be made for the envisaged 20-year period from the expected growth of the GNP and the educational allocations estimated for the national economic plans of each country.

As a follow-up of the Tokyo meeting of Asian ministers of education in 1962, a joint UNESCO-ECAFE working-party on educational planning was set up in Bangkok, and it was agreed to form regional advisory teams for educational planning. Two of these teams, which are about to be set up, consist of an educational planner, an economist and a statistician. The necessary funds are to be allocated under the Expanded Programme of Technical Assistance (EPTA), and this assistance is expected to continue during 1964. The teams will spend three or four months in each country. During the present year one team is visiting Ceylon, India, Pakistan and Thailand, and the other will go to Afghanistan and Iran. Nepal is also to receive a long-term educational planning mission, while Burma, Cambodia, Indonesia, Korea, Laos, Malaya (including Singapore, Brunei, Sarawak and North Borneo); the Philippines and Viet-Nam are to be visited in 1964. A further conference of Asian representatives will be organized jointly by UNESCO and ECAFE in 1966 to put together these national surveys and forecasts, so as to collate the Asian educational development plan with the overall economic development programme of the region. In this way the all-important

relationship between general *economic* planning and *educational* planning—in which science teaching and technical training must take an increasingly larger place in the years ahead—is being built up by the closer co-operation of the functional and regional bodies described in the previous chapter.

EDUCATION PLANNING NEEDS OUTSIDE HELP

The appeals which so many speakers made at the Conference—added to the increasing requests which have been coming from many developing countries for UNESCO's help in the planning of their education—drew attention to the fact that there was a real danger of their far outrunning the Organization's available resources in money and personnel. In spite of this fact it must not be assumed that the spasmodic and unco-ordinated assistance offered to a needy country on a unilateral basis by a donor country can replace the systematic co-operation coming from multilateral sources, such as UNESCO and the other international agencies. This point was often made throughout the Conference.

For example, in speaking of the relation between the scientific training of engineers and the economic development of a country, Professor Elias Gannage, of Lebanon, pointed out that, "since in developing countries we do not have sufficient scientific engineers, we have to plan the use of our manpower in the future. And since there is such planning, we have to foresee how many engineers of various specialities we shall require. And very often technical assistance, international or bilateral, offers scholarships to our countries. This is where the problem arises which we become aware of in Lebanon. The scholarships from the United States, from France, Britain, the Soviet Union and so on were distributed directly by each of these countries in answer to requests. Thus, in practice, there was some disorder. Scholarships were not given according to the needs of our country, but rather the requests—individual requests—sent in to the various embassies. And to put an end to this state of affairs, we worked out a programme in the Planning Ministry for how many engineers we needed in the field of civil aeronautics, or physics, or mechanics, and we transmitted it to various embassies asking them to put at our disposal a certain number of scholarships in these various fields. Thus, co-ordination is now better insured, the giving country will be able to satisfy our needs, and our plans will be better co-ordinated".

Before considering in more detail the problems of national educational planning, as it relates specifically to science and teaching and technological training, it would be as well to summarize the central role which UNESCO is playing in this co-ordination process and in assisting the developing countries to build efficient educational systems related to their economic and social needs. A common pattern seems to be evolving. It implies forecasting the demand for education, setting up planning machinery, drawing up well-phased educational programmes incorporating the most suitable teaching techniques, supervising the

carrying out of the plans, evaluating their results, and, above all else, assisting in the training of personnel. In all the developing countries it is also necessary to assess the human resources required at different levels of attainment for carrying out their development plans. Such a formidable programme involves giving expert help in all these fields, sending out international teams to aid countries in setting up their own plans and formulating aid requests, and furnishing facilities for training.

An extensive demand for educational planning missions and for financial aid in the form of loans and grants for educational projects is foreseen as the Decade proceeds. As regards training, regional centres have been established in New Delhi and Beirut. UNESCO is also participating in the United Nations Development Institutes set up for the training of *planning* staff. Their work is now being supplemented by the establishment of a central institution which has just been opened in Paris—the International Institute for Educational Planning—(described more fully in Chapter 7).

As many speakers pointed out, UNESCO recognizes that *primary* education is the foundation rock on which the whole educational programme has to be built. Hence, its great social and political, and in the long run, its economic importance. But, on short-term considerations, the expansion of secondary education may, in many countries, tend to have a more favourable effect on the rate of economic growth. Thus, it is first necessary to conduct surveys and studies on which policy decisions can be based in the individual country. Aid must be given in accord with the decisions taken by each country. In the case of primary education it consists largely of equipment and material needing foreign exchange for its purchase, and of expert advice on teaching methods and teacher-training, buildings, textbooks and visual aids. In the case of secondary education UNESCO has concentrated on aiding colleges for the training of secondary school teachers, the revision of secondary curricula to adapt them to the needs of specialized training, and the intensified training of teachers of high priority fields, such as science and languages, as well as the production of good modern textbooks for their use.

The needs of both primary and secondary education are considered in some detail in Chapter 3, and those of technical and vocational training in Chapter 4. Here let it be stressed that, in the latter sphere, UNESCO's contribution has a direct bearing on the success of the Decade. The Organization has been made responsible by the United Nations Special Fund for the implementation of various projects, the number of which is expected to increase over the next few years. UNESCO is at present expanding its comparative studies of various systems of technical training, the adequacy of textbooks, and the ways in which secondary education can best provide a basis for advanced technical education.

Thus the requests for help in building up technical colleges of all types are bound to multiply. The provision of such advisory services and of internationally recruited teachers, the organization of training-courses for instructors, and the award of fellowships for higher training abroad will plainly need financing on

a greatly increased scale. The question is whether the Member States, especially the advanced countries, will be prepared in the years ahead not merely to step up bilateral assistance to the developing countries but substantially to contribute to the fast-growing multilateral programmes of UNESCO and other organizations within the United Nations system.

In Chapter 6 further reference is made to UNESCO's world wide role in the eradication of illiteracy, and adult education programmes are also there considered. But it may here be mentioned in passing that UNESCO will initiate a world literacy campaign in 1965. Several speakers at the Conference called attention to the fact that a number of countries had no popular reading material in the languages spoken by their people. It is relevant to this dire need that, as a stimulus to adult education, the Organization is promoting the use of radio, films and television, the preparation of travelling exhibitions, the production of reading materials, the development of libraries and museums, the training of specialist teachers, and the integration of all these various activities with community development programmes.

Higher education is an integral part of any planned educational system. The university is not only a research centre and a nursery of the higher skills, but a necessary means of improving the quality of primary and secondary education. Moreover, the universities are the principal source from which developing countries obtain their leaders, not only in political and social life but also in the sciences, in technology and in teaching. In short, the *quality* of the leadership and the scientific standards prevailing in a country are determined by its universities. Every endeavour must therefore be made to render higher education increasingly accessible to all who have the requisite ability and aptitude. Thus, to help to raise standards of learning is to ensure that less developed countries can take full advantage of the benefits of modern technology in industry, agriculture and public administration.

Finally, UNESCO is engaged on a long-term programme to aid all these countries in recruiting high-level manpower—including managerial and administrative staff—by improving teaching in the natural and social sciences and in technology. In particular, the Organization is directly assisting the developing countries by (*a*) gathering and disseminating information on modern curricula and teaching methods; (*b*) promoting modern teaching through the use of new methods and inexpensive equipment; (*c*) ensuring the quality of teachers of science and technology through special courses, fellowship programmes and international conferences; and (*d*) providing, under the Technical Assistance Programme and the Special Fund, for the establishment of higher educational institutions devoted to science and technology.

THE SCIENTIFIC BASIS OF DEVELOPMENT

Modern economic development and social progress rely to an ever-increasing extent on scientific research and on the application of the discoveries and inven-

tions to which it leads. All the developing countries are becoming aware of the need to work out a systematic scientific policy, aiming at the expansion of national research activities and the fulfilment of their plans for modernization and equipment. The planning of this national scientific effort is normally carried out through such bodies as National Councils of Scientific Research and Academies of Science. In fact it is to be expected that, during the Decade, the developing countries will request the services of a large number of specialists for the setting up of the legal and administrative machinery required for the efficient organization of scientific research.

This is by no means a simple undertaking. It is one reason why the Conference performed so vital a role in bringing together educational leaders of the advanced and the less developed countries to map out the kinds of administrative guidance and assistance that the former can give the latter, particularly in this difficult area of research. The level of a country's scientific development has to be measured, on the one hand, in terms of scientific and technical personnel and, on the other, in terms of national expenditure on research work. It was suggested at the Conference that in countries which already have machinery for a national scientific policy, national expenditure for research and development should, by the year 1970, reach 1 to 2 per cent of the gross national product. This would mean that the number of scientists engaged wholly in research should reach 1,000 per million of the population, and that of engineers 4,000 per million. In countries which have scientific co-ordinating and planning bodies, but whose scientific infrastructure is insufficient, national expenditure for research and development should reach at least 0.5 to 1 per cent of their GNP. The number of scientists engaged wholly in research should reach 500 per million of the population, and that of engineers 2,000 per million. In countries without any form of official scientific organization at present, national expenditure for research and development should aim to reach 0.2 to 0.4 per cent of the GNP, with 200 research scientists and 800 engineers per million of the population.

It should, however, be noted that these general aims, which were before the Conference, are not ends in themselves, but stages in a process of dynamic evolution which could lead to a balanced development of science and technology in all parts of the world. At present UNESCO is responsible for the execution of various Special Fund projects, such as the Power Engineering Research Organization in India and the Institute of Research and Training in Petroleum in Argentina; but, in the years immediately ahead, a spokesman informed the Conference, the Organization hoped to provide yet more assistance for research institutions in science and technology.

SOME ROADBLOCKS

It must not be assumed, however, that "planning" in the field of education is an easy or automatic process. On the contrary, several participants pointed

out that the obstacles to educational planning in developing countries are many and formidable. For example, Dr. Jayme Abreu, of Brazil, explained that the first difficulty to be overcome, if a policy of educational planning is to be adopted by some countries in process of development, is "the antinomy between the very notion of planning and the structural character of societies with an archaic culture". Yet the notion of planning is nothing but the application of scientific method to the handling of natural and social phenomena, the purpose being to increase the range of human foresight and to intervene in the process of social development by accelerating or modifying it (J/33).

"In modern, highly industrialized societies," he continued, "there is a constant readjustment of ways of life, standards, values and organizing processes. Tradition and custom offer no solution. Appeal must be made to reason, expressed in science, to guide action, which is planned and which makes use of characteristically scientific modes of thinking—that is, thinking which is objective, analytical, integrating and projective. In archaic cultures, however, the situation is quite different. The systems of participation that bind persons and things together are not susceptible of verification by the rational and objective thinking of science. The significant relationships of such a culture do not correspond to the same terms of meaning—intelligibility, purpose and so forth—as in modern societies."

Difficulties also arise, it would appear, from the frequent lack of precision as to exactly what educational planning *means*. It can imply, for instance, the closest possible relationship between ends and means, collection of data and co-ordination of their meaning, educational, political and social interrelations and implications; the establishment of precisely defined objectives to be attained within a fixed time—with resulting alternative hypotheses and their results. Moreover it is common to confuse educational *reforms*—involving the setting of educational objectives—with educational *planning*, which involves decisions as to optional educational goals to be attained within varying periods, strict correlation between ends and means, and the incorporation of the whole of the components of the process.

On the other hand the topical approach—that is, rejecting the totality of the over-all social process—seeks to achieve an isolated datum limited to the particular case. All outside connexions are ignored. What exists is taken as local, momentary and finite. The result of this approach is a partial planning of the school apparatus by itself, as though it did not function as a system of communicating vessels. This is educational planning divorced from a dialectical conception of the over-all social process, and is unrelated to the social and economic factors operating in the country. Thus (continued Dr. Abreu) we have planned expansion of the primary school, unconnected with any plan for expansion of subsequent levels. Plans are drawn up to extend elementary schooling for (say) six years to the whole eligible population, without any parallel economic planning capable of promoting the social conditions necessary for the students to be fully absorbed. One result of this topical approach—blind to the needs of the over-all social context—is the creation of purely ornamental

forms of instruction, thus institutionalizing knowledge that is sociologically useless in relation to the basic needs of development. Consequently public budgets are overloaded with the preparation for symbolic occupations with no definable relation to the exercise of any productive or socially useful activity.

Again, argued Dr. Abreu, "prominent among the difficulties before educational planning in countries in process of development are the roadblocks thrown up by the traditional staffs of public administration. In a general way, as a result of the law of inertia or addiction to the conservative comfort of ancient, relaxed routines, they look upon planning as nothing but pure snobbishness, extravagant and unworkable—something that threatens the tranquillity of established customs and vested interests. This attitude of resistance to change is frequently shared by a goodly part of public opinion, which views planning as a kind of intellectual fantasy—a mania for applying new names to old familiar things." (In Chapter 5 closer attention is given to some of the techniques which the Conference proposed for overcoming this kind of resistance and enlisting the support of public opinion.)

The time element is a further difficulty which may easily be overlooked by planners in a hurry. The suitable allocation of specialists is something that should be considered over a long period before they actually graduate. "At least, in the Soviet Union," remarked Professor Sergei Rumiantseve, "up to last year, we made plans for the graduation of specialists seven years ahead. But we became convinced that a seven-year plan for the graduation of specialists is too short an interval, because there is constantly the problem of training the professors. The training of professors is one which lags behind the question of the number of graduating specialists. And, in this connexion, we have had to go on to a ten-year planning interval, and then to a 20-year planning interval. Now, in the Soviet Union, we have got this long-range plan for 20 years, in other words, up to 1980."

"I would like to point out," he stressed, "that this plan is a very realistic and essential one . . . By 1980 the number of students will have to increase from 2,600,000 to 8 million. In other words, there will be an increase factor of four, and by that time we will be graduating approximately half-a-million persons yearly. In other words, by the year 1980 we shall have had to train qualified specialists for higher schools—professors and teachers and so on—and the interval for training all of these specialists is very short, because it is not that easy to create a highly-qualified specialist for our higher institutions of learning. I think that for the developing countries the principal stress now is on the creation of specialists . . . In our country the graduating of engineers, out of the over-all number of specialists, is something of the order of 35 per cent."

The speaker stated his support for the suggestion made by a United States spokesman that it is essential to set up these higher institutions of learning as rapidly as possible in the developing countries, and pointed out in conclusion that the experience of setting the Bombay Technological Institute on its feet, through assistance on the part of the Soviet Union, had been extremely effective;

and that by means of funds made available through the United Nations it would be possible in the developing countries to establish a large number of such higher institutions of learning.

PLANNING AND MANPOWER

Planning must be a continuous effort, carefully balanced between short-term and long-term plans, Dr. J. Timar, of Hungary said: "Continuity does not only mean that plans must be worked out for new periods constantly, but also that the implementation of earlier plans must be continuously attended to and that these must be continuously corrected on the basis of experience acquired during their implementation and during the preparation of the new plan." The speaker then entered into the details of such planning and recommended that "basic plans for high-level skilled workers and for teachers should be worked out for a period of 15 to 20 years, because the total training of high-level personnel does in fact last some 15 years, or may take 15 to 20 years . . . The direct aim of working out a 15-year to 20-year plan is to establish the dimension, shall we say, of the need to expand education at all levels—primary, secondary, and higher—and also to decide the proper proportion between these three levels of education which determine the investment in school construction and the educational systems. These plans should be detailed according to occupational and professional groups: for example, doctors, engineers, teachers, because the training of this level of people requires a different rate of investment".

How these general principles of long-term planning could be applied to one country was epitomised in the following description which Professor Alves Martins, of Portugal, gave the Conference:

> "A general framework for educational planning has evolved in discussions among the national directors, members of the Secretariat and Expert Consultants," he stated, "and, at the same time, it has been agreed that the minimum specific objectives of each of the national groups should be, first, to estimate for the 15-year period, from 1960 to 1975, the required number of graduates expected each year from the various levels of the educational system. Second, to estimate the numbers of teachers required at the different levels of the educational system. Third, to estimate the number of additional classrooms, laboratories, and school-buildings and the amount of equipment required and to plan the optimum geographical distribution of such educational facilities in the light of anticipated population distribution . . . Fourth, to assess the qualitative adequacy of existing educational programmes and make recommendations for needed improvements, including teaching methods and curriculum organization. Fifth, to assess the need for new or expanded educational and training programmes outside the traditional educational structure. Sixth, to estimate the total capital and current costs of the expansion and improvement in education implied by the results already indicated. Seventh, to establish a time-table for

achieving the required expansion and improvements over the 15-year period and to suggest to the Government the best way of keeping a control of the results and of introducing alterations resulting from the experience being gained."

FIXING THE TARGETS

Yet this analysis is still only part of the total process of educational planning. As Professor Martins pointed out, following the establishment of criteria for assessing these educational needs, "we had to take decisions on the meaning of manpower requirements and to estimate these manpower requirements; to study the supply of manpower by educational qualifications; and to set up the educational targets in the light of manpower considerations".

On this aspect, we can turn to some interesting observations concerning a fast-developing country made by Dr. Robert D. Loken, of Ghana, who said that Ghana undertook in 1960-1961 a fairly exhaustive high-level survey of manpower needs covering 90 per cent of all those employed in wage-earning capacities, in a population of 6½ million, of which about 60 per cent are in the agricultural and 40 per cent in the non-agricultural sectors, with most of the wage-earners in the latter sector. "In addition to the manpower surveys," he continued, "we have had several surveys in specialized areas such as, for example, the in-service training programmes now operating in the country. We have a complete index of all the programmes in force and also the types of training being given and the facilities and instructors available."

For the past six months, Dr. Loken explained, a fairly large team had been working on a seven-year economic plan for Ghana. This plan is now complete and the major segment of it is that covering manpower and education. It was important to note that Ghana could not have developed this plan for manpower and education, spanning the next seven years, without all the background information which had been built up in the surveys. "But today," he continued, "we have pretty well set our targets for the next seven years—we know in general terms what we are going to expect in the way of employment opportunities, and we know in fairly specific terms what our scientific, high-level manpower requirements will be."

Some of the figures involved in the Ghana programme give the dimensions of the problem as it affects many of the developing countries. About 450,000 additional employees are needed and these new employment situations will have to be created over the next seven years. On the other hand about 600,000 workers will become "wastage" during that time. So, actually, a million people are needed to provide over the next seven years the additional manpower envisaged.

What does this mean in terms of the school situation? Under the old conditions, the Ghana spokesman remarked, "we could have expected to supply only about 600,000 of that million. But, because of the requirements of the economic

development plan, we have made changes in the educational system which have shortened the primary cycle from ten years to eight years, thereby giving us another 500,000 output during our seven-year period. This is a shortening which, we believe, we can achieve without sacrifice, though it means a complete change in the curriculum of the whole primary and secondary system".

This is, briefly, what is anticipated: about 700,000 children will come out of the primary schools, that is at age 14-15, and this will involve doubling the current enrolment in the primary school. "That is no small task. But it can be done," Dr. Loken asserted. Secondary school enrolment is envisaged as 50,000, or four times as many as are in school today—another tremendous increase. As regards the university, the plan is for a fivefold increase so as to produce 10,000 graduates over the period. Again, the technical institutes are to train about 15,000 people—doubling their facilities. Clerical training—which is a brand new programme, since Ghana has no such programme now—is expected to train 14,000 people during the period. Teacher-training will need 35,000, which is five times the present output. Dr. Loken concluded: "So these figures, as you can see, require a great deal of assistance over the next seven years. We could not possibly do it with our current machine, we could not possibly do it with our current institutions; but the plans are well worked out and are detailed, and if these plans can be followed, we shall reach our goal."

REPULSIVE WORDS?

It is significant, however, that it was another Ghanaian educationalist who gave timely warning that educational planning could not be rushed. "The greatness of the prizes to be won for the nation," stated Basil H. G. Chaplin, "may engender such a sense of urgency that two important factors for success may be treated with insufficient regard when action is planned and carried out. The first is that, before any scheme for the revision of science education at any level can be effective in producing genuine scientific thought and comprehension, it is essential that a very considerable amount of research and experimentation should take place. Secondly, in so far as this is concerned with the human material in our schools and colleges, our knowledge must be acquired 'on the spot'. Other sources in the modern world and their experts can supply a great deal, if not all, of the data for methods of expansion and change in technical and industrial projects. But only a knowledge of our children and their teachers, and their intellectual equipment and possibilities, will furnish valid data for expansion and change in education in places such as West Africa" (K/2).

"The words you use—'manpower' and 'human resources'—are to me very repulsive words," remarked Dr. H. C. Kelly, of the United States, referring to the general trend of the discussion, "as if this is another kind of human fodder,

and we are interested solely in economic development. We have different goals from this. But also I hear people not merely talk about the individual, but contend that the university and educational system should also be directed towards economic goals. The university must certainly react to people who come to tell them that their planning should be determined solely by the economic needs of the country."

That there are definite limitations to planning over any considerable length of time must be evident, if only for the reason that it is the nature of knowledge that it changes. "If it is not changed, and if your plans are not thrown out daily," said Dr. Kelly, "there is something more basically wrong than just your planning. The nature of science is to change. The nature of man and the invention of man is to change. We know this in the last ten years. Ten years ago, for example, who among you would have predicted the demand for mathematicians today? Who among you would have known about the demand for astronomers? I, for one, who was seeking such advice ten years ago, did not hear it".

This bold reappraisal evoked an interesting echo from Mrs. Bedia Afnan, of Iraq, who remarked that she had not heard anyone raise even the basic question: "Is there enough human brain?" And do we know how we are going to get enough physicians if suddenly we find that we need 300,000 in a small population? "I appreciate," she went on, "that methods of teaching, differences of curricula, motivations, incentives and the surrounding social order may influence the choice of a child or of a person. But do any of these really influence the capacity of his brain to become a poet or a mathematician or a physician or an engineer? Have we really given enough attention to that part of our work?" Again, "what is the relation of health to mind? What is the relation of certain climates to certain tendencies? Just now we were told that science and knowledge change, and the nature of man changes. I know that in my country, three years ago, the greatest demand was for poets. Today, it is for mathematicians . . . What is the forecasting that we need to make so as to fit a child to that forecast if we do not know enough of the human brain with which we are dealing?"

It indeed became clear during the discussion that there was nothing "mechanical" about training technicians. For, said Z. M. Karmi, of Kuwait: "Many developing countries have traditional, theological, mythological or philosophical attitudes of mind which are at variance with the scientific method and scientific logic. Hence, it is not enough to train a young man technically without soaking his mind, so to speak, in the scientific way of thinking, so as to impart in him the incentive of further development and further progress in his field. Furthermore, in many developing countries there is a kind of cleavage or, rather, apparent divorce between scientists, technicians and educated people, on the one hand, and society in general, on the other. They simply do not see eye to eye and sometimes do not feel homogeneous enough. Hence it is not enough, in my opinion, to concentrate on training personnel. Science must be projected over to the population to impress upon ordinary people the impact of science

on society and its tremendous effects, especially in this age and in the Development Decade."

INTEGRATION OF PERSON AND COMMUNITY

This theme of personal integration and, at the same time, relationship of the individual with his environment and his community came out in every phase of the discussion. Thus, in dealing with the integration of agricultural education in Israel, Dr. H. Rinott of Israel, suggested as an example, that in the effort to ensure that youngsters get this type of education, they would, at least to some extent, have to go back to their homes or their villages, to the village where their parents were the builders—since they are the first generation to live in most of the places—and so live on a technological level and even on a literacy level with them, for the situation in Israel is that quite a number of them are new settlements. Three hundred settlements have been built since the establishment of the State 14 years ago, and 13 villages in the development areas. Hence, nearly all these schools would be the first for generations in a community—at least the modern type of school—living with electricity and whatever comes with it, such as machinery on the farms. The young people would thus benefit directly from a great technological experience.

"We are getting down to some basic educational principles," the speaker added: "We cannot afford to develop only a technician, in the narrow sense of the word; we have to develop the child's personality and his general approach to life, including a proper balance with his family, since he is getting away from them, to a certain extent, because of these radical developments. We thought, therefore, that in our educational system we should stress a comprehensive approach to manual work. When you go back you share with your colleagues on the farm, in workshops and in the factories a value in your life, as part of the general effort on the village level, on the new urban level, and on the national level."

"Education makes men capable of producing action," stated Captain Carlos Lara, of Argentina. "Yet we should bear in mind that science and technology form either a beautiful tool for production or a powerful tool for destruction, depending on the course of action chosen. Education is received not only in the classroom; it should represent a continual progress throughout the individual's life. Schools should ensure, no matter what the individual's level might be, that the individual achieves a clear concept of his mission in society, and they should give a suitable preparation to make it possible for the individual to continue cultivating himself after he leaves school."

Educational programming (the speaker concluded) should therefore be guided by such principles that each citizen, when leaving school, will enjoy the full exercise of his liberty and direct his action towards higher purposes. He will then be aware of his obligation to work for progress, because he has had the privilege of a school education.

CHAPTER 3

From school to university

The main purpose of this chapter can be summed up in some observations made by Professor G. E. Villar, of Uruguay, who stressed the fact that, "although the second half of the twentieth century is characterized by the predominant influence of science and technology in the development of human life, many countries with urgent development needs cannot wait for the emergence of a climate favourable to scientific and technological growth, as has been the experience of communities which have felt successive impacts of the applications of science and technology". Hence, in order to create this favourable climate among the people at large, it is essential to begin at the foundations and plan the teaching of science and technology at the three levels of primary, secondary and higher education.

This direct national commitment to the teaching of science at all levels assumed a great importance throughout the meetings. In fact, it tended to bring out that, in the past, the Western democracies and the centrally planned societies differed fundamentally in respect of their basic approach to education. On this point, Professor J. Reis, of Brazil, observed: "What seems to mark a decisive difference between the Soviet type of educational system, as it now works, and the one that is in force in some prosperous and economically stable democracies is the total commitment of the nation to the education process. This total commitment is quite understandable in a country which wants to grow fast or, as seems to be the case in the Soviet Union, to make a steady effort of economic recuperation; and it is advisable as an educational policy in the new and underdeveloped countries" (K/36).

It was generally agreed that that type of planning should have the following general aims: (*a*) to teach children and young people, at the primary and secondary levels, about scientific methods, especially the main discoveries of science and their technical applications, so as to acquaint the pupil with his important role in life; (*b*) to encourage observation and experimentation by pupils at primary and secondary levels, with the object of arousing interest in the study of physical and natural phenomena, while cultivating at the same time a vocation for science and technology; (*c*) to intensify experimental teaching of science and

technology at the higher level, with greater stress at this stage on the teaching of the cultural aspects of science and its social applications; and (*d*) to ensure in universities and centres of higher education the diffusion of scientific and technological knowledge by means of lectures and special courses.

Since primary and secondary schools are fundamental stages in a nation's education and the influence exercised by science and technology in modern life cannot be ignored, it is only right that these subjects should have a predominant place in all education. Hence, the dual objective of teaching science and technology at all levels must be to prepare children and young people to play their part in a society where scientific values prevail in their daily lives and to train them gradually in the fundamental principles which govern scientific and technological activities, and thereby encourage them to develop scientific and technological skills.

As science itself does not stand still, any educational programme has to take into account in the long run (as the Conference Secretary-General pointed out in his report) such facts as the following:

(*a*) The gradual disappearance of boundaries between sciences, and the interweaving of all basic sciences;

(*b*) The continuous emergence of new fields, drawing knowledge from the various sciences;

(*c*) The revolutionary developments in equipment and instruments utilized in experimental work in every branch of science;

(*d*) The advance in mathematics, both in its capacity to solve problems hitherto considered inaccessible to mathematical methods and as a language for the formulation of theories in the other sciences [GR.78 (K)].

Again, technology has become so vast a subject, with such wide practical ramifications, that, to meet the demand for technicians, it has been necessary to resort to a high degree of specialization. Yet the basic knowledge required in any one branch of technology is to some extent common to all the various specializations within that branch.

Higher technical education aims principally at training men to advance scientific knowledge as well as to apply it. Accordingly a thorough knowledge of the basic branches of science related to each technical speciality is of fundamental importance. (This technical training is the subject of Chapter 4.)

ADAPTING THE PROGRAMME TO THE CHILD

As regards the problems involved in finding the right curricula for the different stages of teaching, a series of interesting hypotheses were presented to the Conference and the experiences of a number of countries were pooled in the general debate.

It was first agreed that a clear understanding of the stages of mental development of the child is essential in order to know what can be taught at what age

and how. Conversely, certain abstract concepts, if taught at the proper age, may help its mental development. For example, basic concepts of projective geometry may be taught at an early stage, for the method will merely help the child to find out how the same object changes in size and shape on a change of perspective. Such exercises will at the same time help in its own development, since, as is well known, one of the difficulties a child faces is the co-ordination of its own perspectives with those of other persons. Moreover, this form of teaching through concrete examples will enable the child to go on in a natural way towards more complex concepts [GR.82 (K)].

The old idea that it was necessary to wait until the student had a certain maturity—beyond the age of entrance to the elementary school—before teaching him abstract concepts or asking him to exert any intellectual effort, has to be discarded. In fact, what has been found, both through serious teaching experiments and through a better understanding of child psychology, is that one may start much earlier—at the age of four to five years—with much better results.

Moreover, as Dr. R. V. Garcia, a Scientific Secretary of the Conference, insisted, there was no fundamental difference, in respect of the mental approaches to a scientific education, between students from highly developed societies and those from developing societies. The childhood surroundings of the former may have better prepared them to absorb the complexities of higher education, but, even if students from developing countries may require a transitory period of more intense stimulation, they can soon catch up with the assimilating capacity of their fellow-students from more developed countries.

On the other hand, environment during early years cannot be ignored. Dr. Henri Pieron pointed out that an investigation carried out in France in 1944 on 100,000 representative children of school age showed, by means of a non-verbal test, that there was a considerable systematic difference according to environment in average intellectual level. The ascending order was somewhat as follows: farmers, workmen in small towns, workmen in large cities, clerks and civil servants in small towns, their city counterparts, and, finally, teachers and professional people. The differences were exactly the same from ages seven to 12.

Systematic experiments showed, the speaker continued, that environment exercised a considerable influence from the ages of two to seven, but virtually none thereafter. Children brought up in conditions where they had not been able to acquire speech could still do so, provided that they were not more than six or seven years old; after that age it was more or less impossible. "Biologically, the development of the brain, which comprises the growth of the neurotic extensions ensuring communication between the 10,000 million or so brain-cells, calls for functional stimuli. A monkey kept in the dark from birth stays blind."

PROCEEDING BY TRIAL AND ERROR

"Nevertheless," said Dr. Mustafa Nuri Parlar, Head of the Turkish delegation, "some of the difficulties we have experienced in my country in primary and

secondary education may be useful to the newly-emerging countries and to those countries where a large percentage of the people live in rural areas. I do not think that these countries should try to develop a system of education to fit every community in their country. In Turkey we have approximately 20,000 villages. In India, I believe, the corresponding figure is 400,000. If we have to take primary education to all these communities, we have to train the corresponding number of teachers; in addition, we have to build that number of schools. We cannot overcome all these difficulties in such a big task". Instead of trying to take schools to every community, the speaker suggested, one should build better schools, as regional schools, and bring children from neighbouring villages into these schools. It would thus be possible to give the children a better quality education, even at the elementary level.

"We have made other mistakes in Turkey," Dr. Parlar continued: "Between 1950 and 1960 national gross income increased on an average of about 4.5 per cent; and in a few of those years it surpassed 7.3 per cent. But this was done at the expense of the manpower in the primary schools and the elementary schools. Most of the teachers in these institutions were diverted from these schools to industry, because they found better pay and better living facilities there. In discussing industrialization and rapid development we should not forget that in such a programme we should give top priority to the problem of keeping these teachers, because they are the people who are trained for developing industries in our countries."

Dealing with this aspect of the initial difficulties faced by a developing nation, we find Professor F. Harbison, of the United States, commenting: "One of the greatest difficulties that I have encountered in my experience in working with newly developing countries is the tendency many times for the problems of human resource development to be considered in pieces. Somebody thinks about vocational education; somebody else rushes in and talks about an assessment of manpower requirements; another group talks about the matter of primary schools; and so forth. There is competition among the givers of aid, occasionally, and also there is lack of integration at the country level in terms of seeking what kinds of aid would be best. I stress again the importance of co-ordinated, well-planned effort, thinking broadly in terms of human resource development, not thinking about the problem in its pieces."

A RIGHT BECOMES A NECESSITY

The broader problem of national literacy is dealt with in some detail in Chapter 5, but here we might consider the place of science and technology in education. The Conference Secretary-General summarized a large number of views on the basic importance of a general education (see the list of papers in the Appendix). These views made it abundantly clear that not only was it the right of every citizen of an independent nation to be educated, but it had now

become an economic, political and social necessity in any developing country that the citizen should exercise this right "Of course," as Professor José Reis, of Brazil, expressed it, "the general aims of education have not altered with so drastic a transformation in the political panorama of the world. We still think of education as the moral and intellectual development of boys and girls—the immediate goals of which are skill, information and formation; the ultimate goals being the building up of a happy, progressive and fulfilled society. These immediate goals might be summed up as the making of men . . . Change is not an end in itself but rather a means to an end, which amounts to saying that it must be directed towards that purpose of social happiness and fulfilment, through the development and cultivation of the human abilities. In modern society, as in the old one, these changes continue to be from ignorance to knowledge, from capacities to abilities, and from instincts to ideals" (K/36).

Education for every citizen has become an economic necessity for a number of reasons. For one thing, the demand for the type of worker using only his hands in purely manual work is rapidly decreasing with economic development. Moreover, the individual efficiency of a person working at *any* job is known to improve with school attendance. Also, the increasing need for technically-trained personnel at higher levels in various fields calls for a much wider basis of selection, which can be provided only by starting at the elementary levels. It is a political necessity because accelerated development presupposes a collective effort, which is possible only if the level of education permits the participation of the whole population. Economic and social development in a modern State becomes meaningful only if all the citizens participate in the political life of the country through some form of democratic machinery. Finally, it is a social necessity because development brings with it individual and collective prospects of social progress, which in turn means sharing in new cultural patterns linked to higher levels of educational attainment [GR.82 (K)].

It might be assumed in some quarters that, in so far as the main theme of the Conference was concerned, the elementary school could be taken for granted and that only specific problems of scientific and technological training would be relevant to such an agenda. The fact was, however, brought out again and again, that development, both social and economic, requires more than an army of specialists in particular techniques, and that only a society enjoying a certain cultural level and a broad educational foundation could attain adequate stages of development. The transformation of a country with a low level of production, poor sanitary conditions and a backward social structure into a progressive society with acceptable standards of living and social status for every one of its members could not be accomplished without the active participation of the population as a whole. The effectiveness of such a participation is necessarily linked to the level and extent of general education. Literacy—meaning only the ability to read and write—is not enough. Indeed, any campaign to eradicate illiteracy would be to a large extent wasted if the people who acquired the ability to

read were not incorporated somehow into the new world which was being created by the process of development.

This realization implies, among other things, a basic understanding of new patterns of life in which science and technology now play so important a role. And such a pattern must include a solid elementary school system where scientific education plays an ever more prominent part than it has hitherto done even in advanced countries. This is by no means a paradox. In advanced countries the child is brought up in an environment where a number of ideas, concepts and attitudes become familiar to him, even before he reaches the elementary school. In a less developed society the school has to make up for the shortcomings of this kind of environment. In fact, the school is itself one of the most important factors in raising the level of the environment. In this sense, adult education takes on a special importance (see Chapter 5). Such considerations call for a general educational programme which goes much further than simply teaching to read and write, and which includes at least the completion of elementary schooling [GR.78 (K)].

Science in the primary school

As regards the content of education at the elementary level, the foregoing discussion clearly points to the need for the inclusion of science in the curriculum from the moment of entrance into the primary school. But is this practicable? Many speakers addressed themselves to this essential question. Their response was generally that the introduction of science in the elementary school should not be regarded as an accumulation of concepts and information. It should be introduced rather as a way of looking at things and events—a certain approach to the formulation and solution of simple problems. This can be done without forcing the child's psychological development or imperilling his balance as a child. On the contrary, it can even favour his natural mental development [GR.82 (K)].

The introduction of scientific education from the very beginning of the primary school can be defended on the following grounds:

First, on obviously practical grounds a developing society needs a continuous increase in the number of scientists and technicians. Their training must take the shortest possible time and yet reach the highest attainable standards. Hence, the elementary school has to be relied on to teach the simple concepts and the basic attitudes on which the later educational structure is going to be built. Furthermore, by starting at childhood, the acquisition of those concepts and attitudes will have more lasting value and will favour the learning process at the other levels.

Secondly, the elementary school is concerned not only with the children that are going to proceed to higher educational levels. Most of the children will gain there all the background knowledge they will have for the rest of their

lives. So these children must be helped to understand today's scientific world and to behave within it with reasonable efficiency. Jet planes, manned satellites, antibiotics and electronic computers take up more and more space in the newspapers and on the radio. A person who cannot read a newspaper *intelligently* is not far from being illiterate.

Thirdly, a scientific education, regarded as a method of thinking about basic concepts, is an indispensable tool in whatever career a child may follow. The school should prepare individuals to adapt themselves to changing conditions, as well as to training for new types of jobs. This implies an education based on the development of critical attitudes towards problems and on the spirit of discovery.

Fourthly, irrational attitudes—superstition, prejudices, belief in magic—are enemies of social progress. The introduction of scientific culture into a society dominated by magic, myths and superstitions may not always destroy them—in all probability the old myths will be altered to fit the new facts—but a scientific education, started in early childhood, will assuredly bring about changes in collective attitudes. Through the teaching of the causes of natural phenomena and the methods of discovery, confidence in objective knowledge will eventually be substituted for the fear arising from the ignorance that leads to magic.

For, at the primary stage, as Professor Germán E. Villar, of Uruguay, remarked, "the present tendency is to develop the interest and spirit of observation of the child in natural phenomena, giving him progressive instruction on these phenomena, their classification and arrangement, without embarking on a study in the form of separate disciplines. Scientific education at this level should explain to the child the fundamental concepts and the contents of the various branches of science, laying emphasis on the observation of phenomena. In this connexion, measurements and the use of instruments which increase the range of human faculties are of particular importance. It is of primary importance to induce the child to discover the natural phenomena taking place around him, as well as some of the simplest laws which they obey" (K/3).

The earlier, the better

To illustrate how these general principles are being applied in practice, some typical contributions may be taken, almost at random, from among many like them, made by representatives of the Soviet Union, India, Ghana and Kuwait.

"The ability of children to think abstractly," Academician V. F. Kuprievich, from the Byelorussian SSR asserted, "is sufficiently demonstrated, and one can judge it by the fact that the basis of mathematics, which is completely abstract, is assimilated at that level and remains with the child for the rest of life. Furthermore, each one of us has gone through that stage. Recalling our childhood we usually recall the fields that we assimilated better, if we assimilated them earlier—in fact, the earlier, the better. What we assimilated 50 or 60

years later seems to be more confused than what we assimilated in our earlier years. This is why I think that there is no danger of programmes being worked out which will be difficult for children to understand. It is quite a different matter for programmes to be overloaded, for children then do not have sufficient time. A child is a child, and a child must have time to play. It must have free time and this lack is the most dangerous defect in our programming. Furthermore, a programme must contain only the things that have been abundantly proved, that are completely scientific, that have been carefully selected. In no case should a programme be prepared as a 'matter of fact'—even if it be the most new or the most perfect."

The speaker concluded by emphasizing that, to some extent, life requires young people not only to have an all-round education, but also to be able to do productive work. It is on this basis that one must decide how many years young people must devote to general education in order to acquire a general fund of knowledge of mankind and the humanities and the natural sciences, and what part of their time must be devoted to learning in special fields specific to a given country.

"Since early years are the most formative period of a child's life," agreed Professor A. C. Joshi, of India, "science education should begin right from the elementary stage. Children's curiosity is proverbial. They are small discoverers in their own way. Science education should capitalize on this natural curiosity of the child." Professor Joshi told the Conference that a group of some 50 science teachers from high schools and teachers' colleges in India recently put forward the following aims for this elementary stage, which he recommended:

(*a*) To arouse interest in nature and in the physical and social environment, and create the habit of observing nature and its resources;

(*b*) To develop habits of exploration, classification, and systematic thinking;

(*c*) To develop the child's powers of manipulation and creative inventive faculties;

(*d*) Inculcate neat and orderly habits and healthful living (K/21).

The same speaker also reviewed the findings of a seminar, held under the auspices of UNESCO at Bangkok in 1956, on the teaching of science at the elementary stage in South-East Asian countries. It was thought that the general curricula in countries where science teaching had been introduced at the elementary stage was fairly satisfactory, but that a large majority of those teaching the subject were themselves not well enough informed about science. Most of them had not had the opportunity of studying the subject at any time as students. The teaching of science at the elementary level, therefore, is either completely neglected or done in a "bookish" manner. The training of children in systematic observation, collection of data, drawing of conclusions from the observed facts, verification of the conclusions by experiments, or what in general are called the problem-solving techniques are thus largely neglected.

Since the vast majority of people in under-developed countries are not likely, for a long time, to study beyond the elementary stage, it is essential to improve

the teaching of science in the elementary schools if a scientific attitude and a rational outlook are to spread among the masses. For this reason it is vital that the teachers who teach in the primary and elementary schools should themselves know science. Such knowledge can be imparted to them while they are being trained in a normal or teachers' training school. Schools of that type must provide courses not only in the teaching of the sciences but also in the content of general science of about the same level as that prescribed for the higher secondary classes. This implies that such teacher-training institutions should have the basic equipment and the teachers necessary for instruction in science; also, that the duration of the course should be long enough to enable the trainees to learn the subject thoroughly.

USING THEIR HANDS AND EYES

The question of instruments for the teaching of science in the elementary classes has to be carefully considered. The experience of UNESCO is that sometimes lavish demands have been made by schools for the purchase of such instruments. For this reason it should be borne in mind that, although simple instruments like thermometers, measuring cylinders, balances, and charts and models are needed for teaching science even in the elementary classes, they do not cost much and it is not necessary to incur heavy expenditure on such items. Science teaching at this stage can generally be done by improvised instruments. The chief requirements are that teachers receiving training in the normal schools should be properly taught how to set up simple experiments. *Source Book for Science Teaching,* published by UNESCO has proved to be a useful guide. The main objective of science teaching at this level is to orientate pupils in the scientific method of problem-solving, involving systematic observation and simple experiments.

In Ghana, Basil H. G. Chaplin pointed out, a complete change from the old-fashioned learning of "nature study" to science courses of practical experiment and discovery by the pupils of pre-secondary schools arose from his university's major research into science education. This investigation involved 2,000 children and 42 teachers, and covered three-and-a-half years of analysis and work. Some interesting findings emerged from this research, which can be summarized as follows:

(*a*) Ghanaian children differ in no way from their European counterparts in their initial ability to understand how things work, when using their hands and eyes;

(*b*) Different cultural backgrounds do not affect the ability to interpret their own experience;

(*c*) Children can understand scientific processes if they are given the physical experience of every stage of the process;

(*d*) This procedure can provide a sound basis of scientific education for all.

To follow up original research of this kind (the speaker continued) completely new science courses have been developed for pre-secondary schools, and the first three years of these courses have already been introduced into Ghanaian schools. This method differs from other courses in its principle of selecting carefully those processes of contemporary science that can be discovered step by step by the children themselves, using their hands and eyes. Understanding is developed by means of a graded sequence of physical and visual experience. The teacher now becomes chiefly an organizer of the process of discovery. "One of the most important conclusions of our research," concluded Mr. Chaplin, "is that no real understanding of science is available in our schools and in our circumstances in any other way" (K/2).

Mr. Z. M. Karmi, of Kuwait, on the other hand, suggested that some scientists from so-called less developed countries seem to have come to the Conference in the hope of taking back to their countries a ready-made plan for guaranteeing rapid development. "Ready-made suits" have never been known to fit anybody perfectly. "What is more," he said, "I believe there is no such thing as universal development plans or formulae, simply because development is intrinsic and has to come from within, rather than be plastered on from the outside."

Before 1945, Kuwait had a very sketchy school system. After 1945 it was possible to embark on a modern system of schooling. "In our hurry to effect that, and lacking personnel and teachers, we concentrated on school buildings. As for syllabuses, we borrowed the syllabuses and books of one or other of the better-faring Arab countries around us. Similarly, our teaching staff had to be composed almost entirely of teachers recruited from other work. Soon it became apparent that this arrangement must be revised. While still unable to provide teachers from our own schools, we made a hasty revision of syllabuses and changed some of the subjects which had no relation to Kuwait."

In 1961, Kuwait completely revised and developed its science syllabuses in particular. It was maintained that only through full understanding of science and its role in modern life and through sincere belief in its method and philosophy as a way of thinking and solving problems could any slowly developing nation acquire the technological skills and adaptability necessary to set it on the road to proper development. It was considered to be of the utmost importance to start this scientific training at the earliest possible age for pupils, i.e., at the primary school level. This was the more necessary in order to offset the results of unscientific traditional ways of thinking in many under-developed countries.

In Kuwait the school structure is now composed of three levels: primary, intermediate, and secondary. There are four years of primary schooling, four years of intermediate schooling, and four years of secondary schooling. Science syllabuses in primary, intermediate and secondary schools were composed in the past of a number of subjects, with special emphasis on subject matter. Laboratory work was more of a demonstration designed to explain and clarify for the pupils the subject matter under discussion. In this new experiment in

developing the syllabuses for the primary level, three aims have been set as guiding principles:

(*a*) To introduce the child to his environment in an orderly manner and to enhance his curiosity;

(*b*) To introduce him to and train him in the scientific method of reasoning;

(*c*) To keep him interested in science and make him love science classes and look forward to them.

"This is simply because our former syllabuses used to make students hate science so much that nobody wanted to go into science afterwards," Mr. Karmi said. "To implement the first aim the child is introduced to plants and animals he sees at home and in school, to machines and gadgets he comes in contact with—the car, the refrigerator, the fan, the electric fire—and to natural phenomena in his environment. To implement the second aim, every school has an enclosure where a number of birds and other domesticated animals are kept, together with a garden. Pupils are led to observe, register their observation by free drawing at first and gradually by writing, and then draw their conclusions and experiment on the validity of their conclusions. As for the third aim, careful statistics showed that our pupils love two things most: games and story-telling."

THE SPECIAL AIMS OF THE SECONDARY SCHOOL

The teaching of general science at the secondary stage has, more or less, the same aims as at the elementary level; but greater emphasis has now to be given to the understanding of the impact of science on society, so as to enable children to comprehend better their contemporary world. The syllabus should, therefore, be closely related to the everyday needs of the community and correlated as far as possible with the local environment. Training should aim at acquainting the pupils further with the methodology of science—that is to say, sensing a problem, making systematic observations, forming an hypothesis, and testing the hypothesis by experiment. The scientific attitude involves open-mindedness, intellectual honesty, willingness to consider new facts, and a proper perspective of history.

In regard to the last item, Professor Joshi, of India, urged the value of courses on the history of science. Students should be shown how scientific concepts have developed, what has hindered and what has accelerated the pace of science, and what science has meant to civilization and the life of man. Such courses should enable ordinary people to understand the conditions which have stimulated the acquisition of scientific knowledge since ancient times. They can be expanded to include the broad development of ideas, covering the cultural factors and movements that have helped to release man from superstitious beliefs, as also the conditions that have retarded the development of human knowledge and civilization. In brief, the purpose of general science at the secondary stage

should be the preparation of an individual for effective citizenship and fruitful living (K/21).

In introducing the general discussion on the secondary stage the Conference Secretary-General stressed that many of the problems met with in the teaching of science in the elementary school are, *mutatis mutandis*, repeated at the secondary level. On the basis of the reports submitted it would appear that the teaching of mathematics and the natural sciences at this level is much behind the times all over the world, even in the advanced countries. But the situation is changing quickly in a few of them, where important research has been carried out in the last decade. "Some States are now undertaking the immense task of retraining the secondary school teaching staff in mathematics, physics, chemistry and biology, as the only way to introduce modern curricula which has been devised by research teams of psychologists, psychopedagogists and university science professors. Paradoxically enough, in the most advanced countries, with a well-established secondary school system, the task is going to be much more difficult than in new countries just starting their organization. It is far easier to train young teachers in new methods than to change the mind of a teacher who has been applying for years the now obsolete methods" [GR.82 (K)].

This point was emphasized by several participants. The consequences of a wrong start in new countries may jeopardize their educational development for many years. Many areas of the world are, in fact, in the privileged position of being able from the outset to take advantage of the revolution that is taking place in science teaching. A clear awareness of this may enable them to skip a stage in an evolution that is taking, and may continue to take, many years of effort. (See, for example, *The Revolution in School Mathematics*, a report issued by The National Council of Teachers of Mathematics, Washington, D.C.)

Mr. Bowen C. Dees, of the United States, felt that attacking the problem of modernizing science and mathematics at the secondary school level would profoundly influence developments at other educational levels. Although approaches may vary from country to country, three fundamental needs confront those who seek to develop a more adequate system of pre-university science and mathematics, namely, (*a*) improvement of the teaching staff, (*b*) improvement in substantive course content—to assure scientific validity, but in a format which encourages students to learn, and (*c*) improvement in physical facilities—classrooms and instructional equipment. But a venture of this order of magnitude requires adequate time and money and the efforts of many dedicated people (K/88).

Each country has its special attitudes and philosophies in education. The general philosophy of the people of the United States, for instance, has been expressed by former President Eisenhower in his message to the Congress (27 January 1958) in these terms: "Education best fulfils its high purpose when responsibility for education is kept close to the people it services—when it is rooted in the home, nurtured in the community, and sustained by a rich variety of public, private and individual resources. The bond linking home and school

and community—the responsiveness of each to the needs of the others—is a precious asset of American education."

Hence the control of education in the United States is vested primarily in the local community. The central Government's responsibility is primarily that of providing assistance where and when needed, but assistance without usurping control. As scientific advances pointed out the need for more and better-trained scientists and engineers, many people felt that the status of science and mathematics education in the secondary schools of the country should be reassessed. Primary responsibility for secondary school education in the United States rests with the individual States. However, the Federal Government has responsibility for assisting in educational efforts which concern the nation as a whole. Consequently, the Federal Government has become increasingly active in promoting education in the sciences, and during the past ten years substantial improvement in science and mathematics education has been achieved with its massive support. Although the specific approaches employed in the United States are not necessarily applicable to the educational problems in other parts of the world, many countries have expressed interest in them, and have adopted or adapted some of them.

How different is the situation in a developing country? The Conference Secretary-General pointed out that "only a society with a certain minimum economic level can afford to have its members until 12, 14, or 16 years of age doing nothing but studying. Some countries that made tremendous efforts to establish an adequate number of schools have found that the most serious problem was not to get all children of the corresponding age to enter school but to keep them there year after year". Statistics in these countries show a pyramidal structure of attendance from the first to the last school year. The absenteeism cannot be attributed to individual factors, when the index exceeds 50 per cent. In many of these countries elementary education is free in the sense that the parents do not pay anything to enrol their children; but this does *not* mean that sending them to school does not "cost" the family anything—when the help of the child is indispensable at home. This is particularly true in rural areas, but it is not uncommon even in big cities [GR.78 (K)].

The importance of environment has already been stressed. One further instance may suffice before passing to some of the more immediate problems of science teaching against such widely differing backgrounds. Professor F. A. Kufuour, of Ghana, reminded the Conference that one of the difficulties confronting the teacher in some areas is the problem of the medium of instruction. Should the medium be the child's own language, or the language of the erstwhile metropolitan country. In either language there are bound to be difficulties. It is probably best to try to solve this problem by making the child bilingual from the start. Again, the appreciation of science is also made difficult by the lack of all those things that assist children in industrial societies—familiar, scientific appliances in their homes and surroundings, zoological and botanical gardens, natural history museums, radio, television, and so on. Nevertheless, he concluded, these are

arguments for finding a solution to the effective teaching of science at the primary school stage, not for deferring it to a later stage in education (K/30).

A TWO-STAGE REVOLUTION

In dealing with new approaches to science teaching in secondary schools one has to keep clearly in mind that the "revolution" discussed above must proceed in two stages. In fact, although curriculum revision is now taking the form of a revolution in teaching, one has to visualize it as a process that will go on for a long time, and one that will pass through successive stages and be applied by successive approximations. "We think it necessary (states the Conference Secretary-General) to single out two main stages. The one which is presently under way, revolutionary though it may be, has to assume as an initial condition, the output of the elementary school as it is today, with the traditional methods and curricula in arithmetic and geometry and the meagre background in natural science. A quite different perspective will open once the changes already in progress have been introduced as a matter of routine at the primary level, for they will bring to the secondary school students with an entirely different background" [GR.82 (K)].

The revision of curricula at the secondary level, in view of the necessity to train citizens capable of entering efficiently into a society in constant and turbulent evolution, involves all branches of science and the humanities. Mathematical education has already been stressed because this issue has been thoroughly studied. The fact that the teaching of mathematics at the secondary level has undergone a more thorough revision than the teaching of other sciences, i.e., physics, chemistry or biology, is fundamentally due to two reasons, namely, the character of the changes mathematics underwent in this century, and the infiltration of mathematics into other sciences—in particular, the sciences of man: economics, sociology and linguistics—through the application of algebraic methods in logic; statistics, and the development of applied mathematics [GR.82 (K)].

Dealing with the impact of this "revolution" in teaching the individual child, Father M. Queguiner pointed out, on behalf of the Holy See, that secondary education in countries undergoing development is given to adolescents who, in the transition stage from childhood to the adult state, are faced with specially difficult problems, for their whole background is changing from a static and traditional mode of life to a radically new one. Secondary education modelled on that of a Western country and formerly affecting only a limited number of adolescents must now be replaced by a new type of education adapted to the country's special needs.

Moreover, the breakdown of the former society leadership does not make the training of adolescents any easier. Such training can be achieved only by means of a carefully considered plan involving a clear objective. Secondary

teaching will aim at covering "the new dimensions and orientations of a more technical and more economic civilization in which a higher place is given to the human sciences, while at the same time recognizing a hierarchy of values concerned with the real liberation of man". The key to all planning in secondary education, stated Father M. Queguiner, lies in the answer to the question: *"What type of man and what kind of society is wanted?"* (K/47).

As though in answer to this basic question, Professor Carlo A. Cavalli of Italy, stated that a careful balance should be struck between the development of imagination and of the sense of the beautiful on the one hand, and training in more practical areas, which should not be merely mechanical on the other. In the secondary school, mathematics and the experimental sciences, brought together in the same programme of teaching, pose problems—problems of the great differences existing between the exact mind characteristics of mathematics and the experimental attitude required by the physical sciences. This difficulty might perhaps be overcome if the teaching of mathematics were more often based on practice—that is to say, students should learn measurements first and then apply their calculations to practical things.

He said that the new unitary secondary school opens wide possibilities for future careers, since teaching is active as compared with the previous education which was of the memorizing type.

Education should be based on the observation of phenomena and the learning of general laws based on experience. The systematic teaching of science will develop later in the higher secondary schools. Furthermore, the five years separating the university from technical schools has been reduced, and there are technological institutes with programmes varying in duration between one and three years. In these courses technicians with diplomas acquire more thorough specialization, some courses are located within the industries themselves. For example, in the factory of Alfa Romeo and the Società Navale Meccanica in Casta del Mare di Stabbia, near Naples, students are given practical experience in the construction of ships, a kind of experience which it would be impossible to reproduce in schools.

OBSTACLES IN THE PATH

Actually, the scope and place of science at the secondary level depend very much on the meaning assigned to each phase of the educational process. In many countries, warned Professor J. Reis, of Brazil, secondary education is erroneously thought of as a mere bridge that leads from primary school to university. This point of view would, if correct, justify shaping the secondary curriculum, and accordingly the scientific disciplines therein, in such a way as to fit them precisely to university entrance examinations. "But we should rather envisage secondary education as essentially formative, as a stage where the abilities that the primary school began to develop attain full maturity. One

should be able to come out of it well prepared to face life as a competent and conscious citizen and to enter most of the technical professions successfully, either immediately on leaving school or after a short vocational or in-service training" (K/36).

There was, however, a further danger in a tendency which is prevalent in some new and less developed nations to "spend lavishly" at both ends of the educational scale, while neglecting secondary education. This may be due to the "fetish" of universal literacy and universal primary education—if we read universal literacy and education to mean merely the transformation of illiterate men into literate ones, and not as a process of formation that gives to every citizen a sound attitude and the ability to integrate adequately into his *milieu*. "What we see, at least in Brazil," continued Professor Reis, "is the failure of education at this level. We would not dare to say that we spend as lavishly at the primary level as we do at the university level. But we do spend in a very inadequate way, since we are not able to give a complete and formative education to most of those entering primary school. On the contrary, this kind of school is highly selective and, unfortunately, we are not even in a position to say that it selects the brighter or more gifted children, but we recognize that it picks up the economically stronger or those who are from the beginning eagerly directed towards intellectual careers because of the superior status of the white-collar job and the feeling that to work with one's hands is below the dignity of a truly respectable man" (K/36).

Another kind of failure was mentioned by Dr. Mustafa Nuri Parlar, of Turkey, who said that a mistake made in the secondary schools in Turkey was that "we have opened in every centre . . . As Dr. Garcia has already said, it was not a proper school giving full education. They were something called a school, but they did not have the facilities a school should have. Please do not try to open schools in that sense. You are not helping your country, you are training half-men. To overcome these difficulties we are now trying to experiment with one thing, and that is starting this September—we hope to open a science *lycée*. We will admit the graduates of middle schools by examination to this science *lycée* in the hope that we will get a much better quality of physicists for our science studies".

Referring to some of the difficulties found in Israel, Dr. H. Rinott said that the continuous examination of educational needs, which was a pre-condition for economic and technological development, was of tremendous importance. "In our work in Israel we were often surprised by the difficulties in stimulating the general ability of this first generation of children attending school with even a reasonable degree of continuity. The difficulty in educating such a child is to create thought habits which facilitate a gradual and continuous mastery of subject-matter, and particularly the ability for abstract thought which is vital both for his educational advancement and progress in life. From this point of view we have learned from our experience both with children and adults

that the methods which one adopts in presenting to them the theoretical material, or demand for practical work, have vital significance."

As always, in education, there is a danger that the teacher or the books may be speaking above the heads of the pupils. This danger is particularly great in the conditions under which the speaker operated. In such circumstances one has to develop methods of explanation and instruction attuned realistically to the level of the pupils. To examine this problem is the continuous responsibility of those who are concerned with it, and obviously, first and foremost, of teachers who are dealing with children of this type. The greatest danger is that people whose experience has been with Western populations may be unable to emancipate themselves sufficiently from the concept of highly differentiated processes of thought at a time when the instructional educational needs of one part of the population require a more elementary, integrated and less analytic approach. "I am not able here to go into details," said Dr. Rinott, "but on the basis of these thoughts, we established in our Ministry of Education and, with local authorities, special departments to think these problems over and to develop projects which will gradually enable the children to reach a degree qualifying them to enter into studies which would lead them to what we call here science education."

This point about adaptability of secondary school teaching was stressed by Dr. Garcia, the Scientific Secretary: "Classically, it has been considered that determining the content of mathematics and natural sciences programmes in the primary and secondary schools was something which belonged to teachers, pedagogues and psychologists, and that the scientist at the university level was somewhat outside this type of job. Furthermore, as a reaction to this position, in the last decade and in certain countries—as far as I know, particularly in the United States, although this is also true of certain countries of Western Europe—it has been seen that, in actual fact, in mathematics and physics, and chemistry at a high level, teachers of these subjects are in the best position to say what should be taught to children. I agree that this subject has been dealt with from top to bottom, and this is the way the subject should be dealt with."

Perhaps, however, the reaction had recently gone to the other extreme. Sometimes, as Dr. Ward, of Ghana, said, an attempt had been made to transfer from one country to another a text or programme or curriculum or method without the necessary readaptation taking place. Another representative, Mr. Fafunwa, of Nigeria, also spoke about the need for studying in each country just what the child there could understand. "Can we speak of electronic computers to a child?"

"Here, I think," continued Dr. Garcia, "is where we should establish a bridge between what modern psychology has found and what mathematicians, physicists, biologists and others want to teach. The important thing is not to confuse what a level of abstraction in ideas is . . . I think we have seen that a child from any area of the world is capable of the same level of abstraction,

of learning the most abstract ideas of mathematics and physics, provided that it is taught him by the proper method."

Academician N. M. Zhavoronkov, of USSR, pointed out that the task of higher schools, as that of secondary schools, is not only to create a specialist in the given field of science but also to make of a young man a citizen with a sense of his responsibilities and duties to society. How this is to be done is a most serious problem. There must be a minimum amount of knowledge and also a talent for deriving knowledge from life itself. The task of the school from the primary to the highest level is not only, and not so much, to impart knowledge as to find in the heart a thirst for knowledge, to develop the natural abilities and love for independent creative work.

In historical perspective the goal of education, Academician Zhavoronkov went on, will move away from the imparting of knowledge to the training of young men for scientific research. In the future we shall certainly see that a very large part of the population, though not the whole population, will devote its efforts to scientific educational pursuits; but if one thinks of the developing countries one must not forget that education must be built on a scientific basis. "We consider that the working out of methods of teaching, taking into account control and psychological factors and existing experience, must be done by the developing countries themselves—nobody will be able to do better than they themselves. The main thing is that programmes should reflect the present actual level of development of science and thus provide for the training of highly skilled personnel to ensure the progress of industry, agriculture and the whole national economy, and bring their contribution to the common cause of culturalization. The development of the national republics of the Soviet Union, which were most backward some time ago, is a good example. Of course, social transformation played the main role in my multi-national country from the very beginning of the establishment of Soviet power. A single school was created for all parts of the country. There was one single programme for one school at the same level despite the fact that teaching, from the inception of the Soviet Republics, was done in the national languages and under the direction of the Peoples' Commissariat and of the ministries at the national level. But the same level of scientific knowledge was established in all republics and among all nationalities of the Soviet Union. Furthermore, the level of these programmes was constantly debated, discussed and perfected, so as to reflect the development of science."

Finally, in respect of external aid, another representative of the socialist countries, Professor Antonin Bohac, of Czechoslovakia, said that the developing countries were not in a position to use perpetually the assistance of foreign experts, on which they should not always count. They should rather try to count on the students they had sent to developed countries, when they came back. It was necessary for each country to develop its own system of secondary education (K/12). Professor Bohac had given in his paper a precise definition of the ways in which Czechoslovakia had given aid for secondary technical

education. "It was necessary," he said, "to create a sound system of primary education by including in the school curricula a place for basic mathematics and other natural sciences. Secondary education can then meet its duties in the four or five years ahead and the curricula of these schools can provide for a general education."

By way of contrast, Mr. Howard W. Johnson, of the United States, believed that only a programme of massive aid from outside could reduce this gap at the secondary school level. "I have in mind," he said, "the programme in the United States involving several thousand young volunteers who go out. At the end of last year something like 5,000 of these volunteers were in 40 different countries—75 per cent of them teaching at the secondary school level. In one country alone, for example, this meant these volunteers comprised something like 25 per cent of the total number of secondary school teachers. In Ethiopia in one fell swoop, in a sense, the number of students at the secondary school level was doubled by the influx of some 300 secondary school teachers. And this is being done by other countries too."

TOTAL COMMITMENT OF THE UNIVERSITY

"Any thoughtful plan for the progressive development of the less developed nations must begin with a profound understanding of the actual situation in which they presently find themselves," said the Rev. Theodore M. Hesburgh, of the Holy See. "This situation is a complex composite of many historical, cultural, social, economic, political and geographic facts. Historically, many of these less developed nations have achieved national independence since the end of the Second World War. This fact was accompanied by a great growth in national consciousness, a great hope for a better life on the part of millions of people, a hunger for education, better social and economic conditions, and a firm expectation that independence would soon bring all these blessings." Hence, the actual situation is one that can lead to many tensions and frustrations. The move towards national independence is a simple problem compared with the problem of national development. The plans and requirements are of monumental proportions and it must also be recognized that growing political stability is an impossibility without growing economic stability.

"Moreover," continued Dr. Hesburgh, "the problem is different in every area and in every new and emerging nation. Some less developed nations are much less developed than others. Some have fewer educated people, fewer natural resources, less power, roads, schools, ports. Agriculture and industrial growth differ from country to country. Some of the less developed countries are well along the road of development; others have hardly begun the journey. What is needed at this point is not just a total understanding of the problems of development, but a grand strategy for the whole of the less developed world that will take into account the very special needs of each particular part."

One of the greatest dangers at this time is the temptation to give a single simple answer to all the needs of the less developed world. There is no one simple political or economic answer, since the problem itself is not simple. Because of this, the university faculties of science and technology take on a very special importance for the less developed countries. It may seem impossible to build classrooms and to find teachers for 900 million illiterate people. However, through the instrumentality of radio and television, a transmitter room of a university radio or television station can become a classroom for literally millions of people who receive the teaching of a master teacher wherever a radio or television set is available. This has actually been demonstrated in Colombia and in many other countries of Latin America. The Colombian transmitter alone has educated over two million people scattered among small mountain communities where other educational opportunities have been lacking.

"When America was expanding there was created in every State an agricultural and mechanical arts college which trained the young farmers in the latest agricultural skills, which acquainted them and their parents with mechanized farming through a wide extension service that visited all the farms, that vaccinated their livestock, that provided better seed, with soil analysis to indicate the proper fertilizer for deficiencies in the soil, that introduced co-operative farming, production and marketing, and set up credit unions and capital investment. What the university faculties have done in one country they can do in another. With their total commitment to human welfare the universities cannot stand by idly and watch people go hungry when the means are available to produce food in superabundance."

This all-purpose view of the university was taken up by Professor Jan Podoski, of Poland. He reminded the Conference that UNESCO had held a Conference in September 1962 in Madagascar devoted to this wide programme in relation to Africa. Some 30 institutions were being built up in Central Africa and these would be sufficient for the next 20 years; but there was need to ensure sufficient development as far as teachers, students and the level of training were concerned. African universities must have several faculties, since most students were but a first generation and they came from families that had had little or no education. The students were being drawn to live in an environment that would lead to their enrichment—spiritual enrichment.

Moreover, he said, the countries of Africa wish to see the university firmly rooted in the country so that its research may be directed towards the needs of the country. It should deal with problems of the country and the cultural heritage of Africa so that it may be a centre for inspiration leading towards the development of the country. Academic degrees should be kept at their international level, and at the same time there should be shorter courses, and certificates given for these abridged courses. Thus, the traditional degrees and diplomas would retain their international level, but, on the other hand, one could meet the needs of the country by providing for students who follow short-term training courses. In Central and West Africa, universities must offer special

training courses for technicians, courses lasting several months, but limited at times to a few weeks for laboratory workers and for workers in specialized fields. That was not the practice in universities in more developed countries, but in Africa, if universities did not do it, it would not be done at all.

WHERE SHOULD THE UNIVERSITY STOP?

In Africa, universities must also deal with adult education. They have developed, and are still developing, university extension services, extra new departments, thus rendering a great service to the country, because for generations students were not able to receive an education, although they were quite able to acquire it. Thus, these universities fill the gap without losing their present dignity and status. The universities of Central Africa now need above all a teaching staff.

On the other hand, the Conference Secretary-General stressed in his report: "The schools, including the university, cannot teach 'everything' in a given subject. Even if they could, what they teach today will be outdated in a short time after graduation. This is quite obvious in the engineering and technical professions. The school should provide solid basic knowledge, particularly in basic sciences, which will make self-development possible after graduation. The training of technicians and engineers has to continue at the workplace. Workshops and industrial premises have to be classrooms too" [GR.78 (K)].

It should always be kept in mind, however, that scientific and technological training, at any level, should not prepare narrow specialists. To endow the students with the greatest capacity for adaptation to new situations is the prime objective of all education. The interweaving of sciences among themselves and the emergence of new interdisciplinary fields call for the greatest flexibility in the organization of the courses, in the types of careers and in the degrees offered to the students. In addition, it is imperative to prepare the graduates for team work with other specialists.

These facts, the Secretary-General considered, impose profound changes in programmes, methods and even the structure of the universities and higher technical institutes. In more advanced countries these changes have been going on continuously with [the] advance of science. However, the new ideas on training in science and technology, in particular those concerning the training of engineers, have the revolutionary features already stressed above, and these will be examined further in the next chapter. Countries in less developed areas that still adhere to a traditional structure of the universities need a complete renewal of the educational system so as to adapt themselves to the new ways imposed by the evolution of contemporary science and technology. These changes at higher levels automatically impose adjustments at the preceding stages. The well-known interdependence of all levels of education becomes more evident in scientific and technological subjects. "Whatever has been accomplished at a

certain level will determine, to a great extent, the possibilities of the next stage," the Secretary-General concludes: "This is the reason why universities all over the world insist on a more solid background being given in secondary schools to pupils who will go on to more advanced studies. The secondary school, in turn, makes the same demand on elementary school." Dr. Aly Shoeb, of the United Arab Republic, went so far as to say: "Actually, the difference between a developing country and any of the leading industrial nations lies not in the literacy rate nor in the school-leaving age but mainly in the structure of the vocational education system. This is abundantly clear when we compare the effective age of technical education in an industrial nation and a less developed one. In the industrial nation it dates from its industrial revolution, but in most of the developing countries it is not more than a few years old." He also pointed out that the impact of university education on a less developed country is mistakenly understood outside its borders. The universities are not considered as places for higher studies but rather as pilot plants of the social experience through which the country is growing and, unlike the case of a well-advanced country, university output in men and science in a developing country is the sensitive barometer of its social development. Neither economic nor social development can be based on other than university education. The eagerness of the developing countries to expand their higher educational systems by the inauguration of new universities will have an automatic adjusting effect on their societies and will ultimately lead to political and, possibly, economic stability (K/9).

"The universities in the USSR," said Professor A. D. Aleksandrov, "combine the training of rank-and-file specialists (teachers, laboratory workers and others) with the training of creative scientific workers from among the most capable students. The combination of these tasks is a necessary and characteristic feature of universities, but it involves something of a contradiction: the training of rank-and-file specialists requires a definite curriculum and discipline, whereas the training of a creative specialist requires the utmost initiative and a great deal of freedom."

> "In the USSR this last problem is resolved by permitting individual plans for capable students. Another characteristic feature of this kind of university education is the combining of broad scientific training with narrow specialization, without which there is not much hope of producing knowledgeable specialists with practical skills. The conflict between the two tendencies, that is to say, broad training and narrow specialization, demands constant attention, so as to avoid too much of a bias in either direction. In the USSR general departmental training covers the first three years of study; specialization begins in the third year—the students being distributed among the faculties—and terminates with the diploma-thesis."

Professor Aleksandrov concluded his paper: "The universities must be definitely accessible to all who are capable of studying. This is a necessary requirement of genuine democracy and is attained by (*a*) free tuition and stipends

and dormitories for all students with pass-marks who need them; (*b*) preparatory courses for entering higher educational institutions, youth circles, competitions or Olympiads for solving problems; (*c*) propaganda for science and higher education; and (*d*) the development of universal secondary education."

THE UNIVERSITY SHAPES ITS FUTURE

Although, said Professor Francis A. Kufuor, of Ghana, the new universities in the new nations have opportunities to make new experiments with courses, there still remains the basic need to train people for research, for industry and for work in the universities and schools. Suitable arrangements might be that all science students in the first two years of their university course should take two major science subjects, as well as spread over different parts of the two years—courses in mathematics, if not already a major subject, and in the history and philosophy of science and in a modern language. A third and final year in the university might be a continuation of the two major science subjects, especially for those who would like to teach in schools, or a concentration on one of those two major subjects for those who would like to remain in university work or go out into industry or research laboratories (K/30).

It is of some interest to compare or contrast with the foregoing discussion the views put forward by the representatives of the United Arab Republic and Israel, respectively. Dr. S. A. Huzayyin reminded the Conference that the United Arab Republic was a country which was old and new at the same time—both in its general history and in its university life and practice. "We have El-Azhar University," he said, "which in 1970 will celebrate its thousandth anniversary, the most ancient of all universities. And then we have four other modern universities, with two big ones under construction now. I shall deal more or less with the experience which I have been having in connexion with establishing the new modern university in a provincial town, Assiut, 400 km south of Cairo."

This university is, first, responsible for the formation of future leaders, that is to say, citizens taking up professions in various ways of life. Teaching in less developed countries must remain for a certain number of years a first preoccupation, because the country needs a good many engineers, medical people and scientists. But there is also the formation of technicians. "Should we just limit ourselves to teaching the specialized subjects," asked the speaker, "or must we have the broader education of the individual, the future leaders of the country?" He went on to suggest that in teaching for such professions as medicine or engineering it would be worthwhile if the less developed countries would pay more attention to the humanistic aspect of studies. "We do not want just professionals of the ordinary type, we want citizens who live in a country passing through a social revolution like ours. These men must appreciate the new values in human life. Not only in the less developed countries, but also in the very

highly developed countries, we find engineers taking intensive courses in humanistic studies, for the total formation of the individual."

The second function of the university would have to be research. No university could claim to have the name of a university if it did not undertake research, even in the less developed countries, insisted Dr. Huzayyin. Even the newest university should establish its own research programmes. Out of 5,700 students at Assiut, 200 students were doing either a Masters' or Ph.D. degree and some of them had already taken their higher degrees.

The third function of a university in a developing country was that it should become a national centre for national culture—a centre which would help orientate a developing country. Hence, if the country was undertaking planning, then the university must take part in it; if the country was developing industry, then the staff of the university must take part in that too, for it was a centre for leadership.

Professor Rachel Shalon, on the other hand, limited her remarks to the education of engineers at Israel's one technical university, the Israel Institute of Technology, which was established 38 years ago. During that time the institute had undergone many changes. It had been, she said, "a laboratory of influences exerted by teachers from Eastern Europe—mainly Russia—and from the USA, with a sprinkling from Israel itself." It now comprised an undergraudate school, composed of 14 scientific and engineering faculties, with 2,300 students, and a graduate school leading to M.Sc. and D.Sc. degrees, with 740 students. It also runs extension courses attended by some 5,000 men and women.

"But," the speaker asked, "should engineering be taught in institutes of technology or in universities?" She doubted whether there was a clear-cut answer to this question, though it seemed certain that the sciences (mathematics, physics and chemistry) must constitute an integral part of every technological institute, both for teaching and independent research, and the same applied to social sciences. Our experience in the early days taught us that if the activity of these departments is restricted to teaching, they cannot successfully fulfil their duties, because, on the one hand, teaching without research becomes barren, and, on the other hand, no scientists worthy of the name would come to teach without being given facilities for research. Therefore, of necessity, we had to establish fully-fledged science departments. Her view was that, in the less developed countries, where scientific manpower is extremely scarce, this consideration alone calls for inclusion of schools of engineering within universities.

The joint authors of a paper on the University of Brasilia (K/19) explained that only a new university, completely planned for new purposes, based on more flexible foundations, could open new perspectives for higher education in establishing, in their country's new capital, a university capable of providing the teaching and research required by a modern country in its capital city. Besides increasing the opportunities for higher education the university of Brasilia, inaugurated in April 1962, is expected to constitute a milestone in the evolution of education in Brazil. It will diversify scientific and technological education by

establishing new technical-professional courses geared to an increase in production, as well as to the expansion and improvement of services to the people.

The structure of the university comprises two kinds of agencies: the central institutes and the professional faculties. The central institutes will offer introductory courses to all the students of the university to prepare them intellectually and scientifically to follow the professional courses of the faculties; they will also offer three one-year courses for the baccalaureate in any departmental discipline for students who desire to become secondary-school teachers, and two more years of scientific education after the baccalaureate for students who show greater aptitude for original research; and they will provide post-graduate work of two years to candidates for the doctorate.

The faculties will receive students already prepared in the two-year introductory courses of the institutes and give them specialized training for practising a profession. Graduation in these traditional careers will be possible after the minimum number of years of study required by law for each type of higher education. The students will take introductory courses of two or three years, the first year in general studies designed to complete their basic education, giving them university standing; the second and third years will follow with a tendency to specialization. The student will be able to remain in the institute as a major student in one of the departments with the object of becoming an anthropologist, psychologist, economic analyst, demographer, historian, or the like. The majority of the students will go, naturally, into one of the faculties, where they will receive professional training for two or three more years of study (K/19).

FLEXIBILITY BECOMES THE RULE

In a new or developing country with incipient institutions of higher learning (stated the Conference Secretary-General) it is most important to avoid a dispersion of effort. These countries will suffer for a relatively long time from a shortage of high-level scientists and technical personnel. The training of a sufficient number of them to meet the needs of the country has to be accomplished by the universities or similar institutions. It is therefore imperative that, for quite a long time, all research centres capable of training such personnel should be a part of, or closely linked with, the universities and be concentrated in only a few places. In many cases and in certain branches of science the concentration of effort in one place may involve more than one country. As emphasized above, the establishment of regional centres of mathematics, physics and biology, with the co-operation of several countries and with the help of technical assistance programmes, may be the only possible solution for many developing areas or groups of new countries.

In developing countries the universities have an additional basic function. As science and technology show their capacity to solve a large number of social and economic problems, the relation between national plans for development

and the objectives of the universities becomes close, natural and necessary. A country starting on the road of development has to incorporate the universities in this process, not only as sources of scientific and technical personnel but also in order to help in the solution of national problems. In this manner the university ceases to be a passive receiver of knowledge and becomes a laboratory for new solutions.

Reviewing the facts which a university has to face in the world of today, the Conference Secretary-General pointed out that the relative weight of the basic sciences increases considerably not only in all scientific and technical careers but also in many subjects considered humanistic. Mathematics has become a necessary tool for the sociologist, the psychologist and even the linguist. On the other hand an engineer has to possess a more thorough knowledge of mathematics and physics than in the past; a biologist needs more chemistry and a philosopher needs a scientific training.

"Reciprocally," he continued, "the training of an engineer or a scientist must include, in ever-increasing measure, the co-operation of other branches of knowledge. Psychology and sociology, inasmuch as they are sciences of human relations, are indispensable for engineers in executive positions. New specialities come ever to the fore, new orientations are opened up, new careers are created. Often it is hard to place them in terms of the classical terminology. Generally, they are 'interdisciplinary' activities. But this interdisciplinary character involves an increasing number of subjects and problems and the most 'traditional' sciences have to be approached from other sources of science."

The classification of the branches of learning has thus become difficult to adapt to the present state of knowledge. There are no longer sharp divisions to be found between science and technology, but rather interactions. Experimental sciences depend more and more on equipment applying a very advanced technology. On the other hand scientific evolution involves new technologies which require personnel with a solid scientific background. Consequently the centre of gravity of the universities is shifting to the departments of mathematics, physics, chemistry, biology and the earth sciences. Higher education is becoming more expensive. Experimental science cannot be taught with chalk and blackboard. It requires the installation of laboratories with expensive equipment and complex apparatus.

The training of technical personnel now becomes less specific as more time has to be devoted to teaching basic sciences and scientific methods. On the other hand the rapid advance of scientific knowledge determines at certain levels the necessity of specialization. Institutions of higher education must have flexible programmes and adapt their structure so as to offer careers of various lengths and levels [GR.79 (K)].

Professor Vojin Popovic, of Yugoslavia, reminded the Conference that before the Second World War, Yugoslavia's economy was under-developed, but, by the end of the war, having suffered extreme losses in human life and property, the country was in urgent need of rapid reconstructions and intensive development

of the economy and, naturally, in carrying out this task an important role was played by technicians and scientists. In the replanning of the whole system flexibility became the rule. Professor Popovic continued: "The older system of regular study had been standardized and rather rigid, thus producing experts of equal stamp and ability. This soon proved unequal to the new situation created by the rapid development of completely new branches of technical knowledge during and, above all, after the war."

The new organization of the scholastic system aims at vital sectors of a given branch of technical learning, and a complete programme of studies covers two or three stages, not exceeding a total of six years in duration. The first half of each of these stages is devoted to elementary and, above all, theoretical training, whereas the second half consists of training courses of a practical nature. Prospective students are at liberty to select the series of courses which will train them as specialists in a particular category. The difference between the third stage and the first two lies in the work done on the student's own initiative during the last period, and in the requirements to submit on termination of the course, a finished treatise which is in the nature of a scientific research project (K/60).

In developing the universities in the national republics of the Soviet Union said Dean A. F. Shebanov, the basic fact was that each university's mission was to carry on diverse activities. Its tasks included the training of specialists, scientific development, solutions of vital problems for improvement in industry and economy, dissemination of scientific and cultural knowledge among the population, development of education and public health, and many other tasks. "It is difficult to exaggerate the role of the university," said the Dean, "in the study of the history of the people, its language and literature, and the implanting of patriotism and national dignity in the vast masses of the population." The very fact that the greater part of its graduates worked as teachers at schools was of vital importance to the university, for it felt responsible for the condition of the people's education and for fostering the young generation in the spirit of democracy and other high moral principles.

In the founding and development of the universities in the national republics of the Soviet Union major attention had been paid to the establishment of various scientific institutions at universities. These institutions made it possible to achieve the utmost use of knowledge of the highly skilled teaching personnel to raise the pedagogic level and to draw the talented youth into scientific activities.

The universities of the USSR and the individual national republics had diverse faculties and chairs. These distinctions were determined by the demands of each republic's national economy, science, culture and education. As cases in point, at their founding the Tbilize, the Azerbaijan and the Yerevan Universities included faculties for training teachers, lawyers, economists, engineers, as well as doctors, since these republics were in need of just these specialists (K/55).

In seeking for a flexible structure, Mr. A. Chadli of Tunisia, drew attention to the important part played by research. "The first principle stressed by the university teachers in Tunis was that of relating higher education and research

very closely, making available to the teachers equipped laboratories and sufficient credit. This situation, far from being a handicap to the development of the universities, was rather a happy circumstance in that it permitted us to avoid the disadvantages of separating research from education, as is done in certain countries. This fusion—this merging of education and research—has the two following advantages, in our opinion. In the first place it gives an optimum use of the competences which exist in the country. This is necessary because of the few people we have and because of the fact that all teachers are, in principal, researchers and all researchers are, in principle, teachers. Secondly, education at universities will be enriched by the personal research work of the academicians, instead of simply being an exposition of the work done by others. This method is undoubtedly very profitable in the field of applied sciences and human sciences."

"The second principle I should like to mention," said A. Chadli, "was made particularly necessary because of the fast development of science and technology. This principle seeks to make the individual more able to face the new situations created by the progress of science and technology." This principle recommends that solid basic education, especially in the sciences, be given to the students, which will permit them to perfect and complete their own education after finishing their courses. Such a method will develop in them the power to reason without particular concern for a knowledge of details. This type of training encourages students to use the scientific magazines and the other sources of knowledge which are available to them in life. Once they have this basic training they will have a maximum yield and it is not impossible that they will specialize later on.

SHOULD STUDENTS BE SENT ABROAD?

The Conference Secretary-General had stated in his report that "the traditional structure of the universities being divided into faculties, as is the rule in many countries, becomes unacceptable," but Professor Shalon felt that she had to dissent if the same university embraced schools of engineering. Division into faculties might be undesirable in one country and advantageous in another. In a country like the USA, where graduates of engineering schools received additional specialized training in industry, it seemed logical and desirable to devote the major time of study to fundamental and engineering sciences, with a lesser addition of social sciences, and sometimes, also humanities. But in countries in which industry was in its first stages of development, the young engineer would not get his professional training in industry. For there was nobody to train him. He had to be given the tools to tackle practical problems, the opportunity, while still at the university, to solve them under the supervision of his teachers. Under such conditions a technical university had to be composed of separate faculties or departments, as practical aspects differed from one branch of engineering

to another. This applied also to countries which had already passed the early stages of development.

"Consequently, in my institute," continued Professor Shalon, "only the first two years are common to all engineering students, while the curricula of the two years vary according to faculty. The country's needs for research workers, innovators, and the type of engineer who will be able to make considerable contributions to the advancement and progress of industry is being provided by the graduate school. Each newly developing country should aspire to provide such studies at the earliest possible moment, though it may be necessary or even advisable for some time to send students abroad for such advanced schooling."

The sending of students abroad found a useful echo in an intervention by Professor J. Hollo, of Hungary, who remarked that one of the positive elements in the Conference was that everyone had been able to learn about the teaching systems of different countries. As soon as the number of experts necessary in a country had been fixed, they should be sent abroad to continue their studies at suitable technical schools, as was being done in Hungary, in order to meet the engineering needs of its large factories.

On the related question which had been frequently coming up in the Conference: "Should experts go back to their country after they have finished their studies abroad?" Professor Hollo replied: "Obviously the temptation is great to stay abroad, because everywhere in the world there is a great need of experts, and it is sometimes difficult to change habits which have been acquired abroad for habits which must prevail at home. The receiving country—the host country—has great responsibilities towards the experts, and also towards the country that is sending the experts. For, nowadays, universities are not concerned only with teaching but also with education; therefore, foreign students should be made aware of their mission in the interests of the cultural and economic evolution of their own country."

Dr. J. W. Corran, of the United Kingdom, added an interesting footnote on this question of sending students abroad for advanced training, when he remarked that it must be perfectly evident to anybody who has spent any time in the developing countries, especially South-East Asia, that the quality and the standards required to obtain certain university degrees are not quite those of the more developed countries. "I think that one of the things that should be done as an urgency measure is for a conference to be called of principals of universities throughout the world to see how they could help the South-East Asian countries and other developing countries to increase the standards of degrees. That is a very real necessity because in my own country, and no doubt in other countries, which receive many overseas students for post-graduate training and specialized training, we find that people coming with what they call honours degrees need one or two years to bring them up to the standards of degrees in the developed countries . . . There are some universities in the developing regions which train to a very high level, but it is not usual."

Perhaps one way of assisting this rising standard, in the view of Dr. Murat Dikmen, of Turkey, would be that of establishing well-equipped regional universities or higher technical institutes. The advantages of so doing would be that this type of institute could be established in the most developed country of a less developed region. They would serve to transmit science and technology to less developed areas, having already themselves faced the difficulties of adapting readily available knowledge to their needs, and would thus accumulate experience. Graduates of such institutes would prove more successful in solving the technological problems of their own countries. Besides help received from industrialized countries and the international agencies, the countries in the region could join their efforts in building up regional institutes. The graduates of these institutes would become engineers, administrators, or teachers, and work in the other countries, thus helping to strengthen the ties between these countries.

THE ROLE OF RESEARCH

Reverting to the place of research within the university (also dealt with in Volume VII), Professor Jan Podoski expressed some generally accepted principles when he stated that "Modern technology needs two kinds of specialists at higher levels: the professional engineer and the research worker. The professional engineer builds new plans according to projects supplied, organizes and supervises production, and takes responsibility for the operation of technical devices or systems. The research engineer works in scientific institutes on long-term planning and carries the teaching to higher levels so as to propose projects and plans in the development departments of industrial organizations".

A normally-gifted young man or woman should be able to become, after adequate training, a reasonably good professional engineer. But, to become a research worker, special aptitudes are needed. "The professional engineer and the research worker need different training, in my opinion," said Professor Podoski. The primary need of industry in rapidly growing countries is for good professional engineers; the need for scientific or research workers usually comes considerably later, when industry is more fully developed. Abnormal situations frequently create specialists of inadequate quality. What is worse, a university, seeking to avoid criticism, tries to adapt its programme by adding practical subjects to its curriculum without changing the basis of its initial programme.

Perhaps the most comprehensive view was presented by Professor F. G. Torto, of the Conference Secretariat, who said that there was little doubt about the chief function of university institutions in the developing countries. They were primarily to serve as centres for the training of the wide range of personnel required by these countries to run their administrative, social and technical services, to take part in the exploration and exploitation of their natural resources, to plan and implement schemes of agricultural development and of health services, and to direct and run the factories and works of the new industrial

systems. "In short," he said, "these institutions will serve to produce indigenous personnel to take over all the functions which have hitherto been performed largely by nationals of the more highly developed countries. They have also to cater for a large part of the very important and essential research, whether of a fundamental or applied nature, which must be carried out into the problems of these regions. And, finally, they have to serve as centres of culture and sources of intellectual advancement of the societies they serve."

In considering the structure of the ideal university institution it is, therefore, necessary to bear in mind whether the immediate problem is one of the building of new institutions or of the reform of existing ones. The educational authorities have to take decisions relating to the close association or complete separation of differing but related disciplines, such as mathematics and physics, or chemistry and biochemistry. Consideration will also have to be given to the concentration or separation of departments of pure science and of applied science and engineering, while another problem of great importance is the degree of specialization that should be adopted. Is it wise to attempt to produce highly qualified electronics experts or concrete technologists, or should one rather train more general engineers and technologists, with a thorough grounding in fundamental subjects? If the choice is made in favour of non-specialists, a further question arises: when and where is the needed specialization to be acquired?

Research itself has an important part to play, as we have seen, in the development of live and progressive courses and in creating the proper attitudes on the part of both students and teachers, so it must have a prominent place in the modern university institution in a developing country. "The importance of research for the establishment of the right academic atmosphere, both in the country and the university institutions, cannot be overstressed," said Dr. Torto. "The difficult problem of the provision of teaching staff for the universities is linked with the establishment of research, since it is the teachers who must also be the leaders of research. It is agreed that institutions in developing countries must eventually be staffed by indigenous personnel, and this raises a question of the training of such indigenous staff. In the initial stages special measures have to be adopted, including the participation of visiting professors, teachers and research workers from developed countries, the provision of scholarships to suitable indigenes to qualify or gain experience in teaching and research in institutions in advanced countries. The ultimate objective, however, in the opinion of many, is the complete training of staff in the countries themselves."

RELATION OF RESEARCH TO TEACHER-TRAINING

Finally, during the period that the countries will be struggling to establish or reform their universities on the lines that seem desirable, it will be necessary to consider the expansion of the regional facilities mentioned above to cover teacher-training as well as for research in order to make the best use of scarce

local and visiting personnel as well as of the expensive equipment which can be afforded by a group of neighbouring countries more easily than by a single country. Clearly, countries would be acting against their own interests if they frittered away their resources in the establishment of numerous inadequately endowed and poorly staffed institutions within their own borders.

The new nations and international organizations should therefore join forces and set up regional centres of research in education which would serve groups of countries too poor to afford such centres individually. Already UNESCO, in co-operation with Argentina, has set up a Latin American Centre of Mathematics in Buenos Aires and, in 1962, in co-operation with Brazil, a Latin American Centre of Physics in Rio de Janeiro. In this way the road to a fuller regional co-operation has been opened for others to travel.

This link between research and teacher-training in the university was well brought out by Professor Schwarz, of France, when he stated that where the university comes in is to train the teachers—to organize the first cycle of this geometric progression. "This is what the University of Nancy has been trying to do: after setting up a research centre on adult education, the university started the training of teachers—of instructors—in industry, in agriculture and in some hospitals. It is shortly going to start the training of engineers and cadres for developing countries—which cadres, after a brief time, will replace us. This is our goal: to help the countries to develop themselves, first, with our assistance and then, as quickly as possible, without our assistance. This is the action which was started some two years ago. Its extent and the demands the university must constantly face show to what extent this project has satisfied a real need. It is, in fact, an immense problem, because it affects millions of people. It is a practical one, because it conditions the development of countries. It is soluble, because a powerful seed has already been sown."

CHAPTER 4

Training: skills and techniques

Those who emerge from the primary or secondary schools—discussed in the previous chapter—will require at least some training for whatever is to be the individual's job in life, whether in an advanced or a developing country. The most able school-leavers will go on, as has been seen, to universities and become leaders or teachers or practitioners of the liberal arts, the sciences, medicine, economics, statistics, and many other specializations.

All modern knowledge eventually reaches the point where it has to be applied. This requires a whole team of people gifted with manipulative skills and manual or mechanical ability. For example, a book, which may be the concept of a thinker's mind, a scientist's exposition, or a doctor's instructions, has to be printed on paper that has to be manufactured with machinery that has to be made. At every point of the process someone's skill or technical training is required. Where would be the work of the chemist or the physics specialist without the laboratory chemists and technicians who handle his materials or tools? What would result from the architect's or planner's blueprints without the engineers and the builders and the mechanics to bring them into reality?

The problem of manpower in the developing nations is not merely one of quantity and allocation, of numerical strength and its proper distribution to meet the needs of the national economy (see Volume IV); it is also one of quality, of fitness for the tasks to be accomplished. In fact, manpower is, in the developing lands, their most abundant resource. But untrained manpower is not in demand. Training facilities fall desperately short of what is necessary as regards both numbers and levels of skill. Not only is the organizational basis of training deficient, or almost entirely lacking in some countries, but many workers drawn into employment by the demand generated by expanding industry have little general education and no training. What training there is in the least developed countries consists mainly of young workers picking up some knowledge of a trade in the course of their work. This was sufficient, perhaps, so long as industry consisted largely of small artisanal workshops; but it cannot suffice to meet today's ever-growing demands for skilled workers.

On the positive side (states the Conference Secretary-General) there is a considerable store of experience for the developing countries to draw on and there is a growing body of experience within the developing countries themselves; but methods and solutions evolved in other countries have, of course, to be adapted to local conditions rather than merely taken over [GR.9 (B)]. Great advances have been made in training methods. In addition, new techniques are available (audio-visual aids, radio, television) which promise to increase the efficiency of present-day training. Many of these innovations have just seen the light of day in the highly-industrialized countries and, as a result, their full potentialities have yet to be realized (B/45). Although help is increasingly available to the developing countries through international technical co-operation, this aid cannot be sufficient to cope with their training problems as a whole, but it can "prime the pump".

The developing countries should not hesitate to experiment and innovate (B/6). While the best possible use will have to be made of what exists in the way of training facilities, new systems and methods of training will have to be evolved in the light of experience to meet the special needs of each country. This calls for a considerable effort of research. Indeed, all contributors to the discussion laid emphasis on the need for adaptation and, in the case of training supplied through international co-operation, for an advance study to be made of local conditions (B/8). A national body responsible for research into training methods and for the provision of training aids and materials—such as training manuals in local languages—would perform an inestimable service (B/9).

The first point on which agreement appeared to be general at the Conference was that training is a most profitable aspect of development, that it should be carefully planned in both the short and the long term, and that it should be given high priority in any development plan, because the basis of all planning is manpower assessment (dealt with later in this chapter). It is enough to say here that technical training must be planned and carried out in step with general education, and that both must be directed towards supplying the manpower needs of the economic development plan as a whole.

THE CRUX OF PLANNING

Manpower planning calls for the establishment of priorities, not only as regards particular occupations but also for the various levels and types of training—e.g., instructors, supervisors, technicians, semi-skilled and skilled workers. The long-term aim should be to set up a regular system of vocational training capable of providing all the new entrants to the labour force at the various levels of skill required by the nation. It will be some time before this situation can be reached in many of the developing countries; but, just because of this, the foundations for such a system must be laid early. In the meantime, the pressing demands of development must be met by immediate measures [GR.9 (B)]. A start must be

made with long-term training policy, because many expedients are costly and less effective than a co-ordinated system of training. Institutionalized training can lead to great savings, particularly on equipment and teaching materials, since several courses in related trades can share the same equipment (B/9, B/29).

Since general education is the basis of training, it is important to ensure that the two are co-ordinated. In particular, training makes a number of demands on general education. First, emphasis should be given to mathematics, science and other subjects that are of importance in modern life, as we noticed in the previous chapter. Secondly, the school curriculum should make provision for a link between academic and practical life by including some form of instruction in manual skills and by inculcating in pupils a respect for productive manual work. Finally, where language constitutes a problem, it is essential that the schools should provide a thorough grounding in the language to be used for vocational and technical training [GR.9 (B)].

Several examples of solutions along these lines were cited in the course of the discussion. In Romania, training is provided by apprentice schools and technical schools in large industrial, construction and agricultural enterprises. In areas where no such large enterprises exist trade schools are set up equipped with production workshops as well as training workshops. This system has the advantage that training is closely linked with industry and remains sensitive to any technological changes in demand for specific skills that may take place (B/44). In both Israel (B/6) and Italy (B/68) "mixed" systems are used, including full-time vocational schools and industrial apprenticeship, as described later in this chapter.

In several Latin American countries (Argentina, Brazil, Colombia and Venezuela) a new system of apprenticeship covering all economic sectors has been launched and developed since 1945. The essential features of this apprenticeship are "sandwich" courses, the obligation being for employers to employ a certain number of apprentices and to pay them during training; the cost is financed through a special payroll tax levied on all undertakings covered by the relevant legislation. This ensures that available funds will increase in step with economic activity. Obviously, the relative proportion of training carried on in industry and in government training institutions will vary from country to country according to local circumstances, as well as from time to time. What is important, however, is that training should remain sensitive to the needs and changing conditions of industry. For this purpose close co-operation between government and employers' and workers' organizations is essential [GR.9 (B)].

Many different types of training systems are to be expected and are needed in so varied a world as ours. Under one system technicians of all types are trained in technical institutes which require a completed secondary education for entry. The technical institute course, which usually lasts about three years, covers basic scientific subjects, but mainly trains the students in the principles and practice of a chosen specialization. This system, which exists in certain highly developed countries and has been introduced by them or copied in many

developing countries, possesses certain disadvantages in relation to the conditions obtaining in the less developed countries. Amongst these may be mentioned the need to create separate facilities (i.e., buildings, laboratories and workshops) respectively for secondary and for technical education and the duplication of scarce staff to teach basic science subjects. It must be remembered that the entrants to such institutions would, in general, have had a previous education deficient in science, if not in mathematics. Moreover, the majority of them would be persons who, having failed to gain access to university studies, would be suffering from frustrated ambitions. It would appear, therefore, stated the Conference Secretary-General's report, that the production of technicians can be achieved more effectively, and with less call on the total resources of less developed countries, if a good foundation for such training is laid at a lower level in the educational structure, namely, in the secondary school.

The training of technicians in institutions which also give a general education is already in force in certain countries. In one form, pupils who have had approximately nine years of education in primary and lower secondary schools, undergo a course of four to five years' duration in a secondary technical school, where they receive general education in languages, the humanities, basic sciences, as well as technical subjects. The education given in the institution is intended to provide a thorough grounding in the fundamentals of a special field, chosen from a very wide range embracing several branches of engineering, technical and nuclear physics, food technology, building, transport, communications, agriculture and forestry. This foundation is built upon by practical training in school workshops and farms, and during periods of attachment to an industrial undertaking, organized as an integral part of the school course (K/12, K/71, K/91).

A different approach is adopted in a "comprehensive school" organized in the United Kingdom. The curriculum combines secondary education organized in three steps, with the possibility of electing at the succeeding steps either to follow special training within the school leading to qualification as craftsman or technician, or to pursue studies designed as preparation for university entry. A feature of this scheme is the guiding of pupils into the stream for which they appear best fitted. An objective of the system is to raise the status of craftsman and technician by the inclusion of vocational education in the curricula, even for pupils who will eventually go on to all kinds of higher studies at university level, or who decide to leave at the completion of the secondary education to go into employment (K/93).

In another country about 30 per cent of the teaching time is devoted to general educational subjects, the remainder being taken up with technical subjects. And, in yet another case, mathematics and science absorb about 12 per cent of the teaching time, humanities, fine arts and languages together about another 27 per cent, physical training 10 per cent, the remaining 51 per cent being given over to specialized technical subjects. The range of subjects included under humanities is very wide and embraces sociology, history, geography, law and economics (K/12, K/71).

Whatever the mode of apportionment of time among general and technical subjects—and there should be room for flexibility as well as for experiment—certain necessities remain as a basis for the planning of curricula. The tremendous importance of mathematics, both as an educative discipline and invaluable aid to the technician in his calling, cannot be over-estimated. The syllabuses, as well as the teaching methods, should be carefully devised to take advantage of the recent developments in this field (K/93). Again, since the basic sciences are the foundation upon which modern technology is built, the technician will need to have a thorough grasp of the principles underlying the operations of his calling.

In addition, his scientific background should be such as to enable him to adapt himself to the evolution of technology and benefit from further training aimed at upgrading him in his job. This requires the institution of basic science courses devised on modern lines to give an understanding of how science "works", rather than a memorized catalogue of facts. Finally, it is important that a technician should also have a good education in general subjects, such as will make him a useful citizen, give him a sufficient cultural background to understand the significance of his job and its relation to the general economic structure, and enable him to adjust himself intelligently to changing demands of professional and personal life [GR.43 (K)].

STRATEGIC IMPORTANCE OF VOCATIONAL TRAINING

Mr. B. Fortin, of the Conference Secretariat, pointed out that the time factor makes it imperative to provide training with the utmost rapidity. "In this connexion," he said, "too often one thinks of the type of training used in certain industrialized countries during the Second World War, or immediately following it. In particular, one thinks in terms of an extremely rapid initiation in a narrow and specialized field, whereas accelerated training in developing countries means essentially dispensing, in a speedy manner, a type of training which should be of as comprehensive and as high a quality as possible. In other terms, one should attempt, by lightening the training programmes and inventing new methods, to provide an adequate level of training more rapidly. This method might very well apply to many types of training; this is a necessity in the developing countries which requires great efforts of research and imagination."

Since it is not always possible to attain the required qualities in a short time, accelerated training should not be used without continuous training and upgrading for those already in employment. This factor has not been sufficiently underlined in the past. Thus, training in countries in the course of development should be rapid. All available means should be used before creating new ones; at the same time, an adequate national structure should be built up, for optimum means and optimum methods cannot operate within a defective structure or when such a structure does not exist. This same criterion indicates the necessity of observing a certain austerity while establishing new means, and

of refraining therefore from building projects solely for prestige purposes. It also indicates that in order to bring about profound changes in the production programme of an enterprise it is necessary to effect professional and specialized training simultaneously, at all levels.

Such criteria as these may now allow us to define an ideal system of vocational training which needs only to be adapted to particular conditions. The analysis of the situation in these countries shows us the impossibility of conceiving such an ideal system. Nevertheless, such systems must be established within the framework of a comprehensive vocational training policy, and this means that everything concerning vocational training must result from co-ordinated decisions at the national level. This is not easily accomplished. Problems of practical organization—for example, those concerning the establishment of commissions or state committees on vocational training or the setting up of co-ordinating machinery between economic sectors and regions—do not present insurmountable difficulties. The essential thing is that policy-makers should be convinced that vocational training must not be haphazard, but systematically planned, so that it may contribute to the success of national policies. This is much more difficult.

Such a policy should also be integrated within the general development policy of the country. To this end, collaboration with authorities and bodies responsible for the planning of the economy, as well as for the general organization of manpower, is essential. The forecasting of manpower requirements provides a useful base for the elaboration of a vocational training policy, more particularly, perhaps, with regard to the levels of qualification required, at least in short-term planning. Whether vocational training is organized in centres or only in enterprises, or whether it exists in close association with the economic sectors and training institutions, its success will depend upon the manner in which the programmes and corresponding methods are in accord with the realities and needs of production and economic life.

The differences which exist between those favouring training within industry and those favouring training at a centre spring from disparate historical sources. In certain countries the archaic structure of enterprises and the low educational and technical levels of supervisors would result in the total failure of any efforts to rest vocational training on such bases, although success might be possible in the case of dynamic enterprises, with properly educated instructors. In other countries the gradual separation of training institutions from enterprises will produce workers unfitted for the stresses of production. In others, again, "sandwich" training, which is designed to avoid the drawbacks of the above two formulae, will in fact end by combining the faults of both for reasons outside the domain of vocational training: for instance, insufficiently qualified supervisory personnel in the plants, low levels of teaching personnel, and lack of equipment at the training centres. In a country where general conditions allow for institutionalized vocational training, nothing prevents the national system from providing a whole range of means and advice to an enterprise or to groups

of enterprises which, for one reason or another, cannot fully operate vocational training at a centre. In this case, as in others also, the establishment of in-plant training departments, within the national vocational training system, would offer great advantage.

With regard to the programmes, we can see now how necessary it is to ensure fuller basic training (general, scientific and technological) upon a polyvalent base, rather than on too narrow a specialization. Such considerations as these, which bear out the views enumerated above on accelerated training, cause the accent to be placed afresh upon continuous training—i.e., specialization, adaptation, and upgrading ensuing during employment.

Under these conditions it would be dangerous to transplant the rigid apprenticeship structure of the developed and industrialized countries to the developing countries. The organization and the content of programmes, the closely empirical character of training and the excessive duration of such training do not, by and large, accord with the needs of the developing countries.

Finally, this adaptability of programmes should include literacy courses and supplementary general education courses which would take into account the educational deficiences of the workers. The incorporation of such courses could be provided for even in vocational training within an enterprise. The new training schemes should complement and not duplicate general educational and vocational systems. It too often happens that technical education aims at training, over longer periods, persons who, once integrated into economic life, will in fact carry out the same functions which could have been taught them by vocational training systems. Also, vocational training systems designed to complement technical education tend to grow into a parallel structure. The developing countries cannot afford this wasting of resources [GR.9 (B)].

ESSENTIALS OF GOOD TRAINING

Before selecting concrete examples of training schemes presented to the Conference by representatives from different parts of the world, it may be useful to summarize some of the broad principles which appeared to emerge as the most effective methods of training as many people as possible, as quickly as possible, without impairing the quality of the instruction.

The first of these principles is that training should be planned as a part of national development, and be based on an assessment of manpower needs. Next, it should be flexible, so as to allow for changes in the pattern of production and keep pace with technological advance. It ought always to be regarded as a continuous process, linked with the programmes of general education. It should also be related, as far as practicable, to the place of work and the worker's personal development. Not least, it should command the widest possible support of the community.

Above all, training must be adapted to local needs and conditions. "Other people's experience may be excellent raw material for independent thinking, but should never take the place of it", was one speaker's view (B/6). The rigid apprenticeship systems, which are so valuable in some western countries, would be unsuitable in countries where the over-riding need is to produce rapid results. For this reason, the system known as "accelerated adult training" has been sucessfully applied in several countries (B/8, B/45). Adopted by some Western nations during the Second World War, its application to developing countries is somewhat different—as already emphasized by Mr. Fortin—because the latter's need is to train adults who are coming into contact for the first time with industrial life and who have little or no education.

In these cases, adult training is usually given full-time in special centres where working conditions resemble those in industry. The instructors are skilled in a particular trade and tuition is essentially practical. Such a model training scheme, operated in electricity generating and distribution, was developed by the French authorities for training personnel in certain African and Latin American countries (B/29).

It consists of short courses, in which large numbers of workers receive rapid training for given occupations; the most proficient are then selected for training at the next level. At the lowest level, unskilled workers receive elementary instruction in an occupation, together with general education and, if necessary, literacy classes. At the highest level are courses for supervisors and electrical technicians; while, finally, for training new entrants to industry, the prevailing view was that instruction should be given "on the job", rather than in schools and institutions. But even where this view was rejected, it was agreed that training should be closely linked with production. Apprentice schools should be attached to large industrial and agricultural concerns. In areas where there are no large enterprises, training is given in special production workshops in trade schools. As stated above, apprenticeship could often consist of "sandwich" courses, in which teaching is given alternately in training school and industry. Most of the developing countries do, in fact, adopt a mixture of types of training, as is apparent from the examples which follow.

VOCATIONAL TRAINING ACROSS THE GLOBE

Speaking of the new systems of vocational training and apprenticeship in the United Arab Republic, Dr. Aly Shoeb, said that a developing country had an important decision to make in listing the priorities. In the absence of an industry to undertake training, it was necessary to throw most of the load on vocational schools and training centres. An institute for instructor training had been established, and it was the only one of its kind in the Middle East. The training plans included agricultural workers, who formed the greater part of the six-and-a-half million labour force of the United Arab Republic.

The greatest drive was made to change the mental attitude of people towards manual work. The methods adopted were to rely on a fair standard of general education. Practical training was given in vocational schools, which worked on two shifts, 8 a.m. to 9 p.m. Attention was constantly given to the purchase of suitable equipment; each vocational agriculture school had annexed to it a farm of not less than 20 hectares. The number of students had risen in ten years from 18,000 to 100,000, and the number of vocational schools from 23 to 180.

Some of the difficulties (Dr. Aly Shoeb pointed out) met with in the training schemes of the United Arab Republic were, first of all, the desire of parents to have their children follow a course of education up to a university degree. Then there was the great difficulty of providing the instructors, and the absence of technical books in Arabic. Fortunately, the specialized agencies of the United Nations had come to the aid of the United Arab Republic by providing experts and scholarships and by designing suitable curricula, as well as arranging textbook copyrights. Through bilateral aid also it had been possible to train as many as 2,000 men a year abroad. The evaluation of the scheme after eight years had revealed that the time factor was the greatest handicap, that development was an accelerating process and initial provisions might soon become very inadequate, and that industry itself may eventually step in and undertake the greater part of the training (B/9).

In Japan, vocational training based on the Vocational Training Law, said Dr. Shigetoshi Murakamia, is divided into two categories: "public vocational training", provided to applicants for employment by the State; and "vocational training within industry", provided by employers for their employees. If we compare them with those of European countries, said the speaker, it is characteristic that the public vocational training plays a big role in fostering the skilled workers in Japan. As to vocational training within industry, apprenticeship similar to that predominant in European countries can be found only in some skilled trades of the domestic industries, while, as a general rule, within industry, individual employers and the co-operation of employers provide training systematically for their employees during their working hours, and pay ordinary wages to them.

This is because the development of the capitalistic method of production in Japan had been behind that of European countries and was mainly established by transplanting a high level of skills from other countries for a short period.

Hence, there was no continuation of tradition between the fostering of guild craftsmen before the Meiji Restoration and the fostering of the skilled workers in the present age of capitalistic factory production. Moreover, owing to the lack of skilled workers, the tendency of enterprises to foster their own skilled workers for themselves was very strong.

As mentioned above, skilled workers are chiefly fostered by public vocational training and vocational training within industry. Public vocational training means vocational training provided in the ordinary training centre, general vocational training centre, central vocational training centre, or vocational training

centre for physically handicapped persons. Where vocational training is provided with the approval of the Minister of Labour, by a city, town, or village, a public utility association, a trade union or a juridical person, such training is regarded as public vocational training. Public vocational training has to be conducted in conformity with the standards laid down by the Ministry of Labour ordinance, concerning period, equipment and other matters. The vocational training instructor must be a person holding a licence from the Minister of Labour.

In Italy, training in the skilled trades is given either in schools or in training institutes under the Ministry of Education, or in industrial establishments—by apprenticeship, regarded as an occupation for young workers—or by means of courses of study in the skilled trades. These latter are controlled by the Ministry of Labour and Social Planning, in the same way that the Ministry controls supplementary instruction for apprentices. Courses of instruction in the skilled trades, noted for their rapid progression and practical organization, were set up to meet the needs of the labour market in permanent locations. These centres of instruction in the skilled trades were placed by the Ministry of Labour under the management of organizations qualified to give training in the skilled trades. Attendance at such courses is free and leads to the award of a certificate which earns holders preferential treatment when applying for jobs or migrants' vouchers. Two national centres have been created in Italy for training instructors in the skilled trades; one centre, in Genoa, caters for metallurgical trades, and the other, in Naples, for building trades. Further training courses—known as "didactic" courses—have been organized for instructors who are already teaching.

From this Italian experience two forms of assistance would seem to be forthcoming for the benefit of the developing countries to help them either to create a sound training structure from scratch, or to adapt the existing structure to local needs. There must be, in any case, an organization responsible for drawing up training syllabuses and maintaining uniform standards, and in this (according to Mr. A. Pallavicino) Italy has an important contribution to make, whether in the setting up of a co-ordinating body or in the training of instructors (B/68).

In experimenting with vocational guidance and education in Israel, effort has been directed to finding ways to make people at the earliest possible age familiar with materials, tools and processes, and thus facilitate a choice of careers. As there is a tendency among the Israeli population towards unproductive education, this way of familiarizing people with technology is made as attractive as possible. Since many pupils are new immigrants, whose economic, social and cultural adjustment has not been completed at the time when they should start learning a trade, any system of vocational education has to include quite a large share of general education, citizenship and languages. Special stress was laid upon new ways of training which possibly would combine the advantages of different classical patterns of vocational education and would answer the needs of different groups of the population as well. Therefore, so much attention could not, at the present stage, be given to maximum economic efficiency

in training by accepting standardized patterns, however well known in other parts of the world (B/6).

Hence, technical youth clubs were established for youngsters in the age group 12 to 16, gaining in two to three afternoons a week some polytechnic, pre-vocational experience. Pre-vocational training was started in the two upper classes of elementary schools and directed in the age group 12 to 14 to well-defined trades. A higher percentage of graduates went on to vocational education. A two-year technical course was introduced in secondary schools, and these classes will be changed into real vocational classes.

Pre-employment apprenticeship courses for a period of 6 to 12 months, said Mr. P. F. Harburger, of Israel, have been introduced for encouraging weak industries to train more apprentices and for preparing youngsters who for educational, psychological or physiological reasons were not yet ready for the open market. "Sandwich" courses, in which boys spend a full training period, alternately three months as apprentices in workshops and three months in special classes in vocational schools, were especially attractive to the planners, as they gave the pupils good systematic training in schools without preventing them from working under real-life conditions. Accelerated training of adolescents was successfully introduced for youngsters who, at the age of 16 to 17, were occupationally unsettled and for pupils dropping out of secondary schools. Finally, vocational youth centres were built up in development areas where industrialization is in process, but not advanced enough to absorb all graduates from elementary schools. The youngsters are working a half day and get paid for it; and, in the other half, they are learning trades (B/6).

TWO ADVANCED SYSTEMS CONTRASTED

The starting point for technicians in the United Kingdom is, as might be expected, more formal, explained Dr. J. W. Corran. The general certificate of education is recognized by the Ministry of Education at ordinary and advanced levels. These standards of preliminary education, characteristic of the "grammar" schools, are adopted widely in the Commonwealth. Hence, the quality of the pre-technical training in these countries tends to become equal to that obtaining in Great Britain. Parallel to the "grammar" schools are the "modern" schools for general education, with or without the certificate, and, more recently, the experimental or "comprehensive" schools. Following the school stage in Great Britain, there is a series of national technical colleges and many local technical colleges. The national colleges of technology run ordinary courses and "sandwich" courses designed to train technologists and technicians. These latter courses consist of six months at an educational establishment and six months in an industry.

"This type of course is being employed on a very wide scale in my country," said Dr. Corran, "not only with British citizens but with foreign students and Commonwealth students who come to England for training. I think the scheme

is also being adopted to some extent in some of the developing countries. The local technical colleges we have had for many years; they tend to train technicians in local industries. If it is a local engineering industry, the local technical colleges concentrate on engineering. Throughout the country, people are able to get in local technical colleges a very wide range of the type of training which is envisaged under the term 'technician'. These local colleges provide full-time courses and also 'sandwich' courses. But a high percentage of those who take these technician's courses are already employed in industry. And in England there is a wide practice of industrialists allowing their workers a 'part-time release', which involves two or three half-days a week, to go to these colleges—perhaps with a little evening training as well. By these means, qualifications as technicians or even higher qualifications are worked for and obtained on a very wide scale."

Mr. Raymond Lambert, of France—by way of contrast—referred to the experience of training in a large national industry. He said that, in general terms, programmes of vocational training must encompass all levels and be spread vertically, beginning at the base of the pyramid, by selecting the best elements, in order of merit, with a view to promoting the students to higher positions. The training of skilled workers should include, first of all, polytechnic-based instruction—called "the basic stage", according to the type of skilled trade—which would be followed by specialized training. The training of, and the provision of refresher courses for, workers at the medium level should receive special attention and entail serious training for handling problems of management, organization and labour relations (B/29).

Turning to some specific cases, Mr. Lambert explained how the Electricité de France had worked out the fundamental training of specialists at all levels. In the production and transport industries, and in the distribution of electricity in different countries of Africa, and Latin America, original teaching methods had been applied which had been highly appreciated by the countries concerned. The main objective of the work in Latin America in 1946 was essentially the training of technicians at an intermediary level.

For electricity enterprises the methods developed in pilot schools in Neuchâtel appealed to the natural talents of an individual. They involved audio-visual aids of considerable size which had been carefully studied for many years in their national centre of teaching documentation. Working with the ministries of various countries they were able to spread their work on a higher level, and also take in the lower levels of training, even down to that of illiteracy.

> "Our common desire was to bring out from the bottom of the pyramid the sap, as it were—the living forces of the country—and in this way we came to this concept of a training centre which could apply the best teaching methods needed for the training of young engineers. We worked with interested universities; also, when we trained instructors, teachers and skilled labourers, we worked with enterprises and with official governmental bodies concerned. Finally, we carried out our illiteracy programme: this is important

because many technicians in developing countries must necessarily come from levels of people who have not received any training at all. Twenty-seven centres have been created in the last five years, using these methods. Five more are being set up and 23 more are under study in Latin America and Africa, but a number of them will also be built soon in the countries of the Middle East and Far East. Those responsible for the functioning of these centres are generally engineers or teachers in the country who have been trained in teaching methods for from three to five years in our schools."

THE ORGANIC UNITY OF EDUCATION

"It has emerged quite clearly that the problem of education and training is the biggest single hindrance to progress in many of the countries we have been discussing. There is a need to tackle this on a scale never before envisaged at an international level. Even where general education has made strides, scientific and technological education and training have so lagged behind as to slow down the best programmes of development," said Dr. F. T. Sai, of Ghana.

Likewise, the Director-General of UNESCO emphasized further the "organic unity of education and of its administration," because specialized technical training rests on general technical education and this, in turn, implies general scientific training, while scientific training is an integral part of general education.

"The connecting link between scientific and technical education in the school is the workshop," said Professor A. C. Joshi, of India. "Working in a workshop is of great importance for all who intend to adopt either a scientific or a technical profession. It is useful even for others who do not want to become either scientists or technicians. As the Harvard Committee on General Education concludes: 'The manipulation of objects, the use of tools and the construction of simple apparatus, all are required for entry into the world of experimentations'. Even the pure mathematician is greatly aided by shop experience. The forms, contours, and interrelations of three-dimensional objects provide a stimulus and satisfaction not to be achieved within the limits of plane diagrams."

Yet lack of facilities for workshop practice and dislike of manual work appear to be among the most serious weaknesses in the field of technical education and even of training in science, medicine and engineering in under-developed countries. It is desirable not only for the training of good scientists and engineers but also for general education that the secondary school students should be made familiar with the use of simple tools and the manipulation of simple machines and processes like soldering, joining and elementary glass-blowing. If they could be taught also the use of a wood lathe, a machine lathe, or the operation of a drill press, it would be all to their advantage. Training in manual skills should not be conceived as an unimportant accessory which could be dropped when the examination approaches, but as an essential part of general education.

But does this approach imply that "science" and "technology" are inter-

changeable terms?—and that technology, for practical purposes, cannot be subdivided? The technician in a developing country, said Mr. R. Navarre, of France, is sometimes in the position of a Robinson Crusoe. We have to look for a versatile division of talents capable of going from one branch of technology to another. It is not possible to send radio or electrical engineers or railway engineers to some of these countries, for there would not be any job for them there. So they have to be versatile. They are in an environment which is sometimes quite primitive, with hardly any developed technology. The technicians in a developing country, therefore, should be polytechnicians; they should have had training in quite a large number of specialities and subjects.

"This is what we need to emphasize—to train this versatile technician," continued Mr. Navarre, "our Robinson Crusoe would have to develop many areas, and be able to adapt to any situation. Can we make a polytechnician out of this type of person? If we imagine knowledge to be like the surface of the earth, having mountains and valleys, it is not possible for a technician to move from one valley to another valley—from one branch of knowledge to another. What he can do is go from one branch of knowledge to another by going deeper—going deeper into that kind of common knowledge, basic knowledge, where all branches of technical knowledge can communicate together. The true needs of a developing country are to have basic scientific teaching and application of common ideas which communicate with all others. Therefore, the technician should understand that teaching for work in under-developed countries should consist of a basic educational programme. He should have a philosophy of technology at the centre of his effort, a kind of volcanic nucleus from which will be released all kinds of energy. At this level there can no longer be differences between science and technology."

CLASSIFYING TECHNICAL EDUCATION

In presenting recommendations on technical education on behalf of UNESCO, Professor V. S. Martinovsky developed further the idea of the organic unity of education in science and technology, by confirming that experts from many countries had agreed on findings which undoubtedly reflected current trends in technical education throughout the world.

"We had to classify technical education," he explained. "There were two opinions—either that three categories existed of higher technical institutions or four. We first thought that all technical institutions should be divided into four categories: those preparing skilled workers, those preparing technicians, and those preparing engineers for higher technical education and a second group of engineers as research workers—that is to say, engineers would be divided between those who were doing practical activities and those doing research. The last General Conference of UNESCO decided that it was better not to divide engineers into two categories. Thus, we accept three main categories: skilled workers,

technicians and engineers. But in many countries there are, in fact, four categories, and I suppose they will go on having four categories for years to come. There will thus be practical engineers and research engineers—closer to physicists than to engineers working in factories."

As regards programming in higher technical institutes, the UNESCO statement reflects the dual role of all higher technical institutions. This is, on the one hand, to prepare and train engineers and, on the other, to undertake scientific research in a given speciality. But the link between these two activities is essential to the achievement of proper results. It is impossible to train good engineers if the teaching staff cannot pursue research activities. "The existence of special research institutes in many countries," concluded the UNESCO representative, "does not mean that in higher technical educational institutions there must be no research work. Every such institution must be a centre of scientific research; but that does not mean that one should not set up special research institutes for the solution of concrete problems in science and technology. There is really no conflict here."

Along this line of approach an interesting account of the kind of adaptability encouraged and practised in many differing areas was given by the French National Inter-Professional Association for the Rational Training of Labour. The Association's objective has been to train suitable workers to occupy, as quickly as possible, production posts essential to the life of the country concerned. These include posts for semi-skilled workers or workers specializing in using imported prefabricated components or imported machinery, posts for qualified workers, and posts for executive staff composed of equal numbers of native and foreign personnel, relying on qualified workers to carry out orders.

At the preliminary stage the material resources may not yet have arrived, as this generally takes one or two years. This period must be used for the rapid training of a relatively small number of adults as qualified tradesmen in order to form the framework of the labour force. The training, covering a period of about six to nine months, is carried out in accordance with a curriculum worked out by the Association. At the second stage the majority of the posts for semi-skilled specialist workers can be filled by the native labour force after a few weeks' training. At the third stage a further selection among the qualified tradesmen, currently in employment, will make the adequate training of executive staff a possibility.

Countries where this rapid-training system has already been tried include Pakistan, Yugoslavia, Spain, Argentina, Congo (Brazzaville) and Congo (Leopoldville). The Association's programme, it is claimed, can be adapted to the character of people, taking into account their customs, ancestral traditions, difficulties in interpreting graphic representations, the use of audio-visual aids, and so on. This programme also has to take into account the individual's capacity for paying attention and his disregard of personal safety. The best candidates produced by this process are selected to teach their various trades to others (B/8).

PRODUCING GOOD ENGINEERS QUICKLY

"How are the new nations going to produce enough scientists and technologists and promote the means of training and using them in universities and institutes?" asked Dr. V. Kovda, of UNESCO. He points out that most developed countries have from 500 to 4,000 scientists per million of population. For the less developed countries he suggested a target average of 1,000 scientists per million of population. To judge from the experience of most developed industrial countries the number of engineers ought to be five or ten times this number, say, 10,000 engineers per million of population. Could anything like this figure be achieved?

The planned training of scientists and university professors has, of course, to be prepared and carried out well ahead of present needs and in anticipation of future needs. Dr. Kovda suggested that out of 100 pupils, only ten to fifteen would attend a university; out of 100 university students, only ten to fifteen would become scientists, if conditions were favourable; but of 100 scientists, perhaps only two or three would be innovators of significance. He estimated, as the present drain of able young scientists and engineers from countries which needed their talents to countries which offered more scope and more money income, that no less than 20 per cent to 25 per cent of the newly-trained cadres of scientists—and the most gifted—leave their countries. According to information published in the United States, 3,350 specialists trained elsewhere annually immigrate to that country; of this figure, 20 per cent to 25 per cent are scientists.

"I was happy to hear the representative of UNESCO declare emphatically" said Dr. M. N. Parlar, of Turkey, "that a technical school cannot train technicians and engineers at one and the same time. However, we should not rule out the possibility of a very good technician enrolling in the first year of a higher-level engineering school and of obtaining, after a long study period, a diploma in engineering." The speaker accordingly advocated two courses of action: the direct method for the training of engineers—two-year engineering schools, with mathematics and physics (these are basic years), followed by specialization. Professors are needed, he said, at the level of specialization, capable of applying mathematics and physics for research work in laboratories. The alternative course, beginning with a technicians' school, is the slower one because the technicians' school is specialized from the start.

"I believe that some of our experience in this field can be useful for the developing countries," said Professor Ignacy Malecki, of Poland, "because after the Second World War the industry of Poland was completely destroyed and we had, in a very short time, to prepare engineers for our industry. Our present industrial strength is due, in a large part, to the right choice of a system for training of engineers at high levels."

Dr. Malecki explained that in Poland the type of training pursued in some of the polytechnic schools was similar to that which was to be found in the institutes of technology or engineering faculties in universities in the United

Kingdom or the United States. The curricula included broad bases of fundamental disciplines in the field of mathematics, physics, theoretical mechanics and theory of electro-magnetics. This covers a period of five to five-and-a-half years' teaching. After finishing the university this type of student is able to begin work at once as assistant professor in high schools or as an assistant research-worker. Alternatively, he is able to begin his future work in large plants where he comes under the supervision of good engineers.

The situation is quite different for the young engineer who enters a small workshop. From the first day of his employment he must give orders and make decisions. This initial period will decide questions of the status and mutual relations between himself and the whole staff. A young man in this category must have a good knowledge of technology in a rather narrow field, a good grasp of problems of organization and social relations, together with some teaching qualifications. Training this type of engineer necessitates, prior to a technical university, a period of training of some four years in a high school of engineering. Students having this type of education are better equipped for immediate participation in economic life. The national economy of developing countries needs, first of all, engineers for small plants for ensuring transport and building operations.

Academician N. M. Zhavoronkov, of the USSR, made the further important point that there is a difference in principle between the training of engineers in our day and that which was given at the beginning of the century. Previously, a young man, after going through primary, secondary and higher schools, acquired knowledge which he applied during his whole life; but, nowadays, that was impossible. A higher educational institution had to give the necessary impetus; after that, a man had to study all his life, and work all his life, in order to master the achievements of science in this field (K/2).

"These circumstances lay a very heavy responsibility on us," continued the speaker, "when we work out educational programmes and forms of training for scientists and research workers. It is true that one could say, as Napoleon used to say, that it is not the general who made the best plans before the battle who is the most gifted, but the one who won the battle. Yet, in this matter, a good plan is an important guarantee of success. If we are to solve this problem we have to find the right principles through discussion. This will be of great assistance to the developing countries. It does not require any expenditure. It can be done most simply through transmitting the principles that we are working out here—those of the tradition and experience accumulated in developed countries—and applying them to the developing countries, taking into account the specific conditions in any given country."

Professor S. Mackey, of the United Kingdom, suggested that the Conference might widen the discussion by clarifying, in the matter of technological education, the terms of craftsman, technician and engineer. "We have the engineer," he said, "whose education, as has been repeatedly pointed out, should be broad-based rather than specialized. The probable path of his future career has been

very aptly summed up by Professor Irmay, of Israel: 'The growth of many engineers follows the path: machines, materials, men, management, methods, money' (K/10). The liberal type of education, which is traditional of university teaching, seems to me to provide the only satisfactory foundation for this type of professional career. The Secretary-General's report states: 'The centre of gravity of the universities is shifting to the departments of mathematics, physics, chemistry, biology and the earth sciences.' This may be true of the teaching content of the first and intermediate years of many university first degree courses. But, in terms of the over-all research and teaching activities of those universities which still embrace the four major disciplines of arts, science, humanities and technology, it is truer to say that a greater overlap is developing between the humanities and technology" (K/17).

Professor Mackay uttered a word of warning to newly established universities in developing regions. Under pressure of rapid diversification, current industrial trends were demanding an ever-increasing variety of engineers. Some developing universities tried to meet this challenge by the institution of *ad hoc* courses, leading to awards of masters' degrees, before they were ready for such courses, either because of inexperienced staff or inadequately equipped laboratories. As such action would inevitably lead to a lowering of the standard of the first degree, it should be actively resisted. Once it became apparent that the standard of the degree fell below the acceptable level, it would take generations and a tremendous effort to remove the stigma thus caused.

Also from the Far East, the Conference heard a progress report from the Indian Institute of Technology, founded in Bombay in 1956, which recently held its first graduation ceremony. In the past six years the Bombay Institute has grown to be one of the major centres for the training of engineers in Asia. It is a fully-fledged engineering institution which now has 1,600 students (2,000 are expected next year) selected on the basis of nation-wide and highly competitive examinations. From an average of 22,000 applicants from the whole of India, 900 students are chosen each year for admission, either to the Bombay Institute or to the Kharagpur Institute near Calcutta. At Bombay, where stress is placed on post-graduate work, 250 students are preparing for masters' degrees or doctorates. The Institute also offers refresher courses for practising engineers and a consultation service for industrialists. India has spent about $US10 million on bringing the Bombay Institute into existence. In addition, UNESCO aid, under the United Nations Technical Assistance Programme, includes three types of services: the sending of specialists and teachers, the supply of equipment, and the award of fellowships.

DIFFICULTIES AT THE MEDIUM LEVEL

The importance of medium-level "supporting staff" was not overlooked at the Conference. It was apparent that the less developed countries had been obliged

to organize training at the medium level after the pattern of similar training in the highly developed countries. Yet, even if a certain degree of success had been attained in some cases, the peculiar circumstances prevailing in these countries had given rise to serious difficulties, including the constant need to accelerate the rate of training.

Among these difficulties is the nature of the policy to be adopted as to the most suitable form of institution and the programming of technical education. How far, it was asked, can good results be obtained by adopting, with appropriate modification, one of the systems employed in other countries? Another problem lies in the selection of pupils for training as technicians. On the one hand is the need to ensure that able students with mechanical aptitudes are chosen; on the other is the fact that, in the conditions at present existing in these countries, able students find themselves under the strong social pressure to seek a high level professional training.

Then, adequate provision must also be made for education in general subjects, aimed at producing technicians who can play their full role in the economic and social advancement of their country. This raises the question of the relative proportion of scientific and liberal subjects to be included in the curriculum. Practical instruction is, of course, most important in view of the general absence of manual dexterity due to the lack of opportunities for handling mechanical equipment from an early age. Other difficulties arise from shortage of equipment —though some of these may be overcome by the setting up of joint centres for laboratory instruction to serve several areas. Perhaps the major problem is that of affording technicians in training experience of actual operations in an enterprise or a laboratory. This difficulty is obvious in the absence of an industrial set-up with fields for training personnel at all levels in the industry itself.

Of crucial importance (insisted the Conference Secretary-General) are suitably qualified teachers for the institutions that are to train technicians and equivalent personnel. The general shortage of science teachers and the greater prestige and remuneration of other types of employment open to graduate teachers are factors which contribute to this situation. The solution may be found in a more intense appeal to selected secondary or technical institute graduates to become teachers. Teachers already involved in the training of technicians should therefore keep in touch with the rapid advances in technology, and provision should be made for them to attend refresher courses. Arrangements should also be made for a system of examinations, recognition of certificates and the regulation of university entrance to make it possible for technicians of the right calibre to pass on to universities on equal terms with secondary school graduates.

Dr. Sri Luxman de Silva, of Ceylon, took up the need for training medium-level technicians, describing the medium level as that coming between the technologist and the artisan or tradesman. He considered it important that training of these grades should be as wide as possible and include as much practical experience as the system could furnish. These technicians should, as far as possible, be trained in the countries themselves, because they should be aware

of what conditions existed in their own country and not aspire to conditions that would not be attainable for some time to come. "It is not always possible," he added, "to provide for this on-the-job experience in our own countries, because there may not be a sufficient number of factories and industrial units to which we can attach them for training. Therefore, it is necessary that the schools, where these technicians are being trained, should have 'production-units' attached to their workshops. This is a scheme Ceylon is now trying out. In our Institute of Practical Technology the workshop is also the production unit. The idea is for this unit to take in work on a regular basis and for the students in their final stages to be associated with actual production."

DEFINING GRADES AND RATIOS

"We can speak of four grades of technical cadres," said Professor B. Lengyel, of Hungary, "skilled craftsmen, technicians, engineers and specialized engineers. The technicians in the second grade must know the technology of a certain branch of production as well as the scientific basis and principles of management of technology. They must have a thorough experience of the whole field of their professional branch and must have a sound knowledge in the planning and organization of production, as well as the elements of a general education in the humanities."

This kind of training can be developed adequately only by institutions that range between the secondary school and the university. Such schools, which may be described as superior technical schools, are to be found in the developed countries. Generally speaking there are more special branches at these schools than at technical universities. However, in countries with a different economic development the educational problem is different, and the maximum programme cannot be realized, at least for the time being. Other forms of education—simpler, quicker, and less expensive—have to be found.

"It is characteristic of all the backward countries," continued Professor Lengyel, "that the situation is worsened by the fact that, owing to great differences in social and material standards, the smaller number of people for whom education becomes possible prefer to take the university road. My own country presents a good illustration of the problems of technicians. After the Second World War the number of engineers amounted to 12,000 corresponding to the degree of development of the country at that time, when we had only 12,000 technicians at our disposal. This is a very small number, since, according to one estimate, the necessary ratio of the technicians to the engineers should be 4:1 or 5:1. With a view to accelerating the training of technicians, we instituted a training scheme in a secondary four-year course, following on from the primary schools. In these secondary technical schools, the curriculum consists—besides general humanities—of theoretical technical subjects and of practical training in technology, drawing and so forth."

By means of this shortened course, explained Professor Lengyel, the number of technicians amounts to 60,000 in training today, as against the previous figure of 12,000. Thus, medium-grade training of technicians must be planned in a similar way in the developing countries, even though superior grade training is still lacking.

Mr. P. F. Harburger, of Israel, thought that technicians who, though above the highly skilled craftsmen in technological knowledge, were beneath the academic engineer, but who had practical experience, workshop practice and laboratory experience, as well as a general education above the elementary level, should be classified in more than one grade. "There are interested groups who try to convince us," said Mr. Harburger, "that there should be one grade of technician and only one grade. I think that that is wrong, for various reasons. The actual reason is that there are different levels of technicians. A man who is a food technician and specializes in milk—a milk technician—has another level as a dairy technician, who is not a general food technician. But this lower level of technician's work is very important. It would do a bad service to less developed countries if he tries to be a perfectionist and acknowledges only the highest level of technician's training. He would just make it impossible for his country to train its own technicians for the necessary lower level. The other reason why I am much in favour of different grades of technicians is that, if we had more levels of the technician's training, it would encourage people to try to reach at first the lower level, and steadily go up to the higher levels. There should be a continuous system of technologist's training—from the craftsman, maybe from apprenticeship, up to the academic engineer."

"I would like to destroy a myth which seems to be gaining ground," commented Professor J-J. Morf, of Switzerland, "that technicians are of an intermediate level. They are not half-engineers, nor are they failures as engineers. Professor Lengyel defined the three different kinds of personnel which industry needs as skilled workers, technicians, and engineers of varying levels. When the Iranian Government asked the United Nations Special fund and UNESCO to set up the technical school in Teheran, I was called upon as an expert for the creation of the Electricity Institute which was to be attached to the school. On the one hand UNESCO wanted at the start to give its support to the establishment of a technical school at the intermediate level. On the other hand the Iranian Government wanted to set up a polytechnic school of a higher level. Finally, after long discussion and research, an attempt was made to bring about the following compromise: the name given to the school was 'polytechnic school', that is a school of higher level with a curriculum lasting four years, at the end of which the diploma of engineer was awarded."

Provision was, however, made for the possibility of leaving the school after two years, with an intermediate diploma as a technician. This solution, on the face of it, seemed to meet some of the objections, since it tended to bring about a smooth flow from the intermediate to the higher level. Yet the curriculum followed by the student during the first two years was quite different from that

followed by the student aiming at becoming a technician. In consequence, at the end of two years, if the student left the school, he was neither an engineer—not having finished his studies—nor a technician, because he had not received the training of a technician. "He has very general ideas of mathematics, very broad ideas of physics; but he is a very poor technician—we might speak of him as a failure as an engineer" affirmed the speaker. "In this way we train people who are disappointed by the result. That is why I should like to emphasize the absolute necessity, every time we consider establishing a new school in the developing countries, clearly to define at the very start the goal and the purposes of the new school, and thus avoid confusion between intermediate levels and higher levels, or a school which, in two years, might be expected to produce a technician and later a trained engineer."

IS FORECASTING FEASIBLE?

In approaching the difficult topic of forecasting we have to go back a little to first principles. It will be said that a human being is a free individual. He must find his own path in life, create his own world; be ever exploring new fields of knowledge if he has the intellectual capacity; be following his own bent if he is a natural craftsman. He cannot, from cradle to grave, be fitted into a plan designed not for the individual but for the community. It is the age-old argument of the State as the protector of freedom *versus* the State as beehive.

The truth probably lies somewhere between these two concepts. Modern Man must be prepared to fit himself into the highly-organized community now required, so that all may enjoy the benefits of modern science and technology—including the human sciences—whether his personal part is that of a machine-minder, machine-maker, or creative planner. The wonderful capacity of the human individual for adaptation is already giving part of the answer. With the help of the shorter hours of work, made possible by technology, man can allow himself other hours of creative living, can still "do it himself", perhaps better than before. For how can he find happiness if in following his own bent he finds only unemployment, frustration or social rejection?

The answer seems to be that the majority of mankind must divide themselves between doing the work that is wanted, for the hours required, and the creative use of leisure. For "work", occupational education and training must exist; for creative leisure, general school education, along with adult education. Many voices were raised at the Conference in favour of forecasting the needs of a country for trained workers, and for creating them by planning schools and training courses accordingly. There was, on the whole, general agreement that forecasting is essential—as far as it can be taken.

The difficulties were freely discussed, while several participants recognized the dangers of trying to forecast too closely, of planning training too narrowly. Training should be as wide and adaptable as is technically advisable according to

country and degree of development. One requirement, for example, would have to be a careful recognition of the difficulties, both sociological and technical. Scientific and technological manpower planning is usually based on certain forecasts. Underlying these forecasts is the assumption that there is a calculable relationship between the pace of economic development and the availability of highly trained manpower. Economic growth depends on a proportionate increase of highly trained manpower. This reasoning is based on the assumption that the over-all patterns of employment of scientists and technologists in each country are given and will remain almost unchanged for the period of the forecast.

This assumption, however, lacks any firm theoretical basis; it is used only as a means for making possible the projection of trends. In this context the assumption becomes legitimate, but one has to beware lest it is pressed so far as to affect the interpretation of the forecasts. Moreover, it cannot provide a basis for forecasting manpower requirements in countries which are at a very rudimentary stage of development of either their economy or highly trained manpower, or both (K/20). But it only increases the difficulties of education—and of the proper investment in education—if planners of education and training are not given reasonable forecasts of how the talents of their pupils can be used by the community. No educator or trainer likes to face a gifted or hard-working child with the news that his skill and determination are not wanted. "Forecasts are, in the first place, a tool for planning education."

At the same time, as Mrs. A. Béguin, of the Scientific Secretariat, reminded the Conference, the costs of training highly skilled people are high. Therefore, countries interested in doing so need to determine as precisely as possible the requirements that the investments which they are preparing to make in the field of education and training will have to meet in order to obviate the waste of limited financial resources. Hence, the general interest which exists today in means of forecasting manpower requirements and, especially, long term forecasting. What, then, is the main purpose of these forecasts and within what organizational framework should they be considered?

Forecasts should, first of all, enable the planners of education and training to establish orders of priority and develop the educational and training facilities required for the training of those categories of personnel which the economy will need in the short, medium and long term. Forecasts are a tool for planning education. Yet this is not their sole use, for manpower forecasts are not merely a sub-product of economic forecasting. They must also show, where possible, any inadequacies of resources devoted to education and training, within the scope of the economic development plans and of the general allocation of available resources. Manpower forecasts must lead, therefore, to an integration of educational and training planning and global development planning. Only thus, when facing the various choices open in the economic field and the education field, can coherent decisions be taken with a view to the harmonious development of the whole country.

Both the organizational necessity, on the one hand, and the mathematical limitations, on the other, of this kind of forecasting were emphasized throughout the Conference. "Forecasts of the numbers of scientists and technologists and engineers that may be required in a given country at some date in the future may be needed for a variety of purposes. But the need to make such forecasts arises principally from the need to plan educational policies on a scale sufficient to meet the future needs of the country concerned," stated Professor E. A. G. Robinson, of the United Kingdom (K/43). "This fact is important because it implies that estimates must be attempted for a period sufficiently far ahead for remedial action to be capable of being taken. The working life of a scientist or technologist, possessed of sufficient experience to carry high executive and directional responsibilities, does not begin much, if at all, below the age of 30. His training will have to begin soon after the age of 15. Thus nearly 15 years is necessary to vary at all considerably the number of trained personnel, capable of carrying top-level responsibility, and at least ten years to vary significantly the number of persons available in more junior posts."

Estimates of future manpower requirements have, of course, to be expressed ultimately in terms of educational categories. From the experience gained in countries such as India (K/41) it appears that, since forecasting techniques of requirements of scientists and technologists are still not fully developed, there is need for an almost continuing review of the methods employed, and this can be achieved only if there is a central agency responsible for looking after the whole programme on a permanent basis, as postulated in Chapter 2.

It has been stressed that, from the point of view of educational policy, the demand for trained manpower needs to be foreseen only in the rather broad categories into which scientific education is divided in the more elementary stages. The balancing of particular specialist training, more particularly at the post-graduate stage, could be achieved relatively late in the educational career and would reflect much more nearly the current needs at a given moment. But this balancing could be done only if the aggregate flow of university graduates, or of persons qualified to pass through technical colleges, was adequate and equally so the number of potential teachers (K/43).

In the matter of training—and in view of the huge size of the skilled manpower gap, as well as of the need for rapid results on a limited front—two broad alternative approaches presented themselves at the Conference either the methods evolved and tested in the economically advanced countries can be used with such adaptations as are necessary, or training programmes, which are new in structure, methods, and means of application, should be specially conceived for the purpose [GR.2 (B)].

In the long run it is rather the second approach that appeared to commend itself. Thus, to sum up: on the negative side, there is the sheer size of the problem and the fact that many developing countries have to start almost from

nothing, as well as the low prevailing level of general education and the small extension of industry; while, on the positive side, the present favourable climate of development planning and the great advances in pedagogical methods and the use of audio-visual aids and mass-communication techniques—all these factors point to the need for a comprehensive, dynamic and imaginative programme of education and training, based on research into local circumstances, rigorously planned and oriented towards the demand for various categories of manpower emerging from the development plans as a whole.

SOME WORKING EXAMPLES

An interesting current example of how this forecasting approach works in practice was given by Mr. J. Paleocrassas, of Greece, in a paper entitled "Demand forecasting for scientific and technical skills in Greece by 1975". The Greek Government, he said, considered that the elaboration of a thorough educational plan was absolutely necessary within the process of planning economic development contained in the Five-Year Programme. This work was undertaken in co-operation with the Directorate of Scientific Affairs of the OECD, within the framework of the Mediterranean Regional Project, and was devoted to forecasts of demands for scientific, technical and generally trained personnel for the years 1970 to 1975 (K/40).

But it was left to Professor F. Harbison, of the United States, to put his finger on the central problem—priorities—when he argued that the essential part of a programme of manpower assessment is the analysis of the development of formal education at the primary, secondary and higher levels, both academic and technical. "And here it seems to me", he said, "that the essential element is that of determining priorities. What must come first in order to achieve this goal of accelerated, rapid development? Now, all the newly developing countries, as we know, are short of highly educated manpower, but they are shorter of experienced manpower. When we are thinking about a programme of human resource development we must think not only of producing educated people but also of producing experienced people. An assessment of human resources, in my judgement, therefore, includes an appraisal of the capacity of the major employing institutions to produce experienced people. In many countries the major employing institution is the Government itself. In addition, there are the large private enterprises or the government enterprises, both medium-sized and small."

Hence, human resource development programmes should regard the government services, the government ministries and the major establishment as more than consumers of educated manpower. They ought also to consider these organizations as producers of experienced manpower. The analysis of the training capacity of employing institutions, of training on the job, and the training of regular employees, is the essence of human resource development assessment.

"There is general agreement," said Dr. Joseph Ben-David, of Israel, "that developing countries have little use for very high-level scientists and technologists. The theory is that there is little prospect of their performing sophisticated research or of introducing industries based on very advanced technology. Highly trained people would be wasted under these conditions. It is said, therefore, that such countries need rather skilled technicians who are cheap to train and can be trusted—under some expert supervision—to undertake most of the jobs available in the country. This reasoning has guided official thinking in developing countries everywhere. Yet the figures consistently show that, in practice, the obverse has happened. In Britain, the oldest industrialized country, and some other highly developed European countries, the ratio of technicians to fully trained engineers is about 5: 1 to 4: 1; while in countries more recently industrialized, such as the United States and the USSR, it ranges between 1: 1 and 1.75: 1. In Israel the ratio between technicians and engineers is estimated at almost 1: 1, and the ratio between technicians in medical laboratories and professional personnel is similar" (K/20).

There would seem to be, according to the Israeli estimate, a simple sociological mechanism which diverts would-be technicians and turns them into engineers (or other professionals). The ability necessary to obtain some kind of professional degree is not much higher than that which is necessary for a thorough technical education, while the potential rewards are much higher. Technical education, therefore, has thrived only in countries with a tradition of class differences debarring people with the necessary capacity from further study. Such class traditions exist in European countries. In the new countries, however, traditional class differences have usually been abolished. At times, of course, there are immense differences of income between the very few who are on the top and the very many who are on the bottom of the scale of income and wealth; but this is not the same as a tradition of social classes. Once a person is mobile there will be nothing to bind him emotionally to the middle ranges of society.

As a result there will be constant pressure for the provision of higher education and relatively little interest in a technical one. The forecaster, therefore, as well as the planner, will be better advised to adopt models of development with low ratios of technicians to engineers, rather than the seemingly more logical models of high ratios. Whether the low ratio model is really as inefficient as is usually assumed is another question. The belief is progressively growing, that much larger numbers of fully trained engineers can be usefully absorbed in industry than were previously estimated (K/20).

THE IMPORTANCE OF INSTITUTES

The link between the forecasting process and the establishment of training institutes was brought out by Mr. Bechir Jaibi, of Tunisia, who suggested the creation of additional training centres for trainees recruited as far as possible

among students who had failed in their other studies, or who had been unable to reach the end of their normal studies, whether at the high school or the university level. "If all goes well," he said, "and if all our forecasts are confirmed, in fact and in life, we shall perhaps at the end of these ten years be able to balance the requirements with the needs of production—at least as far as the basic cadres and the intermediate cadres are concerned. We will have to wait the next ten-year period for the higher cadres. In other words, we shall be able to balance requirements and production only within a period of about 15 to 20 years."

"But, at present," he continued, "we have a far more delicate problem and that is the one of the evaluation of manpower requirements in a more accurate fashion. The National Education Institution and the centres of vocational training are turning to the plan and are asking what will have to be the strength in two or three years of the fitters or mechanics in the intermediate schools or of the commercial and economic sectors of the high schools. In view of the present state of our statistics—in the absence of any accurate idea of the requirement of employment in a few years—the Plan leaders cannot answer. We tried to make an exhaustive survey, we tried to make soundings and samplings; but all this appeared to me to be so many fumblings."

This is an area, the speaker went on, where international organizations, and in particular UNESCO and the International Labour Organisation, could usefully assist the developing countries in clearing the underbrush from these questions and in overcoming such difficulties, which are indeed considerable. The organizations concerned might engage in action not only at the level of a given country but also on a regional level. "These problems certainly arise in Algeria and Morocco, as they arise in Tunisia. Here is a region which represents a portion of mankind amounting to some 25 million inhabitants, who will certainly be more numerous in ten or 25 years from now, and who would wish to be enlightened on some of the points on which they still have so little information. Co-ordinated action on the part of international organizations at the level of a whole region could be extremely useful for these regions, as well as for the enlightenment of the organizations themselves engaging in this work."

Apart from their major objectives, the general experience of such institutes is to encourage the exchange of personnel. India is fortunate, said the joint authors of a paper entitled "Exchange of Personnel and Education", in that it has been able to establish a large number of projects involving such exchange of personnel. These projects cover almost every facet of national development. "While receiving a great deal from the more advanced countries," the authors point out, "India has also given to the less developed regions of the world. Under the Colombo Plan India has offered training facilities to well over 1,200 persons, and has also made available the services of a fair number of its nationals for work in the Colombo Plan countries. In the educational field collaboration has been established with a number of countries. For example, the United States is assisting in the establishment of four regional teacher-training colleges; in a

scheme of training of technical teachers in selected technological institutions in this country; in the establishment of the Indian Institute of Technology at Kanpur, the last in the chain of four higher technological institutes planned by the Government of India, in the training of teachers of craftsmen; and it has played a vital role in developing training in the application of radioactive isotopes in agriculture."

Soviet aid has also been received through UNESCO and directly in the establishment of the Indian Institute of Technology at Bombay, the second of the higher technological institutes. A project under the aegis of UNESCO is also being formulated to help India in the teaching of science at the secondary school level and in promoting scientific research in selected centres at the university level. West Germany, too, is participating in the project for the establishment of the Indian Institute of Technology at Madras, the third in the chain of the higher technological institutes. It is also helping to train Indian skilled workers and technicians at the Prototype Production-*cum*-Training Centre of Okhla, primarily for the benefit of small-scale industries. The United Kingdom is helping in the establishment of a College of Engineering and Technology in Delhi, which will provide facilities at the university level. There are many other such collaborative arrangements, as, for instance, with Japan in the field of training for small-scale industries, and with Switzerland in the field of training of instrument mechanics and technicians. Almost every country in a position to offer training facilities has come forward with scholarships to enable Indians to avail themselves of those facilities and thereafter, on their return to India, to participate in national reconstruction (K/28).

In the United Arab Republic (said Dr. Aly Shoeb), national research centres shoulder an important part in the training of young scientists who tackle such national problems as the utilization of local mineral resources, improvement of cotton breeding and other problems of applied research. It was realized also that the creation of new levels of training must go hand in hand with the training of scientists and research workers. The army of trained personnel, of laboratory assistants, of technicians, of designers and draftsmen who must support any research activity could not be assembled except from technical education at secondary and post-secondary levels. The establishment of industrial institutes some five years ago to provide for the technician's level of personnel is beginning to bear fruit. One of these institutes is the only one of its kind in the Middle East, training instructors for technical schools in a five-year course, after completing twelve years of general education (K/9).

THE EXPERIMENT AT TURIN

This chapter may well conclude with a brief sketch of an experiment in institute creation which promises so much for the future. In the summer of 1961 the Italian Government asked the ILO to study the possibility of using buildings

which had been erected for the Turin International Labour Exhibition for the establishment of an international centre for advanced technical and trade training. The main purpose of the centre is to assist developing countries to improve the skills of persons working at all levels in their industrial undertakings, large and small, who are considered suitable for more advanced training than could be given in their own country. The Turin site can accommodate something like 2,000 holders of fellowships each year from countries in the course of industrialization. These fellows will attend advanced theoretical and practical training courses ranging in length from one month to a year.

Since it is now universally recognized that the development of human resources calls for machinery far beyond the means of experience of many countries, such machinery is designed as an integral part of over-all economic development planning or of national policy-making machinery. It is already enlisting the co-operation not only of Governments but of broad social groups such as the trade union movement, employers' organizations and industrial relations machinery generally. The ILO has arranged for a periodical appraisal of the results achieved and for reviewing the institute's policies.

It should be recalled that the technical assistance programme of the ILO has over the past 15 years concentrated its efforts on behalf of the developing countries by associating itself with the efforts of Governments, employers and workers in establishing the vocational training centres and productivity and management development institutes which these countries need. It has devoted special attention to the training of instructors and, in general, of technical personnel who, by their example and teaching abilities, will be able to train workers, foremen, technicians and management personnel. As a result there is now a network of training centres and management development institutes extending through more than 60 countries in Africa, Asia, the Middle East and Latin America. In response to the requests of many Governments the ILO has endeavoured to give basic training to the foregoing classes of technical personnel in these centres.

As a result of this experience it became apparent that, in addition to this basic training, there was an urgent need to give advanced technical training to the ablest of the persons passing through the basic training centres. Such advanced training cannot usually be given locally, either through lack of facilities or because staff of the requisite high standard is not available. The advanced training must be given in a modern industrial setting to enable carefully selected trainees not only to acquire the skills needed for operation of modern machinery or for the management of modern industrial plants but to experience the conditions and tempo under which modern industry operates.

To meet such needs the ILO decided to establish the International Centre for Advanced Technical and Vocational Training. The centre is planned as an advanced training centre as distinct from the aforementioned basic training centres established in the developing countries. It will thus act as a vital link in the growing chain of national training and productivity centres, and concentrate

in one place both the highly qualified teachers and instructors and the material equipment needed for advanced training.

The programmes of the centre, as worked out by the ILO, will consist of practical instruction in the centre's workshops, laboratories and classrooms, which will be so designed as to create an industrial atmosphere. This instruction will be supplemented by periods of practical work in factories and plants, not only in Northern Italy but in other industrialized European countries as well. The programmes will cater for two main categories of trainees: technical and supervisory grades, i.e., highly skilled workers, foremen, instructors and technicians; and senior management personnel. The centre will also hold short training courses designed to prepare future technical assistance experts in vocational training, productivity and management development.

The number of trainees will be limited in the first two years to a maximum of 600 per year, but, if during those two years the Centre fulfils the hopes placed in it, the programmes may be progressively expanded in subsequent years. The ultimate target—dependent on the necessary assistance—is 2,000 trainees per year, a figure which appears to correspond to the current needs of developing countries for highly qualified teaching staff.

The centre will hold its first study course at the beginning of 1965. Throughout their stay in Turin all the participants will live in a residential area adjoining the centre. This area will comprise, in addition to bedrooms, the necessary dining rooms. Workrooms for small groups and recreation rooms will be provided, together with all the facilities needed to enable the community to live in an atmosphere which is pleasant and yet fully oriented towards the desired objectives of advanced technical and vocational training.

CHAPTER 5

Educating the adult

Without the active and conscious participation of the people as a whole, economic and social progress cannot go fast or far. "Where there is no vision, the people perish." Development presupposes a collective effort, which is only possible if the level of education of the entire population encourages the participation of all individuals in common patterns of achievement. Literacy, if it means only the ability to read and write, is not enough. Any campaign to eradicate illiteracy must have as its overriding objective the orientation of the attitude of the whole population towards change and progress. This necessitates a basic understanding of the existing patterns of life that science and technology have created, a general knowledge of the current events in the world and, at the same time, a critical approach towards prejudices that may become obstacles to progress.

Public understanding of the dynamic processes of modern life is important, therefore, not only as a precondition of economic and social change, but as a means to bring about a wider participation in the political life of the country. People who are not themselves scientists can become consciously involved in scientific and technological development. By seeking to raise the general intellectual level of the population, adult education, in this broad sense, narrows the gap which exists in all countries between the community of scientists and the masses of the people. But its role is more important in the developing countries than in the advanced countries, where ideas and concepts of the modern world are already familiar to the child long before he enters school. In the less developed countries, new schools must make up for deficiencies in the child's environment, as well as teach ideas that may actually be in conflict with it. If for no other reason, the education of grown-up people is of fundamental importance, since environmental conditions play a dominant role in the development of mental capacity, and home and community influence during the early years of childhood may be decisive for later life.

In surveying, in this chapter, some of the issues and problems surrounding the education of the adult, our enquiry will take us far beyond the normally accepted limits of "adult education" as it has been conceived in terms of the "continuative"

education process common to the Western world. For example, the topic "Methods for stimulating Technological Change" provoked varied reactions from educators and sociologists, as well as from experts in other areas. Dr. Hollis W. Peter, of the United States, analysed under this head some of the techniques of "how to get people to act differently" and "how to stimulate social change", so as to accommodate a changing technology, "especially in view of the fact that technology changed much faster than social attitudes". What had to be appreciated first, he added, were the risks and dangers people saw in the new technology offered to them. Understanding the process of change, according to Dr. Peter, was a task requiring a high degree of perception. The social psychologist had, therefore, a pioneer work to perform before the technician could step in and gain public support.

Mr. Robert Maxwell, of the United Kingdom, suggested that scientific and educational institutions in developed countries should "adopt" corresponding institutions in less developed ones. In his view, such guidance had produced excellent results in the past. Mr. Maxwell also proposed that members of teaching staffs in developed countries should be required to spend a few years of their careers in developing countries—a practice which he believed would render service to both sides. Professor Destanne de Bernis, of France, drew attention to the "indispensability of changes in the social structure" as a prelude to the mental transformation that could stimulate technological changes.

> "The purpose of introducing science early in the school curriculum", said Dr. Ralph W. Tyler, of the United States, "is to develop in all children and youth the knowledge, attitudes and habits required to utilize science and technology fully and effectively in the economic development of the nation. It is not limited to those whose special interests and aptitudes would lead them into scientific and engineering occupations. Its aim should be to develop in the students an understanding of the nature of science and technology, an understanding of the contributions of science and technology and their social effects, attitudes characteristic of a scientific outlook, including willingness to make necessary changes in their ways of working and living which seem, in scientific terms, to be more productive or more healthful than the previous ways and habits, in harmony with this understanding and these attitudes."

This systematic approach is even more justified so long as the uninformed public thinks of science and technology in terms of a specific set of devices and practices—the motor car or the television set. Science is commonly viewed as having stock answers to all the major questions—a kind of modern magic. For most people, school instruction in science has not developed a different view, but simply filled in bits of information and terminology within this kind of picture. What is needed, therefore, in developing public understanding is to present science as a process of continuing inquiry, depending upon observation, rational processes, naturalistic notions of cause and effect, and possibilities of explaining phenomena and predicting the outcome of specified events. Science seeks to answer questions; but in the process of scientific investigation, while

tentative answers are often obtained to the questions with which the inquiry began, new questions arise, new data are observed, new explanations are worked out, and so the inquiry goes on. It is never completed, but it expands and deepens the individual's understanding of his world.

"Technology needs to be viewed by the public", suggested Dr. Ralph W. Tyler, on behalf of UNESCO, "as a form of ingenious invention and development by which scientific knowledge is put to work in accomplishing some of men's purposes. Thus, scientific knowledge about electricity was put to work by the invention of electric generators and electric motors. Scientific knowledge about genetics and about plant ecology was used to develop new strains of plants which could survive the limited rainfall of arid regions. Each technological device is a man-made product and is often superseded by another invention which serves men's purposes more effectively and efficiently than the previous one. Scientific enquiries are continually expanding and changing our knowledge. Technology is continually expanding and changing both because of new knowledge and because of new inventions which improve upon the earlier ones. It is this view of the nature of science and technology that is required by the people if they are to understand the need for continuing scientific research, for continuing efforts at technological inventions and improvements, and for continuing study on their part to keep abreast of major developments."

DRAWBACKS AND PITFALLS

On the other side of the picture, it is equally necessary to understand the nature of the undesirable consequences of science and technology. People need to be prepared for the fact that the employment of new technological devices will sometimes produce unintended or undesirable outcomes. For example, the rapid increase in the use of motor-cars has greatly increased the accident rate, and in crowded areas has produced heavy smog. The use of weed killers in agriculture has also destroyed beneficial plants and animals. Technological inventions should be recognized as having a potential both for good and evil. Ordinary people need to understand something of the probable consequences before the widespread adoption of a particular device, and to recognize the importance of making later assessments of the result of the devices in use (K/83).

So much for the long run, creating an environment for the child. But the short run may also be full of pitfalls. "In the short run," observed Professor Beals, dealing with the problems of resistance to technological change, "the simplest type of innovation at some point involves an educational process; while inculcating a generally favourable attitude toward innovation, it calls for more complex and longer-range programmes for adults. Such programmes must be designed both in terms of long-range goals and with the cultural conditions, perception patterns and value standards of the community in mind. Visual aids

are especially subject to misinterpretation. A colour film, successful in some areas, may fail in Egypt because a woman is shown in a red dress. As red dresses are worn only by brides, the peasant is completely confused, because he does not understand what a wedding has to do with the picture."

Visual aids should not show a too advanced technology or require sophisticated powers of interpretation. A film of the most modern techniques of chicken-raising, for instance, might be high comedy. The birds shown might be too different from local breeds to be identified as chickens, while the materials and behaviours shown may be so different as to suggest a fantasy. Giant insects on the screen are not related to actual insects known to the audience; their role in disease transmission is meaningless to people who do not believe in bacteria!

> "A film on hookworm," Professor Beals continued, "presented without connecting it with the work of an accepted local health clinic impressed people in an Ecuadorean village—but fourteen years later no Indian had yet built a privy. Evidence abounds that, even in societies with advanced technologies, the very best educational and training films have far more impact if their relevance is carefully explained both before and after by a competent instructor. This is the more true among peoples little experienced in the conventions of the written word, the picture, or the film, that are current in other cultures." (See also Chapter 6.)

To sum up, if adult education, in its broadest sense, is essential for reducing resistance to specific innovations and in developing a deeper interest in culture change, it is often of even more importance in maintaining innovations. A technical aid agency, for example, with unusual flexibility in catering to local desires, financed the landscaping of a previously barren town square. No attention at all was paid to training people to care for the expensive plantings or to the fact that no funds existed for maintenance. Machinery is sometimes provided by outside aid and people trained to use it, but no one is trained to maintain it. Water systems are installed, but no one is taught to repair leaks in pipes or faucets. In these and many similar cases, training in maintenance and in administration is essential if the innovation is to continue to be used (J/68). It is in this sense that education of the adult population takes on a special significance in this chapter.

CONQUERING ILLITERACY

As regards the fundamental issue of world-wide illiteracy, recent statistics reveal that there are some 700 million illiterate adults throughout the world. But the total is as high as 900 million, if countries still without reliable statistics are included. Yet, these distressing data, assembled by UNESCO in 1961, still do not give a complete picture of illiteracy in the world as a whole. The gravity of the problem is accentuated by the lack of national legislation and systematic

programmes in many countries, and by the failure to include anti-illiteracy and adult education measures in many of the development plans.

"The question arises," as the Director-General of UNESCO put it to the Conference, "what is it that is needed to undertake a great international campaign to assist countries which are afflicted by the scourge and to liberate them from it?" Mr. René Maheu continued: "The perpetuation of this scourge is just as absurd from the point of view of economic efficiency, as it is scandalous for the moral conscience. UNESCO considers that the political, economic and technical means are now available to make its abolition possible—*if it is desired*. After having consulted numerous experts, I have submitted to the General Assembly of the United Nations, as authorized by the General Conference of UNESCO, a plan designed to liberate in ten years the illiterate adults of these under-developed regions of from 15 to 50 years. This means to make literate approximately 300 million humans. Of course, this will cost money, but would it not be more expensive to let some 300 million brains be lost to the world? Are there not other expenses which are also high, but which mankind could do without if it decided to proceed?"

The existence in a country of a high proportion of illiterates does not merely mean a loss of substance, for this mass holds back the progress of the literate people of a country. It is well known that the education of adults is a direct factor of efficiency and that, as stated above, it also affects the education which the children are receiving in school. Many developing societies are experiencing this wide gap between the generations—those which are provided with a modern education, and the others which remain illiterate. This state of affairs is unhealthy for the unity and the balance of the community; is inimical to the intellectual enrichment of society as a whole; and it is contrary to the scientific spirit, which is the basis of all true development at this time.

The three major elements in the planning of a world literacy campaign are: (*a*) incentives and aims; (*b*) legislation and organization; and (*c*) methods. Taking these factors briefly in order:

(*a*) Incentives have to be found to provide the drive and enthusiasm required for a prolonged literacy campaign. Without some specific purpose, illiterate adults will be unable to overcome their apathy and indifference and the difficulties encountered in developing countries where illiteracy is almost universal;

(*b*) National legislation and organization are needed to deal with so serious a problem. Such measures may appear costly to countries which are already heavily committed; they are not in fact so when the potential wealth and human energy released by a literacy campaign are utilized;

(*c*) Methods, both as to the teaching of reading and writing and to the maintenance of the knowledge so acquired, will have to include the establishment of institutions suited especially to adult requirements, thus providing genuine incentive.

"Hence," contended Professor A. Lorenzetto of Italy, "measures to eradicate illiteracy form part of adult education, of which they at present constitute the most serious and tragic aspect. Adults must not only be taught to read and write; they also need culture, knowledge and occupational training. A positive experiment in this direction is the establishment of Adult Educational Centres in Southern Italy by the National Union for the Eradication of Illiteracy. Each of these centres is a focus of activities and a school of democracy, as well as being an occupational training centre. For the Mediterranean area and the under-developed countries, these centres correspond to the Advanced Schools for Adults in Denmark and the Residential Schools for Adults in the other Scandinavian countries" (K/78).

"It is known that before the revolution in Russia," stated Professor S. V. Rumyiantsev of the USSR, "76 per cent of the population was illiterate and, in many regions of Central Asia, the population was entirely illiterate. Out of 10,000 people, only eight could become students. How were we to solve the problems which existed at that time in our country? As a speaker from UNESCO said earlier, there was an inexhaustible source of potential in the people. Through the co-operation of all literate people, a general campaign against illiteracy could be and was carried out. Primary school, secondary school and higher educational systems were completely reformed, and we succeeded in obtaining unification of the three levels. In the curricula, we picked out the physical sciences and mathematics and increased the amount of time given to these subjects by removing others which had lost their interest. We should give all people the education to which they have a right, without waiting for the secondary schools to prepare sufficient numbers of students to fill the universities."

SPEEDING TRAINING FOR ADULTS

Another reason why adult education is so urgent in all developing economies is because the growth rate of skilled personnel exceeds the rate of increase in the total labour force. At the same time, the Conference was told, the demand for skilled personnel tends to grow faster than the national income. It is essential that the earliest possible provision should be made for the training of skills, and a figure as high as 10 per cent of a country's total development expenditure should, it has been suggested, be devoted to this end. This figure may be regarded as being too high in some quarters, but it is believed that to devote 10 per cent of working capital for training purposes would be to double the output of trainees (B/9).

Of course, priorities arise, not only as regards the need for various levels and types of training, but for instructors, supervisors, technicians and semi-skilled and skilled workers. It is urged, therefore, that priority should be given to the training of instructors, because of the "multiplier effect" they have on the over-

all development process (B/9). Again, the stress on training personnel who occupy key posts in industry is equal to the strategic importance of the training of manpower already in employment, and especially of those adults in the 20-40 age group. Where the presence of a regular training system is lacking, economic development can best be served by the system called "Accelerated Training for Adults", which can best be described as a short course, of one year's duration or less, in a special centre wherein are reproduced, with the greatest possible fidelity, the conditions of industry. Such training is pragmatic rather than theoretical, the accent being more on the step-by-step process of an industrial operation than on the theory of its action, although the latter aspect is not entirely overlooked. The advantage of such a method is that the turnover is rapid: an instructor can handle 15 to 20 trainees in various "step" exercises at a time. This accelerated training is relatively expensive, but it has been found that this drawback is offset by high output. Care must be taken, however, to ensure that when a particular technique is transferred from one country to another it is adapted to local conditions (B/45).

In those developing countries where a measure of industrialization has taken place, much can be accomplished by in-plant training. This form of training can cover a wide range of activities, including literacy classes, and leads either to semi-skilled occupations or to courses for supervisor training. An interesting model training scheme, designed to cover all levels of competence, was described by Mr. R. Lambert, of France. This scheme takes into account many of the problems which have been mentioned above, with special reference to the electrical industry. Basically, it consists of a number of graduated and interlocking short courses, by means of which large numbers of workers can be rapidly trained for different occupations. In accordance with their ability and diligence trainees can, by means of a broad polyvalent course, attain high skills which could result in their being selected for specialized training in one of the skilled trades. Additional courses for supervisors and technicians complete the scheme (B/29).

"The first point of attack," insisted Dr. A. B. Fafunwa, of Nigeria, "should be at the elementary level (we should introduce science right from the first year at school); but the second point of attack must be on behalf of the 18-year and 30-year olds. My proposal," continued the speaker, "is that the less developed countries of the world should institute compulsory national service. Compulsory national service is nothing new in the world. It is operating in developed countries, but with the precise purpose of training for defence or for 'peace', as they call it, which includes military tactics. The kind of compulsory national service that I propose should be the type that would prepare illiterates to be literate, to be civic-minded, to be community-minded, to have loyalty to their country, and to be able to learn some skills.

"The last level," Dr. Fafunwa said, "should also be on the adult education level, for people between 30 and 50 years old. We should institute compulsory adult literacy classes in the evening, where, again, science will be taught. Here the literate adult will teach the non-literate adult and, if we are able

to launch this programme with the help of UNESCO and other international agencies, we might begin to break the science barrier."

"In my country," said Mr. Z. M. Karmi, of Kuwait, "we had two attempts at this problem of getting through to the adult. The first one was a television programme on 'Science in our Lives', and it was meant not for the educated layman, but for the ignorant layman. Starting from scratch, from the basic principles of science, the subject moved up to something which he was using or seeing. The second attempt was to fix the 15th of April as an Annual National Day, called 'Science Day', accompanied by celebrations and exhibitions of scientific inventions which have had a tremendous effect on the life of the population in general. Thus, I believe, we can gain some sort of response from a society which is lagging behind the newly-trained people in science and technology."

"The kind of technical and scientific training that is given to adults in Algeria," said Mr. Hamid Bouhadji, "owes much to an original programme conducted by the Institute of Works. Professional specialists and higher cadres are being produced through the universities and post-graduate courses. Algeria, after six months of independence, is certainly not capable of finding a solution to this great problem. Hence, I want to speak of two institutions which we have set up. One is the Commissariat for the Promotion of Cadres in the University. Algeria has tried to solve the problem of technical cadres through a regional formula. For this purpose, we have created a Commissariat for Professional Training and for Training Cadres, which is connected with the General Commission of Economic Studies. The Commissar has the responsibility of co-ordinating activities in the field of training and promotion, and, for this purpose, we have drawn up a plan for our university, which is not to be regarded as a second stage to classical studies. This, however, is the same thing as the popular universities and the working universities which, in certain socialist countries, are organizations providing education in various fields and which are not necessarily higher institutions. The working universities bring in adults from the economic sectors and thus fulfil the hope of opening doors to workers who would normally not have gained access to them. Their purpose is to give to the working classes as wide a series of subjects as possible, and so make it possible for man in a socialist context to cope with as many issues as possible."

WHAT EXTENSION MEANS TO AGRICULTURE

Agricultural extension and training are dealt with at some length in Volume III (Chapter 16). But a summary of some of the relevant aspects can be attempted at this point, since they bear directly on the general education of adults and because of the important place the subject occupied on the Conference agenda. "Extension" has been described as an informal out-of-school educa-

tional service for training farmers and their families to adopt improved practices in crop and livestock production, management, conservation and marketing. It is not solely concerned with teaching and securing the adoption of a particular improved practice, but with changing the outlook of the farmer and encouraging his initiative in improving his farm and home. The effectiveness of extension, the Conference Secretary-General stated in his report, is measured by its ability to change the static situation which prevails in the rural areas into a dynamic one. One of the problems, in fact, that extension seeks to overcome is the tendency of rural communities to resist change and cling to static patterns of traditional agriculture. Thus, extension tends to modify the traditional farming system in ways that will be beneficial to the rural community. It is a complement to research, as practised in the agriculturally advanced countries. Improved practices have often been developed in less advanced countries, but their value is limited by the failure to make them known in a persuasive manner to the mass of the agricultural population.

Given the fact that each country must develop its own system according to its own specific conditions, a large part of agricultural improvement is of universal application or requires only slight modifications to be applied to local conditions. For example, one effective means of directing the rural world towards modern agricultural progress has been through Pilot Centres. The aim of these centres—sometimes defined as "cells" of psychological and technical impregnation—is to increase production as a basis of better living and greater prosperity. The centres are established among groups of farmers and the physical and human environment is studied to discover more productive and socially acceptable farming methods. Similarly, the Farm Institute is a pivot for agricultural education and extension policy. The average Farm Institute accommodates some 60 people at a time; the courses vary, but a duration of one or two weeks is to be recommended, in view of the learning capacity of the average peasant and his wish not to be away too long from his family [GR.92 (C)].

Speaking of the success of agricultural extension under the Farmers' Association in Taiwan, Mr. Frank Colling, Chief of the Agricultural Extension Division of the Chinese-American Joint Commission on Rural Reconstruction (JCRR), said that there are 340 multi-service farmers' associations at the three levels in Taiwan, with a total membership of 653,000 farm families. Through small agricultural units, farmer members elect representatives and these representatives elect directors and supervisors, whose functions are policy making and supervision. Extension work in Taiwan is a co-operative programme sponsored by the Department of Agriculture and Forestry and Township governments. The programme enjoys the full support of specialists from the Joint Commission, agricultural research institutes, improvement stations, vocational schools, and colleges and universities. The associations help to train local extension workers and prepare appropriate materials for use in extension education programmes (C/12).

About three-fourths of the Philippine population lives on farms, said Dr. Elpidio V. Munsayac. A large percentage of these persons have had little schooling, and so they are slow in accepting scientific knowledge in agriculture. Their main avenue to learning is through observation and practice. As a result, many farms are unproductive. Incomes derived therefrom are hardly adequate to meet the bare necessities of farm families. Ignorance of sanitary and hygienic ways of living is prevalent. One of the most important bureaux in the Philippine Government which plays a vital role in the rural development of the country, is the Bureau of Agricultural Extension. This bureau is entrusted with the responsibility of bringing to the rural people useful and practical information on agriculture, livestock, soil and forest conservation, public lands and natural resources, laws, home economics and rural life. Teaching is done by the "learn by doing" method. Through its highly trained professional field staff of extension workers, results of research useful to agriculture and home economics are translated to the level of understanding of the rural people and disseminated for practical application to farm and home situations.

The general objective of the Bureau is divided into three main fields of activities, and its three programme divisions—Agricultural Programme Division, Home Economics Programme Division, and Rural Clubs Programme Division—map out their respective roles. The first is geared to improved agricultural methods and increased production of rice, corn, and commercial crops; improved methods of raising farm animals; conservation of soil, water, forests and other natural resources; increased production of quality fibre; and improvement of livestock and poultry; while the Home Economics Programme Division is devoted to "better homes and better living". There is a phase of this latter programme which provides for the training of women and girls in keeping the home healthier and more pleasant to live in. Emphasis is given to the construction of sanitary privies, improvement of the kitchen, extermination of household pests, proper budgeting of time and money and the promotion of harmonious family relations (C/156).

Mr. A. Storrar, of the United Kingdom, said that Kenya has five Provinces of agricultural importance and each Province comes under a Provincial Agricultural Officer responsible for all agricultural activities with the exception of the Specialist Research Stations. The Districts within each Province have a District Agricultural Officer exercising the same general responsibilities, but at a lower level. Prior to 1955, facilities for agricultural education at the adult level were almost non-existent, and all extension was carried out by field officers in Districts and in Divisions. "However, since 1955," he said, "we have been developing Farmers' Training Centres, and these are now playing an important role in the field of extension. The Farmers' Training Centre provides dormitory, feeding and lecture accommodation for about 60 people at a time, and modern visual aid equipment is available throughout. At each Farmers' Training Centre there is a farm varying from 60 to 500 acres, and this facility is considered fundamental to effective teaching."

Courses in Kenya vary from place to place, but generally are of one to two weeks' duration, as being most suitable for the average peasant farmer, in relation to his absorptive capacity. It has been found best to concentrate on a limited number of aspects of agriculture in any one course and on those aspects which should be of prime importance to the livelihood of those attending. Hence, the participants for each course are normally drawn from a restricted area, within one ecological zone, where the problems confronting them will be similar. The main aim of a Farm Institute is to improve the farming capability of those who attend and to demonstrate new methods of farming and new crops. "It is imperative that the standard of farming practised at an institute should be at a good level and that all points demonstrated are simple and intensely practical. The peasant farmer can learn best by seeing, and what he sees should be directly applicable to his own holding" (C/87).

Thus, extension has already proved a vital agent in bringing agricultural education directly to rural people. Most of what has so far been said has dealt, however, with formal education. But at all levels there is an urgent need of informal education—through all methods and means. Popularization of science, when correctly done, can play a fundamental role in keeping citizens aware of the progress of science and the problems created by it.

THE INTERNATIONAL LABOUR ORGANISATION AND WORKERS' EDUCATION

As we turn to a brief survey of that fast-expanding field of workers' education which lies within the special competence of the International Labour Organisation (ILO), recent words of the Director-General may be recalled: "While adult education aims principally at broadening the general knowledge of the worker as an individual and as a member of the community as a whole, workers' education is addressed to the worker as such to improve his understanding of the problems which he, together with his fellow workers, has inevitably to tackle in modern society."

The Constitution of the ILO places upon it a responsibility for promoting the organization of technical and vocational education and for further programmes aimed at ensuring equality of educational opportunity for the world's workers. To give the effect of this, the International Labour Office initiated a Workers' Education Programme in 1956. The Office had, in fact, undertaken activities related to workers' education since its establishment in 1919; but, as its special contribution to the Development Decade, the ILO workers' education programme has been intensified for the particular benefit of the developing countries.

In many ways, the workers, through their organizations, have come to occupy a position of outstanding importance in national affairs, above all in today's planning of economic and social progress. In order that they may carry out

their vital functions in a complex and changing society, both as citizens and as members of their organizations, it is important that the necessary knowledge should be made available to them on a continuing basis. A workers' education programme aiming at such objectives benefits the community as a whole by helping workers and their organizations to equip themselves not only to deal successfully with specific social and economic questions, but also to provide a basis for healthy and equitable labour-management relations (see Volume IV, Chapter 5).

The activities of the ILO in the field of workers' general education naturally place emphasis on the specialist knowledge which the organization has accumulated directly related to its professional interests. But this emphasis does not imply neglect of more general cultural and literacy education. In fact, close relationships already exist between the mass education programmes described earlier in this chapter and workers' education in its stricter sense. This is an area in which the ILO and UNESCO have a common basis of co-operation. Thus, in organizing the activities in the field of workers' education, the ILO aims at supporting and stimulating the many educational programmes undertaken by the workers' organizations throughout the world. The ILO does not attempt to substitute itself for the trade unions or other workers' educational bodies, but it keeps in close touch with all groups engaged in workers' education.

Under the Workers' Education Programme, for example, the Office has recently initiated a series of educational courses, written in concise language on subjects within the scope of the ILO, and these have been published not only in English, French and Spanish, but also in Arabic, German, Hindi, Japanese and Urdu. These courses are in the nature of technical tools at the disposal of workers and their organizations everywhere, especially in the developing countries. The ILO's programme includes participation in seminars, schools and conferences organized to promote workers' education, as well as contributions towards travel expenses, seconding of lecturers and the supply of educational materials and the ILO's own publications. In this way, the ILO has helped organize numerous seminars throughout the world, sponsored by various international and national workers' educational bodies, such as the British Workers' Educational Association Summer School, the Scandinavian People's Summer School, and the colleges or institutes of international trade union organizations in Africa, Asia, Europe, and Latin America. Courses have been organized for members of national trade unions in, for instance, Germany, France, and Switzerland. Seminars have been instrumental in making available to participants coming from Africa, Asia and Latin America the experience gained in workers' education in Denmark and other countries where such education has been well developed. A manual on workers' education methods and techniques has been prepared, for use by organizations in the less developed countries, and a bibliography on workers' educational practices is periodically brought up to date.

Technical assistance in the planning of programmes of workers' education in different parts of the world are supplemented by ILO missions, which have

been sent to Greece, Peru, the United Arab Republic, India and many other countries. Fellowships for study abroad have been initiated, and lending libraries of films and filmstrips on labour questions are located at Geneva and at regional field offices at Bangalore, Istanbul, Lima, Mexico City and in other countries. In Chapter 7 of this volume—looking more to the future—an account is given of the new International Institute for Labour Studies.

Three brief examples must suffice, at this stage, of the programme in operation. In 1959, at the request of the Indian Government, the ILO sent an expert to serve as a consultant to advise the Government on developing its workers' education scheme. He made a detailed study of the central and regional structures and programmes of the scheme, and participated in some of the training courses. This enabled him to formulate a set of recommendations concerning administration and study material, as well as the relationship between the Government's scheme and the educational activities of the trade unions proper. An ILO staff mission, which visited India two years later, ascertained that a certain number of the expert's recommendations had already been implemented. The same expert also worked in Malaya for four months, conducting a series of demonstration courses and seminars and training a corps of Malayans for the purpose of spreading union education to rank-and-file members. He made suggestions for improving existing programmes and recommended a long-range expanded trade-union training programme. Within a year of his mission, much of the short-term plan had been put into effect and the educational work of the Malayan Trade Union Congress carried a substantial step forward. Finally, in 1962, the Government of the Congo (Leopoldville), with the agreement of the five main trade-union movements, requested the ILO to send experts to organize courses of workers' education dealing, in particular, with the techniques of workers' education, labour legislation, and social security. The Government and the unions formed a joint national committee in charge of the administration of the courses. In November 1962, in co-operation with the Government and trade unions, an ILO three-man team organized a three weeks' course in Leopoldville and another in Stanleyville, when about 50 participants from various trade-union organizations attended.

TEACHER-TRAINING, THE LINCHPIN

The fact that large numbers of adults—many of them citizens of the developing countries and many, perhaps, new to modern education—will become teachers in the years immediately ahead emphasizes that the best preparation available is needed to equip such adults for this vital profession. Teacher-training must clearly come at the top of every list of priorities concerned with mass education. In speeding up its general programme during the Development Decade, UNESCO is expanding especially its activities directed at the training of primary and secondary school teachers. The establishment of national colleges for the train-

ing of secondary school teachers is one way to meet these goals, special emphasis being on the training of science and language teachers. In addition, a programme for the training of instructors in teacher-training institutions for primary school teachers is being intensified, so as to meet the national and regional targets of universal primary education by 1980, as described in Chapter 2 of this volume. At the same time, research in the reform of teaching methods in primary schools and the establishment of pilot projects is being accelerated, involving, as it does, a revision of secondary school curricula in the light of economic planning. The close link between the national plans and teacher-training becomes daily more obvious.

"An integral part of the problem of providing facilities for the training of technicians," states the Conference Secretary-General, "is the training of the teaching staffs for secondary technical schools and equivalent institutions. The normal requirement for teaching in a school of this type is a university degree in an appropriate faculty. It is essential that such graduates should have both appropriate pedagogical training, for example in a university, institute of education, or special centre, and some industrial experience (K/85). To save time and expense, both kinds of training and experience could be organized for teachers during their school vacation periods" (K/85, K/93).

The increasing demand for graduate scientists and technologists for other kinds of employment, often carrying greater remuneration and prestige, results in a lack of interest in secondary technical training. A solution adopted in one country consists in the establishment of national training institutes for engineering teachers (K/91). The entrance requirements are similar to those for a university, and the three-year courses combine basic, professional, technological and pedagogical courses in such a fashion as to bring the professional level attained up to that of graduates of the engineering faculty of a university, as well as to that of fully trained teachers.

Apart from graduate teachers, a need will exist for master craftsmen to conduct the classes in workshop techniques. In most less developed countries this need is often more difficult to meet than that for graduate teachers. The immediate needs of most of these countries may have to be met by the recruiting of overseas staff, but it should be a part of an integrated plan for technical education to induce some of the local people who qualify as craftsmen to take up instruction in secondary technical schools after a suitable course in teaching methods, and provision should be made for such pedagogical courses. Finally, rapid and continuous advance in technology makes it essential that teachers and other personnel engaged in training should attend frequent refresher courses, preferably organized in collaboration between university departments and appropriate industrial concerns, where possible, or in higher technological institutes [GR.43 (K)].

Against this background, a few of the experiences which were discussed at the Conference may be reviewed. In the Philippines, for example, a survey of some 100,000 teachers, made in 1957, revealed that 76 per cent had only three

units in natural science, about 9 per cent had no course at all in science, and about 11 per cent had only two laboratory subjects. To remedy this situation, the Science Foundation of the Philippines initiated a summer science teacher-training institute in 1958. When the National Science Development Board was organized, more teacher training institutes were established, and these have served as a most effective means of introducing modern techniques in the teaching of science at all levels: primary, secondary and higher education (K/14).

UNESCO's action in the sphere of technical and vocational education, alongside the programmes of vocational training promoted by the International Labour Conference, and also the general programmes for the eradication of illiteracy have been mentioned earlier. But, as regards the training of science teachers in particular, an observation made by the Director-General of UNESCO is relevant, in case it should appear that some of the examples which follow do not sufficiently stress the longer-term aspects of teacher-training: "The time is past when the training of a master was terminated at 25 years of age. Nowadays, a master trained at 25 years must re-learn at 35 years, so as to continue to be a master, from the point of view not of the one who teaches, but of the one who learns. This rapid wearing away of knowledge, which is a direct consequence of science and technology, requires something that the great educators call 'permanent education'. Learning is a process that occupies a whole life—it is not a process that is limited to a certain age."

THE TEACHER AS ORGANIZER OF DISCOVERY

Among the more important mechanisms that have been developed for the improvement of secondary school education in science and mathematics are the training programmes for "in-service" teachers. According to Dr. Bowen C. Dees, of the United States, programmes known as Summer Institutes, Academic Year Institutes, In-Service Institutes and Research Participation for High School Teachers are much in demand throughout the United States. Summer Institutes, inaugurated by the National Science Foundation (USA) have proved especially effective in improving the subject-matter competence of teachers. These carefully designed programmes afford teachers the opportunity of reviewing basic subject-matter and becoming better acquainted with recent discoveries in the subjects they teach. Beginning with two Summer Institutes for teachers of science and mathematics in 1953, institutes of this type increased to 421 by 1962. The number of secondary school teachers who attended such institutes during the summer of 1962 reached a record total of 20,469. Dr. Dees stated that the success of the Summer Institutes could be attributed to three basic facts: (*a*) the courses are specifically suited to the needs of teachers; (*b*) the institutes are so conducted as to result in maximum learning; and (*c*) teachers who attend receive financial support, enabling them to devote full time to training (K/88).

In contrast, however, to this valuable experiment, a cautionary note was

sounded by Professor B. Lengyel, of Hungary: "I am convinced that no teaching system can be imported. It must be developed according to the character proper to each country and supported essentially by inland bases. The assistance of the developed countries can by no means do more than give a hand to them to reach complete independence in the field of education as well. This independence will ensure the development of the most efficient methods for the training of technicians and their teaching."

"In fact," said Mr. Basil H. G. Chaplin, of Ghana, "the greatest problem here is a psychological, rather than an academic one. Teachers are unwilling to believe that they could manage such a revolutionary method; and even the words 'science' or 'natural science' instead of 'nature study' make them feel that it is beyond their unscientific capabilities. The obvious long-term solution lies with the Teacher Training Institutions; but for the thousand of teachers already out of college only a very prolonged system of in-service training can provide them with the background of scientific knowledge and understanding."

They require to develop imaginatively their own lessons in the subject, Mr. Chaplin continued. Hence, pre-secondary courses have been devised, using the teacher himself mainly as an organizer of discovery—an experience in which the teacher has possibly himself taken part only a very short time before. The main preparation for the lesson is the performance of the pupil's experiments, and the answering of "Questions for Pupils" by the teacher himself. "There is no suggestion that this really provides sufficient background for a teacher of science; but it does allow the revolution in method to be absorbed almost immediately. It has produced a sufficient change in attitude and grasp of some scientific ideas to initiate a fairly rapid progression towards full implementation of the new curriculum" (K/2).

"Here in Nigeria", stated Dr. A. B. Fafunwa, "we have over 350 Teacher Training Colleges. The trained teachers are at the lower university level; there are only 5 of these with a science curriculum. This is the kind of problem we face. When we talk of children who should be exposed to scientific thinking, I can give you over 8 to 10 million children and, at present, less than 5 million are in school anyway. Also, when we talk of teaching-machines, it should be remembered that we need people to be able to read and *manipulate* the machines for us, before they can be used on their own. This is the kind of problem we are facing. Let it be granted that for advanced students, if you can give them teaching-machines, it will relieve some teachers who may be able to get down to help those who cannot read at all . . . In my country, what we would like to have at the bottom of the primary school level is sufficient equipment, like educational toys, for instance, so as to enable the children to use their hands and their minds and to be able to construct simple gadgets."

In the developed countries, Dr. Fafunwa continued, the introduction of science at a more advanced level was feasible because children were used to some form of scientific environment in their own homes. Even in their play, "across the street", they were surrounded by science. But how, he remarked, when our own

children live in rural areas, can we get "science" to them? He asked the Conference for practical answers to practical questions like these. Would it be possible, for instance, instead of expensive glass test tubes, to have plastic test tubes, that would be very cheap? Could they have the shilling microscope, so that every child could look into his own microscope? For it is this type of thing that would stimulate the scientific "attitude" in the children of the less developed countries.

CONSOLIDATING A REVOLUTION

Yet it had to be admitted that not all the obstacles were to be found in the developing countries. On the question of adaptability of teaching methods, Dr. R. V. Garcia, a Scientific Secretary of the Conference, pointed out that "the task will be much more difficult in the advanced countries, where there are well-established programmes. It will be harder there than in countries that are just beginning their curriculum. It is easier to train young teachers to follow new methods than to change the habits of a teacher who for years has been using methods that are already out-dated." This point has tremendous importance, he observed. The consequences of a bad start in a new country may last for a long time and endanger for many years its educational development. "Many areas of the world are in the privileged position of being able to take advantage from the very start of the revolution which is taking place in the teaching of sciences. A clear awareness of this fact will enable them to skip an entire stage in an evolutionary process which will demand a great deal of effort."

Turning to organizational questions, Professor F. A. Kufuor, of Ghana, pointed out that "much of the teaching of science in the schools in the less developed areas will inevitably fall on people trained in teacher-training colleges. There will probably not be enough science graduates for even the higher forms of some of the secondary schools for some time to come. On the ordinary teachers, therefore, will fall the more difficult parts of the work—science teaching in the primary and lower forms of secondary schools." Hence, the effective teaching of science in these training colleges will be a condition for the success of the whole programme. "It is necessary", he said, "that the teachers should have the broadest possible knowledge of science. In addition, they should acquire manipulative skills that will enable them to make their own improvised equipment. With it all should go imagination and a deep interest in the subject of science itself. This is a difficult order, and it is most likely that only a temporary arrangement will meet the situation—that of providing trained specialist teachers in special centres that serve a number of schools in any given area" (K/30).

"Moreover", Professor A. C. Joshi, of India, reminded the Conference, "science is today advancing at a rapid pace. Many of the old science teachers in high schools are not familiar with the recent advances in science or with

the improved techniques of teaching. Even those who are graduating now will soon be behind the times, if something is not done to keep them abreast of the new advances. For these reasons, it is necessary for good science education to organize regularly during the summer vacation refresher courses, workshops and summer schools of fairly long duration. A very satisfactory beginning in this direction has been made recently in the United States, on the initiative of the National Science Foundation. Every country can learn a great deal from this programme. Repeated exposure to refresher courses and summer institutes organized in universities would not only keep the teachers abreast of new advances in knowledge and techniques, but would also sustain their motivation" (K/21).

Professor José Reis, of Brazil, agreed that all the emphasis that had been placed by the Conference on the formation of people with a scientific attitude enhanced the fundamental role of the teacher. "The preparation of such teachers is a formidable task which confronts the Government, especially when imbued with the idea of universal literacy, instead of universal basic knowledge. The teacher must be a scientific-minded person himself, able to face the ever-changing needs of the community and his pupils and to meet every new case. To be efficient, the teacher has to make an appraisal of the needs which can effectively motivate his pupils; and these needs are not to be gathered as mere averages from the text book" (K/36).

Naturally—though it was repeatedly stressed throughout the Conference—the teacher requirements for the upper elementary or junior secondary level (age group 11 to 14) and the high school or higher secondary level (age group 14 to 17) are equally vast. It was generally felt that teachers for the age group 11 to 14 ought to be graduates in science, with one year's pedagogic training. Teachers of general science for the higher secondary schools should have at least the same qualifications; and those who have to teach selective science ought to have a still better knowledge of the substance of their subjects. In India alone, the number of students (in 1961) in classes 9 to 11 was approximately 2.9 million. By 1965, this is expected to rise to 4.5 million. If all the high-school students are to receive education in general science and about one-third take selective science, it is estimated that approximately 40,000 additional science teachers will be needed by 1965. These figures were given by Professor Joshi, who added: "As many other under-developed countries are equally heavily populated, their demands for science teachers are likely to be of a similar order" (K/21).

But it is not quantity alone that matters, massive as is the world demand for teachers. Above all else (to quote again the words of Dr. Harry C. Kelly, of the United States), the economic and social planner and administrator has first "to recognize the teacher as a key to the problem of quality, to give him every opportunity we can for intellectual refurbishment, to keep himself up to date in his field, and so to furnish these teachers with the proper material and teaching aids."

FROM MANAGEMENT TO CULTURAL ADJUSTMENT

Perhaps one of the most significant items of research bearing on the specialized techniques involved in the education of adults was presented to the Conference on behalf of the Holy See by Professor Charles Mertens de Wilmars. Dr. de Wilmars's thesis might well introduce the topic of training for management, with which to conclude the chapter. The modern theory of management, he argued, makes a distinction between management itself, which is the process of making decisions within a system of functional interdependence, and administration, which is the body of techniques that make management possible. Management involves tasks of maintenance and execution, and these presuppose forecasting, co-ordination or supervision, on the one hand, and introspection, on the other. Experimental research relating to training for management tends to prove that this training is acquired in the course of an introspective experience of the above-mentioned functions.

Investigations made at the University of Louvain, continued the speaker, have shown that the economically weak countries suffer from a shortage of management staff and a labour force lacking the technical qualifications, and also from an inadequate economic and health infrastructure. Each one of these factors creates a vicious circle, which must be broken from "outside" by dealing systematically with at least one of these causes. Action on the management level may be compared to accelerated training and presupposes two types of preliminary research: (*a*) study of the qualitative and quantitative training needs of the under-developed areas; and (*b*) study of the cultural attitudes of the indigenous population.

> "In fact", said Professor de Wilmars, "everything leads us to believe that foreign systems of information, improperly presented to the indigenous population, create ambivalences which either make them reject any training whatsoever, or which make for very irregular performance. Training must be applied within a homogeneous frame of reference in order to produce training personnel who will in turn analyse the cultural conditions in their country of origin and apply to them a type of training which is accessible to the indigenous population" (B/40).

It is in fact only in recent years that management has come to be regarded as a science in itself. The traditional idea that managers are born and not made has given way to the realization that they must be carefully trained, and that training must be based on systematic research and planned as systematically as any other branch of production. Management development is the process whereby managers and those destined to become managers in the near future, who are already holding positions in industry, can progressively develop their knowledge and skill as managers and are thus enabled to do their jobs more effectively and prepare themselves for promotion to greater responsibilities. This process of development may be pursued with benefit throughout a man's whole career, even when he is at the head of an enterprise.

The job of general management differs in kind from other posts in the hierarchy. The effects of decisions taken by top management are likely to be far more influential on the destinies of the enterprise and the people working in it and, in the long run, on the economy of the country. The idea of managers—the term includes owners and directors of businesses who also manage them, as well as directors and managers in public sector enterprises—could be trained in this way is quite new. Even in the United States (the birthplace of "scientific management") the first programmes for managers practising in industry go back less than 20 years. The development of managers did not start seriously in Europe until after the Second World War. Nonetheless, in this short space of time, the idea of management as something which can and should be taught and of managers as people who need to be developed throughout their working lives has become almost wholly accepted.

Every year, in the industrially advanced countries, thousands of managers from industry, public and private, top managers, departmental managers, section heads, specialists in various functions of management and supervisors participate in programmes of development, and then return to their enterprises with new ideas and new attitudes the better to tackle their managerial problems. Thus, in less than two decades, management development has been enthusiastically accepted by managers themselves.

What, then, are the marks of the proficient manager? He is versatile and understands production techniques and has a good general knowledge of economics and industry. He is familiar with methods of cost-accounting, market research and work study, and keeps abreast with developments in these fields. He has to be good at dealing with people and able to delegate responsibility; he maintains sensible relations with his staff, and is able to win their confidence. At the same time, he must have a broad vision and see the economy as a whole, and not merely his particular corner. Above all, he must nowadays be science-conscious and receptive to change.

MANAGEMENT MOVES TO WIDER FIELDS

In most of the developing economies, concrete steps have been taken in the field of management training. Productivity centres have been set up and are usually attached to the appropriate government department—the Ministry of Industry or Labour—although they may also be associated with a university. The type of training offered is essentially practical, through short, full-time courses. Practical projects and follow-up work are an essential part of the programme. Those trained are normally already employed in technical or managerial positions; quite often they have academic qualifications in engineering, accountancy and so on (B/5, B/21, B/31).

One of the problems which these centres face is the promotional problem—that is of persuading the people who need the training to come and acquire it.

In some cases, the use of their acquired skills necessitates organizational changes which top management is unwilling to implement. There is in fact little doubt that the most difficult of all the problems is the education and training of existing top management itself. We have already dealt, at the beginning of this chapter, with the general problem of resistance to change. Here we are faced with a concrete example. The modifying of their attitude to organizational change, and to their role in society generally, has an element of circularity: the attitude which needs changing is the internal barrier to the process of change. The man in charge of an organization who assumes that newer techniques of management cannot help him or who is afraid of their consequences is unlikely to attend any courses designed to change his attitude (B/25, B/40, B/70, B/74).

One of the methods used in the industrially developed countries and in some of the more advanced of the developing ones is the administrative staff college (B/27). This affords a valuable opportunity for exchange of opinion and for the general broadening of viewpoint which is inevitable when a number of business leaders and higher executives study and work together. A speaker from Thailand, however, described an experiment, which was not a success, in setting up an Institute of Public Administration, staffed mainly by American professors—while Thai students were being sent abroad to study administration. The Americans apparently had insufficient knowledge of Thai culture and customs, and there were major language barriers to overcome.

Nevertheless, foreign help and guidance can be of real assistance if due note is taken of such possible pitfalls. Management colleges on the lines of the Henley Staff College in the United Kingdom have been successfully set up in India, Australia and Pakistan. The College has also helped to develop schemes in the West Indies, Turkey and Yugoslavia (B/27). The Massachusetts Institute of Technology and the Ford Foundation have similarly assisted development programmes in India and Africa (C/155). One example of "on the job" co-operation concerned a steel plant. An American management team consisting of 25 executives and 150 technical specialists, worked on a local steel company's payroll and assisted in building up a nucleus of local leaders. After 12 years, production had been trebled and only a few of the operational staff of the foreign team remained. The objective of all such training was well summarized by a speaker from the United Arab Republic when he made the point that "a manager whose company runs while he is away is the only successful manager".

There was general agreement at the Conference that management colleges and institutions in the more advanced countries can offer useful help, but that there must be no slavish reproduction of western methods in the less developed countries. For instance, foreign student enrolment in the United States business schools would appear to range from 8 to 15 per cent, but considerable problems sometimes arise when the students return to their own countries and find it hard to acclimatize themselves to their home conditions (D/155). Difficulties may even occur over simple matters of vocabularly—as when a young man gave a lecture on economic development to a group of senior civil servants, on his

return after advanced training in the United States, and used such terms as "input" and "output". "What are those 'in and out things'?" asked one of his audience.

"We are working in management training, and management developing programmes", said Dr. Robert D. Loken, of Ghana, "both through the universities and institutes and through a local management association. We have developed a series of career booklets, trying to entice students into these areas where we are short of experienced and trained people. We have also a new programme developing now on the crafts and trades level, which looks very promising."

The Yugoslav approach to the process of management training is rather different. As might be expected, the focus is not so much on workers' consultation, as on workers' control. It is specifically laid down in the Constitution that every worker has a "basic right" to participate in management. In Yugoslavia, the fundamental aim is maximum participation and control by the workers themselves. Hence, there is a network of local and central Workers' Councils, through which workers are directly involved in decision-making and in the determination of planning, production, finance and marketing policies. This system would appear to result in accepting technical change, in spreading authority, and in encouraging genuine co-operation in increasing productivity. Management, it is claimed, relieved of disciplinary functions, is free to concentrate on its technical functions (B/28).

THE ILO AGAIN IN ACTION

It is in this field of training senior management that the Turin Institute—already briefly mentioned—is expected to play so significant a part. Its programmes for senior management are based on the assumption that the participants already possess sound theoretical knowledge and practical experience, at least equal to the average that may be expected in the field in which they are to be trained. The Institute's prospectus covers the special areas of general management, managerial accounting and office organization. The courses are designed to enable trainees, on their return to their home country, to teach or to pass on to others the knowledge they have acquired.

As a general rule, the length of the courses will be 22 weeks, 12 spent on theoretical and practical training at the Turin Centre, 8 in an undertaking in Europe, to enable the theory learned in Turin to be put into practice, and 2 weeks back in Turin for final evaluation of the experience acquired. For the basic programme in general management, however, the course will total 52 weeks in duration. These advanced training programmes comprise study of the economic and social conditions in the participants' countries of origin; theoretical and practical study of modern management; and study of modern teaching methods in regard to management. The courses consist of individual

instruction, modern training methods (lectures, discussions, psycho-dramas and practical exercises on given subjects) and checks on the ability of the participants to adapt the knowledge acquired to the special circumstances of their own countries.

Finally, as regards the contribution which the ILO has been making for many years to the philosophy of management training, the attitude reflected in a statement by the Director-General has much to commend it: "Management's ability to fulfil its function depends basically on its capacity to understand and master two elements. The first is the complex of factors, internal and external to the enterprise, which may affect its productivity, some of which may be beyond the control of the individual management, but nevertheless must be taken into account. These factors are economic, commercial, financial, technical, social and psychological, and may include considerations imposed by government policy and shortages or deficiencies in material and human resources. The second element is management's knowledge and understanding of management techniques, such as production control, cost accounting, quality control, market research, work study and preventive maintenance. By having a full knowledge of the organization's economic, political and social environment, and by skill in the use of management techniques, a systematic approach may be made" (B/74).

The Director-General adds, that in management as in other fields, experience is an important teacher; but it is not the only teacher, nor is it always the most efficient. The process of managerial self-improvement is going on in most industrialized countries and is undoubtedly one of the important reasons for the high level of productivity in these countries. Management's role in development is a major one, but it can be played actively or passively, and it can be positive or negative in its contribution to the over-all effort. Given the appropriate attitudes and ever-improving skills, management can play a leading role in the development process. As one writer has metaphorically put it, concludes the Director-General: "The lock which shackles the economies of under-developed countries will be opened not by a 'key' but by a 'combination lock' . . . " Management is a vital element in the combination.

CHAPTER 6

The use of communication media

"If education is to supply the personnel needed for the technological promotion of the multitudes who still make up the majority of mankind, then education itself must carry out its own technological revolution", declared the Director-General of UNESCO; and he added: "With ingenuity and boldness, it must use the incessantly growing possibilities of audio-visual techniques—the radio, the cinema and television, to say nothing of machines now being tested that are to education what automation is to industry. These means and techniques of so-called information are used most of the time for entertainment, but they are actually the most appropriate instruments for accelerated, though by no means inferior, education."

Similarly, the Secretary-General of the Conference said at its closing session: "Another great task is to use more widely the mass communication media. Educational broadcasting and television are still at a formative stage in many countries where they could play a role of primary importance."

"One aspect of the effort to improve educational quality", declared Dr. Jerome B. Wiesner, of the United States, "is the development of new aids for teaching. The blackboard and textbook have done good service for half a millennium, but that does not mean that the presentation of information cannot profit from a little re-design . . . We are beginning to make new use of media that until recently have been the province principally of the entertainment industry—film, tape, records, radio and television. This new approach to education could make possible a massive attack on the problem of illiteracy, from which so many of our countries suffer."

The link between information media and economic and social advance was thus recognized throughout the sessions of the Conference. A UNESCO report revealed that nearly 70 per cent of the total population of the world, living in more than 100 countries, at present lack adequate mass communication facilities. Development of information media forms part of economic development as a whole and could well be assisted by resources drawn from the technical assistance and other programmes, as described in Chapter 2 above.

The minimum standards set by UNESCO, and endorsed by the Economic

and Social Council, provide that for every 100 inhabitants in any country there should be at least 10 copies of a daily newspaper, 5 radio sets, and 2 cinema seats. These are standards which have not yet been attained by some 2,000 million people. It has been estimated that the establishment of new, and the expansion of existing, facilities needed to reach the UNESCO target would necessitate a global investment of slightly more than $US2,800 million. If educational television is included, the total cost of such a development programme would be $US3,400 million. This is the sum required for capital expenditure alone, exclusive of provision for recurring annual costs. Such figures as these give the true measure of the problem discussed in this chapter, and explain why the use of mass media in education and training must be related directly to over-all planning.

The close relationship between the development of mass media and general economic and social development has often been demonstrated. An earlier study initiated by UNESCO showed that in all of the less developed countries of Africa, Asia and Latin America, the expansion of mass-media techniques corresponds closely to other factors in national growth, such as individual incomes and levels of literacy, urbanization and industrialization. As income rises, so the demand for mass media increases more rapidly in the developing than in the developed countries. Expansion of a nation's economy is paralleled by the expansion of its media; the two processes interact, because development of these media spurs economic growth, while current economic and social expansion brings in turn a progressive increase in the demand for the media.

A tentative forecast based on estimates of increases in the demand for newsprint resulting from increases in personal incomes, shows that total demand for the media in Africa, Asia and Latin America is likely to be more than tripled by 1975. High as this estimate appears, it does not allow for the effects of spreading literacy, which is expected to increase during the next 15 years more rapidly than might be expected from the increase in personal incomes alone. This period it may be noted, will also witness further technological advances which are already transforming communications in the advanced countries, and which before long will make their influence felt in all parts of the world. It suffices to mention the possibilities of transmitting press dispatches and radio and television programmes over wide areas by means of space satellites in outer space, and possibly of employing television and facsimile services to transmit a newspaper direct into the home. These advances have opened not only a new era in world communications, but, in addition, a new approach to international co-operation. (See also Volume IV.)

OBSTACLES TO BE SURMOUNTED

With this not-too-distant objective in view, the developing countries are nevertheless impeded by a maze of economic and technical obstacles in their efforts

to develop their information media. Many of these countries lack even the basic data as to the volume of mass-media facilities and the transport, communications and other services needed to support a programme for mass-media development. In most of them, expansion of the media is hampered by the high cost and inadequacy of telecommunication, postal and transport services. Machinery and essential materials, such as newsprint, are in short supply, and a scarcity of foreign exchange limits their importation. Some countries, again, face special problems arising from a multiplicity of languages or from climatic and other natural difficulties such as are encountered in tropical broadcasting. Lack of development capital is of cardinal importance. Of the total of public development expenditure, slightly under 1 per cent is, in general, now being devoted to the development of information media—and that mainly in the broadcasting field. In many countries, much of the expenditure on the development of mass media is private, particularly in the establishment and operation of newspapers, the production or importation of radio receivers and films and the building of cinemas.

The complexity of the tasks involved in drawing up and carrying out a development programme would seem to require some kind of co-ordinating machinery, and Governments of the developing countries might well consider the possibility of establishing national committees to assist in formulating and carrying out programmes for their information media. These national committees could bring together representatives of all the interested institutions and governmental agencies, including those concerned with economic development, education, telecommunication and transport, so as to enlist the participation of the information professions. The establishment of national training programmes for professional and technical personnel becomes ever more urgent as does the fostering of research in the use of the information media. This lack of qualified professional and technical staff is one of the most formidable obstacles to the development of the information media in all the regions concerned. The provision of trained staff is essential not only for the operation of information enterprises, but also for the improvement of standards such as would enable mass media to play their full role in programmes of economic and social development. To initiate national training programmes, government assistance could be devoted to establishing training schools or courses; providing training fellowships, study grants and expert aid; organizing the production of textbooks for training; and equipping libraries and laboratories at schools of journalism.

Such obstacles as these, which at present impede the developing countries in their efforts to reach higher levels of technological, economic and social development, and to train the personnel required, were set forth in the Conference discussions. The main purposes of the present chapter are, therefore, to examine the nature of the contributions that could be made towards the solution of these problems and suggest how visual aids and other media can help to overcome resistance to technological change and thereby stimulate learning at both the community and individual levels.

"We are here concerned," said Professor V. Bronson, of the United States, "with communications as a tool to meet the educational needs of the developing countries. In conferences of this kind, there is often a tendency to identify 'communication' predominantly with the technology of transmission and reception with machines and electronic hardware. There is no doubt that these are important and necessary, but they exist only for an end—they exist only to enhance the communication process among human beings. The use to which the machines and the electronic hardware are put is the important thing, and especially important to a developing nation struggling toward social and economic fulfilment. The techniques and skills involved in using effectively the available communication technology are as essential as the mechanical and electronic processes themselves. Only by understanding and applying the techniques of educational communication can the force of the various audio-visual media be brought to bear successfully upon the educational problems of the developing nations."

Similarly, Mr. R. Maybury, of UNESCO, called for a "technology of education" as being essential to the provision of adequate learning opportunities to large areas of illiterate and partially literate populations. Such an educational technology has many media of communication to draw upon (K/75). The Conference Secretary-General's report, for example, outlined many new devices for self-learning, for programmed instruction designed for self-learning, for motion-picture films (both 16 and 8 mm sound-on-film, 35 mm film strip, and slide projectors), overhead projectors for large transparencies, and opaque projectors that could make it possible for a whole group to share a small picture or a printed page. There also exist working models of things and functions, magnetic tape-recorders and their application to language laboratories, record players, pictures, maps and charts, in addition to the normal radio, radio-vision and finally, television—which will be discussed in detail below. All these media are effective instruments of communication and all are today part of educational technology.

Fortunately, the need for wide and continuous education of large numbers of people is now matched by the new technical possibilities in the means of reaching them and enabling them to assimilate knowledge relatively quickly. Television, in particular (stated the Conference Secretary-General), by making possible the rapid visual recognition of material can not only educate, but also do much to prepare people's minds for modern civilization. It thus keeps education firmly linked to real life, so that young and old can appreciate what is required of them.

COMMUNICATION AS A TEACHING TOOL

Illiteracy, it was pointed out, has the effect of insulating the minds of the people from the progressive influences of the written word. This means an absence of understanding of the physical and human environment and the

prevalence of superstition. On the practical side, it leads to a lack of appreciation of the role of proper nutrition and sanitation, thereby undermining the health of the individual and the community. Inefficient and wasteful methods of farming prevail, and measures for the preservation of natural resources are not taken.

How then can formal education be brought to the teeming millions who are crying for it? Alongside the lamentable shortage of trained teachers and the lack of physical facilities, such as classrooms, teaching materials and suitable textbooks, there are also problems created by a multiplicity of languages—languages often insufficient to serve as a means for conveying the complex ideas of modern technology. Moreover, the shortage of teachers, in the face of the phenomenal numbers of children to be educated, is a problem continuously aggravated by a large population increase.

Consequently, radio and television offer the best, and at times the only, means of reaching large numbers of people through a comparatively small team of qualified personnel. A great deal of effort has already been put into studying the potentialities which these aids possess in teaching at all levels, and the Conference listened to a variety of projects and programmes.

There are many ways in which formal education at the elementary, secondary and higher levels can be benefited by radio and television. The broadcaster may, for example, take over completely the role of classroom teacher. This happens when carefully prepared courses in school syllabuses are presented by good teachers and are broadcast or televised, either from a national or regional centre, or in closed-circuit installations covering a district or an institution.

Direct teaching by this method, in the absence of a teacher, has already been practised in certain countries as a means of counteracting the shortage of teaching staff. Classes, small or large, may be assembled to view or listen to the broadcasts, either with or without supervision from some person responsible only for discipline. Study aids in the form of manuals may be supplied to the students beforehand to reinforce the lesson and to help in personal study. It is believed, says the Conference Secretary-General, that this method is satisfactory only with individuals, groups or classes old enough to have acquired their own discipline of learning, such as may be found at the university level. In the absence of teachers, such contributions to the learning process as are made by direct contact between the teacher and pupil are obviously missing. With very young children, adequate concept formation can only take place when the child participates in the lesson by manipulating objects.

Broadcasting serves moreover, to raise the standard of teaching at all levels, and it enables the ill-equipped or non-specialist teacher to deal with unfamiliar subjects. It can perhaps make its greatest contribution to formal education in this way in the developing countries, since the authorities are in many instances obliged to rely on teachers with an incomplete grasp of subject-matter or without proper pedagogical techniques. Radio lessons can provide the inadequately qualified teacher with a basis for his work, provide him with the framework of the subject, and guide him in taking the lesson further.

It is possible to enhance the skill of the teacher by using as broadcasters, outstanding teachers who will serve as pedagogic models. The lessons are made more effective if the teacher is provided with a manual indicating how he can make use of blackboard illustrations, charts, slides or films projected simultaneously with the broadcast lesson. Such a combination of sound broadcasting and other audio-visual aids makes possible the teaching of science even at the elementary level, through a teacher who may be learning the subject at the same time as the pupils [GR.39 (K)].

Audio-visual aids have special merit in those branches of professional or technological education which are carried out in universities or other training institutes. The greater maturity of the students, the widespread use of one or other of the major world languages and the greater similarity of content between the courses in scientific and technological subjects permit the use of a larger range of the material produced in the developed countries. For example, whatever the country of origin, films depicting experiments in chemistry or physics, or operation techniques in medicine can be employed in many parts of the world.

At this level, the movie film is unquestionably the most important audio-visual aid, for the reason that it can give schematic explanations of highly complex processes by means of animated diagrams. It can be employed with advantage in all forms of professional and technological training; for example, to instruct technological trainees in factories in safety procedures or rhythm of operation, as well as for production planning and control, statistical control of quality and sales organization. Television has also been used at this level in closed circuit systems for enabling a single teacher to serve large numbers of students simultaneously. It has been found particularly useful in medical schools and science colleges, where it enables a large group of students in a lecture hall to watch a surgical operation from an operating theatre, or to observe delicate experiments. Not least important, radio and television can bring to the attention of young people the nature of the possibilities for training and the courses and qualifications required, as well as avenues for employment [GR.39 (K)].

As regards the growing importance of mass communication media in the promotion of world literacy, "communal listening" has advantages in areas where illiteracy is high, in so far as local announcements concerning immediate community issues can be made over the public address system (L/75). Equipment suitable for communal listening in rural areas is now available (L/61). Communal television, on the other hand, is applicable to a much greater range of social and cultural development and it may be used not only in rural areas, but also in towns and larger centres. The main disadvantage of this process, however, is the high cost of television receivers (L/11). If individual, rather than communal, listening is contemplated, means of reception have to be adapted to the financial resources of the listener, and it is in this respect that the alternative possibilities of programmed distribution become an important factor. In general, medium-wave amplitude modulation broadcasting seems to be the most suitable

at this stage, except in areas where atmospheric noise is too high or the ground conductivity is too poor. The use of medium-wave broadcasting with high field intensities carries the advantage that the receiver can be simple and consequently of low cost (L/61).

THE SUPERIORITY OF TELEVISION

Experience has shown (the Conference Secretary-General continued) the considerable value of television in the struggle against illiteracy (L/61 and L/72). But this raises a serious policy issue as to whether television should be introduced at an early stage in the economic programmes of the less developed areas, or wait on the normal course of development of the broadcasting networks. Because the cost of establishing a television network to cover an extensive area is very high, it was suggested that a start should be made with small stations in the larger towns (L/15). Obviously, television is an expensive medium, which is more complex than sound-broadcasting, but there is urgent need for data and experience from the less developed areas which are already using this medium, so that the benefits of this valuable tool of education may be extended more rapidly to those areas where it is now practicable [GR.21 (L)].

Television possesses, of course, the great advantage of the visual presentation of material. Hence, it is an effective medium for the display of maps, charts, models, animated diagrams and other illustrative material. It can be successfully employed to teach manual skills, mathematics and science at all levels. At the elementary level, it can present experiments to the class, however ill-equipped the teacher. At the more advanced level, it can serve to provide a complete science course in the absence of a specialist teacher, or enable a specialist teacher to supplement his own resources through the demonstration of difficult or dangerous experiments, and obviate the use of expensive or large apparatus and equipment. It can bring into the classroom different types of people, different ways of life, and unfamiliar phenomena in different parts of the world. Moreover, it can illustrate in a graphic way methods which are being used to solve technical problems of all kinds in factories and in the field.

Yet the provision of an educational television service in the less developed areas is a more difficult undertaking than radio instruction. The cost of installing television broadcasting is greater, partly because the area that can be served by a single station is relatively limited, and reception is affected by the physical features of the terrain, such as mountains and large stretches of water. Serious obstacles of this kind can, however, be overcome by adequate financial resources and technical ingenuity. An effective educational television service has been provided even to a scattered group of mountainous islands (L/74). The production of television programmes is also more difficult, because it calls for the joint efforts of technicians, cameramen, producers and dramatists, while the field of selection of suitable broadcasters and lecturers is restricted.

The success or failure of sound broadcasting and television in education depends largely on the conception, organization and presentation of the courses of instruction. It is essential that there should be close consultation between the broadcasting services, the educational authorities and the schools. The specific problems of each school area—infant, primary, secondary and higher institutions—and the deficiencies of equipment and teaching should first be ascertained and a programme devised to meet the needs. The programmes must fit rationally into the curricula of the national education system. The closest collaboration between broadcasters and teachers is required if the programmes are to be effective, for ultimately the decisive factor in the classroom is the attitude of the teacher towards the broadcast. Such collaboration can be assured by consultation with representative teachers, as well as by the issue of regular bulletins to all teachers in schools taking the programmes. Finally, to maintain their effectiveness, the programmes should be kept under constant review.

MAKING USE OF THE MOVIE FILM

Closely related to television, and possessing all its essential features is the movie film. Film projection in a classroom possesses certain advantages over television, including the possibility of stopping the film for discussion, repeating parts or the whole, either at normal speed or in slow motion. But projection equipment is expensive, complicated to operate and requiring constant maintenance. Furthermore, the acquisition and storage of films are likely to prove too difficult for the ill-equipped teacher, whether in a remote village or in an urban school (K/75).

The organizers of audio-visual services in certain countries have sought to overcome these difficulties by mobile teams which operate on a district level and visit schools at regular and frequent intervals, screening films and exhibiting other visual aids. The best medium for the film, however, is through television broadcasting. In practice, most educational television broadcasting makes use of films previously prepared, rather than live broadcasts from the studio. An important type of film is the "concept film"; that is, a short silent film which presents a single concept or idea, without introducing any human being, to provide material for discussion by the teacher. Groups in some countries are working on the production of such films for use in schools, and UNESCO is proposing to build a library of concept films (K/75).

A potential aid for solving the problem of the scarce or inadequately trained teacher in the less developed countries is a system which permits the projection of a single picture or series of pictures or diagrams. Systems have been developed in certain countries which enable a relatively untrained person to give a complete course in simple science with the aid of a carefully graded series of pictures, in the form of filmstrip or printed material, with suitable explanations which are read out from a manual.

Recorded lessons on tape or discs are also capable of playing a role similar to that of radio. Discs, which can be played on the simplest spring gramophones, have given remarkable service as an educational aid, particularly in language teaching, and can be employed by the teacher in the remotest village. The tape-recorder, however, suffers from the same drawbacks as the movie projector, namely, heavy initial cost and the need for competent technical maintenance.

Programmed self-instruction devices offer a further possibility for meeting the shortage of qualified teachers. These usually involve the step-by-step presentation in a logical sequence of small units of subject-matter, arranged so that the student can work alone, can participate actively at his own pace, be psychologically rewarded for his successes or guided into new paths of comprehension by his failures, and thereby gradually master a whole subject area—incidentally, testing his understanding as he goes along. These devices work very much like a private tutor, guiding the student along in his study. The original programmed devices were intricate electronic machines, but it is now possible to implement programmed teaching with special manuals requiring no machines, and such programmes are being increasingly used in many countries for science instruction at all levels [GR.39 (K)].

VALIDITY OF MASS-MEDIA METHODS

There is, however, a key question which calls for an answer from the educationalist; it was put by Dr. Henry Cassirer, of the Conference Secretariat: "Are these media today valid tools of mass education? Should they be given a cornerstone, with corresponding financial investment in economic and social and educational planning, or are they relatively expensive, unreliable, incidental and, therefore, only adjuncts to more traditional forms of education?"

In attempting an answer to his own question, Dr. Cassirer reviewed the main tasks of mass media in formal education. "Broadcasting", he pointed out, "may under certain circumstances, completely take over the role of the classroom teacher. In other cases, it may supplement his work—especially in areas where the classroom teacher's competence is limited; that is, in science, music, language and geography. Yet, at the same time, the role of the broadcast media will depend on the quality of the teacher and the availability of the teacher, and the broadcast media themselves can serve teacher-training, particularly in-service training."

Granted that television is a more effective medium than radio (continued the speaker), it also involves some basic problems: higher costs, reception in areas without electricity, the smaller range of dissemination, and so forth. The organization of a broadcasting system should be integrated into the educational system. Film projection has the advantage of being able to repeat its message, and of being able to study the material under the control of the teacher, but it has problems of projection, of distribution and of cost. The 8 mm film, particularly the cartridge-loading film, may open up an entirely new area in teaching and

really make the film as accessible as is the book to every school that may wish to use it.

Tape-recording plays a special role in language-teaching. Programmed instruction has so far not been applied in developing countries, but efforts to this end are now being made, and it is expected to cause a revolution in the teaching methods of these areas. "But, in each case," stated Dr. Cassirer, "complete re-thinking is required in adapting these techniques to developing countries. This is also true in adult education where, for instance, television has proved to be very valuable in literacy teaching in Italy and in the United States. But we have very little valid experience in a truly less developed society. In rural education, the radio has been found to be effective, particularly when it is integrated into community discussion, along the lines of the farm forums. Furthermore, education can use these media in home reception, as well as for group reception."

"This does not mean", Dr. Gerald F. Winfield, of the United States, pointed out, "that television substitutes for the teacher. It means that you take the best teacher and multiply him by hundreds or thousands of classrooms and make it possible for him to be a teacher of teachers, as well as a teacher of pupils, simultaneously. We have *got* to do this job, because in less developed countries we have a school-age population of at least 350 million children in the 5 to 14 year age group. Less than 100 million of those children are in school and 250 million of them are not in any kind of school. It will require $6\frac{1}{2}$ million additional teachers, above the ones we now have, to provide one teacher for each 40 of these 250 million children."

Another inescapable fact must be taken into account. The population is increasing at the net rate of 25 million children every year. Where are the teachers for these children coming from? "If we go through the processes of developing teachers the way we have done in the advanced countries," argued the speaker, "we are not going to do this job in this generation. It will be two generations from now, before we have enough teachers to put these children into school. This is the reason why we have *got* to use methods that seem to involve big costs. But if we begin to set the cost of instruction against the entire cost to society of developing the teaching force, then we cannot match these new techniques in producing extensive education for the whole population with any other method at the same cost figure . . . This is not an easy decision to take, and probably no country is going to take it immediately; but these are the directions that the new media lead us towards in reducing the cost of the total educational task that confronts us on a world-wide basis."

"The approach to curriculum development, course and lesson planning, and school schedules," Professor Vernon Bronson, of the United States, insisted, "must be centred around the television instruction. If television, or any educational communication technology, is used on an occasional or permissive basis it will fail in its task. We can recite numbers of instances where this has occurred. It is essential that a communications system designed to apply

modern methods to less developed areas be as completely integrated into the educational system as possible. And by 'educational system' we mean systematic instruction in school or out of school, as well as adult and extension education. In planning the use of television and/or its supporting technology in the developing countries, it is important to consider all areas of public education and their relationships and interactions."

"We might say" (quoting from a UNESCO statement) "that the teacher is the oldest and still the best of the 'educational media'. But, as technology has developed, a series of devices has been produced to represent and aid the teacher in providing experiences from which students can learn efficiently. There were a number of such devices even before print, but the printed textbook was the first educational medium that permitted the teacher to multiply his efforts and provide learning experiences for many more students than he could teach personally. Several hundred years after the textbook was introduced, technology gave teachers the ability to extend educational experiences by projecting films, slides and other teaching materials. Mockups and models became available. Educational radio and television made it possible to circulate lectures and classroom demonstrations very widely. And, in the last few years, programmed instruction has made it possible to bring an efficient tutorial experience to a very large number of students."

"Thus," the statement continued, "the new educational media are different at different times and in different places. The textbook was the 'new' educational medium some 300 years ago. Films and projected materials were new 50 years ago; educational radio, 35 years ago; educational television, 10 years ago; and now programmed instruction is new. This is the timetable for the most advanced countries. In many developing countries, educational radio is still new, and educational television and programmed instruction are yet to be discovered . . . In one sense, however, the use of the term 'media' is not the same for programmed instruction as for other educational media. Television, films, radio and print are simply channels to carry any kind and method of teaching or information. Programmed instruction, on the other hand, is itself a method of teaching, and must be carried by one of the other channels —by print in the form of programmed books, by films in teaching-machines, or by the use of programmed methods in television."

Such educational media, extensively used and tested in the more advanced countries, are particularly important to developing countries because they hold out the opportuinty of multiplying teachers and classrooms, speeding up education, spreading information more widely, and thereby increasing the pace of national development. Indeed, these media may be the only way that the traditionally slow rhythm of educational growth may be sufficiently hurried and the benefits of knowledge and skill shared in this generation with millions of people who otherwise would never have an opportunity to be educated, or to participate as informed citizens in the development of their nations.

"This is not the same as saying", the UNESCO statement concludes, "that television or sound films are adequate substitutes for a teacher. They are not. Research in advanced countries shows that television and films *plus* a teacher make a uniquely powerful combination. If a qualified teacher is not available, then a discussion-leader, with opportunity to discuss what has been seen and practise what has been taught, will add considerably to the effectiveness of television or films alone. And if neither a teacher nor a leader is available, then there will still be considerable learning from television or films alone" (L/25).

Since the mass communication field embraces and is affected by a number of disciplines, UNESCO organized in March 1962 a meeting of experts on "new methods and techniques in education," which brought together specialists in education, communications and psychology from 14 countries. This meeting recommended an intensified effort on the part of the organization to explore the application to developing countries of media such as television, or methods such as programmed instruction. In view of the limited experience of such techniques in these countries, emphasis was placed on pilot projects which not only could be useful for demonstration and training, but would also provide valuable opportunities for experimentation. Co-ordination between UNESCO and the governmental departments of education, natural sciences and mass communication is now being worked out in Paris.

RADIO VERSUS TELEVISION

In spite of the superiority of television, the facts of the situation are frequently against it. "When one thinks in terms of which medium is the better of the two for the less developed country," said Mr. C. A. Wiltshire, of the United Kingdom, "one has no choice but to decide that radio is the most economic, the easiest way to educate masses in isolated areas of less developed territories. By its use, and the use of appropriate pamphlets and tape-recorders, we have found that it is possible to reach even the most remote parts of the country at very little cost . . . there is no choice between radio and television in the case of British Guiana and a number of other countries. I think we must necessarily evolve through the first stage of radio, and then, at the later stage, to television."

Mr. J. Scupham, of the United Kingdom, confirmed this opinion, though, from quite a different angle. "Even in a developed country, with an expanding television service," he explained, "there is no sign that sound radio is dead. Its use is on the increase and has been sharply increased by the growth of tape-recorder apparatus in the schools. I would recommend any country that leans heavily on sound radio to go in for a policy of equipping the schools with good tape-recorders. They will then be able to record the programmes, to use them with many classes and at the times they wish, and store them for the school year, so as to fit into the pattern of their own syllabus. There is no such flexibility yet with television, though something can be done by distribution of

television programmes on 16 mm and 8 mm film, but sound is the cheaper and the more flexible instrument."

Mr. Scupham in no way belittled the value of television, which is, he said, "invaluable at the higher levels, where the mind and the eye have to move together, where the process of thought involves following a complex visual sequence, perhaps with the aid of elaborate apparatus. We, therefore, use it for advanced science a good deal. Finally, we use television increasingly and with great success for technical education . . . " But he added: "Those perhaps are the chief uses; in every other field I would only say that radio, supplemented by booklets of the right kind, can do a first-rate and cheap job and even in the developed countries it shows no sign of dying now the new medium has come".

Another point of view, however, was expressed by Professor Filippo Neri, of Italy, who referred to the findings of the international conference on school broadcasting, organized by Italian Radio and Television, in Rome, about a year earlier, in which many delegates from Africa, Asia and Latin America had emphasized the importance of radio. "Nevertheless, I think that altogether", Professor Neri said, "television is much more important from the point of view of its didactic value. I don't agree completely, for example, with my friend and colleague Mr. Scupham, when he says that radio is still more effective in teaching music and languages; because I think, on the basis of my personal experience, that also in these subjects, television is giving better results. In other words, I consider that in every subject and at any level teaching through television can be more effective than radio. It is for other reasons that radio and radiovision are still very important."

The speaker then gave the Conference some details of the television courses for illiterates in Italy, and remarked: "This experience proves very clearly that in this field the magic power of television can better exert its full impact, reaching even groups and people more isolated and particularly resistant to the usual ways of fighting illiteracy, also for psychological reasons, because they are ashamed to admit their ignorance. That is why the courses for illiterates on the Italian television are followed by an increasing number of women, 41 per cent in 1961 and 47 per cent in 1962. That is also why we think it necessary to include in our lessons several elements of entertainment. We do that, not only in order to preserve television's power of attraction, but also because we feel it our duty to provide illiterates with basic general notions, together with teaching of reading and writing. Through entertainment, they can acquire simply, without excessive effort and even without realizing it, some notions of civics, history, geography, science, and so on. Of course, we carefully maintain a fair balance between entertainment and teaching."

In Japan, television broadcasting services are carried out by the broadcasting stations attached to the Japanese Broadcasting Corporation (NHK), which is a public broadcasting body, and by other broadcasting stations of commercial bodies. As of 1962, NHK had 91 general broadcasting stations and 38 educational stations. The distribution rate of TV receiving sets installed in primary

schools was 64 per cent, that in lower secondary schools 53 per cent, and that in upper secondary schools 35 per cent. In order to promote education in primary and lower secondary schools in the most isolated and remote places within the service areas of TV broadcasting, the Ministry of Education installed 300 sets at such schools in 1960, 400 sets in 1961, and 400 sets in 1962, with a national subsidy for half of the cost of each TV receiving set. The Ministry is taking steps to install TV sets at all schools in such areas in 1963.

For the purpose of developing scientific and technical education, the Ministry of Education broadcasts through a commercial educational broadcasting station a series of programmes mainly for students of technical courses of upper secondary schools for 30 minutes weekly. In addition, the Ministry broadcasts for one hour weekly programmes on the existing educational problems under the title of "Education in Japan" through 24 local stations. Of the working youths who are taking correspondence courses of upper secondary school level, those who are studying systematically through TV broadcasting are exempted from a part of their schooling.

The educational radio programmes for schools are used by 58 per cent of primary schools, 39 per cent of lower secondary schools, and 26 per cent of upper secondary schools. As regards the production of educational films and slides, the Ministry has made since 1960, for the purpose of developing science and technology, 35 reels of films for technical courses of upper secondary schools, and at the same time has encouraged the persons concerned to produce films of other kinds (K/51).

THE MAN IN THE VILLAGE

"The question unavoidably arises", said Dr. M. Dikmen, of Turkey, "whether the installation of a television set, even with such an important purpose as education, should or could be placed at the very beginning of the economic development, or whether it should be deferred to a later stage of economic expansion. We should not forget that some countries, even among developed areas, are still discussing whether television is an imperative necessity or a luxury. In fact, limitation of the area served by a single transmitter, influence of geographical features, demographic scattering, lack of electric power and the cost of electrification of villages, cost of installation, regular servicing and overhauling of receiving sets make television a difficult and rather expensive undertaking, which cannot be overcome without adequate financial resources."

The French National Commission for UNESCO had faced a similar problem. Mr. R. Grandbois, of France, told the Conference that the Commission had carried out two experiments in Senegal and the Ivory Coast in the transmission of culture for the rural inhabitants. The attempt was made to determine the best conditions for transmitting these programmes by French television. The problem was a twofold one: first, to provide education well adapted to local

circumstances; and secondly, to ensure that concrete benefits should be drawn from the programme. To interest the people directly a publicity campaign was conducted in the villages. There was to be set up a "tele-club", which was the central theme of this campaign. An attempt was made to interest people in setting up listening groups, which were placed under the responsibility of a monitor. The decision to create a "tele-club" would belong to the village. Only the village could make this decision, and once it was made, a committee was proposed consisting of literate persons and three illiterate persons. This committee was to appoint a leader, who would direct the work of the group which would watch the programmes.

"How did we organize the programmes?" continued Mr. Grandbois. "The programmes were of a threefold nature. First of all, they had to interest the listeners, and this is why they had a utilitarian nature. The leader, after his training period, had to explain to the people what was seen on the screens and following the programme he had to stimulate discussion. But, so that they could be an element in training and education, the programmes were followed by films, in the language of the country, and by literacy programmes also. The organization was undertaken by a commission of experts, who had to deal with a hundred themes, and these were shown in a hundred films. Once the results were assessed, 30 more films followed of 15 minutes each. These films included a useful group of approximately 500 French words, plus local terms for an explanation of details of the film. Later, there would be a third series of 100 films to give literacy training and also films on how to calculate."

Thus, commented the Conference Secretary-General, a considerable amount of educational broadcasting is carried out in certain African and other countries with recorded material produced in European countries. The material must, of course, be related to the environment of the pupil, and be presented in a form capable of assimilation into his language and way of life. Ideally, films and broadcast scripts should be devised and produced by competent indigenes, with local speakers and actors. Particularly at the more elementary levels, they must be in the language and be based on the experience of the pupil, and only introduce other experiences with the deliberate intention of widening his horizons [GR.39 (K)].

It is important, therefore, that material produced in other countries, and intended for the social and cultural conditions found in the highly industrialized countries, should be very carefully scrutinized, and that it should be employed only if judged suitable by the above-mentioned criteria. Some authorities consider that it is necessary to envisage the reformulation of scientific concepts to take into account the particular cultural conditions in a given less developed country (K/75).

In this deliberate effort to reach "the man in the village", it has to be recognized that the raising of educational standards in the developing countries calls for the dissemination of knowledge of farming techniques, health and

community development, among other things. "But when one is attempting to accomplish in a matter of years a task that it has taken centuries to complete in the advanced countries," states a recent UNESCO report,[1] "the traditional means of education alone prove inadequate. It is here that the mass media, unsurpassed in speed, range and force of impact, offer the greatest possibilities for effective action . . . The media can thus serve in winning public support and participation in those efforts. The feeling or knowledge among the general population of being part of a developing economy is an invaluable incentive to a country's economic and social expansion. This, in turn, facilitates more effective planning by governmental, as well as by financial, industrial and other agencies. In the long run, this development forms part of the transformation of a primitive agricultural economy into a largely industrial economy, characteristic of the modern State."

DEARTH OF FACILITIES

Both for education and for information generally there is a lamentable dearth of mass-media facilities over the greater part of the world. In some advanced countries, there are for every 100 people as many as 58 copies of daily newspapers, 94 radio receivers, 13 cinema seats and 32 television receivers. But elsewhere the distribution of facilities falls sharply below this level. In order to measure the insufficiency of facilities in the less developed countries, a general yardstick has been established. UNESCO has suggested,[2] as an immediate target, that a country should aim to provide for every 100 of its inhabitants at least 10 copies of daily newspapers, 5 radio receivers, 2 cinema seats and 2 television receivers. Yet as many as 100 States and territories in Africa, Asia and Latin America fall below this very low "minimum" level for all 4 of the mass media. These countries have a combined population of 1,910 million, or 66 per cent of the world total. An additional 19 countries, representing 2 per cent of the world population, fall below the "UNESCO minimum" in respect of 3 of the media. In short, nearly 70 per cent of the world's peoples lack the barest means of being informed of developments at home, let alone in other countries.

The actual situation is even worse, because the foregoing criteria do not take into account the distribution of facilities within countries. In many of the less developed countries, over 60 per cent of the population live in rural districts, whereas the facilities for information are concentrated in a relatively few urban areas. Consequently, the estimate given above does not fully reflect the dearth of facilities in the rural areas of most of the less developed countries. Another striking fact is that some 40 sovereign States in these regions have no national

[1] UNESCO, *Mass Media in the Developing Countries*, Report No. 33, (Chapter II), Paris, 1961.
[2] *Ibid*, page 16.

news agencies and must rely for much of their domestic news on the five major world agencies.

Mr. Zaimi Mustapha, of Morocco, who explained that he had been responsible for audio-visual media in Ades in Morocco for five years, said that for the less developed countries the first task was that the technicians had to be trained. "Then we must begin with the simplest of things, and use what is found locally, such as film strips, which are particularly expensive. This year, we have begun to use television, but television, for the time being, is a means of information with us. We have tried to use it for educational purposes, but I can assure you that it is so very difficult that we have given up the educational aspect for, let us say, the recreational aspect. We have had to do this because of a lack of educators. We cannot just 'equip' a country with television; we must think about the people who are going to give the education through television. That is to say, the teacher must at the same time be a technician. This teacher must be someone who is something more than just a teacher."

THE TEACHER IS IRREPLACEABLE

"Does resort to new teaching methods and techniques mean that the teacher as a human individual is of diminishing importance?" asked Dr. R. Maybury, of UNESCO. His own view was that, broadly speaking, the main objective of the new teaching methods and techniques is *to help the teacher in his tasks.* What are some of these tasks? A science teacher must: (*a*) impart information, (*b*) promote understanding, (*c*) present experiments and demonstrations of physical phenomena, and (*d*) test the comprehension of his students. But he has other functions, which are primarily human. He must inspire his students, take their relative capabilities into account, and guide them individually by assigning special problems. These latter tasks make the teacher as a human being irreplaceable. What he also needs is a better blackboard (or an improved substitute) and better books and a whole set of new aids that will cut down the time he now spends on the major tasks.

The prime objective of the new teaching techniques is to improve the level of comprehension of the student, whether it be through an "improved blackboard" in the form of films or self-instructional devices, or through inexpensive take-home experimental apparatus. "Some of the new aids," continued Dr. R. Maybury, "may serve primarily to reach an ever-increasing number of pupils. About five students can hover around a teacher writing on a pad. Up to several hundred can follow him if he writes clearly on a blackboard, but thousands or millions could follow him on a motion picture or a television screen."

Advocating programmed instruction, the speaker said that it depended on the step-by-step presentation in a logical sequence of small units of subject-matter, arranged so that the student could work alone. With a good programme, he could do for himself what used to require the guidance of a private tutor. Such

programmes are being used for science instruction, even at the university level, in the United States, the Soviet Union and possibly a few other countries (K/75).

Reverting to the need for close relations between the teacher and the new media, Mr. F. Watts, of Australia, urged that "the subject-matter of programmes must be carefully selected, teachers and broadcasters working together even more closely than in radio. In each area of the school, certain types of programmes are more successful than others. Not only the ages, but the mental and social backgrounds of the children, as well as the techniques of teaching, affect their value. The attitude of the teacher is vital. No matter how carefully a broadcast is prepared, its value ultimately depends upon the teacher's attitude towards it . . . if the teacher is willing to take a programme and the reception conditions are ideal, the value of the programme depends upon the reasons the teacher has for using it. He alone can decide his objective, though the nearer this is to what the programme planners had in mind, the more valuable the broadcast is likely to be."

In estimating the value of teaching aids, Academician N. M. Zhavaronkov, of the Soviet Union, said that "one should not underestimate them; they can be very useful and there is positive evidence that their use is important. But they should not be overestimated—they are only complementary, additional, auxiliary; the teacher is the main thing. I remember that Voltaire said that 'one hour spent with a clever man is worth a thousand books'. The role of a teacher is extremely important at any level—primary, secondary, and higher. This is why one must be very careful in choosing teachers at all levels of education. One must take on wise men, devoted men, and successful teachers."

The relation of teacher and the teaching-machine came up at several points of the discussion on the problems of equipment. It was easier to change the student than the teacher in everyday routine, insisted Professor Isaias Raw, of Brazil; and he continued: "So we decided to create a set of small laboratory kits, ranging from $US3 to about $US30, and supply them to students all over the country at cost price. Thousands of students applied for them and started to do experiments with those kits in the directions provided. Many of the students brought those kits into class or brought their doubts into class, and very soon the teacher realized for the first time that he could do experiments or the students could do experiments with very simple equipment, easy to build, at low cost—nothing to do with the chrome-plated $US1,000 equipment previously imported from abroad."

BOOKS ARE STILL BASIC TOOLS

Books are most effective if their use is co-ordinated with all other techniques and devices. None of these methods can be considered in isolation from the others. But without books and other printed materials, to intensify and support the educational function of the other media, the effect will be transitory and

superficial. Such was the view of the co-authors of a United States paper on "Books and Economic Development" (K/87).

An indigenous book industry (the authors assert) is the only means of producing books fully responsive to local needs and interests. It is an essential element of economic development in any country. It cannot be prefabricated and "laid on" from abroad. It must grow in local soil and in closest articulation with local education. Useful as foreign books may be for some purposes, and especially during an interim period, they cannot serve the continuing need.

Generally speaking, the creation of a book industry is not very difficult, but the personnel-training for the staff of publishing and printing establishments is a primary need. Of the chief elements in the total publishing operation, only the manufacturing phase (printing) involves mechanical techniques difficult to learn. "Eventually, every country should have schools of printing for meeting that training need; but on-the-job training, under foreign technicians, where necessary, at the beginning, is extremely useful, and selected managerial personnel can be given training abroad as a supplement to that . . . The mental level and the imaginative power of editorial personnel must be high, and those to take part in distribution should have outstanding business competence. But the techniques themselves are not complicated and can be mastered in a very short period of time" (K/87).

A similar concern for an adequate supply of books was expressed by the joint authors of a Brazilian paper dealing with geological education: "The major problems still lie in the importation of specialized laboratory equipment and supplies and printed material. The most difficult of these—largely unsolved—is the supply of reasonably priced textbooks for students. It is being met in part by the preparation of textbooks by various Brazilian geologists, of which a half a dozen already have been printed. The financial support for their publication comes largely from various government sources" (A/120).

> "The best teaching aid that needs to be provided in schools in less developed countries today", remarked Professor A. C. Joshi, of India, "is good textbooks. While these may not be necessary for the early primary classes, for higher classes, from the fourth grade onwards, good textbooks are an essential need. While the training of competent science teachers takes a long time, and is likely to cost a great deal, it should be possible to provide good textbooks at very moderate expenditure. Besides the textbooks, there should also be available for the students supplementary reading material, both of the popular type and of the inspirational nature. The school library should contain reference books, including works on the content of various sciences as well as on teaching techniques. Most of the new countries lack popular journals and magazines on science in local languages. Without suitable literature of this kind, the study of science is likely to remain restricted. It is desirable, therefore, to encourage the production of science journals in local languages and efforts should be made to provide good teachers' manuals" (K/21).

To sum up, the words of Mr. A. V. Baez, of UNESCO, expressed something of the scope and of the limitations of the aids and media discussed in this chapter. We are going to use the new tools of teaching for teacher training, he said, and for the training of secondary school teachers right at the start. "The teacher is our most important target; we are not interested in replacing teachers, but in helping them . . . we do not have faith in any one new technique alone. We do not think that films alone, or television alone, or experimental kits alone, or programmed instruction alone, are going to do the trick. The pilot project that we are going to run in Brazil will be an attempt to utilize a combination of all these teaching tools."

Looking further ahead, Mr. Newton Minnow, of the United States, led the Conference into considerations of outer space, while at the same time appealing for a sober realization of the tasks immediately in hand: "Those of us who are concerned in our daily work with communication very often become absorbed with the technology of communication, rather than with the purpose of communication." And he continued: "We have little time to grasp the meaning of our work, for science itself provides little guidance in the use of its marvels. As Dr. Albert Schweitzer tells us, 'Today, thought gets no help from science . . .' Last year, many parts of the world caught a glimpse of the future meaning of television when, for the first time, 200 million people in different parts of the world were able, through Telstar, to see the same programme on television at the same time. This was a fulfilment of the purpose of television, a word itself which comes from an ancient language, based on the words 'to see from afar'."

This seeing from afar, the speaker concluded, was accomplished through international co-operation in outer space, with many nations joining hands across thousands of miles. The European Broadcasting Union, with its headquarters in Geneva, was one of the agencies through which different traditions, different heritages, different arts, different languages were able to exchange the simultaneous marriage of sight and sound.

CHAPTER 7

International co-operation

"Science and technology are very seldom spoken of as champions of freedom. Yet in our day, science and technology provide the most effective means of liberating the people of the less developed countries from their ancient and traditional servitudes of ignorance, illness, malnutrition and lack of adequate shelter and clothing. How free are the 900 million illiterates of this world who cannot read or write, to whom all of the intellectual and cultural heritage of mankind is closed off? How free are those hundreds of millions who are ill-clothed, ill-fed and shelterless, whose utter poverty leaves them bereft of hope and inspiration? How free are those whose life expectancy is so short, whose energy so weak and debilitated that the effort required to create a better life seems impossible? Such has been the lot of many millions of people for all the historical past of the less developed countries; but the present capabilities of modern science and technology make it possible to put an end to these inhuman servitudes and to create for man a material situation in which spiritual and human dignity can be a reality and not a travesty."

This quotation from the presentation made on behalf of the Holy See by the Rev. Theodore M. Hesburgh may well epitomize the over-riding purpose of the Conference as set out in the earlier pages of this book (K/52). In this final chapter, then, we might briefly review the grand design that was so often manifested throughout in terms of the individual man, woman or child whose welfare and fulfilment as a human being was the only true end of all that the Conference thought, said and did.

"As the report of the Secretary-General states," said Dr. W. T. R. Flemington of Canada, "education is fundamental to everything else . . . You may recall the famous definition of Lord Elgin, who said that education fits you for nothing, but prepares you for everything. I think that is still so fundamental: education fits you for nothing, but prepares you for everything."

The speaker recalled that Professor C. A. Cavalli, of Italy, had mentioned the importance of preserving "the concept of beauty" in the field of education, and

he cited William Wordsworth's definition of education in the lines written on Tintern Abbey,

" . . . when thy mind
Shall be a mansion for all lovely forms,
Thy memory be as a dwelling place
For all sweet sounds and harmonies . . . "

"But, in this atomic age," Dr. Flemington continued, "more emphasis must be placed upon science, from the earliest years. I think our schools are often teaching on a level that does not challenge the student. We under-estimate the student. A story is told that comes from south of our border, in USA, of two youngsters in kindergarten, who were playing during recess. An aeroplane passed overhead, and one said to the other: 'Oh, B55', the other replied: 'No, you can tell a B55 by the angle of the wings', then the other said: 'It is not coming very fast', and the other: 'No, only 600 miles an hour, it has not broken the sound barrier yet'. Just then the school bell rang and one youngster turned to the other and exclaimed: 'Well, let's go in and count those damned beads.' "

CAN THERE BE TWO CULTURES?

"The vision of the beautiful is really common to both sciences and the arts", Professor M. Raziuddin Siddiqi of Pakistan maintained, "and both of them have a vital impact on each other, in the blossoming of creative activities either in one field or the other." Professor Siddiqi said that he did not believe in two cultures. In actual fact we are trying to have in our present system of education, both educated scientists and uneducated scientists. "That is something which has to be very much avoided. No less a man than Heisenburg has revealed that neglect of the classics and the humanities in the education of the younger men in the advanced countries is a danger also to the countries belonging to the older civilizations in the East, which are now being termed under-developed countries."

This responsibility of scientists, as members of the human race, sharing a common heritage and linked in a common destiny with the rest of mankind, came forcibly before the Conference. "Science and technology also find their place in military defence and, unfortunately, offence", declared Dr. Harry C. Kelly, of the United States. "This places an added responsibility on our scientists to assist their fellow scholars, especially the humanists, to find the way for man to live peaceably with his neighbours, using the material by-products of science for the material and cultural welfare of man living under the awful spectre of the misuse of the products of science for civilization's destruction."

Science education (the speaker continued) cannot exist apart from general education. Man, in order to be adaptable to his surroundings, must be educated in the liberal arts. This broad education, especially in the humanities, is desir-

able, not only as a solid foundation for all professions, but also for the understanding of science itself. Anyone who tries to understand such ideas as an imaginary number, or probability, or the product of probabilities can acquire a better understanding of his difficulties by seeking the meaning of an ancient Greek tragedy portraying the limitations of man's mind or the failure of human reason.

On the other hand, a physicist who understands the "boundary" conditions of nature—where precisely the physical conditions on the external boundaries of a body determine the physical conditions at any point within the body—cannot escape the historical conclusion that economics or political events anywhere on their borders help to determine the economic and political conditions within their own country. The first principle, then, is that education in the sciences is only part of the educational programme to be developed (K/92).

This inherent unity of the world of science, and the resultant responsibility it places on the individual scientist, has been expressed in a statement by the United Nations Secretary-General: "The scientific community of the whole world must be more closely related. At the present time, the scientist in the developing countries is all too often cut off from the main stream of thought, and it is thus extremely difficult for him to make a major contribution; for while the complexity and breadth of scientific knowledge require an ever-increasing degree of specialization, the very extent of this specialization at the same time demands increasing cross-fertilization between apparently unrelated disciplines. The creation of a world-wide scientific community would help to solve these problems."

In a similar vein, Professor A. C. Joshi of India, remarked that "knowledge of human behaviour, resulting from a long chain of scientific findings, has shed light on many intricate problems of existence, thereby liquidating deeply entrenched prejudices and myths which, for ages, have stood in the way of human progress. The great increase in the speed of means of communication and transportation has given reality to the conception of One World; but, at the same time, by bringing nearer many countries and varieties of culture which were until recently widely separated, has released new tensions and conflicts."

Mr. Newton Minnow of the United States, believed that, perhaps within this decade, "all people of the world may be linked together in a truly uncommon market of mankind—the market of the free exchange of experiences, cultures and ideas. Through this uncommon market, mass communications may prevent mass destruction . . . But the miracle of space communication satellites", the speaker suggested, "is only a link between places far away. Dr. Jaffee pointed out the other day that each nation must have its own effective communications system on the ground in order to participate in, and to provide its own communications as part of, the global system we all hope to create together. And this requires that all of us, each in our own way, use these great gifts of science in the service of education."

Yet, while the search for the unity of science continues, the recognition of diversity in national educational plans cannot be ignored. National institutions have to be related to a nations' history and culture. "It goes without saying," said Dean A. F. Shebanov, of the USSR, when speaking particularly of universities, "that there can be no similar ways of solving this question for different countries. The role and the significance of universities may differ in various countries and at different periods. When considering this question one should take into account many factors: the country's population; its national structure; its main occupations; the level of economic, cultural and educational development; the needs of individual national economy branches, as well as the extent to which the State apparatus, national economy, and education are supplied with national specialists" (K/55).

Yet this understandable emphasis on national purposes and needs is being supplemented today by an international co-operation which takes many forms. In the training of scientific and technical personnel, stated Mr. H. Chang, the Republic of China is one of the few countries which receives training from more advanced countries and meanwhile offers training to others. Chinese students—technicians and scientists—have the benefit of receiving training in the United States, Japan, and European countries. Some of them pursue fundamental studies, others receive specialized training in various fields. In either case, they are a net gain to the country, and have contributed substantially to its economic and educational development. For another kind of training, Chinese students invite foreign professors to come and offer courses in the university. The United States and the Federal Republic of Germany have both rendered this kind of training to the Republic of China.

"On the other hand", Mr. Chang continued, "the Republic of China has always contributed a humble share, by offering training to some Asian and African countries. Agriculturalists and scientists from many countries came over to China under a study and observation programme, arranged by the United States Operation Mission to China. Thus, from 1954 to 1962, the Republic of China acted as host to 1,484 participants from Thailand, Viet-Nam, the Philippines, Korea, Ryukyus, Japan, Cambodia, Laos, Nepal and Pakistan. A further type of training offered by the Government has been to conduct special courses for technicians coming from other countries. In April 1962, 25 agricultural technicians from 12 African countries were sent to the Republic of China to receive practical training in rice and other dryland crop cultivations for a period of six months. A second training course of the same nature will soon commence for training African technicians in farm practices . . . Technical teams are also sent to other countries upon their request, to help local specialists develop their sugar industry, farmers' organizations, irrigation projects, and crop improvement programmes, as well as demonstrating farming practices both in Asia and in Africa."

International co-operation has frequently been put forward in varying ways in the preceding chapters as a solution to the problem of shortage of specialist teachers and institutions. "For many highly specialized jobs", said Professor L. J. Mostertman, of the Netherlands, "we should concentrate teaching in a few corners of the world. There are some professions—for instance, in oil drilling, in computer technology, in photogrammetry and in specialized health services —where only a very limited number of people are needed. Moreover, whether we need the people or not cannot be predicted in advance. For instance, in oil drilling, one never knows beforehand how much success exploratory drilling will bring, and only afterwards one knows how many drilling-masters are needed. In this case, international co-operation is indispensable. Centres should be set up in various parts of the world, specializing in education for those types of personnel of benefit to other countries. Also, on the international level, much attention could be given and useful studies could be made on the continuous application of technical education to these needs, because this technical education can be in itself much more flexible than university education."

In line with this policy, Mr. Enrique Martin, of Spain, praised the regional approach and pointed out that international co-operation was essential in the carrying out of projects of the scope of the MRP project (see Chapter 4). He stressed that, in spite of the great differences between the various countries taking part, these six countries had managed to achieve, from the point of view of structural, social and educational methods, "perfect co-operation and have produced results which will be of interest to the whole world."

Yet it is not enough to attempt to teach people the principles of getting across "this gap between the scientists and the traditional culture," as Professor A. H. Leighton, of the United States, expressed it. "You can teach a person the principles of riding a bicycle, but he still will not be able to ride it unless he has some practice . . . One can teach applied psychology, of the limited type I have in mind, in a matter of six weeks, but it involves teaching people in real-life situations. It can be done in relation to either a training institution or technical training on the job or in an industrial centre. But it does involve placing the technical personnel in a real-life situation and supervising him in the midst of the problem which he has to solve."

Giving a graphic example of what he meant, Professor Leighton said that "in the south-western part of the United States, we had the problem of teaching technicians to teach improvement in diet to people of a very low level of education—people who belong to a non-scientific culture, namely a group of American Indians living in a large desert area . . . We took our dietician-technicians, who are very competent in their field of diet, but who knew nothing at all about how to bridge over to people who have a non-scientific orientation. We took them out early one morning on the desert and confronted them with the problem of learning what the attitudes and actual diets were, and the practices and the daily round of life of the people living in these villages. We gave them 24 hours in which to do it. We drove 20 miles through the desert without seeing a

house; we came to a small village, we left there two of these people; we drove another 20 miles until we came to another village and we dropped two more. Our students called this the parachute jump. They found themselves in a village where the villagers could not speak English, except for about 10 per cent of the population."

These experimenters, Professor Leighton explained, had the problem of winning co-operation, of getting from the 10 per cent who could speak English one or two to act as interpreters for the rest; and of being left there for 24 hours overnight. They had to persuade someone to feed them, to give them a place to sleep, and they were picked up the next day by the car. This technique was repeated many times, as the area was large enough to make this possible—"almost like breaking through the sound barrier," concluded the speaker. "The men and women who had this experience, of which they were very frightened to begin with, came back completely convinced that they knew how to *communicate* —at least on the subject of diet—how to go about breaking through the barrier, how to go about getting an insight into the feelings of people who were concerned."

UNESCO LOOKS TO THE FUTURE

In all this experimentation, it was recognized that, often behind the scenes, and at the constant call of all governmental and voluntary institutions, the services of UNESCO were increasingly in demand and were expanding as far as budgetary limitations permitted.

For example, UNESCO will be publishing in 1964 a "Handbook of International Exchanges" which will supply the necessary information on which effective programmes for the exchange of knowledge and ideas can proceed. Action is also being directed towards providing advisory services for Member States wishing to develop their international relations in the fields of education, science, and culture. So far as direct training is concerned, the main method contemplated is the award of fellowships, which would make it possible to organize courses, some on a regional basis, combined with study visits to other countries. These training programmes cover many aspects of acquiring knowledge and ideas from abroad, through the fellowships, as well as expert missions, teacher exchange, the provision of equipment, and participation in information services. National and international agencies and organizations equally concerned with such matters will be invited to co-operate.

This kind of forward planning by UNESCO is especially needed at this time, since—as the joint authors of a United States paper (J/85) pointed out—foreign training and assistance are providing a supplemental supply of certain kinds of professional manpower, during a period in which the shortage of such manpower is most acute in countries embarked on vigorous development programmes. "This period of shortage," they continued, "is inherent in the process of accelerating modernization and growth. A country may start with a supply of pro-

fessional people more or less in balance with its previous economic system. But it may wish in the course of a few decades to make a revolutionary transition to a more productive economic system. The future economic system will have tremendously expanded requirements for professional people, and each step on the way towards it raises the demand for professionals to perform current operations in new government agencies, industrial and agricultural enterprises, and educational institutions. At the same time, the transition itself generates new and expanding demands for professional services, notably in development planning."

Because this close interdependence of economic planning and training reflects the insistent needs of the developing countries—of which the pages of this book have given such abundant evidence—UNESCO has recently initiated a series of international projects of crucial importance to educational advance everywhere, and especially in the developing countries.

An International Institute for Educational Planning has been set up in Paris to train high level educational personnel and economists along the lines that modern planning requires. Regional institutes for training planning specialists from the regions are being established in New Delhi, Beirut, and—as parts of the economic development institutes—in Santiago, Bangkok and Dakar.

The separate countries of Africa, Asia and Latin America, during the next three years, are committed to translating the Development Decade targets into national educational plans, integrated into over-all development programmes, as described in earlier chapters. Hence, development economists are being included in UNESCO missions to advise countries on framing their educational plans. Courses on the relation between education and economic development are given in all the educational planning institutes.

At UNESCO headquarters specialists have also been assessing the future demand and supply in respect of different types of education, and conducting studies into the relations of educational science and economic and social development. With the help of outside scientific institutions, new methods are being sought of assessing educational needs. Such research work as this links UNESCO with the ILO, with the regional economic commissions of the United Nations and with FAO and other members of the United Nations family.

The newly formed Institute for Educational Planning in Paris is intended to bring together educators, economists and other development experts to help the nations of Africa, Asia and Latin America to accelerate their economic and social development programmes by integrating educational expansion more effectively with over-all development plans. The Institute was created as an autonomous body by UNESCO in July 1963, and is financially supported by UNESCO, the International Bank for Reconstruction and Development and the Ford Foundation. The French Government is providing the premises and physical facilities for the Institute. The Institute will work through UNESCO, the International Bank for Reconstruction and Development and the regional development institutes, as well as through national agencies, to help them strengthen their staff

and conduct research and training programmes in their own fields. The Institute itself will carry on research and training at an advanced level, directed at solving problems which confront development workers in the field. It will also co-operate with universities in longer-range projects and research.

The bond between education and economic growth, brought out constantly in the foregoing chapters, has been expressed in the following terms by Dr. Philip H. Coombs, Director of the Institute: "Education's help is urgently needed to provide the trained and educated human resources essential for economic growth, for strengthening local institutions and for general social advancement. New steel mills, dams and jet airports can end up simply as expensive status symbols, unless a nation's human resources are developed in balance with its physical resources. For these resources to be effective, however, educational expansion must be carefully planned in relation to the rest of the economy. The developing countries must design their own educational systems to fit both their needs and their pocket-books".

LABOUR STUDIES MOVE AHEAD

Also looking to the future, the International Institute for Labour Studies was established by the ILO in 1962 to further a better understanding of labour and management problems in all countries and of the methods for their solution. The Institute provides wide educational facilities, arranging for discussions among persons with experience, encouraging research and disseminating information. It is governed by a Board consisting of the Director-General of the ILO, as Chairman, 6 members of the Governing Body of the ILO—2 from each group: Governments, Employers and Workers—and 5 members appointed by the Governing Body from among persons of outstanding international experience, having a knowledge of educational and labour problems. The *Conseiller d'Etat* in charge of the *Département de l'instruction publique* of the Republic and Canton of Geneva is an ex-officio member of the Board.

The Director of the Institute is advised on programme questions by an advisory committee, which includes members appointed by the Director-General of the ILO, the Secretary-General of the United Nations and the Director-General of UNESCO. The Rector of the University of Geneva and the Director of the Graduate Institute of International Studies of Geneva are also members, thus ensuring full co-operation with educational institutions in the city. In addition, the Committee has a number of members from different parts of the world, appointed by the Board after consultation with the Secretary-General of the United Nations and the Director-General of UNESCO from among educators and recognized specialists in the field of labour studies. The Institute is financed by the revenue from an endowment fund, to which many Governments have already contributed.

For the first study course of the institute, 30 participants were selected from the government services and national employers' and workers' organizations of 28 different countries. Twelve were government officials, 12 were trade unionists, and 5 came from employers' associations. The course itself was based on a central theme: "The labour force and its employment". But it also covered a number of major labour problems, such as wages and the status of wage earners, organization of workers and the functioning of their organizations, relations between employers and workers and workers' participation in management, social security and welfare, and special labour problems relating to rural areas, as well as labour problems of economic growth and development planning. In the main, teaching was by means of lectures designed to open up a subject, later studied in depth by means of seminar discussion, reading and writing.

The response of the first participants to the opportunity of studying in company with men and women drawn from other walks of life and from a world-wide variety of nations, cultures and economic systems has been notably encouraging. They were able to widen and deepen their experience by sharing it with others. Their intellectual curiosity was stimulated by contact with experts and scholars whom they could never otherwise have met. They returned home with an increased awareness of the significance of their own work within the total community.

During 1963, a programme of preparatory research work, a regional seminar and an international meeting of labour economists will be followed in the autumn by a second international study course for selected participants drawn from government service, from management and from trade unions in about 30 different countries. The great interest shown in the work of this Institute and the extent of the demand for its services have proved the need for institutions of this type, where both scholars and practitioners can come to study and seek to understand, through a frank and friendly exchange of experience, the labour problems with which they must deal in their day-to-day work.

When the Institute began its work in 1962, the Director General of the ILO said in his address as Chairman of the Board at the closing ceremony, when certificates were awarded to the first participants: "The Institute is only at the beginning of its task. It is a modest beginning, but it is the beginning of a great process, for I am convinced that over the years it will become an institution of the utmost importance, a world centre not only for education and study, but for research and information on all problems that are of interest to us."

THE FOLLOW THROUGH

As one looks back on the whole Conference, there can exist little doubt that it is the follow-through that is all-important. However spectacular its immediate results, its highest achievement will be to set the stage for the vastly greater

contribution which science and modern technology have yet to make to human progress.

"The work of the United Nations family in the whole field of science and technology", said Mr. Paul G. Hoffman, Managing Director of the United Nations Special Fund, "should be brought under continuing review so as to ensure an inter-disciplinary approach and a maximum of co-operation and co-ordination."

"In the past it was possible for a rather under-developed community to live a peaceful and balanced life, based on the dominance of a cultivated, and sometimes highly cultivated, class that ruled over the great illiterate majority, which was not touched by the impact of the ideas and the progress going on in distant countries," declared Professor José Reis, of Brazil. "But today, when the 'unit of survival' is becoming so increasingly larger as to be confounded with humanity as a whole, that situation has practically disappeared from the earth's face. This shows how world-wide and urgent is the problem of adequately establishing the right scope and place of science in education" (K/36).

List of Conference reports and papers

arranged by sessions

EXPLANATORY NOTE

GENERAL

(1) All papers and reports considered at or emanating from the Conference bear a symbol, the common main term of which reads E/Conf.39/... *For the sake of brevity, this term has been omitted in the lists at the end of each volume* and in the comprehensive list in Volume VIII (see below).

(2) The common term of the symbol is supplemented by further notations indicating:

(*a*) The main item of the Conference agenda to which the paper or report relates. There are twelve such items, denoted "A", "B", "C" and so on up to "L".

(*b*) The nature of the document, i.e.:

(i) Papers submitted by Governments or other authorized contributors for consideration at the Conference. *These bear NO supplementary notation other than that described in (a) above,* which is followed by the serial number of the document. The papers are numbered *separately* for each main item.

Examples:

Full form	*Abbreviated form*
E/Conf.39/A/71	A/71
E/Conf.39/G/26	G/26
E/Conf.39/H/14	H/14

(ii) Reports of the Conference Secretary-General, summarizing the papers considered at each of the general and specialized sessions. These bear the symbol "GR", followed by the serial number of the report (1-93), followed in turn by the appropriate agenda symbol (see (*a*) above) within brackets.

Examples:

Full form	*Abbreviated form*
E/Conf.39/GR.12(A)	GR.12(A)
E/Conf.39/GR.81(D)	GR.81(D)

(iii) Rapporteurs' Reports, summarizing the proceedings at each of the general and specialized sessions. These are denoted in the same way as the Reports of the Conference Secretary-General, except that the distinguishing item is "RR".

Example:

Full form	*Abbreviated form*
E/Conf.39/RR. Serial number and agenda symbol*.	RR. Serial number and agenda symbol*.

(3) Two other points should be noted in consulting the lists:

(*a*) In NO case does the symbol indicate whether the session at which the paper or report was considered was either a general or a specialized one.

(*b*) The serial numbers of the Rapporteurs' Reports (2 (*b*) (ii)) do NOT coincide session for session with those of the Conference Secretary-General's Reports (2 (*b*) (iii)).

(4) A comprehensive list of all the documents described in (2) above, in numerical order within each category, will be found in Volume VIII, which also gives the titles of each main item (see 2 (*a*) above) and each sub-item (see (7) below) of the Conference agenda.

THIS VOLUME

(5) The list which follows includes:

(*a*) All papers and reports relating to the subject matter of this volume.**

(*b*) Papers and reports pertaining to other items of the agenda but cited in this volume.

(6) The Conference Secretary-General's Reports occur in numerical order with the exception of that.*** relating to the General Session which heads the list.

(7) Papers considered at the general session and at the specialized sessions are listed separately in numerical order for each session. It should be noted that each specialized session relates to *one* sub-item of the Conference agenda (see 4 above).

(8) The Rapporteurs' Reports are listed in numerical order (see also 3 (*b*) above).

(9) Hence the best way of tracing a paper or report not explicitly referred to in the text of this volume will be through the agenda item or sub-item to which it relates, *of which each such document bears the letter or number,* in addition to the Conference symbol described in (1) and (2) above.

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*E/CONF.39/RR.1(B). E/CONF.39/RR.39(K).
**Agenda items B: Human resources, and K: Training of scientific and technical personnel.
***GR.2(B), GR.78(K).

List of Conference papers and reports
arranged by sessions

PAPERS RELATING TO THIS VOLUME (EDUCATION AND PLANNING)

REPORTS OF THE CONFERENCE SECRETARY-GENERAL

Symbol, title of report and agenda items covered

B. HUMAN RESOURCES

GR.2 (B) Human Resources, B. (General)
GR.1 (B) Population trends, B.1.
GR.9 (B) New systems of vocational training and apprenticeship, B.2.2.
GR.14 (B) Sound management and management development as a factor in technological progress, B.3.
GR.22 (B) Techniques of manpower assessment, forecasting the requirements and priorities of numbers and types of scientists and technologists, B.2.1., K.1.1.
GR.32 (B) Employment implications of the application of science and technology in less developed areas, B.4.
GR.33 (B) The application of science and technology to conditions at the workplace, B.5.

K. TRAINING OF SCIENTIFIC AND TECHNICAL PERSONNEL

GR.78 (K) Training of scientific and technical personnel, K. (General)
GR.39 (K) Communication as tool of education to meet the specific problems of developing countries. Educational services, K.2.4., L.2.4.
GR.43 (K) Specialized training at technical schools and means of accelerating formation of scientific and technological cadres, including teaching staffs, K.1.2., K.2.3.
GR.79 (K) Specialized programming for training at higher technical institutes and universities, K.2.3.
GR.82 (K) Scope and place of science and technology in general education. Specific new approaches to educational programming in primary and secondary education, K.2.1., K.2.2.

GENERAL SESSIONS

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

B. HUMAN RESOURCES

B/7 Indonesia (E), S. Siswomartojo, W. Nitisastro, Human resources and the application of science and technology in the developing areas

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

B/9 United Arab Republic (E), A. Shoeb, New systems of vocational training and apprenticeship

B/10 Canada (E), N. Keyfitz, Science and population trends

B/17 ILO (E), International Labour Office, The interdependence of high-level manpower planning and economic planning

B/32 France (F), G. Ardant, Plan for mobilising available labour forces in the developing countries

B/40 Holy See (F), C. Mertens de Wilmars, Training for management and cultural adjustment

B/43 India (E), V. K. R. V. Rao, The human factor in economic growth: an introductory exercise with special reference to India

B/48 Romania (E), S. Taigar, Problems of the estimation and rational utilization of human resources in the process of economic development

B/51 USA (E), E. Peterson, Women in the labour force

B/55 USA (E), F. Harbison, High-level manpower development and economic growth

B/58 France (F), M. Debeauvais, The planned development of human resources

B/63 USSR (R), R. Smirnova, The role of female labour in the economy of the developing countries of Africa

B/65 USSR (R), P. G. Podyachikh, On the methods of estimating the numbers and composition of manpower. Importance of the data on labour statistics for ensuring full employment of all able-bodied persons for training of personnel

K. TRAINING OF SCIENTIFIC AND TECHNICAL PERSONNEL

K/3 Uruguay (S), G. E. Villar, The scope and role of science and technology in general education

K/5 France (F), B. Schwartz, From the training of engineers to the permanent education of all adults

K/6 Nigeria (E), A. Babs Fafunwa, Scope and place of science and technology in general education

K/7 India (E), G. K. Chandiramami, Training of scientific and technical personnel

K/24 USSR (R), B. G. Gafurov, Training national cadres in Soviet Central Asian Republics

K/26 Hungary (F), J. Timar, The problems of planning and of recruiting qualified personnel

K/35 Brazil (E), I. Raw, Scientific experiments in school and at home as a means of improving the teaching of science

K/63 France (F), J. Capelle, Is it possible to planify the formation of the senior staff in the slightly developed countries? General principles

K/64 Romania (E), M. Manescu, Some problems of the training of scientific and technical personnel in correlation with the requirements of the development of the national economy

K/79 UNESCO (E), V. S. Martinovsky, F. F. Papa Blanco, Basic principles for the planning of technical education

K/83 USA (E), R. W. Tyler, Programming of science and technology within the educational structure

K/84 USSR (R), S. V. Rumiantsev, Training of national scientific and technical personnel for Asian, African and Latin American countries at the Peoples' Friendship University named after Patrice Lumumba, Moscow USSR

K/94 USA (E), J. B. Wiesner, Planning policies for investing in scientific and technological education

K/95 USA (E), J. R. Zacharias, S. White, The requirements for major curriculum revision

K/97 USSR (R), L. P. Lasarev, Latest achievements in sciences and engineering as the basis for the contemporary system of training scientific and engineering cadres

SPECIALIZED SESSIONS

B. HUMAN RESOURCES

B.1. POPULATION TRENDS

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

B/2 Ghana (E), B. Gil, K. T. de Graft-Johnson, Application of modern population census techniques in Ghana

B/13 Sweden (E), H. Hyrenius, New demographic technique for studying demographic-economic-social interrelations, instruments for projections and development planning

B/30 France (F), A. Sauvy, Rate of population growth in the less developed countries according to the 1960-1961 census

B/35 Yugoslavia (E), M. Macura, Demographic projections and economic planning

B/38 Brazil (E), G. Mortara, Human fertility in Latin America

B/39 France (F), R. Blanc, The problems of African demography

B/46 Senegal (F), L. Verrière, The use of the theory of the quasi-stable population to verify the age distribution obtained in a census or enquiry in countries in which the civil administration is inadequate: application to Senegal

B/47 Romania (F), M. Biji, Methods for the long-term estimation of the sex and age structure of the population

B/59 USSR (R), P. G. Podyachykh, Population statistics planning of economic and cultural development

B/67 USA (E), P. M. Hauser, Population and labor force resources as factors in economic development

B/71 Ukrainian SSR (R), D. I. Valentey, Economic problems of developing countries and population questions

BETTER UTILIZATION OF HUMAN RESOURCES FOR ECONOMIC DEVELOPMENT

B.2.1. TECHNIQUES OF MANPOWER ASSESSMENT

B/1 Ghana (E), R. D. Loken, Techniques of manpower assessment: the application of the findings from Ghana's manpower survey

B/3 Nigeria (E), C. W. Bunker, Techniques of manpower assessment

B/11 UAR (E), H. M. Hussein, M. A. El-Shafei, A. M. Shehata, S. M. El-Hammamy, S. H. Barghout, T. E. Safwat, Techniques of manpower assessment and their implications for development plans of the UAR

B/12 Finland (E), T. Pulkkinen, Assessing manpower in Finland

B/19 Sweden (E), T. Dalenius, New survey techniques applicable to labor force surveys in less developed areas

B/26 ILO (E), International Labour Office, Methodology of manpower forecasting

B/34 Mexico (S), M. Martinez del Campo, F. Contreras Aguilar, An estimate of present and future requirements for technicians in Mexican industry

B/57 Madagascar (F), R. Granger, Methods of estimating the requirement for training qualified personnel in developing countries of small or medium-sized population

B/60 USA (E), S. L. Wolfbein, Manpower projections and techniques

BETTER UTILIZATION OF HUMAN RESOURCES FOR ECONOMIC DEVELOPMENT

B.2.2. NEW SYSTEMS OF VOCATIONAL TRAINING AND APPRENTICESHIP

B/4 France (F), Latouche, G. Dormeau, Applied psychology in the field of labour, in the present stages of socio-economic development in the African States

B/6 Israel (E), P. F. Harburger, Experiments in vocational education in a developing country

B/8 France (F), Association nationale interprofessionelle pour la formation rationelle be la main-d'œuvre, Evaluation of the possibilities of quickly-trained labour in developing countries

B/14 Japan (E), S. Murakami, Public vocational training in Japan: present situation and problems

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

B/29 France (F), R. Lambert, Vocational training in countries undergoing rapid economic expansion

B/44 Romania (E), P. I. Burloiu, New systems of vocation training and of apprenticeship

B/45 France (F), G. Ardant, Outline of a productivity policy for countries in the process of development

B/50 France (F), J. Guermonprez, Results of an experiment by means of knowledge and aptitude tests on a group of Moslems born in Algeria and residing in France

B/68 Italy (F), A. Pallavicino, Italian experience in the training of workers in the skilled trades and the training and further training of instructors

B.3. Sound management and management development as a factor in technological progress

B/5 Portugal (F), E. Gomes Cardoso, Management training in Portugal

B/15 Netherlands (E), A. W. Sissingh, Integrated plant survey

B/18 Netherlands (E), B. van Harreveld, Management education through assignments in industry

B/21 Spain (S), C. Moreno Arenas, Training schemes for supervisory grades in industry organized by the Spanish National Commission of Industrial Productivity

B/25 United Arab Republic (E), A. F. Sherif, Management techniques and their application in less developed areas with special reference to the UAR experience

B/27 United Kingdom (E), J. P. Martin-Bates, The administrative staff college in the United Kingdom and in the developing countries

B/28 Yugoslavia (E), S. Han, Management techniques and their application in less developed areas: workers' management in Yugoslavia

B/31 Brazil (E), P. J. Pardal, Experience of the Study Group of Industrial Productivity (GEPI) at Escola Fluminense de Engenharia (the School of Engineering of the State of Rio de Janeiro, Brazil) in the development of programs for training of the technicians of industrial firms in methods of organization

B/33 Spain (S), M. Sanches Rodrigo, Methods of management and their application to less developed regions

B/36 Mexico (S), M. Marin Gonzales, Training for management

B/37 France (F), M. Gourbault, Psychological training of supervisory staffs at the National Inter-professional Institute for the Rational Training of Labour

B/70 USA (E), B. F. Hoselitz, The entrepreneurial element in economic development

B/74 ILO (E), International Labour Office, The role of management in economic development

B/75 Ghana (E), G. Soloyanis, Training for management: a co-ordinated national management development program

B.4. Employment implications of the application of science and technology in less developed areas

B/22 Canada (E), B. Higgins, Employment implications of the application of science and technology in less developed areas

B/41 Mexico (S), G. Islas, A. Romero, Technological structure as a basis for the comparative evaluation of capital investment

B/42 Greece (E), A. A. Pepelasis, Employment problems in a developing economy: the case of Greece

B/49 Byelorussian SSR (R), N. I. Shishkin, Methods of effective utilization of manpower resources

B/53 USSR (R), B. I. Braginsky, Planning of full employment in the USSR

B/66 India (E), R. Krishna, The size of the firm, efficiency and growth: the recent Indian experience

B/69 Federal Republic of Germany (E), K. Billerbeck, Mobilization of manpower potential in Asia and Africa

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

B/73 United Nations (E), Department of Economic and Social Affairs, Choice of capital intensity in operation planning for under-developed economies

B.5. THE APPLICATION OF SCIENCE AND TECHNOLOGY TO CONDITIONS AT THE WORKPLACE

B/16 Cameroun (F), J. Bowen, Industrial safety and health

B/20 France (F), J. J. Gillon, Methods of creating industrial medical services likely to improve the health and safety of the workers

B/23 Finland (E), L. Noro, The role of the occupational health institute in national health services

B/24 ILO (F), International Labour Office, Contribution of "ergonomics" to the knowledge of human problems in relation to work in developing countries

B/52 Federal Republic of Germany (E), G. Lehmann, The effect of human working capacity at high temperatures on the development of industries in tropical and subtropical areas

B/54 USSR (R), A. A. Letavet, Hygiene and labour accident prevention at the plants of countries under development

B/56 USA (E), E. Clague, Occupational safety in a newly developing industrial area

B/61 France (F), J. Bessou, Improvement in working conditions and prevention of electrical accidents in rapidly developing countries

B/62 France (F), J. Scherrer, A. Wisner, The application of ergonomics to countries in the process of development

B/64 United Kingdom (E), B. Shackel, An introduction to ergonomics

B/72 USSR (R), M. G. Kluyev, Safety rules and labour protection at USSR industrial enterprises

B/76 France (F), M. Leplat, Ergonomy in the countries in the process of development, possible applications and measures for assuring diffusion

K. TRAINING OF SCIENTIFIC AND TECHNICAL PERSONNEL

PLANNING POLICIES FOR THE ACCELERATION OF THE DEVELOPMENT OF SCIENTIFIC AND TECHNOLOGICAL CADRES

K.1.1. FORECASTING THE REQUIREMENTS AND PRIORITIES OF NUMBERS AND TYPES OF SCIENTISTS AND TECHNOLOGISTS

K/1 Ghana (E), R. D. Loken, Forecasting the requirements and priorities of numbers and types of scientists and technologists: allocation of students

K/14 Philippines (E), R. A. D. Hermano, Manpower for science in a developing State: current trends and programs in the Philippines

K/20 Israel (E), J. Ben-David, U. Hurwitz, Sociological considerations in forecasting the requirements for scientific and technological manpower

K/40 Greece (E), J. Paleocrassas, Demand forecasting for scientific and technical skills in Greece by 1975

K/41 India (E), R. Prasad, Forecasting the requirements of scientists and technologists

K/42 Ceylon (E), S. L. De Silva, Training of scientific technological and technical cadres in less developed countries

K/43 United Kingdom (E), E. A. G. Robinson, Forecasting the requirements and priorities of numbers and types of scientists and technologists

K/44 Japan (E), K. Kawakami, Forecasting the requirements and their priorities of numbers and types of industrial manpower

K/53 Yugoslavia (E), H. Haas, Forecasting the requirements and priorities of numbers and types of scientists and technologists

K/69 USSR (R), K. G. Nozhko, Planning of higher and secondary vocational education and personnel requirements of national economy and culture

K/74 Chile (S), J. L. Cauas, J. A. Mardones, The employment of engineers in the manufacturing industry

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PLANNING POLICIES FOR THE ACCELERATION OF THE DEVELOPMENT OF SCIENTIFIC AND TECHNOLOGICAL CADRES

K.1.2. SPECIALIZED TRAINING AS A MEANS OF ACCELERATING THE FORMATION OF SCIENTIFIC AND TECHNOLOGICAL CADRES, INCLUDING TEACHING STAFFS

K/25 Cameroun (F), R. Le Faou, Specialized training as a means of speeding up the formation of scientific and technical cadres, including teaching personnel

K/32 FAO (S), A. Chaparro, The training of technical and scientific personnel for agricultural development

K/38 France (F), H. Baïssas, J. Debiesse, The training of personnel for research into and application of, nuclear energy

K/39 Nigeria (E), A. Taylor, The selection of personnel for science and technical training

K/48 France (F), F. Ciolina, Evolution and adaptation of the teaching of tropical agriculture

K/49 France (F), R. Rocoffort, Staffing of air transport services

K/54 USSR (R), A. I. Narkushevich, Forms and methods of training modern elementary and secondary school teachers in colleges of the USSR

K/56 Ukrainian SSR (R), N. S. Kurbatova, System of training scientific and engineering cadres in off-work hours

K/59 Ivory Coast (F), G. Riou, Training of soil surveyors on the Ivory Coast

K/61 Ivory Coast (F), A. Anghui, The importance of agricultural training in the development of the Ivory Coast

K/66 Cameroun (F), A. Ficatier, Training of statisticians for under-developed countries

K/71 USSR (R), B. A. Kuzmin, Medium-level technical training in USSR

K/80 Brazil (E), W. O. Cruz, Education of the above-normal child as an effective cultural process in countries of incipient industrialization

K/85 USA (E), W. Ellis, Specialized training for the improvement of secondary school teachers in science and mathematics

K/91 Japan (E), T. Inumaru, Specialized training as means of accelerating the formation of scientific and technological cadres including teaching staffs

K/93 USA (E), A. S. Skapski, Specialized training for developing basic scientific and technological cadres in developing countries of Africa

K/98 USSR (R), N. M. Javoronkov, System and methods of training engineering and scientific personnel for chemical industry and allied branches of industry and science

H/10 Finland (E), L. Törnqvist, How to cope with the urgent need for statistical services in developing countries

THE PROGRAMMING OF SCIENCE AND TECHNOLOGY WITHIN THE EDUCATIONAL STRUCTURE

K.2.1. SCOPE AND PLACE OF SCIENCE AND TECHNOLOGY IN GENERAL EDUCATION

K/21 India (E), A. C. Joshi, Scientific and technical education at the elementary and secondary levels

K/30 Ghana (E), F. A. Kufuor, Scope and place of science and technology in general education

K/36 Brazil (E), J. Reis, Scope and place of science and technology in general education

K/92 USA (E), H. C. Kelly, Principles and policies for developing a comprehensive program for improvement of science education

THE PROGRAMMING OF SCIENCE AND TECHNOLOGY WITHIN THE EDUCATIONAL STRUCTURE

K.2.2. SPECIFIC NEW APPROACHES TO EDUCATIONAL PROGRAMMING IN PRIMARY AND SECONDARY EDUCATION

K/2 Ghana (E), B. H. G. Chaplin, Specific new approaches to education programming in primary, technical and secondary schools

K/31 France (F), H. Pieron, Importance of early training for the formation of cadres in less-developed countries

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K/37 Japan (E), K. Nishimura, Specific new approaches to educational programming in primary and secondary schools

K/47 Holy See (F), R. P. M. Queguiner, Planning requirements for secondary education in a traditional society in process of rapid development

K/62 Argentina (S), A. Valeiras, Mathematics and science curricula for secondary schools

K/76 Switzerland (F), J. Piaget, The importance of psychopedagogy based on the psychological development of the child

K/78 Italy (F), A. Lorenzetto, World literacy campaign

K/86 USA (E), J. R. Mayor, Programs for the improvement of primary school education in science and mathematics

K/88 USA (E), B. C. Dees, Programs for the improvement of secondary school education in science and mathematics

K/89 Italy (E), C. d'Elia, Results of the experiment of the roving unit of physics in high schools of Sicily

K/96 Italy (E), C. A. Cavalli, E. Cavallaro, Training of scientific and technical cadres, involving teaching staff, in Italy

THE PROGRAMMING OF SCIENCE AND TECHNOLOGY WITHIN THE EDUCATIONAL STRUCTURE

K.2.3. SPECIALIZED PROGRAMMING FOR TRAINING AT TECHNICAL SCHOOLS, HIGHER TECHNICAL INSTITUTES AND UNIVERSITIES

K/4 Uruguay (S), J. L. Sala, Vocational training and its relation to general education

K/8 Netherlands (E), W. Schermerhorn, Specialized training as a means of accelerating the formation of scientific and technological executives, including teaching staff

K/9 United Arab Republic (E), A. Shoeb, Specialized programming for training at technical schools, higher technical institutes and universities

K/10 Israel (E), S. Irmay, Training of engineers in Israel

K/11 United Arab Republic (E), S. A. Huzayyin, The structure of a modern university, with special reference to the University of Assiut

K/12 Czechoslovakia (E), A. Boháč, Training of medium technical staff

K/13 Indonesia (E), R. M. Soemantri, Training of scientific and technical personnel: the affiliation between the Institute of Technology, Bandung, Indonesia and the University of Kentucky, Lexington, USA (under aid sponsorship)

K/17 UK (E), S. Mackey, An integrated approach to technological education and training in less developed areas

K/18 Brazil (E), J. P. Gorecki, J. T. Senise, Some problems of engineering education in developing countries

K/19 Brazil (E), A. S. Teixeira, The University of Brasilia

K/23 Hungary (F.), J. Hollo, The training of technical cadres for the food industries

K/28 India (E), G. K. Chandiramani, G. K. D. Wantling, Exchange of personnel in education

K/29 Turkey (E), M. Dikmen, Civil engineering education and the profession of the civil engineer as a social factor

K/34 Venezuela (S), R. A. Martinez, Training of specialized personnel and its significance for industrial development

K/46 Japan (E), T. Inumaru, Specialized programming for training at technical schools, higher technical institutes and universities

K/52 Holy See (E), T. M. Hesburgh, The total role of the university in the development of less-developed countries

K/55 USSR (R), A. F. Shebanov, The experience of the higher educational institutions in the USSR and RSFSR National Republics which had no educational facilities before the revolution

K/57 France (F), L. Capdecomme, The orientation towards the promotion of higher technical studies at French Universities

K/58 France (F), G. J. Bretones, Study of agricultural and rural teaching reform in less-developed countries

K/60 Yugoslavia (F), V. Popovic, Specialized teaching programmes in technical schools, high schools and universities

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

K/65 Mexico (S), A. Barrera, The place of schools and technical institutes in the state educational system of Mexico

K/67 France (F), L. Weil, A short course of higher education: the diploma of Higher Technical Studies (D.E.S.T.)

K/68 Brazil (E), J. Leite Lopes, The need of scientific training for engineers: problems and prospects in Brazil

K/70 Ukrainian SSR (R), U. N. Dadenkov, The development of higher and secondary special education in the Ukrainian Soviet Socialist Republic

K/72 Mexico (S), A. Gamboa Avitia, R. Pesquera Velazquez, Training of geologists, mining engineers and technical assistants

K/73 USSR (R), V. Belkin, Vocational and technical education in the USSR

K/81 France (F), J. Durand, Training and source material for town planning

K/82 Argentina (S), M. Sadosky, Changes in the structure of traditional universities—the study of a case in Latin America

K/99 USSR (R), A. D. Alexandrov, System of university education and methods of training university specialists in the USSR

THE PROGRAMMING OF SCIENCE AND TECHNOLOGY WITHIN THE EDUCATIONAL STRUCTURE

K.2.4. TECHNIQUES OF COMMUNICATION AS TECHNOLOGICAL TOOLS OF EDUCATION TO MEET THE SPECIFIC PROBLEMS OF DEVELOPING COUNTRIES

K/15 France (F), R. Gineste, C. Chicot, Television in the service of rural education

K/22 Chile (S), H. Poblete Varas, Communications and audio-visual systems in rural education

K/27 Portugal (E), A. C. Leónidas, Audio-visual aids in Portuguese primary instruction

K/33 Morocco (F), M. Mustapha, Audio-visual appliances in basic education and occupational training

K/45 Brazil (E), P. J. Pardal, Audio-visual aids used in the courses for training industrial technicians in methods of organization for increased productivity

K/50 Spain (S), H. Escolar Sobrino, Communication systems as a technological means of education to combat the concrete problems of countries undergoing development

K/51 Japan (E), S. Ogawa, Techniques of communication as technological tools of education to meet the specific problems of developed countries

K/75 UNESCO (E), R. Maybury, New teaching techniques in science especially for the developing countries

K/77 Italy (F), S. Fe D'Ostiani, P. Balbo, New training methods in rural areas

K/87 USA (E), T. J. Wilson, W. E. Spaulding, D. C. Smith, Jr., Books and economic development

K/90 Italy (F), F. Cosentini, Television as an aid to vocational guidance

REPORTS OF THE RAPPORTEURS

Symbol and title of report

B. HUMAN RESOURCES

RR.1 (B) Population trends

RR.2 (B) Human resources

RR.9 (B) New systems of vocational training and apprenticeship

RR.14 (B) Sound management and management development as a factor in technological progress

RR.22 (B) Techniques of manpower assessment. Forecasting the requirements and priorities of numbers and types of scientists and technologists

RR.32 (B) Employment implications of the application of science and technology in less developed areas

RR.33 (B) The application of science and technology to conditions at the workplace

Symbol and title of report

K. TRAINING OF SCIENTIFIC AND TECHNICAL PERSONNEL

RR.39 (K) Communication as tool of education to meet the specific problems of developing countries. Educational services

RR.43 (K) Specialized training at technical schools and means of accelerating formation of scientific and technological cadres including teaching staffs

RR.78 (K) Training of scientific and technical personnel

RR.79 (K) Specialized programming for training at higher technical institutes and universities

RR.82 (K) Scope and place of science and technology in general education. Specific new approaches to educational programming in primary and secondary education

PAPERS CITED IN THIS VOLUME BUT PERTAINING TO SECTIONS A, C, D, I, J, L

GENERAL SESSIONS

Symbol (E/Conf.39/...), contributor, original language, author(s) and title

I. ORGANIZATION AND PLANNING OF SCIENTIFIC AND TECHNOLOGICAL POLICIES

I/27 UNESCO (E), V. Kovda, The role of science in the development of natural resources

L. COMMUNICATIONS

L/12 United Kingdom (E), J. Scupham, Educational services

L/25 UNESCO (E), Wilbur Schramm, New uses of mass communication for the promotion of economic and social development

SPECIALIZED SESSIONS

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C. AGRICULTURE

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