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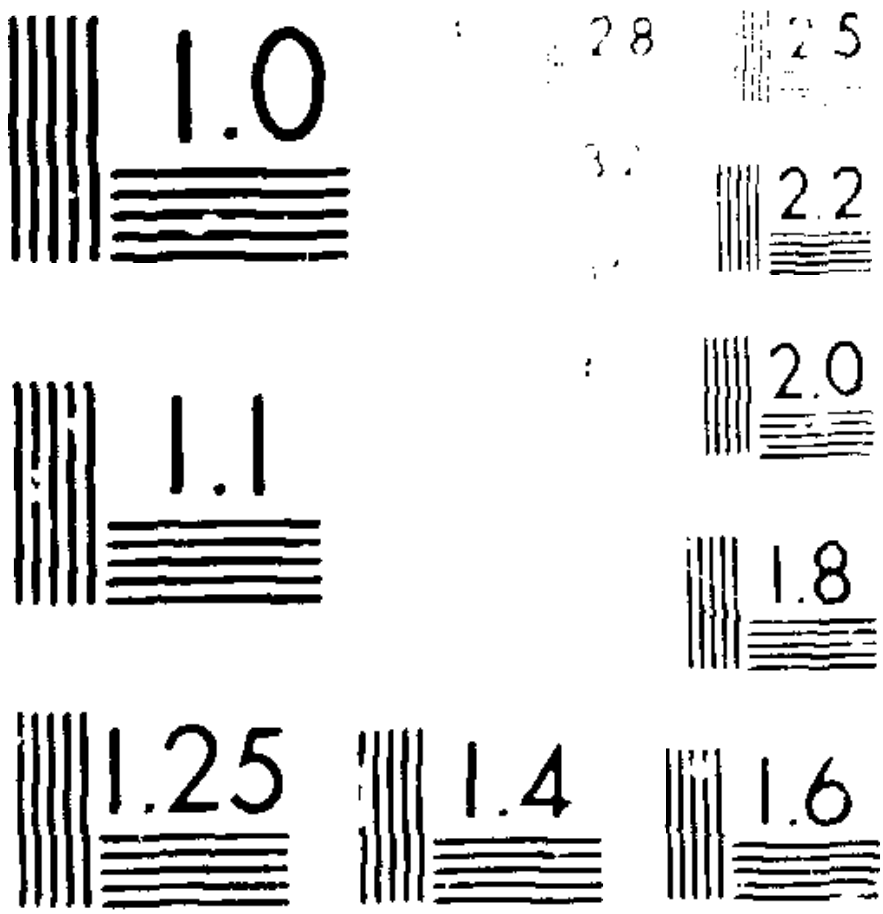
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UNITED NATIONS INDUSTRIAL
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ELEMENTS OF SOME NATIONAL POLICIES FOR BIO-TECHNOLOGY *

Note by the secretariat of UNIDO

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I. Introduction

Today the world regards biology as vitally important to industrial success as physics was some fifty years ago. The introduction of key concepts from mathematics, physics, chemistry and engineering into biology has produced new technologies that have potential applications in a wide variety of economical activities. Biotechnology is the term used to describe several techniques which can be used to improve many industrial and agricultural processes, to develop new chemical and pharmaceutical products and to produce food and energy from renewable resources.

There is a general consensus of opinion that the next two decades will witness the "Bio-technological Revolution" in many industrial sectors; the potential benefits of bio-technology are frequently compared to those achieved with the application of physics in the development of electronics and modern communication technologies. The reader is referred to the well documented reports which appeared recently in the United States of America,[1/] as well as to that prepared by the UNIDO secretariat,[2/] for a detailed evaluation of the opportunities offered to both developed and developing countries by microbial processes and applied genetics.

Prompted by these prospects, some developed countries are elaborating National Plans of Action designed to co-ordinate research efforts, educational programmes and industrial initiatives related to bio-technology. For this purpose, several Governments have set up special Task Forces and Scientific Committees for the preparation of reports containing the basic elements of decision-making necessary for the establishment of national policies and priorities. A summary of the main guidelines issued by several developed countries is provided below.

1/ "Microbial Processes: Promising Technologies for Developing Countries", 1979. Report of an Ad Hoc Panel of the Advisory Committee on Technology Innovation, Board on Science and Technology for International Development, Commission on International Relations, National Research Council, National Academy of Sciences, Washington D.C.;
"Impacts of Applied Genetics, Micro-organisms, Plants and Animals", 1981. Office of Technological Assessment (OTA) of the United States Congress, Washington D.C., USA 20510.

2/ "The Potential of Microbiology on Developing Countries", prepared by Prof. Carl Göran Hedén, Karolinska Institute, Stockholm. UNIDO/IS.261, 27 November 1981.

II. Overview and Scope of Bio-technology Developments

The strength and potential of bio-technology, as a significant factor contributing to the economic exploitation of living systems, stems from recent interdisciplinary advances in basic sciences as they relate to biology. The establishment of this broad, interdisciplinary science base, has constituted the grounds for the development of novel techniques that make feasible the various applications representing a whole range of industrial opportunities. Thus, fundamental research in specialized areas of biology provides a continuous source from which those techniques have emerged and hence, Research and Development Programmes on Bio-technology are on the borderline of "basic" and "applied' research. On the other hand, because of the unique conditions in each country where bio-technological processes may be implemented, careful feasibility studies must be performed, in a case-by-case fashion, in order to quantify indigenous needs and resources.

III. Establishment of National Policies and Priorities in Developed Countries

To realize the potential of bio-technology, several developed countries give priority to three main issues. These are:

(a) Education in basic sciences and training in specific skills;

(b) Stimulation of industrial initiatives via financial support;

(c) Improvement of communication channels among institutions involved (industry, research organisms, universities and governments).

The need for development plans at the national level was determined by the absence of established educational strategies and by the lack of co-ordination among existing resources, national goals and research efforts. Bio-technology needs both specific university centres and suitably trained manpower. However, current bio-technological efforts are characterized by a wide scattering of research activities in universities and other specialized institutions. This circumstance makes difficult the growth of an industrial sector based upon bio-technology and hinders the successful realization of its potential. There appears to be general agreement in that the creation of Centres of Excellence

in bio-technology would be the best way to provide the necessary supporting scientific and technological infrastructure. Similarly, the need for international co-operation is generally expressed.

The following are excerpts from the reports elaborated in several developed countries by their ad hoc committees.

1. Canada

The Report of the Task Force on Bio-technology (TFB) to the Minister of State for Science and Technology[3/] recommends that the Federal Government should signify its commitment to bio-technology by establishing a ten year National Bio-technology Development Plan with a long-term development strategy. US $33 million is suggested for the first year of the Plan allocation, and this will rise to an average annual expenditure of US $50 million over the lifetime of the Plan.

(a) Education and Training

The Canadian TFB considers that bio-technology will develop and mature only if built on a firm interdisciplinary science base. Thus, for the universities, it is recommended that for 1981-82 the budgets of the Natural Sciences and Engineering Research Council (NSERC) and the Medical Research Council (MRC) be increased by US $4.7 and US $2.0 million respectively. These Councils are encouraged to use these additional funds to foster a team approach to research, thereby focusing the effort on national goals, encouraging interdisciplinarity and leading to the eventual recognition of bio-technological Centres of Excellence. Additional US $2.3 million should be allocated during 1981-82 of the National Research Council.

The training and acquisition of appropriate skilled people should also be encouraged both by the NSERC and the MRC; for this purpose, in addition to existing allocations, both organisms should receive US $4.4 million which will be used on graduate training inside Canada and to provide industrial post doctoral support tenable outside Canada; this later programme was considered to require a return clause signed by all interested parties.

3/ "Bio-technology: a Development Plan for Canada". Minister of Supply and Services, Ottawa, 18 February 1981.

(b) Industrial Stimulation

To create the appropriate climate for industrial growth in bio-technology, the Canadian TFB recommends the establishment of tax credits both for current industrial R and D expenditures and for new investors.

To encourage small and medium-size bio-technological industries, direct government assistance is recommended in the form of an additional US $6 million in 1981-82 to the Canadian Enterprise Development Programme of Industry, Trade and Commerce.

To promote effective transfer of bio-technological advances from government laboratories to the private sector, it is recommended that US $6 million be added to current budgets intended for these purposes.

(c) Co-ordination of the Plan

The Canadian TFB recommends the establishment of a Bio-technology Research and Development Panel to oversee the resource allocations of the Plan and to provide advice on bio-technology to all sectors. Industrial representation should be a major element in the Panel's composition.

2. United Kingdom

A Joint Working Party (JWP) formed by the British Advisory Council for Applied Research and Development, the Advisory Board for the Research Councils and the Royal Society issued a report[4/] in March 1980 which reviewed the existing and prospective science and technology relevant to industrial opportunities in bio-technology. The JWP recommended action by Government or other bodies in order to facilitate British industrial development in bio-technology. The British JWP found that "What is required at this stage is a policy of 'technology push' reflected in a firm commitment to strategic applied research. This will progressively produce potentially marketable products and processes and the policy should then be for a more 'market pull' approach."

4/ Bio-technology. Report from a Joint Working Party. Her Majesty's Stationery Office, London, March 1980. Responding to this report, a White Paper on Bio-technology was presented to the Parliament by the Government in March 1981 (Her Majesty's Stationery Office, London, March 1981).

(a) Education and Training

Although the JWP did not support the establishment of new government research centres for bio-technology, they recommended a better use of existing ones. In particular, it was emphasized that the University Grants Committee, the Research Council and the universities should consider essential that a limited number of Centres of Excellence in bio-technology be built up in universities from the best existing in the field. A minimum of 20 new teaching and research posts, they recommended, should be created over the next five years, with a capital investment of around £2 million, to provide adequate laboratory facilities. Similarly, the Departments of Education and Science and the Department of Employment, in conjunction with other bodies, should provide means to obtain adequately trained work forces for this task, the promotion of a greater interaction between departments and undergraduate courses in the biological, chemical and engineering sciences was recommended. Collaboration in postgraduate training should be fostered between universities, research councils and industry. For instance, collaborative arrangements with industry at the post-doctoral level could be promoted by encouraging the use of industrial funds to support research workers from industry working in Research Councils and/or university laboratories.

(b) Industrial Stimulation

The British JWP found that it was necessary to make a concerted approach involving government and industry in order to provide the coherent framework and mechanisms needed for the successful development of bio-technology and industries based on it.

They proposed also actions in the fiscal policy concerning strategic research initiatives.

Industrial and trade organizations such as the Confederation of British Industry, the Association of the British Pharmaceutical Industry, the Food and Drink Industries Council, the Chemical Industries Association, should actively seek to identify opportunities for advances in bio-technology in the fields of potential interest to their members. However, it was felt that the task to stimulate research in areas of industrial interest could not be accomplished by the private sector alone.

It was suggested that public finance could be used to establish a research oriented bio-technology company similar to the ones appearing in the United States. This initiative should be sought by entities such as the National Enterprise Board in conjunction with the National Research Development Corporation, and a sum of £2 million annually for five years was assumed to be adequate to establish the scale of further investments.

(c) Co-ordination of the Plan

The suggestions of the British panel in this respect are most emphatic. Thus, they pointed out the need to achieve better communication between market-oriented and science or technology-oriented institutions. It was suggested that Research Councils create a Joint Committee for Bio-technology to co-ordinate a coherent programme of bio-technology research. A minimum annual expenditure of £3 million was believed to be required. Furthermore, the British JWP recommended continued support (at an annual expenditure of £2.5 million, including existing projects) to programmes sponsored by several Government Departments; to co-ordinate the activities of these, an interdepartmental Steering Group should be created.

3. Other Countries

(a) United States of America

Several recommendations to the United States Congress can be found in the recent report issued by the Office of Technology Assessment (OTA). The following is of particular relevance:

(i) Establishment of a new Institute for Bio-technology and creation of interdisciplinary research groups within major universities:

(ii) Stimulation of industrial activities via tax reliefs and other fiscal actions:

(iii) Continued support to Federal Agencies already involved in bio-technology:

(iv) Funding of specific projects:

(v) Improve communications industry and research institutions.

The OTA report came out in the United States at a time when the number of private research corporations had proliferated to over a hundred. The usual pattern found in the establishment of these bio-technology enterprises was an association between researchers leading the field and venture capital investors. At later stages, large pharmaceutical, chemical, petroleum and food and agriculture corporations joined some of the most representative bio-techclogy enterprises. Thus, the OTA recommends that the US Congress allow proper legislation for the involved parties to follow their own dynamics and establish their own priorities.

(b) France

The eighth National Development Plan proposed a number of actions to develop a competitive industry in high-technology fields. Stimulus through fiscal measures, educational policies and improvement of communications among interested parties were also proposed in that Plan. It was pointed out that the creation of special centres to serve as intermediaries between industry and research institutions was a matter of priority.

The report also expressed the need to improve international co-operation.

(c) Japan

In Japan, the overwhelming majority of research in bio-technology is carried out by the private industry. Nevertheless, in 1976 the Ministry of National Education assigned 650 million Yen to research in selected topics of bio-technology and, in 1975, the Ministry of Industry and Foreign Trade had given 250 million Yen for similar purposes. This organism form a committee in 1975 that proposed a budget of 6,000 million Yen for a period of five years to be distributed over 200 different specific projects of R and D in bio-technology.

It was noted that in Japan there has been a rapid proliferation of bio-technological enterprises. Furthermore, some of the leading American companies are proceeding towards establshing bio-technological enterprises in Japan.

(d) Federal Republic of Germany

A similar financing strategy (i.e. project-oriented) to that of Japan is observed in Germany (Federal Republic). In a National Plan elaborated for the period covering 1979-1983, it was proposed that there should be a progression of budgets for each calendar year so that by 1982 Germany (Federal Republic) would be spending DM 53 million in project financing and DM 17.1 million in funds provided for three selected research institutions.

IV. Summary and Conclusions

The basic elements that integrate most national policies for bio-technology in developed countries are the following:

(a) Education and training;

(b) Industrial input;

(c) Co-ordination of research and development activities, industrial interest and national goals;

(d) Creation of Centres of Excellence;

(e) Project-oriented financing;

(f) Promotion of international co-operation.

Underlying the above elements is the recognition of the vast industrial potential of bio-technology.