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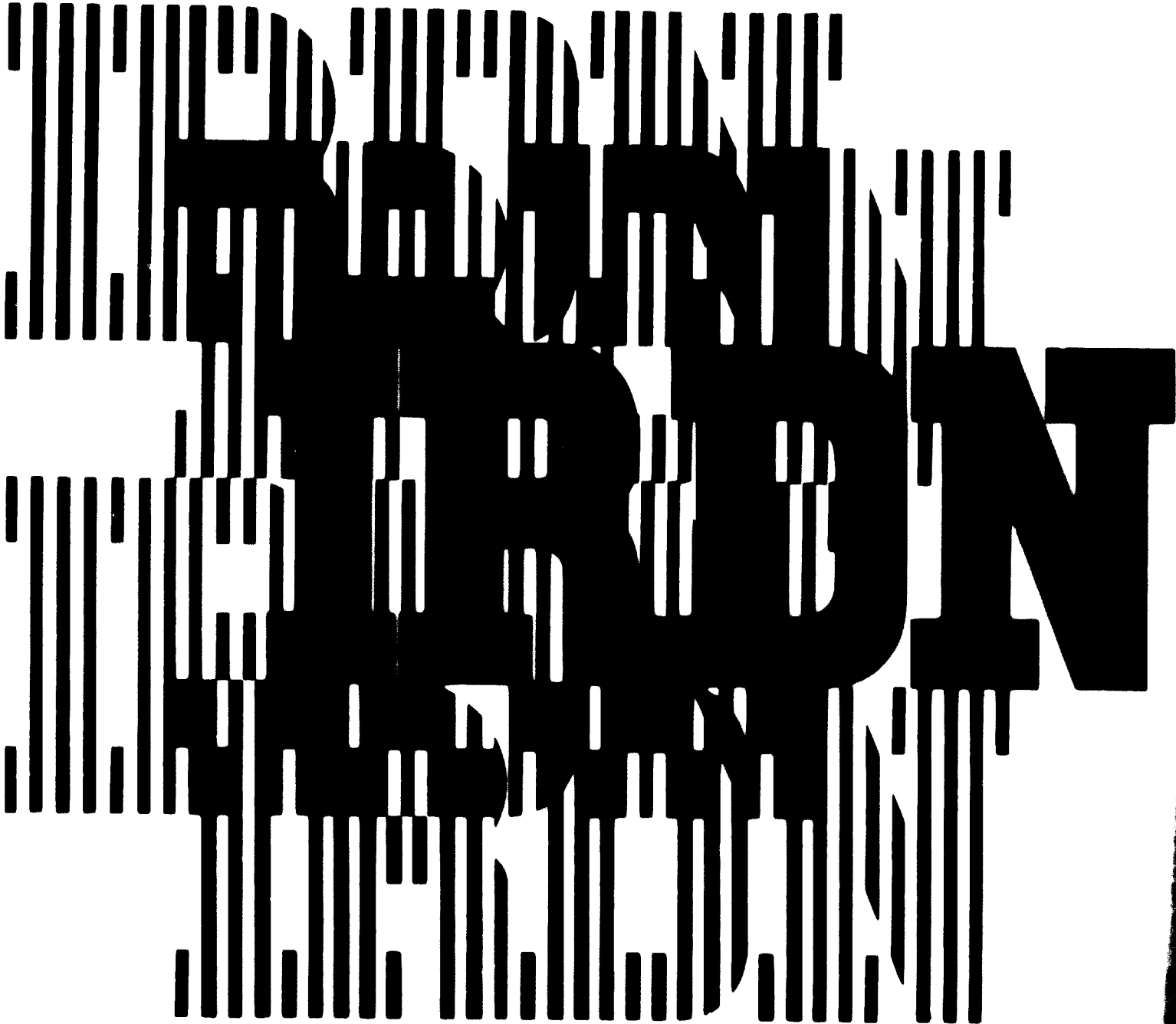
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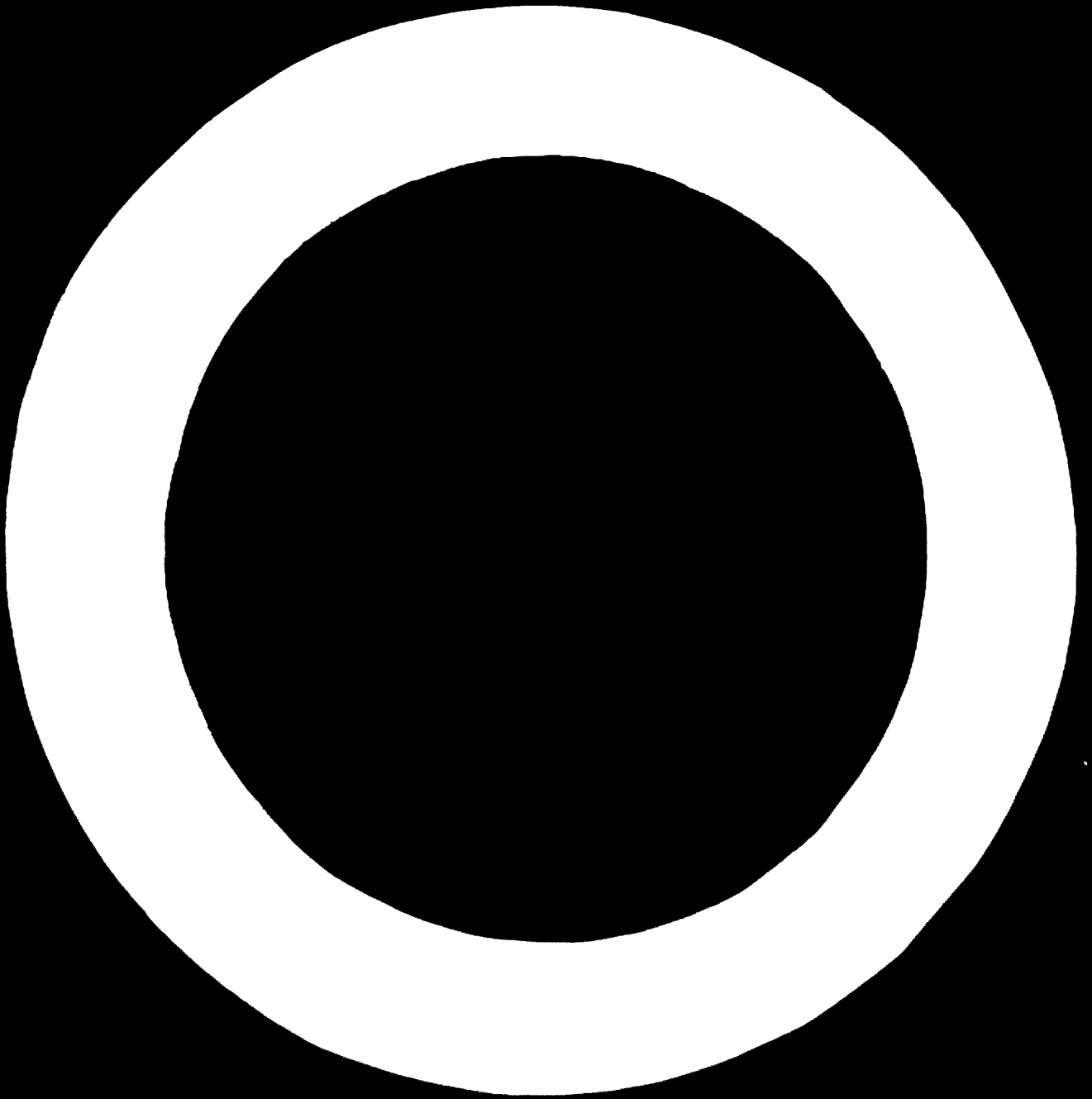
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# Industrial Research and Development News

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# A Suggested Research Policy for a Developing Country

By Harold K. Work

**D**EVELOPING COUNTRIES have certain characteristics that differentiate them from industrialized countries and that affect the pattern of their research and its priorities. In general these characteristics are:

- A depressed standard of living which they are trying to raise;
- An agricultural economy to which they wish to add an industrial economy;
- No realistic research programme, but a need to establish and execute one with all possible speed.

To realize these aims the administrative and legislative authorities of developing countries must show great determination and single-mindedness, calling only for those techniques that will ensure rapid progress. With this object in view, the following aspects of research will be considered: basic research, applied research, education, administration and planning.

## Basic research

Basic research consists of a quest for knowledge, motivated by curiosity, without regard for its possible use. Progress is guided solely by the individual researcher.



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The results are published and constitute a valuable international asset. The country that uses the knowledge is often but not necessarily the one that develops it. The world should be grateful to the basic researchers who have, in many instances, produced the foundation for modern technology.

When a developing country considers its own participation in basic research, however, the prospect is not financially attractive. Even should the research be financed from abroad it diverts scarce technical resources from immediate projects.

The belief that basic research is needed for prestige and that lack of it will label a developing country a "second class world citizen", is invalid. For example, in one of the most highly industrialized countries, two of its major segments, industry and defence, are both severely criticized for an insufficiency of basic research. The explanation for this deficiency is that both areas are under pressure for immediate results and cannot wait for the random progress of basic research. They turn, therefore, to applied research to produce quickly the required new knowledge. For similar reasons a developing country should rely at first on applied research to meet its requirements, postponing basic research until its economy has matured. It will, moreover, be gaining the highest immediate yield from its research funds.

It is recommended that each developing country should make an economic survey of its research activities. Such a study should be carried out impartially by a team that is neither committed nor opposed to basic research. The results would be of help, therefore, in decision-making regarding matters of research.

## Applied research

Applied research involves the application of knowledge, the development and application of new knowledge, or a mixture of both, to produce the technology required to supply the goods and services needed by society. The results are generally available but they must be bought. Developing countries have been paying for their foreign technology in various ways. It is possible that the purchasing of expertise may continue indefinitely, as is the case in several small developing countries. National pride, the desire to control the quality of products, and the need to adapt imported technology to local conditions, however, will eventually persuade the developing com-

munity to carry out its own research, if resources are available. Market demand for the results of its applied research will financially benefit the country undertaking the research and speed industrialization.

Adaptive research is likely to be the first type that applied research will follow. Though imitative, it can be constructive and most professions rely upon it. For example, a lawyer studies famous legal cases as a guide in the preparation of his briefs. Engineers used to make extensive use of handbooks to carry on their professional practice; today they refer to computerized data banks. Although the emphasis at present is on innovation, sound professional practice is a mixture of imitation and innovation. Imitation is undoubtedly the quickest and least expensive method that a developing country can choose to help to close the gap between itself and the advanced countries, and it is the method most commonly followed.

There has been a tendency recently to divide industrial research into two parts, aggressive and defensive. The first consists largely of innovation and is designed to secure for its sponsor a new development or breakthrough, thereby giving him an advantage over his competitors. Defensive research, on the other hand, is aimed primarily at keeping an organization abreast of competition and seems to be more extensive. For example, one of the large steel companies developed a new process for steelmaking and other companies adapted the method to their own requirements. This type of defensive research closely resembles adaptive research in a developing country. As progress continues, a larger degree of innovation can be incorporated in the programme.

After a country attains a substantial level of productivity, research is often generated by quality control activities. Failure to maintain international standards in its products is a sign that research is necessary. Many of the well-known research laboratories of industrialized countries are the outgrowths of quality control work.

Another source of projects for research is in the conversion of indigenous raw materials or waste products to support a new industry. In this instance each country has its own group of special materials to study, and those that can be utilized successfully will benefit the economy.

The type of thinking that regards basic research as the only source of new knowledge and criticizes applied research for its limited objectives requires a re-evaluation. With the advent of massive applied research projects, such as the development of nuclear weapons and landing men on the moon, a new factor has appeared. Both projects required the acquisition of a tremendous amount of new knowledge. The Surveyor studies of the moon prior to the lunar landing are a good example. There can be no question that this programme was far more extensive than the usual basic research and its effectiveness has been clearly demonstrated. Such applied research may initiate an era in the development of new knowledge.

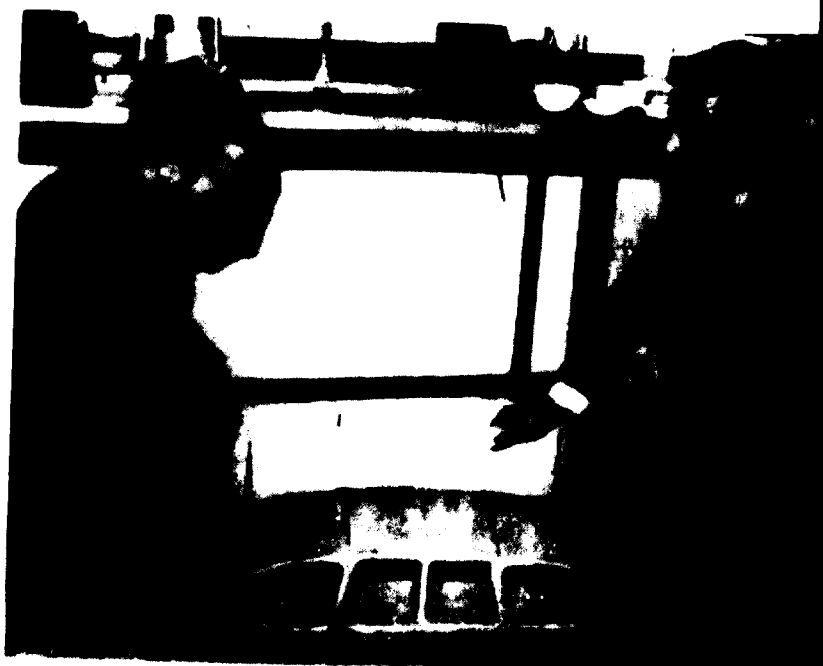
However, undertakings of this magnitude are completely beyond the reach of developing countries. To avoid disillusion, false optimism concerning the possible benefits of research must be carefully avoided.



**Resin washer developed with university co-operation**

The fact that a type of research is called applied is no guarantee that it will produce useful results. Indeed, at times research seems to be one of the fastest ways of losing money if it is not skilfully conducted with a practical aim in view. This has unfortunately occurred in developing countries, and detracted from successful ventures.

**Light-weight roofing block containing waste rice hull ash**



Instead of regarding research as an entity in itself, it should be considered part of an enterprise - a tool to advance progress. Without production and application, research amounts to little. It is almost necessary to have worked in industry to appreciate this situation, and many research policy-makers have not had that experience.

If the concept is accepted that applied research is just one part of the practice of agriculture, medicine and industry, then it becomes easier to understand such research and to do something to improve it. One effective way is to make strict economic or techno-economic studies of the individual projects and even of the over-all operation. In the latter case, studies should be conducted to determine if such research can, in fact, supply the technology needed for providing economically the required products and services, or if such technology could be more advantageously imported. The study should be based on the conditions presently prevailing in the country, then projected

students for the nuclear space age all too often sacrifice them to the brain drain. What is needed first is the training of a group of graduates who can run the agriculture and the industry of the country and provide good medical service. Once sound basic operations are established, the research will not lag behind. The early research workers must be trained practically so that they are capable of solving day-to-day problems. They must, moreover, be taught that their research is not complete until the results of it are put into use. In fact, they must learn to disregard the idea that their work is finished when a report has been written. This attitude is one of the major reasons for the inadequacy of much of the research done in developing countries. It fails to materialize. In industrialized countries this attitude is rarely held owing to the indoctrination of young workers by more experienced ones. When no group of trained workers exists, it is essential for the education system to provide the necessary instruction.



Industrial Research Laboratories of the Institute of Standards and Industrial Research of Iran (ISIRI)

into the future, before a decision is reached. If the decision is to continue to rely on research, then repeated reappraisals should be made to ensure that the work is carried out at maximum efficiency.

### Education for research

Education for research can determine in a large measure the speed of transformation of a developing into a developed country. This will include factors such as the quantity and the quality of the graduates, and the priorities of the system. The number and calibre of the graduates are standard educational problems, but extremely difficult to solve promptly. The priorities need careful selection. To prepare

Universities have traditionally regarded basic research essential for good teaching. This is one of the scientific observations usually not supported by facts and figures. It might perhaps be just as valid to declare that in a developing country the knowledge for teaching should be imported as is the technology for production. In considerations of sophisticated research in universities of developing countries, the question of scale must be kept in mind. A pooling of research programmes of several developing countries may provide a solution. In the meantime, scientists who prefer to engage in basic research may be willing to become involved temporarily in applied research. This changeover has been accomplished successfully in times of national emergency in such areas as nuclear energy, radar and electronic instrumentation. If



scientists in developing countries would recognize the premise that being a developing country should be considered an emergency condition and concentrate on the application of research, they would make an important contribution to the development of their country.

A very effective educational procedure in which training is shared by both the academic and industrial sectors is in-plant training. Students work for a scheduled period of time at a regular job in each of several plants under the instruction of plant supervisors and an academic professor. Graduates from such courses are readily assimilated into industry and have the advantage of being known to the personnel of plants where they have worked. Their job qualifications have already been assessed before employment is offered to them, and their introduction to working experience acts as a guide in their choice of fields of interest. A second similar process aimed at strengthening school-industry activity is to provide two-year courses at the college level to train plant technicians. Both types of training offer practical contributions to research by strengthening the infrastructure on which it is built.

### Administration

Administration of research consists of:

- Choice of projects;
- Selection of research personnel;
- Utilization of available scientific talent;
- Provision for research facilities and funds;
- Realistic programming;
- Integration of research results with the over-all objectives of the organization.

Although this appears to be a straight-forward task, it is complicated by the need to keep the programme flexible and to modify it constantly but still maintain a broad coverage.

Even a small country may have departments that include agriculture, medicine, commerce and industry, housing, city planning, transport, science, education and defence. Each of these interests must develop its own programme in accordance with its mission and will undoubtedly be involved in research. The amount and type of research and its required personnel should be decided on the basis of obtaining the greatest value from the investment made. At first the amount of high-quality research will probably be small, but it should increase when its application in one department proves profitable to the activities of other departments all of which will be competing for research funds to support their programmes.

A decision has to be made whether the over-all research of the country should be handled on a centralized or a decentralized basis. Centralized research would no doubt require the building up of a strong administrative and advisory service at the highest executive levels, which has become popular in developing countries. Although this approach would result in the promotion of research, it could be a contributing factor to the separation of research from its practical use.

Decentralization is widely used in the United States by the Government and by industry, and is often considered

to be a factor contributing to the effectiveness of research in this country. Decentralization avoids extensive duplication, friction and inefficiency and brings research into contact with reality. When such a policy is adopted, both the executive and legislative branches of a Government may need advisory services for interpretation and assistance in decision-making. To aid the functioning of research, an interdepartmental committee may be developed at the working level for the researchers from the various departments to share their problems and experiences. This committee could also co-ordinate and guide joint activities of one or more departments.

### Planning

To develop a successful schedule for a research programme, planning is necessary to provide guidelines. If the programme is sufficiently dynamic, considerable changes should take place within a few years. In the suggested schedule below, no time has been set for successive phases, as these periods will vary from one country to another. It should be recognized that the functions indicated cannot be sharply defined but may overlap to some degree. The plan merely identifies the progression by which the several procedures can reach their greatest potential. The over-all pattern shows an evolutionary growth of technical competence. Parallel to this growth of technology, there must be a similar advance in other areas to produce an industrialized country.

### A suggested schedule for the research programme of a developing country

#### Phase I.

1. Establish an agricultural programme based on the technology available and domestic experience;
2. Provide adequate medical services.

#### Phase II.

1. Adopt current technology;
2. Introduce quality control in industry and agriculture;
3. Organize an extensive education programme.

#### Phase III.

1. Conduct applied research to:
  - (a) Adapt foreign technology to meet local conditions;
  - (b) Resolve questions raised by quality control activities.
2. Begin production based on the country's own research.

#### Phase IV.

1. Initiate innovative research programme based on:
  - (a) Use of domestic raw materials;
  - (b) Use of waste products.
2. Establish an administrative structure for research.

#### Phase V.

1. Plan a basic research programme when the economy is sufficiently strong to support it.

# Major Features of the Second Development Decade and UNIDO's Contribution

**T**O HELP TO ENSURE a major economic and social development of developing countries during the 1970s, the twenty-fifth session of the United Nations General Assembly adopted resolution 2626 (XXV) concerning: International Development Strategy for the Second Development Decade. The Development Strategy will offer orientation to all UNIDO activities in the field as well as those at Headquarters. In this context, the Executive Director of UNIDO made the following statement to the Second Committee of the recent General Assembly:

"UNIDO will have to give full priority to the requirements of the developing countries as regards the preparation of their plans and projects for industrialization, the establishment of the necessary policies and instruments of implementation and the review and assessment of progress."

The quantitative objectives of the International Development Strategy require that developing countries as a whole should seek a 6 per cent average annual rate of growth in the gross product, with the possibility of attaining a higher rate in the second half of the Decade. The average annual rate of growth of gross product per head in developing countries as a whole during the Decade should be about 3.5 per cent. These targets imply an average annual expansion of 8 per cent in manufacturing output which means a marked acceleration. From 1960 to 1967 the average growth of the manufacturing sector in the developing countries was 7.3 per cent, but some countries did not achieve this rate.

The international community, the United Nations family and UNIDO in particular, have recognized that industry will be a most decisive and dynamic factor during the coming decade. Paragraph 76 of the International Development Strategy states:

"Developing countries will take parallel steps to promote industry in order to achieve rapid expansion, modernization and diversification of their economies. They will

devise measures to ensure adequate expansion of the industries that utilize domestic raw materials, that supply essential inputs to both agriculture and other industries, and that help to increase export earnings. They will seek to prevent the emergence of unutilized capacity in industries, especially through regional groupings wherever possible. Developed countries and international organizations will assist in the industrialization of developing countries through appropriate means."

Other goals and policies indicated by the Strategy in trade, employment, transfer of technology and external finance are also closely related to the development of a modern and dynamic industrial sector. It is evident therefore that special emphasis should be placed on industries that contribute to overcoming foreign exchange bottlenecks. Attention should be given to promoting export-oriented industries, and where feasible, intermediate and capital goods industries that provide a basis for future expansion.

As an important objective of developing countries is to prevent the emergence of unutilized capacity, industries that utilize domestic raw materials and industries that supply essential inputs for agricultural production, or that process farm output, will be given particular attention. Many developing countries will take further steps to develop engineering industries.

The issue of choosing the appropriate technology for industrial enterprises requires further investigation, in order to determine which technologies used by industrially advanced countries would have to be adapted for use in developing countries. The ultimate aim of developing countries should be autonomous research and development.

Industrialization and the development of agriculture are not alternative goals of development policy, but are complementary and mutually supporting processes. The slow growth of one of the two sectors may act as an obstacle to the development of the other. The establishment of viable agro-industries processing domestic agricultural

products, both for home and export markets, could be a very powerful instrument for modernization of rural areas.

The International Development Strategy gives special attention to the question of systematic scrutiny of the progress achieved in attaining the goals and objectives of the Second Development Decade. To this end, biannual and mid-decade reviews have been called for. Such appraisal would implicitly take into consideration actual achievement measured in quantitative terms. Shortcomings in achievements would be identified, positive measures recommended, and new goals and policies established as needed. The United Nations family is to participate in the appraisal activities. In order to avoid duplication, the organizations of the United Nations will focus their attention upon aspects of performance that fall within their area of competence and are best analyzed by them. At the regional level the Regional Commissions will assume the main responsibility.

### **UNIDO's contribution to the Decade**

In a sense the entire activities of UNIDO can be envisaged as falling within the framework of the objectives of the Decade. UNIDO will participate fully in development efforts inasmuch as the necessary resources are put at its disposal.

As to the preparation of the International Development Strategy, UNIDO has so far contributed only in a modest way because of its limited research facilities and stock of information about the projections of industrial development in different countries and branches of industry. UNIDO's activities related to the Second Development Decade have been carried out along the lines as defined in the statement of the Executive Director to the Preparatory Committee for the Second Development Decade during its third session; this statement took into account the resolution 24 (III) of the Industrial Development Board at its third session. In document ID/B/74, Review of Past Performance and Future Prospects of UNIDO, which was prepared for the Fourth Session of the Industrial Development Board, the Executive Director indicates:

"It will be noted that UNIDO does not envisage the establishment of a world plan for industrialization among its responsibilities under the Second Development Decade. While it is the task of UNIDO to keep under continuing review the developments in industry in the developed countries—inasmuch as they affect the progress of industrialization in developing countries—the pattern, rate of growth and policies of industrialization of the industrialized countries are entirely outside the terms of reference of UNIDO."

"As many developing countries will be entering more advanced stages of industrialization, new areas of assistance will be uncovered (e.g. in more sophisticated technology, advanced management techniques, supporting institutions for research, quality control and standardization). Thus UNIDO should be in a position to keep the programmes of assistance to developing countries under continuous review and to be adequately equipped to provide the necessary assistance."

As regards the survey and advisory missions, the Executive Director further indicates that they

"might be linked to the programme of interdisciplinary teams which is being set up by the United Nations, in co-operation with the regional economic commissions and UNESOB, to advise governments on planning, policies and implementation of the targets under the Development Decade, following General Assembly resolution 2563 (XXIV)."

Within the framework approved by the Industrial Development Board of UNIDO at its third and fourth sessions, activities will continue to be carried out at three levels: country level, sectoral level and over-all level. The activities of UNIDO will be pursued in close connexion with the Regional Economic Commissions and UNESOB and other interested agencies and will form part of the over-all UN system which will be designed for the implementation of the International Development Strategy.

### **At the country level**

Work at the country level will be based on direct and continuous co-operation with individual developing countries that express their wish to participate in this programme. The activities of all UNIDO Divisions will be involved as they are needed. Governments will be assisted in formulating long-term industrialization objectives, designing their strategy and policies, and setting up adequate systems of assessment, monitoring and follow-up for the industrial sector. Attention will be focused on: survey of past performances; formulation of long-term and medium-term industrial development plans and policies; and planning, evaluation, financing and implementation of projects. Consideration will be given to the development of export industries, technological aspects of specific sectors and projects, training, improvement of existing industries, and the establishment of adequate machinery.

The work at the country level will take into account the urgent need for industrial regional economic co-operation and will be supplemented, whenever requested, by similar activities with sub-regional institutions for economic integration. Close co-operation will be maintained in this respect with the Regional Economic Commissions of the United Nations Economic and Social Office in Beirut. A letter was sent to all developing countries in August 1969 indicating the programme of UNIDO and offering co-operation along the lines described above.

Activities at the country level are closely linked with UNIDO's planned appraisal and evaluation exercise. The ultimate aim of appraisal is to improve the capacity to manage and to control the development process at all levels by feeding back appraisal results into the planning and implementation processes. Appraisal of performances is to be viewed as a form of introducing rationality in the decisions related to industrial development.

Emphasis is put on assistance to developing countries in setting up machinery for the assessment and monitoring of their industrial performance during the Decade. In this respect UNIDO and ECAFE agreed on a joint co-operation

to be proposed to the countries of Asia. The review and assessment activity would be fully combined with advice on policies and technical assistance operations. At the same time, possible future technical assistance which can be rendered by UNIDO will be identified. These proposals for joint action by UNIDO and ECAFE were very positively received by the representatives of Asian countries at the Second Industrialization Conference held in Tokyo in September 1970. This programme of appraisal geared to the needs for technical assistance constitutes a major step towards harmonization of industrial activities in the region between UNIDO and ECAFE. It is expected that the conversations which have taken place between UNIDO and other regional commissions and UNESOB will lead soon to similar arrangements for other regions.

### **At the sectoral level**

In this exercise an assessment is being made on a pragmatic basis of the perspectives of development of individual industrial sectors in the 1970s. Although the nature of these studies requires the use of statistical techniques in projecting future developments, every effort is made to obtain direct information from the industry surveyed on actual projects that are planned for the Decade. The studies comprise projections on an individual country-by-country basis whenever practicable, analyse minimum plant sizes and economies of scale as well as capital and other requirements, pin-point areas where problems are likely to arise, indicate fields where the needs of developing countries can best be served by regional or sub-regional co-operation, and identify potential areas for technical assistance activities. Since the preliminary results are fed back to the developing countries, these studies have led to the establishment of a fruitful dialogue with the industrial sector of individual countries with beneficial effects on both UNIDO's assessment of their real needs and UNIDO's technical assistance operations.

"Perspective studies" for petrochemicals, textiles, fertilizers and automotive industries have been prepared and are scheduled for publication in 1971. Studies for the copper, tinplate, industrial machinery and steel industries are forthcoming.

### **At the over-all level**

Members of the United Nations family recognize their special responsibilities towards the Decade and in the discussions of the various bodies preparing for the Decade guidance of a general nature was offered; it is up to United Nations family members to consider their specific role and how to implement it.

UNIDO is prepared to identify and analyse problems of a general nature raised by the industrialization of the developing countries and will assist the countries in anticipating problems that may arise so that they will be prepared to meet them. This is to be achieved in two ways: by preparing projections of the industrial sector in developing countries, and then by undertaking special studies on specific points

in line with the recommendations included in the International Development Strategy.

The projections will provide a quantitative background of the situation of industry in the developing countries to serve as a reference for objectives, strategy and policy. The projections are expected to provide an open and flexible framework which could incorporate all estimates coming from the sectoral branch programme and from external sources such as regional commissions and UNESOB, UNCTAD and OECD. The UNIDO projections will be conceived in such a way that they could form part of a general system of economic projections of developing countries if the Secretariat of the United Nations decides to establish such a system.

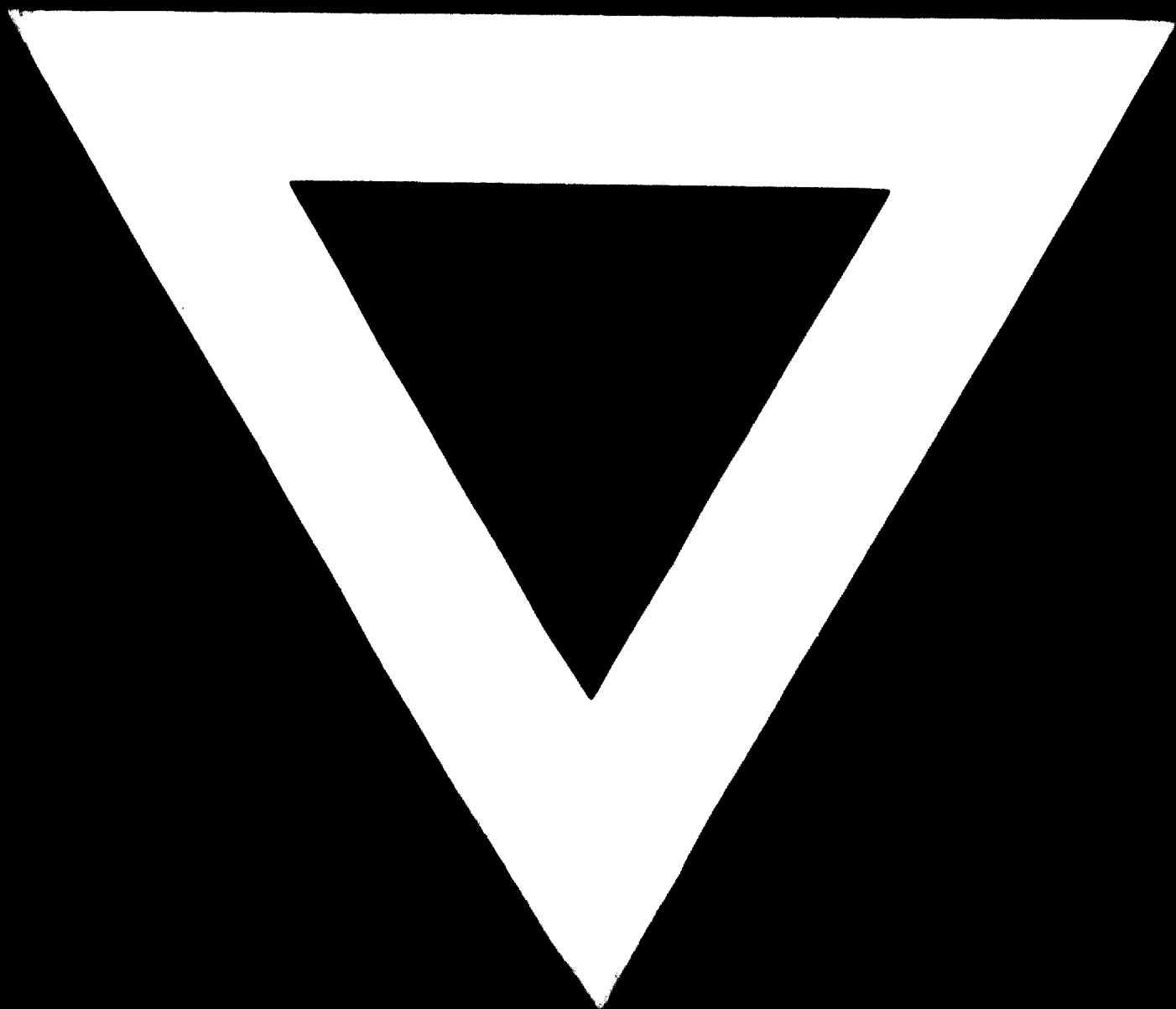
Special studies of a very practical nature have been designed to offer guidance for action to decision makers. The following three studies are currently in progress: Some Special Problems of Industrial Development of Smaller Developing Countries; The Effects of Industrialization on Manufacturing, Employment and Productivity; and Structural Changes in Manufacturing Growth. Another subject chosen for deeper examination is the relationship between industrial and agricultural sectors in economic growth, which will be carried out in co-operation with FAO as a contribution to the inter-agency programme to study the consequences of the "green revolution".

UNIDO is co-operating with ECE in a study to be presented at the Committee for Development Planning on the lessons to be drawn for developing countries from certain changes analysed by ECE in the structure of the European industrial sector and from European experience in industrial policies, industrial co-operation and long-term planning.

Parallel to work on projections and special studies, UNIDO will continue work on the design of the over-all system of assessment and monitoring of industrial progress during the Decade to be incorporated in the general system of assessment of the UN family. For this purpose, the periodic Industrial Development Survey, a task assigned to UNIDO, will put emphasis, in addition to the analysis of current trends, on evaluation of industrialization strategies and policy measures.

Effective efforts of industrialization along the broad lines as conceived for the Second Development Decade will draw heavily upon an attitude of partnership between the developed and developing countries a prerequisite that has been convincingly advocated in the Pearson Report, the Jackson Report, the International Development Strategy and the Report of the Committee for Development Planning.

While the main responsibility for development remains with the developing countries themselves, important contributions will be required on the part of industrialized countries to mobilize their resources and industrial experience to establish closer and more effective co-operation. Indeed, these issues and related problems are expected to be the subject of discussion during the Special International Conference of UNIDO to be held in the summer of 1971.



**74.10.17**