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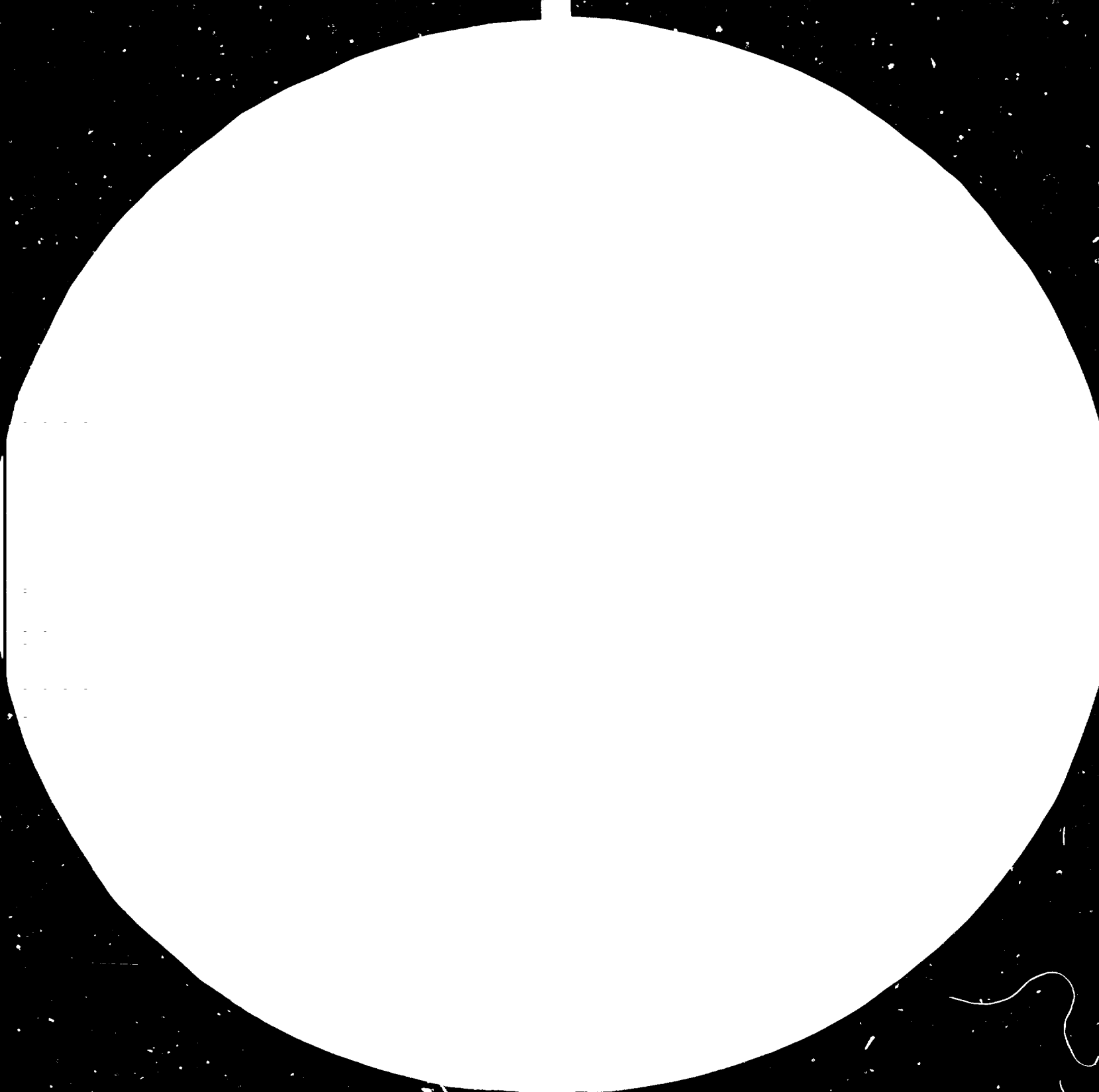

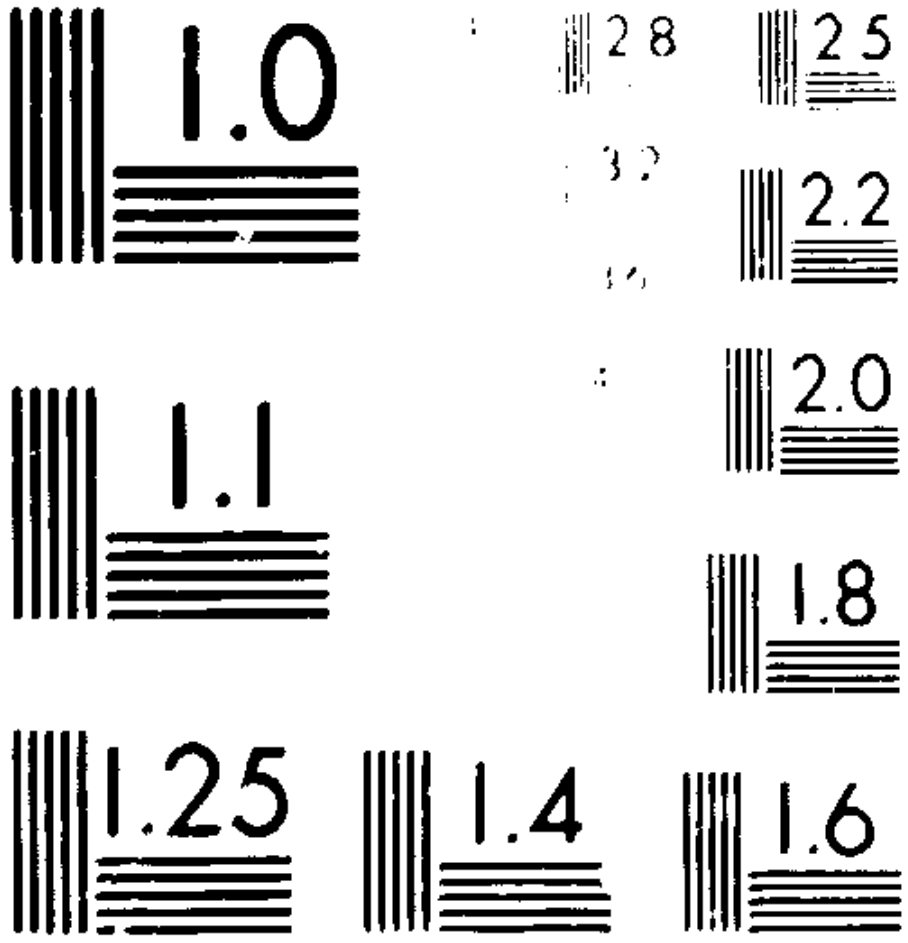

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RESPONSES OF DEVELOPING COUNTRIES TO TECHNOLOGICAL ADVANCES: SOME BASIC CONSIDERATIONS WITH REFERENCE TO BIOMASS AND PHOTOVOLTAICS*

prepared by

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1. The Dubrovnik Workshop is the logical outcome of a series of initiatives by UNIDO Secretariat in response to the challenges of the emerging technologies. Starting almost immediately after United Nations Conference on Trade and Development (UNCSTD) and over the last three years, UNIDO has commissioned a number of detailed studies of the likely promises and threats of these technologies. A number of expert group meetings, some at the regional level, culminated in the Moscow meeting which examined each specific technology in depth and addressed also policy issues. The Tbilisi "Forum on Technological Advances and Development" noted, in its review of preceding efforts, the need for "new perceptions and instrumentalities of action, both at the national and international levels and in particular the will and commitment of the policy makers at the highest levels". However, it has often been the case that when the policy makers were willing to take action, the specialists, who have been seeking the political will, failed to come up with appropriate action plans. It is hoped that our deliberations will prove useful in improving this anomalous situation that one meets often enough in developing countries. The Tbilisi Forum wisely states that facing the particular challenge of the technological advances will not be easy and cautions against starry-eyed optimism on the one hand, and self-defeating despair on the other.

2. The present workshop needs to bear in mind three important facts, that are of particular relevance to its deliberations, and two of which stem from the Tbilisi Forum. First, there is the fact that most developing countries are still grappling after decades of development effort with what have become almost endemic weaknesses and shortcomings in the institutions involved in integrating S&T with development. The danger is that, while the Workshop cannot but take this hard fact of life into consideration, it must not fall into the trap of diverting attention from the new challenges, or that of reiterating worn-out facts, diagnoses and remedies that have failed so far to leave an appreciable impact in the majority of developing countries. It needs to focus on the new features that have emerged on the scene. The second point that the Tbilisi Forum drew attention to was the variety of levels of development in developing countries and the differences among them in goals, priorities and resource endowments. The Forum suggested a broad typology of three main levels of development and spelt out the elements of a minimum competence for each level. The Workshop would do well to start by scrutinising this suggestion and refining these elements

since these are the main tasks that need to be undertaken by the institutions. Finally, it is obvious that it will be dealing with a variety of institutions, in a fairly complex structure, that shape the responses to technological advances. Granted that scientific-technological institutions, in general, and those more specifically oriented towards industrial research, in particular, are important in formulating responses, yet the role, capabilities and impact of other institutions involved (e.g. policy decisions, operational development plants, funding, education and training, etc.) can be decisive. In order that the net not be cast too far and wide and efforts spread too thin, it may be wise to concentrate on Professor Nayudamma's useful characterisation of the institutional subsystems of a total technology system. He lists institutions for:

(a) Goal setting
(b) Technology information intelligence and assessment
(c) Technology acquisition
(d) Technology generation
(e) Technology delivery and utilization
(f) Technology support services
(g) Technical manpower development
(h) Rural institutes
(i) Regional and international institutions.

With these concerns very much in mind, this note starts with a broad brush review of the status of activities in the two fields of energy from biomass and photovoltaic cells and moves on to highlight four issues considered of particular significance in this context.

3. UNIDO's "Directory of Industrial and Technological Research Institutes: Industrial Conversion of Biomass"[1/] lists 154 institutions worldwide. Of these 60 are in developing countries[2/]. Expenditure on biomass research in these institutions in 1981 ranged from a record high of US $ 5,000,000 in one institution in Brazil to a mere pittance of US$ 5,000 in an academic establishment in a West

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1/ UNIDO/IS.372, dated 24 February 1983

2/ Seventeen institutions are in NIC's. These are in all probability the most significant ones, to which has to be added two or three more from countries like the Philippines, Egypt and Costa Rica.

African State. In only seventeen cases has the reported expenditure in that year reached or exceeded US$ 100,000 3/. Only three institutions, or 5 per cent of the total in developing countries, have filed patents in the field 4/. The one data bank listed is not in a developing country. One basic problem in dealing with biomass which is not yet receiving the attention it deserves in developing countries is the formulation of a national biomass utilization policy. Not always is there the fundamental trade-offs between food and energy; but recent technological developments in chemistry and biotechnology indicate a large variety of alternative uses. The UNIDO report on biomass to the Moscow Meeting 5/ lists four resource bases for biomass and seven conversion technologies. A recent Battelle Memorial Institute report 6/ gives a much broader perspective of possible developments and applications. The products that could be obtained from biomass exceed fifty. Furthermore, little attention seems to have been paid so far to developing the resource base in developing countries, even though most of them lie in the "sun belt" region of the planet.

4. Information on institutions involved in photovoltaic activities is scarce and very sketchy. UNIDO's "Directory of Solar Research Institutes in Developing Countries" 7/ lists eighteen institutes involved in photovoltaic conversion. No information is available of their ongoing work or areas of interest. However, the general impression is that not much attention is paid to the formulation of energy system models representing typical situations in developing countries and investigating their techno-economic viability and social impact.

5. The available information on these two areas, although incomplete in coverage and in depth of analysis, does lead strongly to the conclusion that, with few exceptions, the activity level in developing countries in these two fields is far from being of any practical significance, even in the case of biomass where the basic resources are available and sometimes abundant and the need most pressing.

3/ Costa Rica, a small Central American State, claims expenditure totalling US$ 900,000 in 1981.

4/ Barbados, India and Nigeria.

5/ ID/WG.384/6, dated 7 February 1983.

6/ Battelle - Technical Inputs to Planning (B-TIP), No. 8.

7/ UNIDO/IS.341, dated 14 September 1982.

6. We now proceed to draw attention to four issues that seem to acquire a special importance in dealing with the technological advances. These are seen as:

- Technology assessment and forecasting
- Integration of socio-economic investigation and analysis with scientific-technological research
- Developing interdisciplinarity in R&D institutions
- Relating R&D to application on an economic scale at the right time.

The new technologies are, by definition, in a fluid state and are developing rapidly along several paths, the future prospects of which are not always clear. As mentioned earlier there is a large number of possible uses of biomass resources. The relative advantage of each has to be determined carefully on the basis of sound technological forecasting based on accurate and up-to-date information. The debate on the relative advantages of single crystal, polycrystalline, strip and amorphous silicon goes on with new claims being made every day. The use of alternative materials such as cadmium sulfide and gallium arsenide is being actively investigated and the outcome is far from being clear. Apart from keeping track of all such developments and sifting their true significance from the multitude of claims and counter-claims, an ability to look ahead and make reasonably reliable forecasts of future trends is basic to sound decisions on the points and modes of entry for any particular country. It is doubtful if such a capability could be built up in good time within a purely national framework. In drawing attention to this point, the Tbilisi Forum referred to the Caracas Plan of Action and the New Delhi meeting last year of the Heads of Science and Technology Agencies and the call to UNIDO to take into account and contribute to these initiatives. In this context, the proposal 8/ to establish consultative groups is well worth investigating in some detail, and the composition, operations and financing of such groups elaborated. In this context the deliberations and recommendations of the first ad-hoc panel of the Advisory Committee on Science and Technology for Development(ACSTD) on "Integrated Application of Emerging and Traditional Technologies for Development" held in Los Banos, the Philippines, December 1982, are also relevant. One of the five main recommendations concerns the proposed "Advanced Technology Alert System" (ATAS).

8/ ID/WG.384/2, dated 2 November 1982, page 11, para 22.

7. Next comes the issue of integrating socio-economic analyses and investigations with scientific-technological research. Most R&D establishments are still without a capability in socio-economic studies, except perhaps for some competence in pre-feasibility and feasibility studies that are mainly concerned with economics in general and profitability in particular. The impact of the new technologies on life styles, value systems, consumption patterns, population dynamics and employment are part and parcel of any worthwhile assessment of the repercussions of any local innovative development, adaptive effort or decision on technological imports. UNIDO report on biomass energy technology for example points out the need to examine "some very basic institutional factors such as land and industrial ownership, size of farm, etc". It also points out the many competing uses of biomass in its many different forms and the need to calculate the net energy balance of a particular technology and to reckon with the energy/agricultural self-sufficiency position of the country. The photovoltaics report recommends that in acquiring first-hand experience in pilot applications, the social problems have to be monitored, besides the purely technical and economics problems special attention was drawn to the community-based and the user-owned stand-alone systems as the ones of importance. The Los Banos report draws attention to the importance of anticipated improvements in purchasing power and the proper organization of social service facilities towards worthwhile pursuits and safeguarding against social problems resulting from improved economic and social mobility.

8. Related to this issue is the lack of experience in the planning and management of interdisciplinary research, even amongst technical specialisations, and the absence in most cases of "matrix" type operations suited to the environment of R&D institutions in a developing country. Most scientific-technological research personnel come mainly from academic backgrounds where such modes of operation are uncommon. This is a problem in developing capabilities in R&D management, ranging from the level of the top manager in an institution down to that of the individual researcher. The second ACSTD ad-hoc panel on "Human Resource Development for the Planning and Management of Science and Technology Programmes" held in Kuwait, January 1983, recognises the existence of certain essential differences in some aspects of S&T management between developed and developing countries and that there is little in the way of systematic knowledge in the field that has direct relevance to the situations in developing countries. The writer can confirm from personal experience in more than one Arab state that assembling an interdisciplinary team and managing it effectively can be a difficult experience

with lack of synergy and consolidation of efforts.
The need for interdisciplinary effort is more pressing when dealing with the new technologies than in the more classical situations. Discussions of the subject always stress the total system approach and the application of an integrated and systematic approach from the very beginning of operation in any field. Biomass production covers "a very wide field from the very simple and low cost to the very complex and large scale". "It is necessary to carefully match biomass energy production in its various forms with the different sectors of use". This is considered a "complex task and can only be tackled after detailed socio-economic and technical research'. The development of the engineering and technology of solar photovoltaic systems should consider "balance of system (BOS) components; and complete system engineering", and so on.

9. The final issue calling for attention of the Workshop is the absence of the "transmission belt" from R&D to application. Applied research takes the needs of society and identifies where concepts from science and engineering plus new knowledge from fundamental research can be used to formulate and prove feasible on a laboratory scale of new processes and products. Developmental research follows and develops these further into commercially viable processes or products. This may also involve improvements in existing processes and products to reduce costs, use raw materials, etc. In most developing countries the indigenous development research capability does not exist, nor is it easy to start and develop to a significant level. Developmental research is highly focussed and requires close association with the operational function. The personnel involved in it must have field experience and interact closely with operational personnel, i.e. they should be able to communicate both with the applied research and the operational personnel. The Tbilisi Forum notes that while the new technologies are more and more science-based and interdisciplinary, they are amenable to rapid translation into production processes, and that while the technology development may be sophisticated, application in many cases is relatively simple. No clear suggestions have emerged so far to fill this gap for the new technologies, even though it is considered by many as being more bridgeable than others. Incentives to involve the business community in such efforts through the provision of venture capital in technology development, joint development with the industrial base in the NIC's and even the industrialized countries may be practical venues for meeting this need.

10. In conclusion, it may be said that none of these issues is new and that we have fallen once more into the trap of reiterating known platitudes. The point, however, is that they are felt to acquire a high priority and an urgent character in any consideration of institutional and structural responses to the new challenges and hence the need for giving them special consideration in our deliberations.