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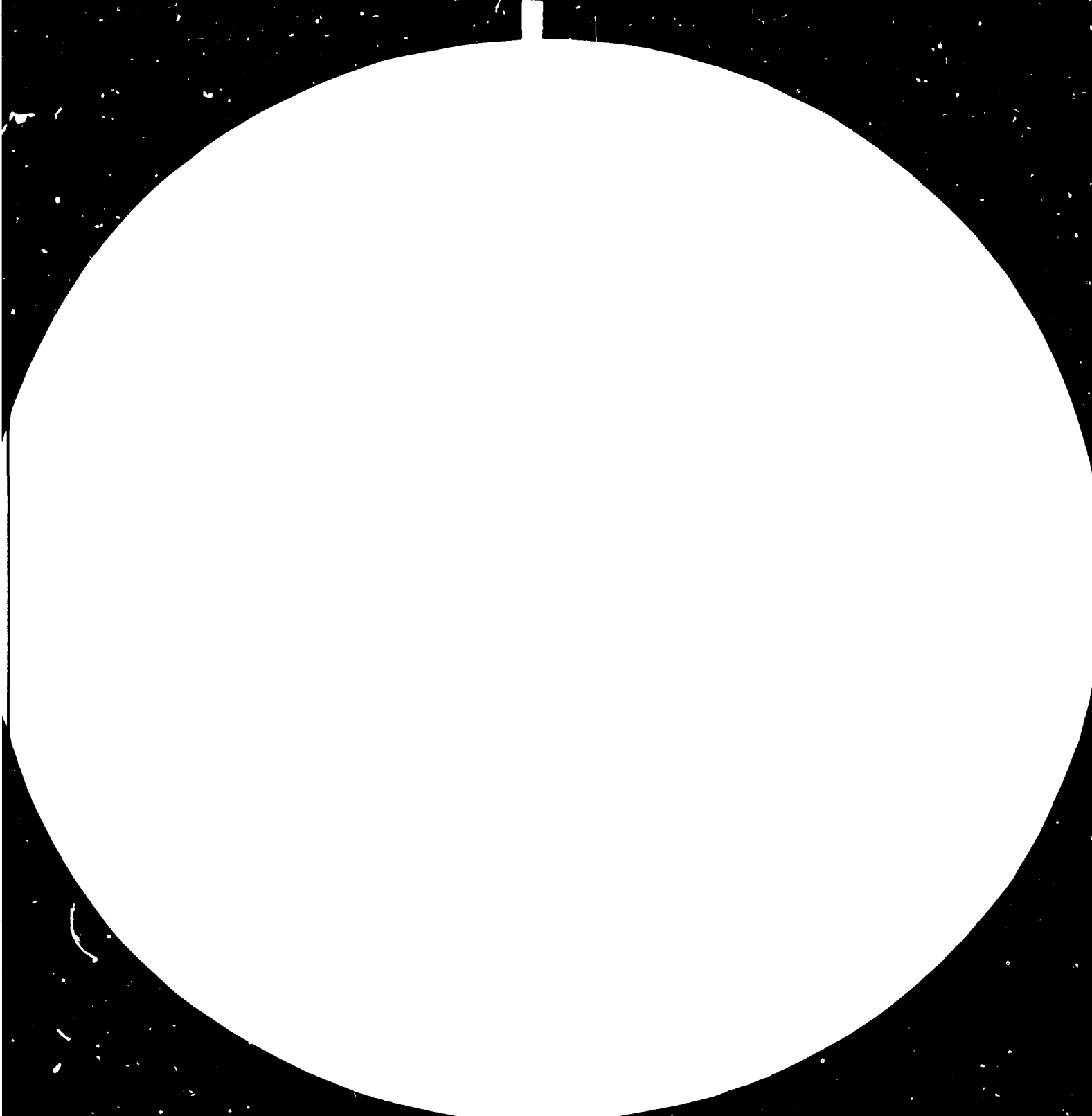

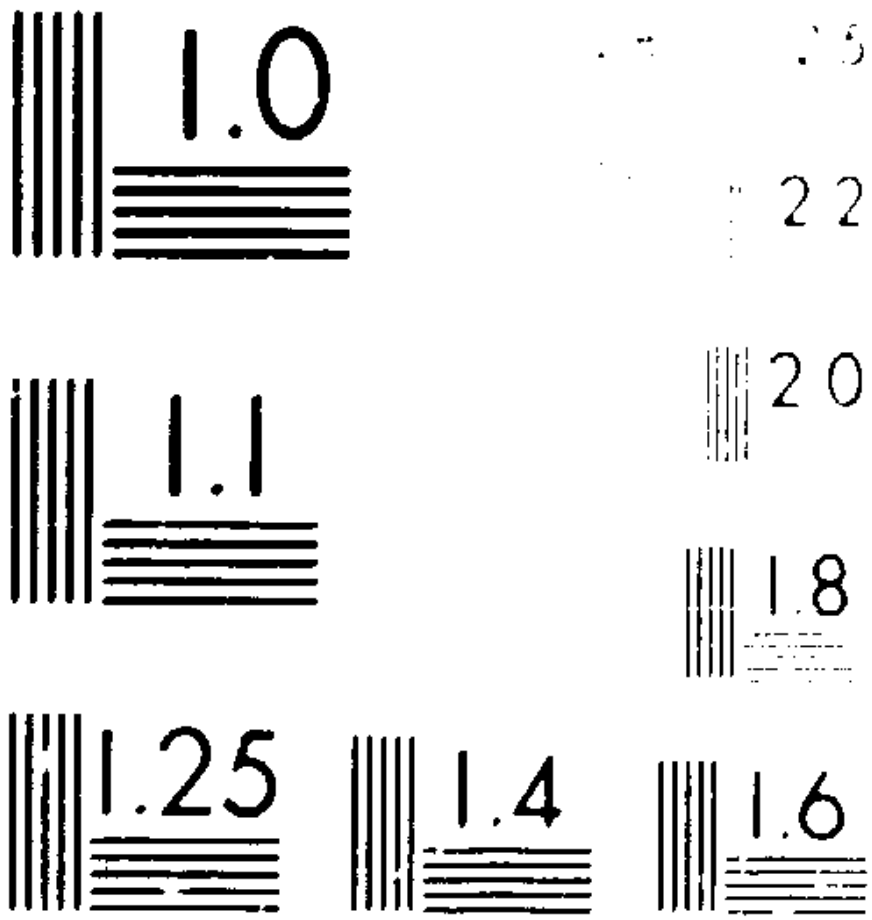
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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

EXCHANGE OF VIEWS WITH EXPERTS ON THE IMPLICATIONS OF GENETIC ENGINEERING AND BIO-TECHNOLOGY ON INDUSTRIALIZATION IN DEVELOPING COUNTRIES

Calcutta, 6 January 1982
New Delhi, 7-8 January 1982

R E P O R T *

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I. INTRODUCTION

A group of eminent experts in the fields of genetic engineering and bio-technology, together with development specialists of UNIDO's secretariat, went on a mission to India to exchange views with the scientific and industrial communities and high level policy makers. The meetings took place in Calcutta (6 January 1982) and in New Delhi (7-8 January 1982).

The programme and the list of participants and documents are in Annexes I, II and III.

II. CALCUTTA, 6 JANUARY 1982

1. Opening of the Meeting

In opening the meeting held at Calcutta, the Chairman of the meeting remarked that the main objective of the Bio-technology Board was to build national capabilities in this field. The Chairman welcomed UNIDO's team and indicated that the scientific and technological communities of India were very receptive and interested to have an opportunity to listen to UNIDO's experts.

2. Background of UNIDO's Mission

The leader of the UNIDO mission described the series of actions that have been initiated by UNIDO in order to promote genetic engineering and bio-technology in developing countries. For this purpose UNIDO has associated a group of eminent experts and has had exchanges of views with a number of developed and developing countries. The overwhelming conclusion of all these interactions has been that an ICGEB is needed to promote R and D programmes of the direct interest to developing countries. He also pointed to the dangers of the current trend towards an increased privatization in the field of genetic engineering and bio-technology, and expressed UNIDO's will to act as a catalyst for international co-operation. The leader of UNIDO's mission stressed that although the ICGEB would be an instrument for international co-operation, national level actions were a matter of priority for UNIDO and the ICGEB as well. Thus, upon identification of relevant topics for R and D, UNIDO could act as a switching mechanism that would help developing countries in the definition of needs with respect to training of specialized manpower. Proper co-ordination of actions at the national level should also provide opportunities for co-operation among different developing countries.

The following is an account of the main scientific and technical statements. They were preceded by an exposé of the latest trends in genetic engineering technologies by Prof. Narang. He emphasized that given the rapid pace of the advances in this area, the aim should be to make the techniques known to the next generation at the school level.

(a) Monoclonal Antibodies

Recent developments in India in relation to immunology and the production of monoclonal antibodies were presented. It was stated that with respect to this particular technology India wants to be both in the "giving end" and in the "receiving end". This is because today monoclonal antibodies developed in India are being tested by international companies for applications on the production of simple kits for use in the diagnostic field (e.g. in pregnancy tests) and in the control of animal fertility.

Vaccines were needed for malaria and filonia. It would be desirable to develop efficient vaccines against leprosy and to construct a library of mycobacterim lepral DNA by genetic engineering technology. Reference was made to the importance of cloning the genes codifying for human chorionic gonadotrophin and human placental lactogen. Although still requiring a great deal of R and D effort, the possibility of using monoclonal antibodies against human egg gona pellucida was suggested as a means to control population growth. In all these areas genetic engineering techniques will have a role to play.

(b) Restriction Enzymes

The meeting also discussed the problems inherent in the availability and use of restriction enzymes in developing countries. This was recognized as a major requirement for developing countries. A proposal to create regional centres producing these reagents was presented and analyzed. It was pointed out that although the existence of reagent banks was desirable (not only for restriction enzymes but also for other fine chemicals currently used in research), a number of problems would make difficult the implementation of regional producing centres. In particular, the most important constraint would be the reproducibility and reliability of enzyme preparations. Considerations of stability and purity were stressed. Also it was pointed out, that the economy of

scale could become a negative factor for the production of enzymes in small quantities to cover just the demand of regional markets. Each country may have to work out an approach to getting the supply of restricted enzymes.

It was pointed out that general restriction enzymes were produced in India by different agencies. There was also a centre for biochemicals under CSIR. Some 300 biochemicals were produced, some of them being exported.

(c) Potential of Plant Tissue Culture

Salient features of on-going work in this area were presented. Of particular relevance was the possibility of using clonal propagation to produce biomass in large quantities. Around 500×10^6 tons/year of elite eucalyptus could be produced if only 5% of the total forest area in India (or 4 million hectares) would be used for this purpose.

(d) Alcohol Production from Renewable Resources

In India there is a shortage of industrial alcohol, current production level is about 3×10^9 litres/year. However, there exists a strong agricultural base for sugar production and hence, molasses in large quantities are available for fermentation. The use of molasses for alcohol production would be based in classical technologies using yeast strains. Technological improvements, however, could be made at the level of reactor design (immobilized cells). In order to increase productivity, it would be also desirable to obtain yeast strains that are more tolerant to ethanol than currently available strains. Finally, it was stated that to develop economical processes for the conversion of ligurcellulosic material to alcohol, it would be of the utmost importance to use genetic engineering technologies for the cloning of cellulase genes in yeast strains that are good ethanol producers.

The bio-conversion of lignocellulosic materials into alcohol offers room for development of indigenous technology. UNIDO is implementing a project for the establishment of a pilot plant in the Philippines that will process biomass with the aid of cellulose enzyme from the fungus Trichoderma viride.

At the end of the discussions it was noted that the on-going work in India could be mobilized towards several goal-oriented projects which may contribute to the solution of problems in regard to population control, immunology, biomass, energy etc. The possibility of India being able to supply other developing countries certain restriction enzymes and fine chemicals was also taken note of.

III. NEW DELHI, 7-8 JANUARY 1982

An exchange of views between representatives of the scientific and industrial communities and the Government of India and the UNIDO Panel of experts took place during the morning of 7 January 1982 at the Science Centre of the Council for Scientific and Industrial Research.

The Chairman briefed the meeting on the discussion in Calcutta and touched upon the steps taken in India in the field of bio-technology. A Bio-technology Board had been constituted and facilities in existing institutions were being strengthened. A committee had been set up to consider the feasibility of establishing a national centre for microbial technology. Thrust areas had been identified and teams of scientists and technologists had been formed to work on specific defined areas.

The leader of the UNIDO team referred to the opportunities and challenges offered by genetic engineering and bio-technology. In view of their wide-ranging potential, their applications had to be looked at beyond short-term considerations of rate of return. Industry, national laboratories and universities should join hands in this task.

In the discussions that followed, it was recognized that the whole field of biology was moving rapidly and the largest number of scientists, journals and papers were at present in this field. Thanks to bio-technology, the concept of factories may itself change in the long run and processes involving lower temperatures, less capital and less pollution will be developed. It was expected that by the year 2000 ninety per cent of carbon-based chemicals will be manufactured through biological means. The application of genetic engineering and bio-technology gave rise to a series of implications extending to legal considerations as well as those of society, ethnics and aesthetics. Developed countries had already initiated long-term programmes. Japan was already spending US$ 2.1 per capita on bio-technology, Canada 1.1, USA 0.6, Sweden 0.5 and UK 0.1.

A wide range of applications were possible in developing countries. Multifaceted applications of genetic engineering and bio-technology would arise from the interaction between social needs and market forces. The developing countries could benefit from the new technology if they were prepared; otherwise they were in danger of being exploited. Support to bio-technology could be through a variety of actions such as support to basic research, general support to the discipline of biology; training and exchange of experience among personnel; policy measures; organization and infrastructure; goal-oriented projects and financial resources.

India was well placed to utilize technological advances in bio-technology in view of its large scientific infrastructure. Historically, it had developed a fermentation industry through forward and backward linkages with other industries. For example, the sugar industry gave rise to molasses, the textile industry required starch and the leather industry required enzymes. There was experience in production of antibiotics and animal vaccines as also in plant breeding. Microbiological, plant and virus culture collections existed.

In addition to this modest but valuable experience, India had the necessary raw materials, market, production capacity and infrastructure for bio-technology. Raw material collection could be done at a low cost and recycling was possible. This was conducive to low-cost production on a dispersed scale. India needs nine million tons of nitrogen requiring nine million tons of hydrocarbons. New investments for synthetic fertilizer production were estimated at four million dollars. 15 per cent of synthetic fertilizer was lost during application. Hence the potential for biofertilizers was great. There were likewise possibilities for applications in improving human and animal health. There were good possibilities of production for exports of hormones and vaccines. The cost of keeping animal houses in India was one twentyfifth of the cost in the United States. Possible applications included increase of milk yield and cattle through direct hormonal control and induced hibernation of animals, with reduced metabolism.

Though India had a substantial chemical industry base the micro-biological applications had so far been limited. However, the potential was vast. Production of ethanol could be substantial if cellulosic materials were used. Big petrochemical complexes might not then be needed.

There were, of course, problems in the application of bio-technology in India. Existing units were not necessarily viable and cost-effective and may need revamping. For new applications, orders of magnitude of investment might be substantial and the obsolescence rate high. Existing technologies would be displaced. There was no agency for technology transfer in this field. The patent policy required examination. Guidelines for the clearance of products from the points of view of health and safety would have to be evolved. Questions relating to licensing the results of research also needed examination.

Marketing of bio-technology products also required consideration. Demand for bio-technology products should be there if industry had to be interested. It may be easier to start with those products which do not require safety testing, for example diagnostic kits. Research private industry in this field was practically non-existent. Industry could not go in for too costly R and D programmes and long-lead times. In this context it was mentioned that there was a "language barrier" between science and industry.

The meeting welcomed the important steps initiated by the Government of India to facilitate the development and application of bio-technology in India. Participants made several suggestions to further advance the efforts in India. These included:

(a) The constitution of the Bio-technology Board should be followed by further steps and a detailed plan of activities published. The Board may have an executive cell to expedite activities in this field.

(b) A technology transfer agency for bio-technology may be established.

(c) Interdisciplinary groups should be established to examine bio-technology applications on the lines of the NCST Groups.

(d) Consideration may be given to the question whether patents and know-how in this area should not be made national properties.

(e) Government should encourage manufacture of products involving application of bio-technology. There should be agreed plans for production and R and D in this sector with qualitative and quantitative objectives accompanied by monitoring mechanisms. Feasibility studies for bio-technology projects should be initiated.

(f) Curricula in schools and universities should be strengthened in regard to disciplines having a bearing on bio-technology. Specialized one-year courses may be started. Fellowships should be provided and international exchange promoted.

(g) Bio-technology should be popularized. A journal on bio-technology development may be started. State-of-the-art reports should be published.

(h) Bio-technology applications in the areas of energy and utilization of by-products and effluents should be given attention.

(i) Culture collections and similar facilities should be increased.

The meeting took note of the activities of UNIDO in this field. It was suggested that UNIDO assist the developing countries in the several aspects of development and application of genetic engineering and bio-technology and in particular in strengthening requisite national technological capacities. A view was expressed that the proposed International Centre for Genetic Engineering and Bio-technology should concern itself with technology development and adaptation. UNIDO was requested to provide assistance in regard to training through fellowships and other facilities. UNIDO, it was suggested, may promote the development of small-scale model fermentors and their use in developing countries.

IV. MEETING WITH THE EXTERNAL AFFAIRS MINISTER

The UNIDO team and some of the Indian participants had a brief meeting with the External Affairs Minister, H.E. Mr. P.V. Narasimha Rau. The Minister referred to the steps taken by the Indian Government in the field of bio-technology and stated that a major concern of developing countries was how to keep up-to-date and not get left out of the on-going developments. He said India would be interested in particular in technologies that were neutral to scale.

Prof. Hedén, on behalf of the UNIDO team, informed the Minister that one advantage of bio-technology for developing countries was that it lent itself to small-scale, decentralized production. There was also scope for co-operation among developing countries in this field. Prof. Hedén also briefly reported on the interest expressed by several countries in the International Centre for Genetic Engineering and Bio-technology.

ANNEX I

Agenda of the Meetings in India

Calcutta, 6 January 1982

Chairmen:	Dr. V. Ramalingaswamy, D.G., I.C.M.R.
12.00 - 12.30	Opening Session - Welcome by Prof. B.K. Bachhawat - Opening remarks by Chairman - Background of the visit of the UNIDO team by the leader
12.30 - 13.00	Advances in and Applications of Genetic Engineering Presentation by UNIDO (Prof. Narang)
13.00 - 13.30	Discussion on the presentation
13.30 - 14.00	Advances in and application of Immuno-Technology Presentation by Dr. G.P. Talwar
14.00 - 14.30	Discussion on the presentation
14.30 - 15.00	Advances in and Application of Enzyme Engineering Presentation by UNIDO (Dr. D. McConnell)
15.00 - 15.30	Discussion on the presentation
15.30 - 16.00	Advances in and Application of Tissue Culture Presentation by Dr. Mascaranhas
16.00 - 16.30	Discussion on the presentation
16.30 - 17.00	Advances in and Application of Photo-Synthesis Presentation by Dr. P. Mohanti
17.00 - 17.30	Discussion on the presentation
17.30 - 18.00	Advances in and Application of Alcohol production Presentation by Dr. Ramachandran
18.00 - 18.30	Discussion on the presentation
18.30 - 19.00	Closing remarks by Chairman

New Delhi, 7 January 1982

Chairman:	Dr. V. Ramalingaswamy, D.G., I.C.M.R.
9.00 - 9.10	Welcome by Director-General, CSIR
9.10 - 9.30	Opening remarks by Chairman
Session I	Formal Presentations on
9.30 - 10.10	"Implications and Applications of Bio-technology with special reference to India and other developing countries"
9.30 - 9.50	(a) Speaker: Prof. Carl-Göran Hedén, UNIDO Team
9.50 - 10.10	(b) Speaker: Dr. P.M. Bhargava, Director, C.C.M.B.
10.10 - 10.40	"Prospects and problems of Industrial Applications of Bio-technology in India"
	Speaker: Dr. S. Varadarajan, Chairman, EIL, New Delhi
10.40 - 11.00	Tea Break
Session II	Discussion
11.00 - 12.00	Discussion on the formal presentations
12.00 - 13.15	Comments and remarks by Indian participants on general issues related to bio-technology
13.15 - 13.25	Summing up by the Chairman
13.25 - 13.30	Closing remarks by Director-General, CSIR

8 January afternoon and 9 January 1982

Meetings of UNIDO's Team with representatives of the Bio-technology Board

Chairman: Dr. G.S. Sidhu, Director-General of CSIR

ANNEX II

LIST OF PARTICIPANTS

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ANNEX III

LIST OF DOCUMENTS

Document No.	Title
	AIDE MEMOIRE
UNIDO/IS.254	THE ESTABLISHMENT OF AN INTERNATIONAL CENTRE FOR GENETIC ENGINEERING AND BIO-TECHNOLOGY (ICGEB) Report of a Group of Experts
UNIDO/IS.261	THE POTENTIAL IMPACT OF MICROBIOLOGY ON DEVELOPING COUNTRIES Prepared by Carl-Göran Hedén, UNIDO Consultant
UNIDO/IS.269	THE IMPACT OF GENETIC ENGINEERING ON INDUSTRY Prepared by UNIDO Technology Programme
UNIDO/IS.270	ELEMENTS OF SOME NATIONAL POLICIES FOR BIO-TECHNOLOGY Note by the secretariat of UNIDO
UNIDO/IS.271	CENTRES FOR THE PRODUCTION OF ENZYMES by Sheikh Riazuddin
UNIDO/IS.272	COMMERCIALIZATION OF GENETIC ENGINEERING TECHNOLOGIES: SOME CONSIDERATIONS Prepared by UNIDO Technology Programme
UNIDO/IS.273	THE POTENTIAL OF GENETIC MANIPULATION FOR THE IMPROVEMENT OF VACCINES AGAINST ANIMAL DESEASES IN DEVELOPING COUNTRIES Prepared by Sir William Henderson, UNIDO Consultant