BOSE INSTITUTE ANNUAL REPORT 1993-94

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ANNUAL REPORT

OF

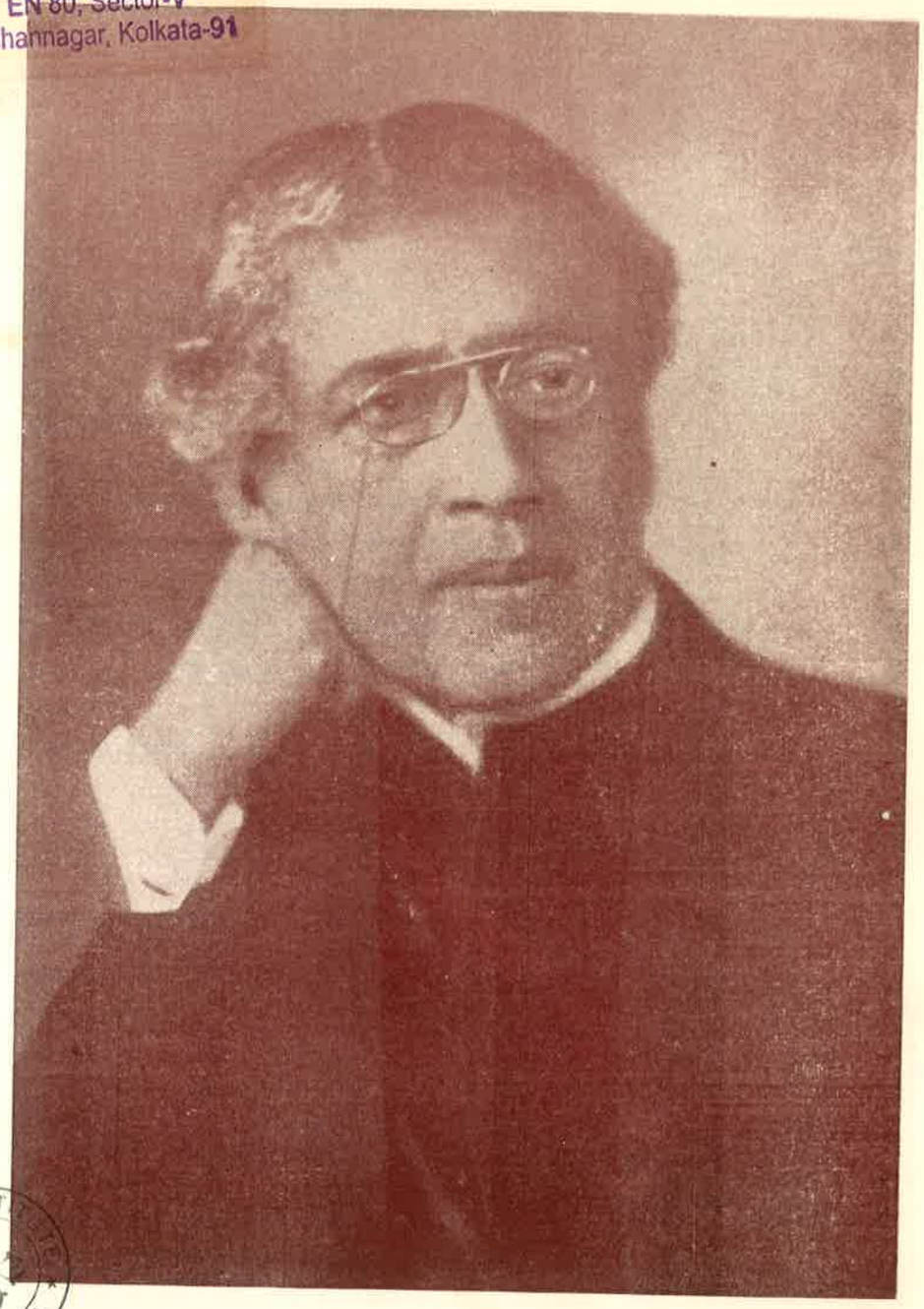
THE BOSE INSTITUTE

FOR

1993-94

Bose Institute

93/1, Acharya Prafulla Chandra Road
Calcutta-700 009



Acharya J. C. Bose
The Founder

Bose Institute

ANNUAL REPORT

1993-94

CONTENTS

FOREWORD

It is with much pleasure I place before you the Annual Report of the Bose Institute for the financial year 1993-94. As you are well aware that this year has been very eventful and a year of reconstruction and renovation. We have been trying to streamline many of our work and activities during the past year.

Major efforts have been directed to appoint some brilliant young Scientists in various Departments/Sections of the Institute. We are happy that six young faculty members have already joined the Institute. Most of them have come from abroad. A few others will be joining the Institute soon. This has given the Institute a new orientation, because their expertise will further promote our overall research activities in the field of Modern Biology.

The Institute had entered into collaborations with a number of organisations by signing Memorandum of Understanding, i.e., with Indian Institute of Technology, Kharagpur, School of Tropical Medicine, Calcutta, Calcutta Port Trust, M/s, Shaw Wallace & Co., M/s. Tata Tea and Rockefeller Foundation, USA. You will be happy to know that the institute is now a part of the Eastern Centre for Research Astrophysics (ECRA), which is a consortium of a number of Universities and Research Institutions in the Eastern Region of India, primarily co-ordinated by University Grants Commission. As a part of this consortium the Institute will be able to share the vast resources available with ECRA for advance research in the field of Astrophysics, Cosmology and related areas.

For the first time the Institute is going to have a Scientific Advisory Committee to help us in properly planning, conducting and implementing various scientific research programmes of the Institute.

According to the new policy of the Government of India Performance Audit have been introduced this year and the Institute was audited by a team of Auditors. They have brought to our attention a number of issues which will help us streamlining our work and activities in the future.

It is a matter of great pride on our part that during the year under reference quite a few of our Scientists have earned recognitions for their scientific contributions. Our computer data indicates that the Institute is now one of the major contributors of

good quality scientific publications in top ranking Journals of the world, such as JBC, JMB, PNAS, Biochemistry, Virology, Gene, J. Bact., etc.

During the year, Prof. Bharati Ghosh of the Department of Botany has been awarded the Fellowship of the National Academy of Sciences, Allahabad. Prof. A. N. Lahiri Majumder has received the Shadaksharaswamy Oration Award from the Society of Biological Chemists, India. One of our students, Sri Somen Nandi has been awarded the Jawaharlal Nehru Fellowship for his research. He is one of the 20 national recipients of this Fellowship. The contributions of Dr. Sibaji Raha has been highly acclaimed in a special publication of CERN Courier, Geneva. Based on the contributions of Dr. Dipankar Home and others M/s. Hamamatsu Photonics, Japan, has been successful to experimentally demonstrate a new angle wave-particle duality of light. Many other Scientists had been honoured in a number of different ways by extending invitation to them for chairing sessions, to deliver invited lectures, etc.

We are in the process of increasing our infrastructural support in a very modest way. Some positive actions have been taken already. Some others are waiting, since adequate funds are not available in our hand. Efforts are also being made to impress upon the authorities to provide us with adequate funds.

Some major initiatives have been undertaken to computerise scientific, administrative and financial activities and programmes. The Department of Physics have acquired a number of PCs. The Administration, Accounts and several other Departments also have been provided with PCs for computational purposes. Our entire financial package is being prepared now on Computers. In most places Wordprocessors are being heavily used. The Institute has installed an EPABX system in both the campuses. New telephones have been provided to all Chairmen of the Departments and Heads of Sections, and also to all other faculty members and Heads of Units. This has provided to all of us a major communication facilities to save a lot of our time and energy for being able to communicate directly with each other through INTERCOM services and the EPABX system. In the Centenary Building our Canteen facilities have been upgraded significantly. The Seminar Rooms of both the campuses have been renovated to give it a new look. The PD Laboratory, the DIC and the RSIC are functioning much better than before to cater to the needs of its users both within and outside. Safe drinking water facilities have been provided to every department. Some constructional activities have also been undertaken such as repair of the roof in the North Building and the Physics Building in the Main Campus. A new car has been procured and few others are going to be procured in the near future. The Institute is providing transportation facilities to students and other staff by hiring a large Bus which facilitated the inter-campus transport and communciation. Some of the outstanding issues in the area of staff benefits such as assessment and promotion have been solved and major efforts have been undertaken to sort out the remaining others in the near future. We have now

an approved assessment promotion scheme for the faculty members. All backlog for the past 4-5 years have been cleared.

The Institute has been successful to publish about 100 full length papers, and a few book chapters, monographs, etc., during the year. The ratio between the number of scientists versus scientific publications is about 1 : 2. The Institute produced 13 Ph.Ds. this year.

I am pleased to inform you that a number of patent applications have been submitted, and some others are in the process of submission to the appropriate authorities. It is needless to mention that until and unless the fruits of our laboratory research are appreciated by those whose money are being utilized for research purposes, i.e., the citizens of the country, in a developing economy like ours scientists will not be able to establish his/her credibility in the minds of our citizens. This is the reason why some modest effort has been made to motivate some of our colleagues to go to undertake those type of both basic and applied research which can bring out results which will be appreciated by the people at large, directly or indirectly. In order to be able to increase our efforts in the area of services to be provided to the users, the industries, major efforts have been made to gear up the activities of RSIC, DIC, PD Laboratory, Workshop activities and also the Environmental Sciences Section. Through these sectional activities the Institute had been successful to meet the requirements of many industries in the region, which have been considered already to be a significant help for them. The J.C. Bose Unit and Museum has been functioning with much vigour and enthusiasm, and participated successfully in a number of exhibitions, lectures, publication of books, pamplets, etc. Our Library has acquired new facilities in the Main Campus in the area of computer based literature search aud also for xeroxing of papers. Library had been able to provide new facilities to faculty members for purchasing one book of their choice and had subscribed to at least 8 new Journals in addition to those being subscribed.

The Institute also conducted very successfully an International Satellite Symposium on "Protein structure, function and engineering" which was attended by a large number of internationally recognised Scientists. This has been a great success in the opinion of everybody concerned.

The Administration of the Institute has been trying to streamline our functioning in the area of procurement of materials, selection, promotion and also the financial matters.

In a way the Institute is marching forward and, I am quite sure, with the co-operation of all concerned we should be able to do much more to fulfil the expectations of the nation. Taking this opporunity, I would like to put on record my personal gratitude to the members of the Governing Body and the Council of Bose Institute, and

also to all the members of staff of Bose Institute for their co-operation and help which they have accorded to me from time to time for dealing with the affairs of the Institute. After all any progress and development is possible with the co-operation and help from all concerned.

Wishing you all a very happy, healty and productive year ahead of us.

Prof. P.K. Ray
Director

Acharya Jagadis Chandra Bose Memorial Lecture

The 55th Acharya Jagadis Chandra Bose Memorial Lecture was delivered by Prof. U. R. Rao, Chairman, ISRO, Bangalore on "Space Technology : The Frontier of Man's Greatest Enterprise".

Lectures

1. Dr. S. Roychowdhury, Sr. Research Scientist, I. D. E. C. Pharmaceuticals, California, U. S. A.—"New Approaches to vaccine Development".

2. Prof. Subhash Basu, Professor & Chairman, Biochemistry, Biophysics & Molecular Biology Programme, Dept of Chemistry, University of Notre Dame, Illinois, U. S. A.—"Initiation of embryonic chicken brain DNA replication at DNA—Pol-alfalectin binding site".

3. Dr. Panchanan Chakrabarty, Scientist, IMEC Corporation, Washington, Seatle, U. S. A.—"Anti-idio type antibody as vaccine against various diseases."

4. Dr. Amit Kr. Roy, BDS, FF. DRCS, Visiting Maxillofacial Surgeon, Medical College & Hospitals, Calcutta—"Remaking of a Face".

5. Dr. Ratan Lal Brahmachary, Division of Biology, Embryology Unit, Indian Statistical Institute, Calcutta—"Diversity of life on earth".

6. Dr. Hanumantha Rao, Dept. of Vetenary Physiology, Andhra Pradesh Agricultural University, Tirupati—"Nuclear transplantation in mammalian embryos".

14. Professor Roger Penrose, FRS, Rouse Ball Professor of Mathematics, Oxford—"Science Beyond Computation for understanding the Mind".

15. Professor Umadas Maitra, Professor, Dept. of Developmental Biology and Cancer Albert Eienstein College of Medicine, New York, U.S.A.—"Protein factors that bind and hydrolyse GTP control translation initiation in Eukaryotes".

16. Dr. Debajit Kr. Biswas, Professor, Harvard Medical School and Dana Farber Cancer Institute, U.S.A.—"Transcriptional Regulation of Eukaryotic gene expression ; Recent studies in several novel systems".

Obituary

The Bose Institute was deeply grieved at the passing away of the following former workers of the Bose Institute. Condolence resolutions, duly adopted in general meeting of the staff, were sent to members of the breaved families :

1. Shri Deben Singh—General Asst.—11.07.1993.
2. Shri Sudhir Hazra—23.03.1994.

Acknowledgement

The Council takes the opportunity to express its grateful thanks to the Department of Science and Technology, Government of India, for providing generous funds in the form of Grants-in-aid, and for the support of research projects, and also to other external ageneics such as the Government of West Bengal, Department of Atomic Energy, Council of Scientific and Industrial Research, Indian Council of Agricultural Research, Indian Council of Medical Research, etc., for their support in various forms. The Council also records its thanks to the British Council, Federal Republic of Germany, United States of America, the Rockefeller Foundation, the ECU and others for their support in several froms, such as research grants, gift of equipments, books, travel grants, collaborative project, etc. The Council further records its thanks to the Governing Body, Bose institute, and to the members of the various Selection Committees for their help and interest.

Members of the Council

1.	Shri Sanjoy Sen	Nominees of the Governing Body
2.	Prof. S Bose	
3.	Shri Debabrata Bose	
4.	Prof. R.N. Chakraborty	
5.	Prof. D. Banerjea	
6.	Prof. B.B. Baliga	
7.	Prof. S.N. Chatterjee	

8. Secretary, Department of Science and Technology, Government of India, or his nominee.
9. Director General, C.S.I.R. or his nominee.
10. Joint Secretary and Financial Adviser, Department of Scince and Technology or his nominee.
11. Representative of the Lok Sabha.
12. Principal Accountant General (A & E), West Bengal.
13. Secretary, Higher Education (Nominee of the Govt. of West Bengal)
14. Municipal commissioner, Representaive of the Calcutta Municipal Corporation.
15. Director, Bose Institute—ex-officio.
16. Deputy Director, Bose Institute—ex-officio.
17. Dr. K.K. Kannan. } Two Scientists from outside West Bengal
18. Prof. D. Balasubramaniam. }

Registrar, Bose Institute—Secretary

Invitees :
1. Representative of the Academic Council
2. Representative of Bose Institute Employees Association.

Members of the Governing Body

1. Shri Sanjay Sen
2. Prof. Sunando Bose
3. Shri Debabrata Bose—Secretary
4. Prof. S. D. Chatterjee
5. Prof. R. N. Chakraborty
6. Dr. (Mrs) Debi Chakraborty
7. Prof. D. Banerjea
8. Prof. B. B. Baliga
9. Prof. S. N. Chatterjee
10. Shri Som Nath Sanyal
11. Director, Bose Institute.

Members of the Finance Committee

1. Shri Sanjoy Sen (Representative of the Council)—Chairman
2. Shri Debabrata Bose (Representative of the Governing Body)

3. Director, Bose Institute—ex-officio
4. Joint Secretary and Financial Adviser to the Department of Science and Technology, Govt. of India, or his nominee.
5. Principal Accountant General (A & E), West Bengal.
   Registrar, Bose Institute—Secretary

Members of the Centre Management Committee, RSIC, Bose Institute, Calcutta

1. Director, Bose Institute—Chairman
2. Scientist In-Charge, RSIC—Member Secretary
3. Representative of DST—Member
4. Prof. C. L. Khetrapal, SIF, IISC, Bangalore—Member
5. Prof. E. S. Rajagopal I & SU, IISC, Bangalore—Member
6. Prof. U. R. Ghatak, Director, IACS, Calcutta—Member
7. Prof. J. Das. Dy. Director, IICB, Calcutta—Member
8. Dr. S. K. Chakraborty, IJIRA, Calcutta—Member
9. Prof. (Mrs) P. Chakrabarti, Bose Institute—Member
10. Prof. R. K. Mandal, Bose Institute—Member

Co-opted members

11. Prof. B. B. Baliga
12. Dr. S. N. Chatterjee, INSA Sr. Scientist SINP, Calcutta
13. Dr. B. K. Sarkar, Director, C. G. & C. R. I., Calcutta
14. Dr. S. R. Das, Chairman—cum-Managing Director, National Instruments Ltd., Calcutta

Members of Research Staff and Scholars

Director : Prof. P.K. Ray, Ph.D., D.Sc., FIBiol. (Lond) FNASc

Department of Physics (10)

Chairman : Prof. M.H. Engineer, M. Tech. , Ph. D.

Professor : Dr. S.C. Roy, M.Sc., Ph.D.

Dept of Physics (Conid)

Readers : Dr. A.K. Chatterjee, M.Sc., Ph.D.
Dr. S.N.Changdar, M.Sc., Ph.D.
Dr. S. Raha, M.Sc., Ph.D.

Lecturers : Dr. I. Bose, M.Sc., Ph.D.
Dr. D. Home, M.Sc., Ph.D.
Dr. B. Roy, M.Sc., Ph.D.
Dr. B.K. Chatterjee, M.Sc., Ph.D.
Dr. S.K. Saha,

Research Scholars : Shri Nirmal Kr. Halder
Shri Sandip Kumar Dutta
Shri Anirudha Deb

Department of Chemistry (10)

Chairman : Prof. Amitabha Ghosh, M. Sc., Ph.D.

Professors : Dr. P. Chakrabarti, M.Sc., Ph.D.
Dr. N.K. Sinha, M.Sc., Ph.D.
Dr. P. Bhattacharyya, M.Sc., Ph D.

Readers : Dr. Dolly Ghosh, M.Sc., Ph.D.
Dr. P.C. Sen, M.Sc., Ph.D.

Senior Lecturer : Dr. Manas Chakrabarty, M.Sc., Ph.D.

Lecturers
Dr. Kalipada Das, M.Sc., Ph.,D.
Dr. Joyoti Basu, M.Sc., Ph.D.
Dr. Manikuntala Kundu, M.Sc., Ph.D.
(Assigned from the Microbiology Dept.)

Emeritus Scientist (CSIR) : Prof. A.K. Barua

Research Scholars
Shri Subhansu Ray (upto 30.9.93)
Sm. Archana Batabyal
Shri Amiya K. Maiti
Sm. Anuradha Bhaduri
Shri Sebabrata Mahapatra (upto 13.1.94)
Shir Amit K. Das (1.12.93—31.1.94)
Shri Ashis Bhattacharyya
Shri Tapan Mukherjee
Mallika Ray
Shri Dipankar Bhattacharyya
Sm. Suparna Bhattacharyya (10.12. 93—31.1.94)
Shri Alex C. Varghese (from March 11, 1994)

Department of Botany (19)

Chairman	:	Prof. S.N. Ganguly, M.Sc., Ph. D., D.Sc. (from 1.12.1993)
Professors	:	Dr. (Mrs) B. Ghosh, M.Sc., Ph.D., (Chairperson upto 30.11. 1993) Dr. S. Chanda, M.Sc., Dr. rer.nat (Gottingen) (upto 31.1.1994) Dr. A.N. Lahiri Majumder, M.Sc., Ph.D. D.Sc.
Readers	:	Dr. B. Majumder, M.Sc., Ph.D. (upto August, 1993) Dr. S. Gupta, M.Sc., Ph.D. Dr. B.B. Mukherjee, M.Sc., Ph.D. Dr. K.K. Mukherjee, M.Sc., Ph.D. (From 31.7.1988) Dr. (Mrs) S. Sen-Mandi, M.Sc., Ph.D. (Cantab) (Foom 2.1.1989) Dr. P.K. Saha, M.Sc., Ph.D. (From 1.8.1990)
Lecturers	:	Dr. D.N. Sengupta, M.Sc., Ph.D. Dr. (Mrs) S. Bhattacharya, M.Sc , Ph.D. Dr. (Mrs) S. Gupta-Bhattacharya, M.Sc. Ph.D. Dr. T.K. Ghose
Research Scholars	:	Shri Saubhik Das, M.Sc (upto 8/93) Shir S.R. Gupta, M.Sc. Shir A. Roy Chaudhuri, M. Sc. Shri Somen Nandi, M.Sc, Shri M.K. Chattopadhyay, M.Sc. Ms. Jayashree Banerjee, M.Sc. Shri Nirmal Mandal, M.Sc. Ms. Sangita Basu, M.Sc. Ms. Sanghamitra Bhattacharyya, M.Sc. Ms Pampa Chakraborty, M.Sc. Ms. Anindita Bose, M.Sc. (from July '93) Ms. Malabika Ray, M.Sc. (from July '93) Shri Biswajit Das, M.Sc. (joined on 23.11.93)

Department of Botany (*Contd.*)

Shri Amal Kumar Sarkar (joined January '94 and resigned)
Shri G. Gangopadhyay, M.Sc. (from Feb. '94)
Shri Amitava Ray, M.Sc. (from Feb. 94).

Department of Microbiology (14)

Chairman	:	Prof. A.C. Ghose, M.Sc., Ph.D- (upto 30.11.93) Prof. A.L. Chandra, M.Sc , Ph.D. (from 1.12.93 to 28.2.94) Prof. T.B. Samanta, M.Sc., Ph.D. (from 1.3.94)
Professors	:	Dr. S.L. Chakrabarty, M.Sc., Ph.D. (upto 31.1. 94) Dr. A.C. Ghose, M.Sc., Ph.D. Dr. A.L. Chandra, M.Sc., Ph.D. (upto 28.2.94) Dr. G. Nanda. M.Sc., Ph. D.
Readers	:	Dr. (Mrs.) Kalyani Sen, M.Sc., Ph. D. Dr. P.K. Chakrabartty, M.Sc. Ph.D.
Sr. Lecturers.	:	Dr. (Mrs.) Roma Chakraverty, M.A., Ph.D. Dr. Pradosh Roy, M.Sc., Ph.D. Dr. Manikuntala Kundu, M.S., Ph.D. (Assigned to Dept. of Chemistry) Dr. Subrata Mazumder, M.Sc., Ph.D. (from 16.12.93) Dr. Sujoy Dasgupta, M.Sc., Ph.D. (from 24.1.94)
Pool Officer	:	Dr. Anjana Banerjee, M.Sc. Ph.D. (upto 9.6.93) Dr. Mrinal Kanti Ghosh, M.Sc., Ph.D. (from 27.12.93)
Research Scholars	:	Smt. Nupur Roy, M.Sc. Shri Ranadhir Chakraborty, M.Sc. Smt. Sumana Majumder, M.Sc. Shri Subhajit Dasgupta, M.Sc. Shri Subha Manna, M.Sc. (upto 8.5 93) Smt. Kajori Ghosh, M Sc.

Department of Biochemistry (13)

Chairman	:	Prof. R. K. Mandal, M. Sc., Ph. D.
Professors	:	Dr. N. C. Mandal, M. Sc., Ph. D.
	:	Dr. (Mrs.) S. Biswas, M. Sc., Ph. D.
	:	Dr. B. Bhattacharyya, M. Sc., Ph. D.
Reader	:	Dr. (Mrs.) Pratima Sinha, M. Sc., Ph. D.
Senior Lecturer	:	Dr. P. Gupta, M, Sc., Ph. D.
Lecturers	:	Dr. (Mrs.) A. Lohia, M. Sc., Ph. D.
	:	Dr. R. Chattopadhyay, M. Sc., Ph. D. (From 30. 11. 93)
		Dr. P. Parrack, M. Sc., Ph. D. (From 30. 3. 94)
		Dr. S. N. Maity, M. Sc., Ph. D. (From 29. 3. 94.)
Research Scholars	:	Md. Golam Faruk, M. Sc. (Upto 31. 8. 93)
		Shri Sudip Chatterjee, M. Sc. (Upto 14. 12. 93)
		Shri Santanu Dasgupta, M. Sc. (Upto 5. 1. 94)
		Shri Basuded Dalal, M. Sc. (Upto 31. 8. 92)
		Shri Aurp Indra, M. Sc.
		Shri Nilanjan Ray, M. Sc.
		Smt Rinku Ghosh. M. Sc. (From 1. 9. 92)
		Smt Suranjana Guha, M. Sc. (From 2. 11. 92)
		Shri Sudit S. Mukhopadhyay, M. Sc. (From 1. 10. 93)
		Ms. Gitaly Ganguly, M. Sc. (1. 11. 93)
		Ms. Surekha Mandal, M. Sc. (From 11. 1. 94)
		Shri VMH Namboodrri, M. Sc. (From 21. 2. 94)

Department of Biophysics (3)

Chairman	:	Prof. Asok Banerjee, M. Sc., Ph. D. (Cal), M. Ny. A. Sc. (USA).
Reader	:	Dr. Siddhartha Ray, Ph. D.

Animal Physiology Section (2)

Professor In-Charge	:	Dr. A. K. Ray, M. Sc., Ph. D.
Senior Lecturer	:	Dr. Rama Ghosh, M. Sc., Ph. D.
Research Scholars	:	Shri Shantanu Das, M. Sc.
		Smt. Sudipta Chatterjee, M. Sc.
		Shri Nilkanta Chakraborty, M. Sc.

Plant Molecular & Cellular Genetics (4)

Professor In-Charge	:	Dr. S. K. Sen Ph. D., D. Sc., FNA.
Reader	:	Dr. Amita Pal, Ph. D.
Lecturers	:	Dr. S. Das, Ph. D.
		Dr. S. R. Sikdar, Ph. D.
Research Scholars	:	Ms. S. Sen Gupta (Upto 7. 7. 93)
		Ms. Monalisha Chandra, SRF
		Ms. S. Roy Choudhury, JRF
		Shri Dipankar Ghosh, JRF

Regional Sophisticated Instrumentation Centre (1)

Scientist In-Charge	:	Dr. A. Chatterjee, M. Sc., Ph. D.
Technical Officers	:	Dr. D. K. Mukherjee, M. Sc., Ph. D.
		Dr. S. Chaudhuri, M. Sc. Ph. D.
		Shri A. Biswas, M. Sc.
		Shri T. Datta, B. E. (E & T. C. E.)

Administration

Registrar	:	Shri A. J. Datta, B. Sc., L. L. B.
Dy. Registrar	:	Shri T.K. Ghorui, M.Com. ICWA (Inter)
Workshop Superintendent	:	Shri Alok Mukherjee, B. E. (Mech).
Librarian	:	Mrs. Ila Biswas, M. Lib. (Sc).

Technical Report

A. PHYSICS

Institutional Project No. VI : Problems in Condensed Matter, Intermediate Energy Physics and Related Interdisciplinary Areas.

A. *Physical Acoustics, Microwave and Solid State Physics*

(i) *Tangential instabilities at the interfaces of flowing liquid layers :* **B. Roy and M. H. Engineer.**

Investigations of tangential instabilities at the two proximate interfaces of three acoustically driven liquid layers (water/oil/water) in a large rectangular perspex tank was continued. To facilitate better experimental results a heavy platform resting on a large worm gear has been constructed for tilting the rectangular tank with respect to the horizontal. This is for studying the instabilities in the cases where the bulk flow has a component parallel to the local gravitational force. A fine adjustment system for rotational, tilting and up-down movement of the acoustic transducer is also under construction for generation of uniform flow of the liquid layers.

(ii) *A new viscous fingering type of instability :* B. Roy and M. H. Engineer.

A new dynamic instabiliity in stratified flows has been observed where the main component of the flow is parallel but opposite to the gravitational force in a systems of two immiscible fluids : (i) water/olive oil-CCl_4 mixture and (ii) water/CCl_4-petroleum ether mixture with very small density difference and very small interfacial tension between the two fluids. At sufficiently strong acoustic driving intensity the interface develops a huge instability which occurs as a long (approximately 1-2cms in (i)) very thin finger which extends from the less viscous fluid to the more viscous one. This is the first instance of 'viscous fingering' in three dimensional two fluid flows ; earlier such fingering was only seen in two dimensional flows.

The observed effect can be important in the oil industry where its presence leads copius production of water and consequent inefficient extraction of hydrocarbons.

(iii) *Noise pollution of Calcutta :* Debashis Chakraborty (University of Kalyani), S. C. Santra (University of Kalyani) and B. Roy.

Road traffic noise level survey of several traffic junctions in Calcutta have been carried out for twenty four hours using a digital Sound Level Meter and also the number of vehicles were counted. Data is being analysed to characterise the day night average noise level (L_{dn}) and the Traffic Noise Index of Calcutta. The response/ annoyance of people exposed to the traffic noise at the different sites of measurement are also being studied by interviewing the local people with questionnaire survey.

B. *Nuclear Physics*

(i) *Analysis of* $^{12}C(\vec{d}, t)^{11}C$ *data :* Swapan K. Saha.

Data reduction for $^{12}(\vec{d}, t)^{11}C$ experiment (done in collaboration with W. W. Daehnick, University of Pittsburgh) is done. Distorted wave Born approximation (DWBA) oaleulations were done to extract the spectroscopic factors.

(ii) *Vanadium Carbide—its Compton profile—Experiment and Theory :* Santa Bandyopadhyoy and A. K. Chatterjee.

The Compton profile of polycrystalline Vanadium Carbide has been measured using 59.54 keV gamma radiation. This compound posesses peculiar physical and Chemical properties suggesting that covalent, ionic and metallic bondings are present simultaneously in VC. To determine the electronic configuration of solid VC, the experimental data has been analysed with the help of Renormalized free atom model and it is inferred that the valence electronic configuration V 3rd $^{2.5}$C2p $^{4.5}$ is appropriate in this case.

To compare the bonding nature isoelectronic and isostructural VC and NbC a Compton profile measurement has been carried out on NbC having same optical thickness of VC sample. The difference Compton profile of VC and NbC is being analysed based on the localization of d-electrons.

(iii) *Calculation of momentum density and cohesive energy using LCAO model calculation :* A. Chatterjee, I. A. C. S. and A. K. Chatterjee.

The calculation of momentum density has been worked out from the second moment calculation of momentum and Compton profile which we already calculated for CuO. We also calculated the cohesive energy of copper and oxygen atoms in the CuO sample.

(iv) *Experiment on High Tc ceramic samples :* S. P. Basu, R. N. Chakraborty (Dept. of Applied Physics, Calcutta University) and A. K. Chatterjee.

The experiment as stated in the title continued with different proportions of Ba and CuO. The measurement of electrical resistance and A. C. susceptibility was performed.

C. *Applied Radioactivity and liquid Dynamics :* S. N. Changdar.

A sliding method based on radioactive tracer technique was used to measure diffusion coefficients in some liquid systems using P—32 as the tracer. The diffusion coefficients were measured in ternary systems to observe the effect of coupled flow on the motion of the diffusing ion.

Preliminary experiments were performed to initiate percolation studies in solid liquid systems. The work was severely hindered because of paucity of funds and lack of research personnel.

D. *Radiation Physics and Condensed Matter (Experiment)*

(i) *Effect of suspended particles on the viscosity of fluids :* Nirmal Halder and B. K. Chatterjee.

The variation in viscosity of 2000 cS and 3000 cS grades of polydimethyl siloxane with various concentrations of silicon powder has been studied using a sensitive differential viscometer. It is observed that the variation of viscosity with concentration agrees excellently with our model (Santra et. al., Phys, Rev. A **43**, 4296, 1991). The viscosity exponent and the volume fraction for viscosity divergence are 2. 1 $\pm$ 0.1 and 0. 55 $\pm$ 0.05 for the two liquids. Another interesting observation is that the scaled viscosity for the two samples fall on a single curve when plotted as a function of the volume fraction, as predicted by our model.

(ii) *Modification of the Raleigh scattering cross section code for its execution on a PC/AT :* B. K. Chatterjee.

Two out of three programs, used in tandem to compute the Raleigh scattering cross sections (Kissel et. al. Phys. Rev. A. **22**, 1970, 1980) developed at the University of Pittsburgh for a mainframe VAX-VXS system, has been modified to run successfully on a PC-80386. All the programs have also been successfully run on the microvax system at the Distributive Information Centre.

(iii) *Design of on optimal scattering geometry :* Swapan K. Saha, B. K. Chatterjee and S. C. Roy.

A realistic optimum scattering geometry useful in scattering experiments has been designed to give a high signal to noise ratio. A design of a (direct) beam stopper is also done which ensures that no γ-ray singly scattered from the stopper can reach the detector.

(iv) *Study of nucleation in superheated liquid drops :* S. Dutta, B. Roy and S. C. Roy.

Some samples of superheated liquid drops of Freon-12 have been prepared by suspending the Freon droplets in a degassed gel. The gel was a mixture of 200 cc of glycerine and 50 gms of aquasonic gel. The stability of the prepared samples have been tested electronically by counting the spontaneous nucleation of drops. The long time stability test is also being attempted by noting the volume change in a capillary tube due to drop nucleation for a specific interval of time. Experiments using neutron source available at VECC, Calcutta are being planned.

E. *Theoretical Physics*

1. High Energy Physics, Astrophysics and Cosmology

(i) *Studies on Quark-Gluon Plasma—Kinetics, Equilibration Phenamena and Diagnostics :* Sibaji Raha (in collaboration with Jan-e Alam of VECC, Calcutta and Bikash Sinha of VECC and SINP, Calcutta).

We had proposed many years ago that in nuclear collisions at very high energies, the quark-gluon system may evolve towards equilibrium through a succession

of many distinguishable time scales. This prediction was corroborated only reeently by other authors following which there has been a burst of activity in the community. Many of these works rely on detailed numerical calculations involving a large number of parameters and often the physics is clouded by artefacts of approximations-numerical or otherwise. We have succeeded in developing a QCD kinetic theory based analytical model which illuminates the physical process and allows one to compute relevant quantities like equilibration time scales of various quark flavours, production rates of heavy flavours, electromagnetically produced particles and so on.

(ii) *Nonlinear Phenomena In Muliparticle Production Processes Induced By Finite Size Effects :* Sibaji Raha (in collaboration with Debapriyo Syam of Presidency College, Calcutta).

The only scaling law obeyed by multiparticle production processes over the whole range of available energies is the Entropy scaling law discovered some years ago by Raha and collaborators. It was shown by independent authors that unimodal nonlinear (quadratic, to be exact) maps yield scaling curves which are similar to the Entropy scaling curve of Raha et al. While this opened up a very promising line of attack on the long-standing problem of multiparticle dynamics, the origin of discrete nonlinear maps was a thorny issue. We studied this challenging question in depth during the past year and succeeded in showing that the finite size effects associated with the final state hadrons naturally lead to a discretization in space-time of the differential equations governing collective models. This, we proved, ultimately yields a nonlinear map which explains the overall features of multiparticle data without the need for introducing additional arbitrary parameters. Further detailed aspects of these considerations—namely, fluctuations and effects on correlation measurements—are currently being vigorously pursued.

(iii) *Finite Temperature Field Theory—Phenomenological Applications :* Abhijit Bhattacharyya and Sibaji Raha (in collaboration with Jan-e Alam of VECC, Calcutta and Bikash Sinha of VECC and SINP, Calcutta).

Finite temperature effects on hadronic masses and decay widths have been calculated in a consistent framework. These effects have been included in calculations related to quark-gluon plasma diagnostics for the first time.

(iv) *Evolution Of Strange Quark Nuggets In The Early Universe :* Sibaji Raha (in collaboration with Jan-e Alam of VECC, Calcutta, Bikash Sinha of VECC and SINP, Calcutta and Pijushpani Bhattacharjee of Indian Institute of Astrophysics, Bangalore).

Continuing our previous work on the survivability of quark nuggets within a QCD-motivated microscopic picture of baryon evaporation, we are studying the

possible growth of the primordial nuggets due to reabsorption of the emitted neutrons, taking into account their finite diffusion rates. These studies are particularly relevant in the light of the recent discovery by two different groups (French and US—Australia collaboration) of dark matter of possibly baryonic composition in the halo of our galaxy, the Milky Way. Work is progressing satisfactorily and will be earnestly pursued in the near future.

2. Foundations of Quantum Mechanics

(i) *Study of Implications of Interrupted Fluorescence Experiments :* D. Home and M. A. B. Whitaker.

The phenomenon of interrupted fluorescence has been of interest for a number of years, starting from the famous experiments by Dehmelt in 1975 using trapped laser-cooled ions. A variety of theoretical approaches have been made to investigate implicatons of such experiments. Recently it has attracted renewed interest because of its possible relevance to "hidden variable" or ontological interpretations of quantum mechanics. In this context a new analysis was made in collaboration with M.A.B. Whitaker (Queen's University of Belfast) which brings out clearly the importance of "hidden variable" or ontological approaohes in comprehending some of the intriguing aspects of the phenomenon of interrupted fluoresence.

(ii) *Relativistic Quantum Mechanics of Bosons :* D. Home, P. Ghose and M.N. Sinha Roy.

There is a long-standing belief in the literature that it is impossible to construct a consistent relativistic quantum mechanics of a boson in an external field analogous to the relativistic quantum mechanics of a fermion. We have been able to circumvent this difficulty for bosons by exploiting the foliation of space-time by space-like hyperplanes and constructing multicomponent configuration space wave functions of spin 0 and spin 1 bosons which satisfy the first-order Kemmér-Duffin equation. As a follow-up, we are now investigating possibilities of new observable effects implied by this formalism we have developed, jointly with P. Ghose (S.N. Bose National Centre for Basic Sciences, Calcutta) and M.N. Sinha Roy (Presidency College, Calcutta).

(iii) *A New Theorem on Quantum Nonlocality :* D. Home.

A new theorem has been formulated showing that the postulate of wavefunction collapse implies a physically meaningful nonlocal effect at the level of ensembles in the Einstein-Podolsky-Rosen (EPR) type examples. This connects the EPR problem explicitly with the Quantum Measurement Problem and complements the nonlocality entailed by the celebrated theorem of John Bell.

3. Condensed Matter and Staistical Physics

(i) *Self-organised Criticality :* I. Bose, S.B. Santra, S. Banerjee (S.N. Bose National Centre for Basic Sciences, Calcutta).

The concept of self-organised criticality (SOC) has been found useful in the description of phenomena as diverse as earthequakes, forest fires, relaxation phenomena in magnets and the organization of river networks. Sandpile models have been extensively studied in recent times to understand the nature of SOC. We have undertaken numerical simulation studies of the sandpile model to determine the scaling behaviour (size distribution, fractal dimension etc.) of the various components of the sand avalanches in the critical state.

(ii) *Strongly correlated systems :* Indrani Bose, Saurabh Gayen.

Some exact results on single hole dynamics in a coupled chain model have been derived. The exact eigenfunctions that have been determined include a bound state of the hole with a localized triplet excitation, a coherent Bloch-type state of the hole in a sea of singlets and a state containing a localized triplet excitation and a propagating hole. The results derived are of relevance to understand the nature of charge transport in the high-T_c superconductors.

(iii) *Magnetism :* Indrani Bose, Uma Bhaumik and Asim Ghosh.

A ferromagnetic Hamiltonian with Dzhyaloshinki-Moriya interaction and in the presence of a strong magnetic field has been considered. Using the exact Bethe Ansatz analysis the existence of two-magnon bound states has been shown

A, study of different types of mean field theories of quantum antiferromagnets has been initiated.

(iv) *One Dimensional System and the Geometric Phase :* M. H. Engineer

The effect of Electron—Electron interaction on the ground state of one dimensional systems was studied to see whether the Geometric Phase effects proved to exist previously are modified.

B. CHEMISTRY

Institutional Project No. I : Improvement of plant productivity using modern biotechonlogy and plant breeding

A. *Application of biotechnological methods for the improvement of oil in oil seeds Brassica campestris and Brassica iuncea with respect to quality* : Asis Bhattacharyya, Manas Pathak, Krishnakali Niyogi, Sharmila Chattopadhyay and Dolly Ghosh (Supervisor)

(i) *Detection, isolation and purification of medium chain fatty acyl ACP thioesterase (MCT) from oil seed :*

As our aim is to improve the oil seeds *Brassica campestris* and *Brassica iuncea* by the intervention of MCT, extensive studies have been undertaken to detect the presence of MCT in indigenous plants. It has been found that in seeds rich in specific fatty acid, the specific fatty acyl ACP thioesterase is present. Two such oil seeds rich in specific fatty acids (i) palmitic acid (16:0) 65% (Kalpataru) and (ii) stearic acid (18:0), 40% (mango) have been identified.

From maturing Kalpataru seeds palmitoyl-ACP thioesterases has been isolated and purified (over 1500 fold) using various methods of chromatography. Further purification to homogeneity is under progress.

Stearoyl-ACP-thioesterese has been detected in plastids of mongo kernel. Work is going on for its purification,

(ii) *Distribution of oleoyl-ACP thiaesterase in the different stages of maturing oil seeds of Brassica campestris (Agrani), its isolation and purification :*

The seeds were collected at different days after flowering from Madhyamgram field and kept frozen at −70°C prior to assay.

The oleoyl ACP thioesterase was assayed at different days after flowering during seed maturation. Maximum activity of oleoyl ACP thioesterase has been found at 28 days after flowering where the oil synthesis also reaches almost maximum level. The oleoyl ACP thioesterase, a 38k protein has been isolated from 28 days-old oil seeds of *Brassica campestris*. This enzyme is purified almost to homogeneity using various ion-exchange chromatography and ACP-affinity chromatography. The specificity of the enzyme is checked using ^{14}C-oleoyl ACP, ^{14}C palmitoyl-ACP,

^{14}C-stearoyl ACP and ^{14}C-lauroyl ACP as substrates. This enzyme is specific for oleic acid. Further work is in progress for N-terminal sequence analysis. Approximately 0.2-0. 3ug of oleoyl ACP thioesterase per gm of seeds could be isolated.

(iii) *Electron microscopic studies nltrastructure of the developing oil bodies in Brassica campestris seeds during oil accumulation :*

Seeds of *Brassica campestris* were collected at different days after flowering and processed for the determination of oil body development by Transmission Electron Microscopy.

(iv) *Assay of glucosinolate in Brassica iuncea plants and seeds of wild and hybrid varieties obtained from breeding program to develop O-glucosinolate mustard seeds :*

A micro method has been developed and standardised to measure total glucosinolate in plant tissues. Leaves of various wild and hybrid *Brassica* plants have been analysed for their total glucosinolate content.

Survey of wild gene pool of Ipomoea species for total lipid and fatty acid profile : Anirudha Aich and Dolly Ghosh (Supervisor) in collaboration with Dr. K. K. Mukherjee (Department of Botany).

Two horticultural, namely *Ipomoea guamochit* and *I. nil.* seven wild, namely, *I. hederifolia, I. chryscides, I. triloba, I. obscura, I. sepiaria, I. pes-tigridis. I. fistulosa* and semicultivated species *I. aquatica* were analysed for their fatty acid profile and total lipid content.

Both the horticultural species have comparable total lipid content (10%) and fatty acid profile. The wilds on the other hand showed marked variation both in total lipid content (varies from 5-20%) and percent composition of different fatty acids. Of all the species studied *I. chryseides* manifested highest (51%) and lowest (25%) percentage of C-18 : 2 and C-18 : 3 fatty acids respectively. Both C-14 : 0 and C-22 : 0 are conspicuously present in *I. fistulosa* and *I. pestigridis* whereas *I. chryscides* contains only C-22 : 0 fatty acid. Conjugated diene is recorded only in four out of 10 species analysed.

Institutional Project No. II Chemical and Biological Studies of Marine Organisms

A. (i) *Chemical and biological screening of some marine polychaetes* : S. Roy, K. Basu, P. Bhattacharyya and A. K. Barua (Supervisor).

A marine polychaete, *Lumbrinereis* species collected from Digha showed very powerful toxicity in the brine shrimp test. It also showed antibacterial activity against some gram-positive and gram-negative bacteria.

Chemical examination of the extract of the above species has yielded several chemical compounds and some progress has been made to chemically characterize these products.

Some work has also been done on another marine polychaete, *Nereis* sp. Preliminary investigation showed the presence of a number of compounds. Attempts are being made to isolate the compound in pure state.

(ii) *Development of scale up technology for the production of EPA, a potent medicine for cardiovascular diseases* : D. Banerjee, D. Pal, C. Banerjee, T. K. Patra and Amitabha Ghosh (Supervisor) in collaboration with Dr. S. Misra and Prof. A. Choudhury, Department of Marine Science, University of Calcutta.

The scale-up technology for the production of EPA has been developed successfully utilising urea adductation and low temperature crystallisation by counter current distribution technique and finally by molecular distillation at a very low pressure. Various preparations of EPA have been obtained, viz., 30, 40, 50 and 60%. Highly purified EPA (90%+) was also obtained by silver ion chromatography of 60% EPA. Preliminary testings with laboratory animals revealed that the EPA preparations are nontoxic. Negotiations are being made for human trials, in collaboration with some leading hospitals in Calcutta.

(iii) *Characterisation of some novel choline plasmalogens from marine bivalves :* Gautam Chattopadhyay and Amitabha Ghosh, (Supervisor) in collaboration with Dr. S. Misra and Prof. A. Choudhury, Department of Marine Science, University of Calcutta, Dr. L. Varticovski and G. Dolnikowski, Tufts University, Boston, U. S. A.

Characterization of some novel choline plasmalogens from the marine bivalve *Macoma birmanica* has been done, via isolation, purification and gas chromatograpny—mass spectrometry of the plasmalogen derived aldchydes which were reduced and converted to alkyl acetates prior to analysis. The results of this study confirmed the occurrence of very long chain plasmalogens (upto C-36) in marine organisms, hitherto unreported in any biological system.

(iv) *Activation of phosphatidylinositol 3-kinase (PI-3K) and stimulation of cell growth by ether linked phosphatidylcholine from marine origin :* Amitabha Ghosh in collaboration with Dr. S. Misra, Harvard University School of Public Health Boston, U. S. A. and Dr. L. Varticovski, Tuft University School of Medicine, Boston, U. S. A.

Phosphatidylcholine (PC) from marine bivalve *Macoma birmanica* enriched in ether-linked PC was used in the present study. The marine animal derived PC's stimulated growth of murine pre-B lymphocytes, whereas chicken PC (egg lecithin) inhibited growth of these cells. Also, it was fount that unlike egg lecithin, PC's from marine animals enhanced PI-3-kinase activity. These findings indicate that ether-linked phospholipids activate PI-3 kinases and may participate in mitogenic responses.

(v) *Pharmacologically active fatty acids of tiger prawn Penaeus monodon* (Fabricius) : C. Banerjee, D. Banerjee, T. K. Patra, D. Pal and Amitabha Ghosh (Supervisor) in collaboration with Dr. S. Misra and Prof. A. Choudhury, Department of Marine Science, University of Calcutta.

The fatty acid composition of the hepatopancreas and body flesh of the exportrble marine prawn *Penaeus monodon* (Fabricius) have been studied by gas liquid chromatography and other techniques of chromatography. Altogether 24 components were detected and estimated. Considerably high levels of pharmacologically active polyunsaturated fatty acids of $\omega 3$ series were recorded. Of the bioactive fatty acids, major components were arachidonic (20:4 $\omega 6$), eicosapentaenoic (20:5 $\omega 3$) and docosahexaenoic (22:6 $\omega 3$) acids were confirmed in high levels in this commercially important species of tiger prawn.

(vi) *Investigation on the lipids of edible marine ray fish of Dasyatis* spp : D. Pal, T. K. Patra, D. Banerjee, C. Banerjee and Amitabha Ghosh (Supervisor) in collaboration with Dr. S. Misra and Prof. A. Choudhury, Department of Marine Scienee, University of Calcutta.

The lipids and fatty acids of the edible ray fish of marine origin have beed studied elaborately. The results indicate that the lipids are rich sources of EPA and DHA, two very important fatty acids, having various pharmacological activities. A seasonal study on the lipids and fatty acids has been initiated in view of its utilization as a commercial source for the production of EPA and DHA for medicinal use.

(vii) *Phospholipids of the edible marine fish Boleophthaimus boddaerti* : D. Banerjee, D. Pal, T. K. Patra, C. Banerjee and Amitabha Ghosh (Supervisor) in collaboration with Dr. S. Misra and Prof. A. Choudhury, Department of Marine Science, Uuiversity of Calcutta.

The body flesh lipids of the edible marine fish *B. boddaerti* has been found to be a rich source of phospholipids, particularly the ether-linked forms, which has received considerable attention during recent years as pharmacological agents and

because of its various biological activities as a cell membrane constituent. Techniques utilizing enzyme hydrolysis of the phospholibids, along with chemical methods for selective removal of a particular class, enriching the desired constituents, are being attempted. Application of this stereoselective enzymatic deacylation procedure would be of immense importance in purifying a desired phospholipid on a preparative scale for further biological studies.

(viii) *Investigation on the lipids of a multifloral honey from Sunderbans marine enviroment* : Gautam Chattopadhyay and Amitabha Ghosh (Supervisor) in collaboration with Arati Malakar, Dr. S. Gupta-Bhattacharyya and Prof. S. Chanda, Department of Botany, Bose Institute.

We have taken up the study of the determination of the lipid and fatty acid profiles of honey in details, because these data were found to be fragmentary and insufficient in one hand and no data could be found from honey samples of natural mangrove environment.

The lipid sample was fractionated, after isolation, by various chromatographic techniques into hydrocarbons, wax esters, steryl esters, triacylglycerols, sterols and polar lipids. Each of these individual fractions was then subjected to gas liquid chromatographic analysis after derivatisation, whenevcr necessary.

The most interesting finding was the occurrence of long chain polyunsaturated fatty acids of $\omega 3$ series, abuormally high levels of cholesterol and very long chain aliphatic alcohols in the wax ester fraction. Further work is in progress.

Institutional Project No. III : Studies on structure, function and dynamics of biomolecules.

A. Physical, Chemical and Structural Studies on Proteins

(i) *Studies ou protein folding* : Tapan K. Chaudhuri and N. K, Sinha (Supervisor)

The folding process of fully reduced, denatured trypsin-subtilisin inhibitor isolated from turtle eggwhite was followed as a function of time by polyacrylamide gel electrophoresis at pH 4.5. The fully reduced inhibitor and native inhibitor were well separated in gel electrophoresis and species with intermediate mobilities during the refolding process were detected, indicating the large changes in conformation of inhibitor molecules. These conformational changes with the progress of refolding are now being studied by circular dichroism and fluorescence measurements.

(ii) *Studies on low molecular weight trypsin inhibitors :* Umes Ch. Halder, Anupa Bhattacharyya and N. K. Sinha (Supervisor).

The LA-1 and LA-2 inhibitors isolated from the seeds of *Luffa acutangula* were devoid of tryptophan residue and contained single tyrosine residues. Normal emission spectra were obtained for both the inhibitors indicating the absence of influence of the microenvironment around the excited fluorophore. Fluorescence quenching studies with the non-ionic quencher, acrylamide and the ionic quencher, potassium hydrogen phosphate showed that they were accessible to the tyrosine residue to each inhibitor, but about 60% of the flurophore of the LA-1 inhibitor was accessible to the ionic quencher, potassium iodide.

Circular dichroism measurements in the far ultraviolet region gave spectra of both the inhibitors with little or no a-helix.

The MC-3 trypsin inhibitor isolated from the seeds of *Momordica charantia* was a small protein composed of 53 amino acid residues, as reported earlier. This inhibitor is now being prepared in homogeneous state to an appreciable amount for its amino acid sequence study.

(iii) *Interactions of proteins with solid surfaces :* Anuradha Bhaduri and K. P. Das (Supervisor).

In continuation of our work mentioned in last year's annual report, we extended our work with ovalbumin and lysozyme. It has been found that acetylation of the NH_2 groups of ovalbumin has caused a reversal in the trend of adsorption of ovalbumin. While ovalbumin has been found to be adsorbed on alumina in positive excess at pH 7.5, acetylated ovalbumin has been found to be negatively adsorbed. In presenee of 1M GuSCN both ovalbumin and acetylated ovalbumin showed positive adsorption. The isotherms at other pH's have been constructed. Effect of acetylation of lysozyme on its interaction with alumina were also studied. The isotherms were found to be affected by increasing ionic strength.

(iv) *Effect of acetylation of proteins on its changes in solution conformation* : Anuradha Bhaduri and K. P. Das (Supervisor).

Changes in surface hydrophobicity of β-lactoglobulin were studied fluorimetrically as a function of the degree of acetylation of the protein. It was found that surface hydrophobicity did not change much as the degree of acetylation of the protein gradually increased from 0 to 65%. Increasing the degree of acetylation to about 80% caused a 50% reduction in surface hydrophobicity. The accessibility of the tryptophan residues for various actylated fractions are now being determined by acrylamide quenching,

(v) *Formation and characterization of microcapsules using protein and studies of release properties of encapsulated compounds :* Chaitali Bhattacharjee and K. P. Das (Supervisor).

Attempts are being made to formulate a suitable composition of the wall material of a microcapsule for encapsulation of oil soluble active compounds using a combination of protein and polysacharide for controlling the release properties of the encapsulated compounds.

(vi) *Surface interaction of low molecular weight proteins at interfaces :* Umes Ch. Halder, N. K. Sinha and K. P. Das (Supervisor).

Surface properties of four proteins having molecular weight less than 5000 were studied at air/water and alumina/water interface at pH 7.0. Electrostatic interaction has been found to play a dominant role in the adsorption process. Positive adsorption was obtained when protein and alumina surface had opposite charges and negative adsorption was obtained when both protein and surface had same charges. Adsorption behaviour did not show any correlation with the surface hydrophobicity of the proteins. All the four proteins were found to undergo gradual unfolding of their compact structure as a function of time despite the fact that all of these proteins retain their activity for more than an hour even at 90°C.

B. *Studies of heterocylic and Organhsulfur Compounds :* A. K. Maiti, K. Basu and P. Bhattacharyya (Supervisor).

(i) A simple method for the synthesis of dimeric carbazole using montmorillonite supported CrO_3 has been developed.

(ii) Considering the importance of thiol ester in synthetic chemistry, a new efficient method for the preparation of thiol ester from acyl chloride and thiol in presence of PEG 4000 under mild condition has been developed. By the application of this method various thiol esters have been prepared in high yield.

C. (i) *Synthesis of Indolocarbazoles :* Archana Batabyal and Manas Chakrabarty (Supervisor).

The multi-directed synthetic approaches to indolocarbazoles was brought to near completion. The product obtained by the Pd(II) acetate-HOAc-catalysed cyclisation of 9-methyl-3- (*N*-methylanilino) carbazole (vide Ann. Rep., 1991-92) was identified by spectral analyses as *N' N'*-dimethylindole [3.2-*b*] carbazole. This method appeared to be the best method (more than 50% yield) of preparing the said IC. Further, the product obtained by the photocyclisation of *N*, *N'*-dimethyl-*N*, *N'*-diphenyl-

o-phenylenediamine (vide Ann. Rep., 1992-93) was correctly identified as the cleaved mono-cyclised product, *N*-methylcarbazole. Also, 2-iodoindole, prepared for the first time from 2-chloroindole by Finkelstein reaction, led to a better yield of 2, 2'-biindolyl by the Bamfield-Quan biarylation reaction.

(ii) *Hetero Diels-Alder Reactions of an Azadiene :* Tanaya Bagehi, A. C. Nath and Manas Chakrabarty (Supervisor)

The first annulation reaction of *N*-substed, indole-3-carbox-aldehyde *N. N'*-dimethylhydrazones (NNDMH), established by us (vide Ann. Rep., 1991-92), was extended to three more cases. *N*-Phenylmaleimide proved to be too weak a dienophile to react with either of *N*-carbethoxy and *N*-benzoyl azadienes. But with *N*-methylmaleimide, the *N*-benzoyl azadiene furnished a fused y-carboline - a behaviour parallel to that observed for the *N*-carbethoxyazadiene. A general synthesis of [*a*] annulated y-carbolines thus emerged,

D. Chemistry of Plant Products :

Chemical Investigation of *Polyalthia longifolia* : Ananya Dan, A.C. Nath and Manas Chakrabarty (Supervisor).

Our search for secondary metabolites of plant origin and likely to have insecticidal property was extended to the seeds of *P.l.* whose bark has already been chemically investigated by us (vide Ann. Rep. 1990-91). The petrol and ehtyl acerate extracts of the freshly collected seeds resulted in the isolation of as many as five metabolites following CC and PTLC. The identification of these compounds is in progress.

E. *Studies on Prostaglandin Biosynthesis :* Mallika Roy and Dolly Ghosh (Supervisor).

(i) Studies on prostaglandin (PG) synthetase : efiect of metal ions on PGE_2, PGF_{2a} and PGI_2 synthetase in comparison to Ca^{2+}.

It has been reported earlier that Ca^{2+} ion regulates PGE_{2a} synthetase activity of goat vesicular microsomes by modulating the enzyme complex, cyclo-oxygenase-peroxidase-synthetase and its target is the cyclo-oxygenase active site. Metal ions similar to Ca^{2+} e.g. Sr^{2+}, Ba^{2+}, Tb^{3+}, La^{3+} exert the similar kind of effect i.e a time dependent alteration of the enzyme kineties (hysteresis) followed by stimulation of product formation on cyclo oxygenase as well as PGE_2 synthetase. But the metal ions like Cu^{2+}, Pb^{2+}, Zn^{2+}, Mn^{2+} have very little or no effect on cyclo—oxygenase and

peroxidase but they are higihly inhibitory to PGE_2 synthetase and stimulatory to $PGF_{2\alpha}$ synthetase. Our preliminary observations show that Ca^{2+} has no effect on $PGF_{2\alpha}$ synthetase but it is stimulatory of PGE_2 synthetase (comparable to PGE_2 synthetase).

(ii) Screening of Diazine derivatives using prostaglandin synthetase system for possible anti-inflammatory compounds.

Development of non-steroidal anti inflammatory drugs (NSAID) has high potential for pharmaceutical applications. The prostaglandin, PGE_α is responsible for inflammation. The majority of NSAIDs usually inhibit prostaglandin synthetase activity. We have developed a good assay system for PG synthetase which we are using for screening a number of diazine derivatives synthesized in our laboratory for possible prostaglandin synthetase antagonists. 50% inhibitory concentrations of some of these compounds are comparable to indomethicin and aspirin, the potential NSAIDs.

F. Studies on Biomembrane

(i) *Structure and function of the erythrocyte membrane :* Amit K. Das, Raja Bhattacharya, P.T. Srinivasan, Indranil Mandal, Manikuntala Kundu, Parul Chakrabarti and Joyoti Basu.

Protein 4.2 has previously been shown to be palmitylated in human erythrocytes. Following depalmitylation of protein 4.2 with hydroxylamine, native and depalmitylated protein 4.2 have been compared with respect to their binding to 4.2-depleted vesicles. Depalmitylation has been found to significantly decrease binding of band 4.2 to membranes.

Erythrocytes from chronic myelogenous leukemia (CML) patients have been found to be more susceptible to uptake by macropages under oxidative stress compared to normal erythrocytes. A simultaneous increase in membrane-bound hemoglobin has been observed. Thalassemic erythrocytes have also shown greater uptake by macrophages under conditions of oxidative stress, compared to normal erythrocytes.

G. Structure, function and interaction of proteins

(i) *Calcium lipid dependent protein kinase in goat spermatozoa :* Rita Sikdar and Parimal C. Sen (Supervisor).

The cytosolic fraction isolated from goat spermatozoa is found to contain a protein kinase which could be activated in the presence of calcium, phosphatidyl

serine and diolein. The kinase phosphorylates histone when assayed in the presence of [$-^{32}P-$] ATP as phosphate donor. The enzyme activity is inhibited by staurosporin, a specific inhibitor of protein kinase-C, hence the kinase is expected to be PK-C. The membrane fraction on the otherhand shows only a very low level of PK-C activity even after mild detergent treatment indicating most of the PK-C activity is present in the cytosolic fraction. Longer period of incubation or higher concentration of protein inhibit the enzyme activity, however inclusion of protease inhibitors donot protect against the inhibition, suggesting that an endogenous inhibitor of protein kinase could be present in the cytosolic fraction.

(ii) *The amphiphilic drug induced conformational change of ion transporting enzymes as evident from tryptophan fluorescence change* : Gautam Adhikary, Sucheta Chandra, Rita Sikdar and Parimal C. Sen (Supervisor).

The tryptophan fluorescence of Na^+, K^+-ATPase, Ca^{2+}, Mg^{2+} and Ca^{2+}-ATPase enriched microsomal membranes have been found to be changed by two amphiphilic drugs e.g. chloroquine (antimalarial) and chlorpromazine (antisychotic) alone or in combination with ligands and/or substrate. The findings suggest that some conformational change possibly in E_1 and E_2 state of the enzmes in presence of these drugs and/or ions and substrate have taken place. The tryptophan fluorescence obtained from *in vitro* and *in vivo* experiments are found to be comparable after drug treatment and normal state of the enzymes could be retained when the enzyme activities returned to the normal level after discontinuation of the drug treatment *in vivo*. By the use of modified Stern-Volmer equation f_a the effectivc fraction of tryptophan most exposed to the drug and effective quenching constant k_a have been calculated. The non-linearity of Stern-Volmer plots indicate that a fraction of "Trp" residues remain inaccessible to the quencher which may correspond to highly hydrophobic region that are normally buried in the membranes.

(iii) *Identification and characterization of low molecular weight inhibitor proteins/ peptides in rat brain cytosol* : Dipankar Bhattacharyya and Parimal C. Sen (Supervisor).

We have recently partially purified and reported a protein from cytosolic fraction of rat brain homogenate which specifically inhibited Na^+, K^+-ATPase isolated either from rat brain or kidney (Chandra *et al.* BBA-1144 : 33-38, 1993). In continuation of the work we have found that a number of small proteins/peptides of molecular weight 5-12 kd are present in the cytosol of brain homogenate which specifically inhibit Na^+, K^+-ATPase. The purification, characterization and role of these peptides in the regulation the ATPase are being persued.

(iv) *Alteration of microviscosity of plasma membranes of rat enterocyte sby a heat stable enterotoxin from Eschrichia coli* : Parimal C. Sen in collaboration with U. Ganguly, NICED, Calcutta.

The fluidity of the plasma membranes isolated from a heat stable enterotoxin (sta) from *E. coli* and phorbolmyristyl acetate treated enterocyte cells in rat is found to be different from the control subject. The change in fluidity is attributed to the change in fatty acid composition and phospholipid-cholesterol ratio. The change in fluidity could be correlated with the change in protein kinase C and guanylate cyclase activities in the plasma membrane of rat enterocytes.

(v) *Localization of active domain of Ca^{2+}-ATPase* : Jitendra K. Gupta and Parimal C. Sen (Supervisor).

A Ca^{2+}-ATPase isolated and purified from goat spermatozoa is found not to require any exogenous Mg^{2+} for its activation. Studies are in progress to locate the active domain of this ATPase by control proteolysis and then compare its properites with the well known Mg^{2+}, Ca^{2+}-ATPase.

Institutional Project No. IV : Studies on ecology, environmental pollution and related problems.

(i) *Field trial of a bioimmunomodulator* : D. Ghosal and A. K. Barua (Supervisor).

The cytokine isolated from bone marrow and showing immunomodulatory activity was used in the field trial for immunomodulating immunosuppressed cases of broiler poultry. Reports obtained from the field were analysed and a modified schedule of delivering the BIM was introduced via nose/eye. Young chicks of 3 day old, then at 12th day, 20th day and between 30-35 the day in a 45-50 day life span of broiler poultry were treated with the BIM. The overall mortality and morbidity rate dropped from 40% to less than 16%, chicken mortality dropped from 20% to an average of less than 2%.

The trial which was initially started at Birati was extended to the poultry farms at Budge Budge, Hooghly and Diamond Harbour.

To meet the cost of production of BIM a nominal charge was levied, which the farmers paid very willingly. The amount received was deposited with the Accounts Section of Bose Institute. This is continued further.

(ii) *Encapsulation of the Bioimmunomodulator* : D. Ghosal, A.K. Barua (Supervisor) in collaboration with A. Bhaduri and K.P. Das.

The delivery of the BIM to adult birds via the conventional route of nose/eye is difficult. To solve the problem, investigation was initiated to delivery the BIM through food or water in an encapsulated form. The BIM was added to gelatin and edible oil base and stirred vigorously in short pulses till fine uniform oil droplets containing the BIM was formed.

Field trial of this encapsulated BIM is going on and reports obtained so far has been encouraging.

(iii) *Immunomodulation of enteric infection:* D. Ghosal, S. Datta and P. Bhattacharyya (Supervisor).

From 8-10 days post hatching poultry broilers were found to suffer from enteric infection due to *E. coli*/*Salmonella* contaminated fish meal. Studies were initiated in our laboratory so as to control this infection by immunomodulation as prolonged use of antibodies not only result in resistant strain but also dampen the health of the bird thereby causing great economic losses to the poultry growers. BIM was given to thr birds either via nose or through drinking water and an immunostimulation was observed. Clinical signs and symptoms of *E. coli* was reduced after 3 days of BIM treatment. To study the mechanism of action of the BIM via nose or through food/drinking water, rats were injected (i) by Salmonella A 'H' antigen (ii) infected with *E. coli* orally. Salmonella A 'H' antigen infection was found to suppress bone marrow and thymus secretion. BIM treatment improves this suppression. In contrast *E. coli* infection initially stimulates bone marrow reaction but as the infection gains hold a suppression in bone marrow secretory profile was observed. A BIM treatment via nose improves bone marrow secretion but this improvement was more pronounced in animals treated with BIM via food.

Institutional Project No. V : Studies on microbes and parasites for Industrial and Medical applications.

(i) *Penicillin-interactive proteins of Mycobacterium smeqmatis* : Tapan Mukherjee. Dhiman Basu, Manikuntala Kundu, Parul Chakrabarti and Joyoti Basu.

The 49 KDa transpeptidase previously reported from *M. smeqmatis* has been found to require arginine and free thiol groups for activity. Its N-terminal sequence of 40 amino acids, shows homology with *B. subtilis* PBP5. Cross-reactive molecules

are present in *M. avium* and *M. tuberculosis*. The 19 KDa beta-lactamase of *M. smeqmatis* is not a metallo-beta lactamase. It preferentially hydrolyzes cephalosporins, rather than penicillins.

(ii) *Studies on a mycolic acid-defective mutant of M. smeqmatis* : Sanjoy Mukherjee, Swapnanjan Goswami, Manikuntala Kundu, Joyoti Basu and Parul Chakrabarti.

A mycolic acid-defective mutant of *M smegmatis* has been found to show increased sensitivity to a range of penicillins and cephalosporins. The uptake of small molecules like (^{14}C) glycine is also higher in the mutant compared to the wild type.

(iii) *Penicillin-interactive proteins of Shigella dysenteriae* : Sebabrata Mahapatra, Anindya Sundar Ghosh, Alok Kanti Kar, Joyoti Basu, Parul Chakrabarti and Manikuntala Kundu.

The 38 KDa PBP of *S dvsenteriae* was found to be immunologically related to PBP 7 of *E. coli*, a PBP associated with imipenem resistance. This PBP is present in maximum amount in the stationary phase of growth. Its N-terminal sequence has been determined. Aztrenonam resistance has been found in clinical isolates of *S. dysenteriae*. This is associated with decreased affinity of PBP3 for aztreonam.

C. BOTANY

Institutional Project No. 1 : Improvement of Plant Productivity, nitrogen fixation and photosynthesis using modern biotechnology and plant breeding.

A (i) *Cytogenetical investigations on naturally occurring diploid and hexaploid Chenopodium album* : B. Bera and K. K. Mukherjee.

Total leaf proteins and isozymic variation of four exenzymes, namely esterase, peroxidase, acid phosphatase and leucine aminopeptidase of two wild diploids isolated from lower Gangetic plains and one semi cultivated hexaploid cytotype of *Chenopodium album* were investigated. A spectra of protein and isozymic bands observed in the leaves of three cytotypes of *C. album* manifested similarities and dissimilarities between the diploids and between the diploids and hexaploid which helped in characterizing each cytotypes separately and understanding their interrelationships.

(ii) *Investigations on the wild gene pool of Ipomoea spp.* : S. Das and K. K. Mukherjee.

Species homology and genetic relationship among nine wild, two horticultural and one semicultivated species of *Ipomoea* were studied. Comparative studies of total seed protein, its globulin and albumin fraction showed presence of Vicilin and Legumin like seed storage protein in the seeds of *Ipomoea* species. Pairing affinity and a denodrogram showing hierarchical cluster was constructed for total seed protein, globulin and albumin fraction separately. The dendrogram for total seed protein, globulin and albumin fraction revealed three major groups among the species studied, The dendrograms of total seed protein and globulin were almost superimposable with minor variation, that of albumin was somewhat different.

(iii) *Cytogenetical investigation on Beta spp.* : K. K. Mukherjee.

The segregating populations of the cross between *Beta vulgaris* and *B. palonga* were studied in F_3 and F_4 generations. Heritability and genetic correlation involving three quantitative character were studied througe interclass correlation and regression. The interclass correlation method revealed consistent estimate of heritability. The genetic correlation in F_4 is much stronger compared to F_3 with respect to the characters studied.

B. (i) *Molecular Analysis of Expression of Arginine Decarboxylase (ADC) in Rice in relation ta Salinity Stress :* Manas Chatterjee, Sudhiranjan Gupta. Dibyendu N. SenGupta and Bharati Ghosh.

Our goals are to investigate the regulation of expression of ADC, a key enzyme in polyamine biosynthesis, both at transcription and translational level in rice in relation to salinity stress and to clone ADC cDNA from rice. The 498 bp genomic DNA fragment, containing the coding sequence for C terminal 165 amino acids of arginine decarboxylase of oat, was PCR amplified and used as probe for Northern analysis using the total RNA prepared from young plants of M-1-48 (salt sensitive) rice cultiver. From 30 ug of total RNA maximum level of the ADC mRNA level was detectable only in the roots of plants treated with 200 mM NaCI for 6 hr and in the shoots of plants treated with 150mM NaCl for 6hr. The inducibility of ADC gene by salinity stress in salt-sensitive and salt-tolerant rice-varieties will be compared.

When 498 bp oat ADC DNA was used to probe the Southern blot containing genomic DNA from *Nicotiana*, *Brassica*, rice and oat, hybridization with a few DNA fragments of rice and oat was revealed, suggesting the homology at nucleotide level. The ADC protein from 72 hr. germinated seedling of rice was purified to homogeneity and by SDS-polyacrylamide gel electrophoresis the molecular weight of about 68 kD was detected, close to oat ADC protein as reported. The purified protein will be used for further characterization (e. g. identification of processed polypeptides, if any.)

(ii) *Heat induced polyamine metabolism in rice calli :* Malabika Roy and Bharati Ghosh.

Last year we have reported that thermal stress causes increased accumulation of free and conjugated polyamines in tolerant rice both at plant and cell level than in their sensitive counterparts. Conjugation of polyamine with protein is mediated by the enzyme transglutaminase. Exogenous application of polyamines help in organogenesis of rice embryogenic calli which suggests that polyamines can function as a substitute of hormone in culture media as differentiating agent. Both spermidine and spermine causes change in the pattern of root growth.

(iii) *Polyamine metabolism in Brassica campestris under salinity stress* : T. J. Bhaduri. S. Das, S. Ghosh and Bharati Ghosh.

We have reported that arginine decarboxylase is stress induced enzyme in rice but in *Brassica* it is not induced by stress ; on the other hand polyamine exidase and diamine oxidase, two degradative enzymes of uncommon polyamines (caldine and thermine), were induced strongly. Maximum amount of polyamines was detected in stamens of *Brassica* flower. ADC has been purified from *Brassica*.

(iv) *Regulation of ribulose 1, 5-bisphosphate carboxylase in rice under thermal stress :* Anindita Bose and Bharati Ghosh.

We have reported that the synthesis of Rubisco was more susceptible to thermal stress in sensitive cultivars than in tolerant ones. In sensitive one, small subunit of Rubisco is decreased much more strongly than large subunit. In heat tolerant rice cultivar N22, the Rubisco protease activity did not change significantly with increasing temperature. But in IR8, sensitive cultivar, with increasing temperature protease activity increased significantly. The level of mRNA encoding large sub-unit increased considerably in tolerant cultivar after 120 min at 45°C than the control. Valne, But no significant change of the level of mRNA was noticed in sensitive cultivar after different heat stress.

C. (i) *Soluble and chloroplastic inositol synthase of plant origin : Biochemical and molecular studies* : Aniruddha Ray Chaudhuri and A.N. Lahiri Majumder.

Homogeneous soluble and chloroplastic forms of inositol synthase (s) have been obtained from *Euglena gracilis*, *Vigna radiata* and *Oryza sativa*, by employing one general purification protocol for all. Complete biochemical characterization is in progress. Studies with protein synthesis inhibitors are suggestive of a nuclear origin of the chloroplastic inositol synthase. A PCR-product, corresponding to the complete yeast inositol synthase (Ino-1 gene) has been generated using the available nucleotide sequence data to search for the gene (s) from both the algal and higher plant sources. The chloroplastic inositol synthase from rice seedlings have been found to be both light and salt-responsive. Further, the salt-enhancement of the organellar enzyme in the tolerant varieties is exhibited only in photodifferentiated chloroplasts.

(ii) *Biochemical & molecular basis of salt response in plants* : Sriparna Bagchi, Sanghita Bhattacharya and A.N. Lahiri Majumder.

An investigation on cytosolic and chloroplastic fructose 1,6-bisphosphatase (s) (FruP ase) was initiated to account for the decline in net photosynthesis under saltstress in salt-sensitive and tolerant varieties of *Oryza sativa*. Both the $FruP_2$ ase (s , which are adversely affected by growth of the seedling in presence of salt have been purified to apparent homogeneity and being characterized.

D. *Plant Growth Regulators :* S. N. Ganguly and Jayashree Banerjee.

(i) Endogenous growth regulators were investigated in the leaves of *Camellia sinensis* (L.) Kunze (Tea) to account for the alternating phases of growth and dormancy which the plant phases through. While gibberellic acid A_3, A_4, A_7, A_{13} and indole-

3-butyric acid (IBA) were found from the leaves collected during growing period, abscisic acid (ABA), scopoletin, a considerable amount of indole-3-acetic acid (IAA) and a number of lower fatty acids viz. Caproic acid, lauric acid, palmitic acid and oleic acid were found from the dormant period leaves.

(ii) A now cytokinin, 2-hydroxyl-1, methyl dihydrozeatin was isolated from the immature leaves of *Bruquera gymnorhiza*. The structure of this compound was established. This compound was found to have a considerable plant growth activity. Besides the above compound zeatin was also isolated and characterized from the same plant.

(iii) From the petrolem ether (60-80°) extract of *Luffa* cylindrica (L.) Roem. fruit, a white solid, crystallised from petroleum ether-chloroform, m.p. 192° was obtained. It gave red colouration with Liebermann-Buchard reagent indicating the triterpenoid nature of the compound. The compound was found homogeneous in TLC. On the basis of physical and chemical evidences structure of the compound was established.

E. Introgression of submergence tolerance trait to cultivated rice.

(i) *Hybridization programme :* Nirmal Mandal and S. Gupta (in collaboration with Dr. S. Sinha, Botanist, Chinsurah Rice Research Centre, Hooghly)

It was desired to establish hybrids between known submergence tolerant rice (FR-13A & *O. rufipogon*) genotypes and high yielding local varieties with relatively tall plant types (Pankaj & Mahsuri) with a view to transfer the submergence tolerant character to the cultivars. Consequently 700-900 hybrid seeds were obtained for each of two interspecific (Pankaj x *rufipogon* & Mahsuri x *rufipogon*) and two intervarietal (Pankaj x FR-13A & Mahsuri x FR-13A) crosses.

(ii) *Production of androgenic rice plants :* Nirmal Mandal and S. Gupta.

Attempts has been made to used androgenic plant production technique for early fixing of desired characters. It was possible to derive calli at a rate of 4-15% in all four parents and 5-9% in different F_1 hybrids (Pankaj x *rufipogon*, & Mahsuri x *rufipogon*, Pankaj x FR-13A, and Mahsuri x FR-13A). Regeneration of green plants in calli of four parents was as high as 13-31% and in these F_1 hybrids was 9-15%. Moreover, albino plants, were also regenerated along with the green plants in all cases.

(iii) *Mechanism of androgensis in rice :* Nirmal Mandal and S. Gupta.

Study on histomorphological course of events during androgenesis revealed that rice pollen grains exhibited a morphological and physiological trimorphism of

development in culture and callus induction efficiency of uninucleate pollen was found to be about three times that of binucleate pollen. Polyploidization was observed to occur even 7 days after initiation of callus. Plantlet regeneration occurred through organogenesis with root and shoot arising separately from indiviaual meristematic zone which ultimately interconnected to from a single unit.

(iv) *Cytogenetics of partially sterile interspecific hybrids :* Nirmal Mandal and S. Gupta.

Varying degrees of pollen and spikelet sterilities in the F_1 plants of two interspecific crosses (Pankaj x *rufipogon* and Mahsuri x *rufipogon*) was observed. The most common indications of structural hybridity at the pachytene stage of meiosis were loose pairing, inversions and translocations. Univalents and quadrivalents were observed in diakinesis and metaphase-1. Laggared and chromatid bridge with acentric fragments were noted in anaphase-1. All these suggested that partial sterility was due to both structural heterozygosity and complex gene interactions in these F_1 plants.

F. *In vitro studies on salt and water stresses in Nicotiana tabacum var. Jayasri and Brassica juncea var. RW 85-59 :* Gaurab Gangopadhyay, B.B. Mukherjee and S. Gupta.

(i) Effect of salt and osmotic shock treatments on tissue growth, viability, free proline and amino acid contents were studied in unadapted and NaCl-and mannitol adapted callus lines of *N. tabacum*. Adapted calli showed increased level of tissue viability and capability to grow after severe shock treatments than the unadapted calli as they acquired additional potentiality of osmoregulation. Selective retention of free proline and release of other amino acids by adapted calli after shock treatments were noticed indicating a probable mechanism of biochemical adaptation during osmotic stresses.

(ii) A specific band of an ionic peroxidase isozyme was identified as a probable marker of osmotic stress adaptation as it intensified gradually with increasing concentrations of both NaCl and mannitol.

(iii) Salt adapted lines acquired the potentiality to grow in iso-osmotic or higher concentrations of mannitol indicating their acquirement of cross tolerance to related stresses.

(iv) Callus lines of *B. juncea* adapted to different concentrations of NaCl and mannitol have been established and biochemical parameters related to stress adaptation are being evaluated.

(v) *Physiological changes of Oryza sativa (L.) callus due to salinity stress ;* Sangita Basu, S. Gupta and B.B. Mukherjee.

By gradual stepwise adaptation callus lines were found to be suitably adaped to high concentrations of NaCl while direct adaptation was not satisfactory. The previous callus lines accumulated proline more efficiently for osmoregulation in stepwise manner while the direct adapted lines were found to be devoid of such mechanism and they always showed less tissue growth and viability. The level of soluble proteins and the activities of some key isozymes altered with increased NaCl stress in culture media. Specific bands of α-amylase isozyme were identified in NaCl-adapted tissues. Comparison of different biochemical parameters between salt-sensitive and tolerant cultivars indicated that different mechanisms were in operation within them.

(vi) *Improvement of oilseed Brassica through conventional breeding and in vitro technique* : Amitava Roy, Dr. P.K. Saha, Dr. B.B. Mukherjee and Dr. S. Gupta.

Two varieties of *B. juncea* (MCN-9 and RLM 198) and three varieties of *B. campestris* (B, 9, B-54 and Candle) were screened for assessing the *in vitro* response of anther culture and their regeneration potential. In *B. juncea*, the rate varied (28-30%) under optimal condition. The anther-productivity was 2% In *B. campestris* the callusing rate was different for each variety. Candle variety showed highest callusing (30%) followed by B-54 (22%) and B-9 (20%).

Intraspecific reciprocal crosses were made between *B. juncea* cv MCN-9 and *B. juncea* cv RLM-198. Also intraspecific crosses were made between the varieties of *B. campestris* namely CANDLE, B-9 and B-54. Hybrid seeds have been raised successfully for further studies.

G. I. Screening of rice germplasm using physiological and biomolecular parameters.

Seedling vigour : Somen Nandi, Gitals Das and Swati Sen-Mandi.

(i) Some high and low vigour Basmati (scented) rice varieties have been identified through correlative studies on germination performance, analysis of DNA integrity, enzyme activity, isozyme pattern and electron paramagnetic resonance spectra for free radicals.

(ii) *Cold tolerance :* Syamali Chakrabarti and Swati Sen-Mandi.

Out of thirty ricc varieties studied, forteen have been found to be tolerant, nine semitolerant and seven highly snsceptible to cold stress. The sereening tests used are : (i) germination performance at 4°C, (ii) response to cold stress of seed pretreated at 4°C followed by seedling growth at low temperature (12-23°C), (iii) plant performance in the field during 'Boro' season.

(iii) *Salinity tolerance :* Gitati Das and Swati Sen-Mandi.

Response to salinity strese (EC varing from10-70 m mohs/cm) was studied in different varieties of rice. To develop biomolecular parameters, isozymes of superoxide dismutase, peroxidase, alcohol dehydrogenase and esterase are now being studied.

II. Studies on cellular events associated with tolerance to abiotic stress.

A. *Cold stress*

(i) *Short term agrotechnique for enhancing seedling growth in summer paddy :* Somen Nandi, Gitali Das and Swati Sen Mandi.

Cold pretreatment of rice seeds at 4°C upto a critical time period enhances rate of seedling growth in the field during winter (12-23°C). The growth enhancement was found to be associated with higher *denovo* protein synthesis and lower alcohol dehydrogenase activity upto 24 hour.

(ii) *Studies on lipid changes associated with cold tolerance in rice :* Syamali Chakraborti and Swati Sen-Mandi (in collaboration with D. Banerjee and Prof. A. Ghosh, Dept. of Chemistry, Bose Institute).

A comparative study shows significant difference in the fatty acid compositions regarding carbon chain lengths and unsaturations. Further work in progress.

B. *Salinity stress*

Developing resistance to salinity in rice callus : Gitali Das and Swati Sen-Mandi.

Rice callus has been raised from leaves in MS supplemented media. Attempts are now being made to initiate callus in media at different concentration of salinity for establishing germplasm screening marker through isozyme studies.

III. *Cell ageing in 'dry' stored rice seeds* : Somen Nandi and Swati Sen-Mandi (in collaboration with Dr. Asish Roy of Saha Institute of Nuclear Physics, Calcutta).

Dry seeds of rice were used to study active oxygen scavenging ensymes viz. superoxide dismutase, peroxidase and catalase, active oxygen accumulation and state of DNA integrity. The data obtained suggest that age associated DNA damage during dry storage may occur at specific DNA sites. Attempts are now being made to use relevant cDNA probe for Restriction Fragment Length Folymorphism analysis of the genomes.

IV. *Plant-insect interrelationship*

(i) *Biochemical interactions between the different instare of Diacrisia casignetum larvae and its Host-Plant, Sunflower* : Madhuchanda Chatterjee and Swati Sen-Mandi.

A study of the phenol content (that is known to be involved in defence mechanism) as well as nitrogen (that constitutes dietary requirement of the insect) in control and infested sunflower leaves were studied. Simultaneously assay of these chemicals in larval instars of the insect and their faeces was also done to develop strategies of Biological control.

H. (i) *Studies on seed viability of some Leguminous seeds :* Biswajit Das and P. K. Saha.

Eight plants of the family Leguminosae have been selected after preliminary screening to study seed viability, dormancy and their germination. Ultrastructural features of seed coat is being studied by SEM.

(ii) *Studies on physiological aspects of Bauhinia sp., Pachyrrhizus sp. and Leucaena sp.* : S. Biswas (Guest worker) and P. K. Saha.

Seed germination and dormancy can be correlated on the basis of water uptake and morphological characteristics of seed coat. Physiological seed type can be separated to screen viable and non-viable seeds in a given seed lot.

I. (i) *Molecular analysis of regulation of Gene Expression in Rice in Salinity Stress* : Sudhiranjan Gupta, Manas Chatterjee, Bharati Ghosh and Dibyendu N. Sen Gupta.

To work out the regulation of expression of a salinity stress inducible gene in salt sensitive and salt tolerant rice cultivars IR29 and Pokkali, respectively, salT genomic DNA of IR-29, containing the entire coding region with 150 bp intron was amplified and subcloned in TA cloning plasmid and used as probe.

Total RNAs from salinity stress and untreated seedlings were extracted and fractionation by agarose gel after glyoxal treatment has been standardized and Northern analysis has been started. The cDNA GC19 for wheat abscisic acid responsive element binding protein (generous gift from Dr. Quatrano, USA) was used as probe in Northern blot analysis and the level of mRNA was found to be high in roots of both Pokkali (salt-tolerant) and IR29 (salt-sensitive) rice cultivars. The gene expression is inducible by salt (200mM) in root, sheath, and also in leaves. Two oligonucleotides were made according to the sequence of abscisic acid responsive

elements (ABRE) and will be used for gel mobility shift assay to compare the expression of ABRE binding protein in salt-sensitive and salt-tolerant rice seedlings exposed to salinity stress.

(ii) *Plant DNA polymerase* : M. Sanath Kumar and Dibyendu N. Sen Gupta.

For our CSIR project on Plant DNA polymerase : Possibility of cloning cDNA (s) for characterization and Expression in E.coli (until 28.02.94), we are purifying protein (s) with DNA polymerase activity from germinated rice (*Oryza sativa* L. cv. IR8) seedlings. So far, we have purified protein with DNA polymerase activity by following conventional column chromatography. The DNA polymerase activity found to be NEM sensitive, ddTTP sensitive and aphidicolin resitant. These results suggest that the rice seelings DNA polymerase is polymeras β type. In Southern blot analysis when human DNA polymerase β cDNA was used as probe homologous DNA fragments were detected from *Nicotiana*, *Brassica* and rice. By using sequence specific oligonucleotides we have amplified the entire coding region for yeast DNA polymerase I and III by PCR and subcloned in TA cloning vector. In Southern blot analysis of EcoRI cut genomic DNAs from tobacco, *Brassica*, rice and yeast DNA by yeast DNA pol. III DNA as probe, homologous DNA fragments in plants were detected. Attempts will be taken to clone the genes for plant DNA polymerase homologous to yeast Pol III and human pol beta.

J. (i) *Micropropagation of Nyctanthes arbor-tristis* : Sanghamitra Bhattacharya and Sabita Bhattacharya.

Nyctanthes arbor-tristis, a tropical deciduous tree, important in many aspects including its various medicinal values has been selected for micropropagation with the objective of rapid multiplication of the clone. Meristematic tissues from both apical and axillary buds responded equally in culture medium (40-60%), standardized through selection. Presence of cytokinine (BAP) in higher conc. with auxin (NAA) in lower conc. resulted resumption of growth of existing meristem as well as initiation of new shoot apices ($\leqslant$4/ explant) within four weeks.

(ii) *Improvement of Brassica through anther culture :* Sabita Bhattacharya and Sanghamitra Bhattacharya.

Out of six *Brassica* varieties, two of *campestris*, three of *juncea* and one of *napus*, only *napus* anther callus yielded shoots in the third passage of culture. Inositol and adenine sulphate jointly in the culture medium enriched with BAP anp NAA improved % of regenerating callus.

K. *In vitro studies on regeneration Cumium Sativa callus :* Romit Poddar and S. Gupta.

Calli obtained from leaf and hypocotyl could be maintained in MS medium containing IBA (1·O mg/1)+15% coconut milk when these calli were transferred to regeneration medium (MS medium+BAP (2mg/1), NAA (1 mg/1)+3% sucrose) 23·8 per cent of these showed regeneration of shoots. The rate of differentiation was 3-5 shoots/callus. The rate of differention could be increased by sequential ommission of hormone from the medium (1 passage each) and then transferring the tissue to the IAA containing medim. This sequential treatment resulted differentiation of 6-8 shoots/ callus. Cytological study of differential calli showed that the callus of the calli were predominantly deploid up to 4th subculture. During 8-9th subculture though 48% cells were diploid there were increase in number, of tetraploid and aneuploid cell population with cytological abnormalites like unequal separation chromosome (2·7%), chromatids bridge (1·8%). The differentiated shoots 89%) were predominantly diploid.

L. (i) *Improvement of Aromatic Rice :* T.K. Ghose, J. Sen, J.S.R. Murthy, C. Roy, R. Poddar, P.K. Saha, K.K. Mukherjee, B.B. Mukherjee and S. Gupta.

A total of 270 aromatic lines were collected ; 188 lines from IRRI, 6 lines from W.B., and 76 lines from the rest of India, and grown in Madhyamgram Experimental Farm (North 24-Parganas), Bose Institute, Calcutta. Of these, 77 lines were identified to have aroma in grains under the agroclimatic conditions of South West Bengal. During the monsoon season of 1993, 46 crosses were made involving 18 of the identified aromatic lines with three non-aromatic, high yielding, dwarf varieties. Seeds were obtained from 33 of these crosses. The lines involved in the crosses have been characterized agronomically, grown in the boro season at the same site, and the scented lines shown to contain aroma in the leaves and grains. The putative hybrid seeds of the crosses and the 77 lines identified for aroma (during monsoon '93) have been sown in monsoon 1994 for further breeding work.

With a view to identify conditions suitable for generation of androgenic plants from the F_1 s, anthers from 15 of the 18 aromatic parents and the three non-aromatic high yielding dwarf varieties were cultured. Although the callusing frequency range was similar, green plant regeneration from anther derived calli was better in non-aromatic lines than that obtained in the aromatic lines. Inclusion of silver nitrate in the culture medium improved green plant production. Regenerated plants are heing maintained in liquid medium.

M. *Germination of wild Rice seeds :* J. Sen, T.K. Ghose and P.K. Saha :

Seeds of five rice species, *Oryza longistaminata, O. officinalies, O rufipogon, O. barthii* and *O. nivara* obtained from IRRI, were treated with 5 μM GA_3 and subjected to germination test under laboratory conditions. Results obtained after 7-days incubation were 100%, 5)% and 40% germination by *O. nivara, O, longistaminata* and *O. barthii*, respectively. The seeds of *O. officinalis* and *O. rufipogon* could not be germinated after GA_3 treatment.

Institutional Project II : Chemical and biological studies on marine organisms.

(i) *Regulatory properties of brain Fructose 1-6 bisphosphaiaer :* Sanghita Bhattacharya and A. N. Lahiri Majumder.

Brain fructose 1,6-bisphosphatase, ordinarily insensitive to the allosteric inhibitor 5'-AMP, has been earlier demonstrated to become sensitive to 5'-AMP on treatment with chelators like histidine, EDTA, citrate or imidazole. Further work demonstrated that the brain $FruP_2ase$ is a metalloenzyme and contains 5 to 6 mole of Mn^{++} and Zn^{++}, the latter being bound near the allosteric site. On removal of Zn^{++}, the brain enzyme becomes 5'-AMP sensitive, and is bound to an affinity column, Blue Sepharose.

Institutional Project No. IV : Studies on ecology environmental pollution and related problem.

(i) *Environmental biopollution in relation to human and plant diseases :* Sunirmal Chanda, Swati Gupta Bhattacharya and Swati Sen Mandi.

Rotorod sampler was placed in Madhyamgram field station for monitoring airborne particulates including fungal spores to test the pathogenicity with reference to human respiratory allergy and plant diseases. The common spore types are *Alternaria, Aspergillus, Curvularia, Cladosporium, Helminthos sporium, Fusarium, Bettrania*, etc., which occur more or less throughout the year in different concentrations.

(ii) *Clinical Investigation and chemical characterization of some airborne pollen grains causing respiratory allergy :* Pampa Chakraborty and Swati Bhattacharya.

Round the year, intradermal skin prick tests with diffenent pollen antigens had been made on 1100 patients (above 5 years old). Highest response was shown by *Azadirachta* followed by *Cocos, Phoenix, Catharanathus, Eucalyptus, Areca* etc, Total carbohydrate, lipid and soluble protein has been estimated in all cases.

(iii) *Palaeoenvironment of Bengal Basin during Holocene :* Sunirmal Chanda (Supervisor), Arghya K. Hait, H.K. Das and S. Chakrabarty.

Four bore holes viz., Canning, Pakhiralaya, Bakkhali and Dankuni have been drilled during the year 1993-94. Four samples from Digha, Salt Lake, Diamond Harbour and Kolaghat have been radiometrically dated. The mangrove palynomorph bearing lower horizons of Digha and Diamond Harbour are radiometrically dated as $22360 \pm \frac{450}{420}$ and $14460 \pm \frac{350}{330}$ YBP respectively.

(iv) *Late-Quaternery vegetational history and biostratigraphy of some deposits of West Tripura :* Sunirmal Chanda and Satadip Sarkar.

The Holocene sediments collected from four localities viz. two from Kalapanya and one each from Nandannagar and Sekerkot have been analyzed palynologically. Four composite pollen diagrams have been constructed from the profile of four localities. The pollen analytical result of the sediments four localities. The pollen analytical result of the sediments reveals the dominance of pollen grains and spores from non-arboreal plants including a good number of ferns.

(v) *Biochemical study of Honey samples with the pollen contents :* Arati Malakar and Sunirmal Chanda.

Squeezed and extracted honey samples collected from various parts of West Bengal have been chemically and palynologically analyzed to pinpoint the source of energy and to decide the *biochemical* potential of segregated pollen grains and also the base honey.

Gel electrophoresis technique was adapted to locate the types of protetn in different honey samples. Gas liquid chromatography has also been done to know the different fatty acid components. Total carbohydrate was also estimated.

D. MICROBIOLOGY

Institutional Project No. I : Improvement of plant productivity, nitrogen fixation and photosynthesis using modern biotechnology and plant breeding.

A. (i) *Interaction of Al^{3+} with the siderophore of Rhizobium sp. (Cicer arietinum) :* Nuper Roy and P.K. Chakrabartty.

The extent of growth of the strain *Rhizobium* sp. (*Cicer arietinum*) BICC 651 in absence of iron decreased linearly with increasing concentrations of Al^{3+}. However, maximum level of siderophore was produced in presence of 100 μM Al^{3+}. The level was almost twice than it was produced in absence of Al^{3+}. In presence of 100 μM iron, addition of 1 mM Al^{3+} did not result in significant change in the growth pattern of the strain. On the other hand, addition of Fe^{3+} at a concentration of 1 μM alleviated the toxic effect of 100 μM Al^{3+}, resulting in normal level of growth.

The interaction of Al^{3+} and Fe^{3+} with siderophore was studied by comparing the change in absorption pattern by spectrophotometry. In a mixture containing 10 μM Al^{3+} and siderophore, a shift in the absorption spectrum could be noticed when iron was added to 10 μM. Addition of higher concentrations of iron shifted the spectrum further towards that of Fe-siderophore. On the contrary, addition of 1 mM of Al^{3+} to a mixture containing 10 μM Fe^{3+} and siderophore did not noticeably change its spectrum. This indicated higher affinity of Fe^{3+} towards the siderophore.

Institutional Project No. III. : Studies on structure, function and dynamics of biomolecules.

A. *Studies on molecular genetics of mycobacteria with particular reference to DNA replication mechanisms :* Mamta Chowla and Sujoy Dasgupta.

Dr. Dasgupta joined the Department of Microbiology in January, 1994 as a Lecturer and has just initiated his research programme mentioned above.

Institutional Project No. IV. : Studies on ecology, environmental pollution and related problems.

A. (i) *The effects of some pesticides on the phylloplane mycoflora of certain crops :* Naim Uddin and Roma Chakraverty.

The effects of pesticides, Cildon, BHC and Bavistin, used at the recommended field doses (at 0·06%, 0·5% and 1·0% concentrations respectively) on the phylloplane mycoflora were studied. BHC was found to completely inhibit all the fungal isolates including some plant pathogens. Cildon inhibited the pathogens *Fusarium* sp., *Helminthosporium oryzae*, *Alternaria brassicae* and *A. solani*. Bavistin, a fungicide, was found to be less significant in the inhibition of growth of the phylloplane mycoflora.

(ii) *Fungus having potential in biotechnology :* Roma Chakraverty.

Paecilomyces sp., a common fungal component of the airspora, showed antagonistic activity against certain gram negative bacteria and also *Rhizoctonia solani*, an important plant pathogen. The fungus exhibited a wide range of pH tolerance, between 2-10. It was also found to have significant proteolytic activity.

Institutional Project No. V : Studies on microbes and parasites for industrial and medical applications.

A. (i) *Biotechnological enrichment of magnesite ore :* B.K. Mohanty and A.K. Mishra.

The mineral salt medium was modified replacing yeast extract by dried yeast for maximum silica release from magnesite.

The air-flow rate to the fermentor was standardised at 1·5 1/min.

Switch-over to fed-batch process was made. Feb-batch cultivation was performed at 37°C with a fixed value of μ (0·091 h^{-1}) controlled by a glucose feeding strategy. This led to a marked increase in soluble silica release at 72 hrs.

Trial runs at 5 MT pilot plants with different carbon sources, viz., glucose, commercial sugar and Anil srarch revealed that both common sugar and Anil starch were equally effective in removing silica from magnesite.

(ii) *Biotechnological enrichment of bauxite ore :* A.K. Halder, B.K. Mohanty and A.K. Mishra.

Bacillus cereus Z and *B. circulans* FM were found to break down 9 and 15%

respectively of pure kaolin. Kaolin is present as impurity in bauxite. Second step UV mutagenesis of the strains improved capacity to break down 38 and 42% respectively.

In a improvised glass slurry fermentor the improved strains were able to release 38 and 47% silica from bauxite ore thereby reducing the original silica content of 4·8% to 3·0 and 2·3% respectively.

(iii) *Biobeneficiation of dolomite ore :* B.K. Mohanty, A.K. Halder and A.K. Mishra.

Five dolomite samples were tested by treating them with bacteria isolated from the respective ore samples. The isolated strains were able to remove silica ranging from 9% to 20%.

(iv) *Biochemical studies of a thiosulfate oxidising bacteria :* Subrata Kr. Das and A. K. Mishra.

A new thiosulfate oxidising bacteria was isolated which has thiosulfate oxidase, rhodanase, sulfite oxidase and cytochrone C_{550} and C_{552}. Mutants with low sulfite oxidase activity with tendency to extrude elemental sulfur have been isolated.

(v) *Influence of oxygen on ferrous/thiosulfate oxidation in Thiobacillus ferrooxidans :* Amitabha Das and A.K. Mishra.

Ferrous iron/thiosulfate oxidation by *T ferrooxidans* increases with increased oxygen tension. A linear relationship was found between the ferrous iron/thiosulfate oxidising activity and the cytochrome c and cytochrome a content. Studies on respiratory inhibitors indicate that ferrous iron/thiosulfate oxidation have a common electron transport chain and the electrons from the oxidisable substrate enters at the cytochrome c level.

B. (i) *Amylolytic enzymes of Myceliophthora thermophila D-14 :* R. Sadhukhan and S.L. Chakrabarty.

Saccharification of starchy material was carried out by *Myceliophthora thermophila* D-14, The hydrolysate was later fermented by free and immobilized *S cerevisae*. The ethanol produced varied from 56 to 113 ml/kg of the substrate.

(ii) *L-asparaginase and its antineoplastic activity :* Subha Manna, A. Sinha and S. L. Chakrabarty.

purified L-asparaginase produced by *Pseudomonas stutzeri* MB-415 exhibited antineoplastic activity. The presence of thiol group in the enzyme was established by

protective and blocking reagents. L-asparaginase from *P. stutzeri* MB-415 was immunologically distinct from that produced by *E. coli*.

(iii) *Production of lactic acid :* M. Chatterjee, R. Sadhukhan and S.L. Chakrabarty.

Lactobacillus cellobiosus D-39 exhibited the dual capacity of hydrolyzing starch and production of lactic acid under the conditions used. The conversion titre to lactic acid was 50% using waste potato (30%) as substrate.

C. (i) *Studies on the epidemic isolates of V. cholerae O139 :* Dilip K. Sengupta, Tapas K. Sengupta, Ranjan K. Nandy, Sharmistha Mukhopadhyay and A.C. Ghose.

Vibrio cholerae O139 strains isolated from recent epidemics in India and Bangladesh were characterised with respect to their haemagglutination activities, plasmid content, cell surface protein and lipopolysaccharide profiles, intestinal colonization, cholera toxin production and other virulence properties. Although, the O139 organisms shared certain common virulence factors with O1 strains, certain important differences were also noted. Thus, the O139 organisms expressed novel pilus colonization factors which was morphologically and antigenically distinct from the toxin corregulated pilus of Ol strain. The 20 kD subunit protein of this novel type of pilus was found to be an important protective antigen.

(ii) *Immunobtological studies on Leishmaniasis :* Mrinal Kanti Ghosh, Ashis K. Ghosh, Shubhajit Dasgupta and A. C. Ghose.

Attempts were made to identify leishmanial antigen responsible for the induction of IgG subclass specific antibody responses in kala-azar (KA) and post kala-azar Dermal Leishmaniasis patients Furthermore, distribution of T lymphocyte subpopulations ($CD2^+$, $CD4^+$ and $CD8^+$) in the peripheral blood and lymph nodes of KA patients was studied to delineate the mechanisms of the altered immunological status.

D. (i) *Studies on Streptomyces collagenase* : R. P. Mukhopadhyay and A. L. Chandra.

Antiserum raised against the collagenase of *Streptomyces* sp. A_{11} induced by bovine achilles (BAT) collagen cross reacted against *Strepomyces* collagenases produced in response to BAT collagen and hide powder and protein A in immunodiffusion assay but not against clostridial collagenase. The results indicated that immunologically similar collagenases were produced by the streptomycete when BAT collagen and hide powder were used as inducers.

(ii) *Keratinase production by soil actinomycetes :* Sumana Mazumder and A. L. Chandra.

Two soil actionmycetes AC_{36} and AC_{175} hydrolysed chicken feather, human hair, wool and silk in a basal salts medium. Microscopic examinations revealed growth of the organisms within the substrates.

In liquid cuiture AC_{36} hydrolysed feather keratin to amino acids, viz, alanine, glycine. lysine, cysteine and glutamic acid.

(iii) *Actinomycete proteases :* Papia Mitra and A. L. Chandra.

Two proteolytic actinomycetes AC_{80} and AC_{90} caused unhairing of goat skin after 18 h of incubation at 37°C. The protease was present in the culture filtrate.

E. (i) *Oxidative cleavage of C_{17}-C_{20} bond in pregnane by a Pseudomonas sp.* : Alok Dhar and Timir B. Samanta.

The esterase produced by the *Pseudomonas* sp. has been shown to have a distinct role in side chain cleavage of progesterone. The esterase has been purified (51 fold) by combination of ion-exchange, salt precipitation and gel filtration chromatography. The purified enzyme (esterase) seems to be a homotetramer with subunit of Mr 43000. The esterase is highly specific for 17β-steroid esters. The Km and Vmax of the enzyme against testosterone acetate were found to be 0.25 mM and 5.5 μmol/h respectively.

(ii) *Studies on extracellular invertase produced by Aspergillus ochraceus TS* : Kajori Ghosh and Timir B. Samanta.

The kinetics of growth in sucrose supplemented medium showed that the enzyme (invertase) production attained maximnm with 1% (w/v) sucrose. On the other hand. glucose exhibited repressive action and addition of C-AMP (10 mM) eliminated the repressive effect of glucose which indicated the inducible nature of the enzyme.

(iii) *Host-parasite interaction in Visceral leishmaniasis : Role of xenobiotic metabolizing enzymes* : Rittika Chanda and Timir B. Samanta.

The phase I enzyme (cytochrome P450) was detected in promastigotes of *Leishmania donovani* grown in liquid medium. The cytochrome P450 level in liver microsomes of the model host (Syrian Golden Hamster) decreased as a result of infection with the parasite and the decline in Cyt P450 level was found to be partially reversed by antileishmanial drugs. Studies are underway to understand the cause of fall in Cyt P450 level in infected host and mechanism of reversal of this enzyme.

F. (i) *Purification and characterization of an endoxylanase from Aspergillus sydowii MG49* : Mousumi Ghosh and Geeta Nanda.

A 30 kDa extracellular endoxylanase was purified to homogeneity from the culture supernatant of *A. sydowii* MG49 and characterized. Chemical modification of the enzyme revealed the presence of essential tryptophan, amino and carboxy groups in the catalytic site of the enzyme while eliminating the possibility of both reactive cysteine/cystine residues. Thermal inactivation of xylanase follows first order kinetics at a temperature of 60°C-90°C and pH 5.6. Thermal denaturation at 60°C, pH 5.5 (temperature and pH optima for activity) appears to be due to an irreversible polymolecular aggregation. Enzyme thermostability at this temperature is enhanced in the presence of glycerol.

(ii) *Production of xylanolytic enzymes and sugars by Aspergillus ochraceus*-42 : Amitabha Das and Geeta Nanda.

Xylanase and β-xylosidase with 6.46 u mg^{-1} and 0.50 u mg^{-1} activity respectively were produced extracellularly by *Aspergillus ochraceus* during growth on pulverised grass in liquid state fermentation. About 8.43% sugars were liberated from the alkali treated grass by the action of xylanolytic enzymes. Both mono- and divalent cations, specially K^+ and Zn^{2+} influenced the release of sugars from grass lignocellulose.

(iii) *Studies on beta-amylase enzyme of Bacillus megaterium* B_6 : Rina Rani Roy, Subhas Chandra Jana and Geeta Nanda.

The production of beta amylase was found to be highest when *Bacillus megaterium* B_6 was grown in 0.1% starch, but addition of glucose brought about an immediate and irreversible repression in enzyme synthesis. The synthesis of the enzyme was inducible. The enzyme was also produced by the strain during growth on waste starches. When the cells were immobilized through ionotropic gelation, thermal gelation or polymerization, the ionotropic gelation using strontium as divalent cation proved to be the most successful method.

G. (i) *Studies on lichen metabolite :* Kalyani Sen.

Plant growth nutrient (PGN) from the laboratory cultivable lichen biomass has been tested on seed, such as gram, peas, carrot, radish, etc., and the results are encouraging. Solvent extraction and TLC analysis indicated the presence of gibberellic and indole-acetic acid in the PGN of lichen biomass.

(ii) *Studies on lichen morphology* : Kalyani Sen.

Studies on the micromorphology of the lichen thallus has revealed the presence of three symbionts in the thallus.

H. (i) Genetics of sulfur lithotrophy in *Thiobacillus* : C. Deb, R. Chakraborty, P. Mukherjee, Keya Banerjee, A. Sengupta and P. Roy.

Following transposon mutagenesis in a facultative *Thiobacillus* strain, twelve mutants defective in thiosulfate metabolism were obtained. Physiological characterization followed by physical mapping of the chromosome revealed at least four genetic loci involved in this lithotropic function. One of the flanked transposon has been cloned and that of others are in progress. Cryptic plasmid from a *Thiobacillus ferrooxidans* strain was detected and its physical mapping and characterization was done. A vector is constructed, capable of mobilization, and suitable for searching minimum replicon of this plasmid. Gene bank of the plasmid is made in this vector. Mobilization and other studies are now in progress.

A repetitive sequence having inverted repeats at its ends from a strain of *T. ferrooxidans* has been identified and isolated. The cloning and detailed genetic characterization of this new repetitive element is in progress.

A bacteriophage specific for a *Thiobacillus* strain was isolated, particles were purified through CsCi density gradient centrifugation. Electron microscopic studies revealed its morphology with a isometric head and a very short tail. It contains DNA of approximately 38Kb. The physical characterization of the phage genome is in progress. This work has been done under the active supervision of Prof. N. C. Mandal, Department of Biochemistry.

To understand the basic phenomenon of microbe-mineral interaction, several chemotaxis defective mutants of *Thiobacillus ferrooxidans* were isolated. Studies on biophysical parameters including hydrophobicity and adhesion to relate the role of chemotaxis in bio-beneficiary process are in progress.

(ii) *Biology of arsenic resistance in bacteria :* A. Saha, P. Mukherjee, R. Chakraborty, C. Deb, A. Sengupta and P. Roy.

Soil isolates from different ecological zones in and around Calcutta were tested for arsenic resistance. One of the resistant isolate revealed an extra chromosomal DNA whieh conferred the resistance supported by curing studies. The genetic

heterogeneity of the arsenic resistance factor existing among the different bacterial isolates of diverse species is the objective of this study.

I. (i) *Cytokines activated functions of protein kinase C isotypes in the activation sequence of human neutrophils :* Subrata Mazumdar.

(ii) *Synthesis of isotope specific pseudo-substrate for the inhibition of protein kinase C signalling pathway which will be useful for the development of anti-inflammatory agent :* Subrata Mazumdar.

Dr. Mazumdar joined the Department of Microbiology in December, 1993 as a Lecturer and has just initiated his research programme mentioned above.

E. BIOCHEMISTRY

Institutional Project No. I : Improvement of Plant Productivity Nitrogen Fixation and Photosynthesis using Modern Biotechnology and Plant Breeding.

1.1. *Improvement of mustard seed proteins :* R. K. Mandal, Santanu Dasgupta, Sudip Ghosh, Somenath Bhattacharya, Nrisingha Dey, Biswajit Roy and Surekha Mandal.

As a part of the continuing programme of improvement of nutritional quality of mustard storage proteins, we have previously reported cloning and sequencing of 2S albumin genes and their promoters from several different *Brassica* species. This year, several deleted promoters of Indian mustard *B. jnncea* 2S protein gene have been assayed for their promoter efficiency by following the expression of tagged β-glucuronidase (GUS) gene in transgenic tobacco plants. In the most variable region of the otherwise conserved 2S protein gene, a stretch of 40 nucleotides have been changed with only 7 nucleotide mismaches by site-directed mutagenesis so as to contain 4 more methionine residues. This modified enriched methionine-coding 2S gene will be used to transform plant to see if seed proteins with enriched methionine content is synthesized. Restriction fragment length polymorphism (RFLP) and random amplified polymorphic DNA (RAPD) analysis are being carried out with the parents and their F1 hybrids in *B. campestris* to identify some molecular markers. Specific processing enzyme(s) responsible for proteolytic cleavage of precursor 2S protein (19 Kd) into mature subunits (9 and 4 Kd) have been identified in mid maturation seed extracts. (Supported by UNDP/FAO, DST, DBT and CSIR).

1.2. *Production of transgenic virus-resistant plant throngh intrduction of viral coat protein gene :* R. K. Mandal and Pallab Kundu (in collaboration with I. B. Maiti of Univ of Kentucky, USA).

One of the strategies of producing virus-resistant crop plants is the expression of a viral coat protein gene whereby the transgenic plant may be resistant not only against the same virus but also to other related viruses. With this in view, we have produced transgenic plants with TVMV (Tobacco vain mottle virus) coat protein gene under universel CMV 35S promoter in two varieties of tomato Pusa Ruby and Pusa Early Dwarf. The plants have been rooted after kanamycin selection and have

been transferred to soil. The integration of the coat protein gene has been confirmed by dot and southern blot hybridization of DNA from these plants. These studies and expression of virus coat protein in T1 generation plants will be coutinued. (Supported by CSIR).

1.3. *Studies on a novel ATPase from Mimosa pudica leaflets* : Rinku Ghosh and Susweta Biswas (in collaboration with Dr. Parimal C. Sen, Chemistry Department).

It has been reported earlier that an active Mn^{2+} dependent ATPase, present in the leaflets of M. pudica, contains polysaccharide in a large amount. The ratio of polysaccharide to protein in the pure homogeneous enzymes is 9 : 1. This strong association of polysaccharide to protein can not be dissociated by treating the enzyme with 8 M urea or 6 M guanidine chloride for 24-hours and even after treating it with 4 M trifluoromethane sulfonic acid for 2-3 hours. Inhibitor studies showed that Ca^{2+} blockers specifically stimulate the enzyme activity instead of inhibting it. That the enzyme contains 12.6 μg of Ca^{2+}/mg protein was revealed by Atomic Absorption Spectrophotometric determination. Interestingly, when this Ca^{2+} is removed by treatment with Quin 2, from the enzyme protein, polysaccharide component is completely separated from the protein leaving the enzyme inactive. This result indicate that a Ca^{2+} dependent conformational change of the protein is playing a role in association of the polysaccharide for the activity. The reconstituion of the enzyme in order to study its structural and functional aspect is in progress.

1.4. *Receptor for myoinositol trisphosphate from microsomal fraction of Vigna radiata :* Mita Sen and Susweta Biswas.

Microsomal fraction from mung bean (Vigna radiata) hypocotyl has been found to contain Ins- $(1,4,5)P_3$ and Ins- $(2,4,5)P_3$ binding activity. Preincubation of microsomal fraction with sulthydryl reagents reduced $InsP_3$ speeific binding. A single class of binding site with a kd value of 1.5 nM and Bmax of 1.1 pmol/mg protein has been detected. Besides Ins- $(1,4,5)P_3$ or Ins- $(2,4,5)P_3$ other myoinositol phosphates exhibited little affinity for this protein. The hinding protein has been purified to homogeneity and the MW of the native protein was recorded as 400 KDa. However, the protein under denaturing condition showed the MW 110 KDa suggesting that this protein is a homotetramer. That this protein is associated with Ca^{2+} release has been confirmed by its inclusion to proteoliposomes subject to the addition of Ins-$(1,4,5)P_3$ or Ins-$(2,4,5)P_3$. The affinlty of Ins-$(1,4,5)P_3$ is 3 fold higher than that of Ins-$(2,4,5)P_3$. The binding affinity of those $InsP_3$ is also reflected in the extent of

Ca^{2+} released from microsomal fraction. Heparin inhibits binding of $InsP_3$ with this protein and K 1/2 for this being 0·26 μM. It is also shown that this protein acts as a receptor for $InsP_3$ having characteristics of high affinity and low density. (Supported by CSIR).

1.5. *Expression of reporter gene, β-gluenronidase (GUS) under seedspecific Arabidopsis thaliana promoter (2S) in Bacteria, yeast and plant* : Mahadeb Pal, Samarpan Majumder and Susweta Biswas.

Storage proteins are major components of seed. They are expressed during a particular developmental stage of the seed. The 2S gene is expressed under the control of 2S promoter. Since 2S proteins are synthesised at a particular developmental stage of the seed, the 2S promoter must have some important characteristic features, regulation of which makes 2S proteins synthesised only at that particular period of seed development. But preliminary observation in this laboratory using 2S promoter from Arabidopsis thaliana (At) indicates that this promoter can be recognised by Agrobacterium tumefaciens and Saccharomyces cerevisiae as well, because the expression of GUS under PAtS3 in A. tumefaciens and S. cerevisiae is similar to that obtained in transgenic tobacco plant. The analysis of 2S promoter sequences and its comparison with the highly expressed promoters in yeast and bacteria are now in progress inorder to explain the data so far obtained. (Supported by UGC).

1. 6. *Expression of GUS gene under different plant promoters in Saccharomyces cerevisiae :* Mahadeb Pal in collaboration with B. B. Biswas (Calcutta University).

In continuation of last years report the At2S3 promoter (pAt 2S3) was compared with those of *S. cerevisiae* Pyk (pPyk) and cauliflower mosaic virus 35S (CaMVp35S) using GUS as a reporter gene. The pPyk is 45 fold more active than pAt2S3 which is in turn is 32 fold more active thau CaMVp35S. The transcription start point (tsp) for pAt 2S3 was found to be same as that in plants, and in the case of CaMVp35S, one major and several minor tsp were found, none of which is similar to that reported for plant tissues. The overall homology of pAt2S3 and CaMVp35S with that of yeast pPyk taking 325 bp upstream from the tsp have been searched by 'Best fit' computer analysis. It has been found that this pPyk has 80% and 60% homologies with pAt2S3 and CAMVp35S respectively. For the expression of GUS gene the pAt2S3 can effectively be recognized by *S. cerevisiae*. This is also apparent from the fact that the At2S3 gene contains several key sequence motifs near the tsp that match those of native *S. cerevisiae* promoters.

1. 7. *Studies on acyl carrier protein (ACP) from plant and bacteria :* N. Das, M. K. Maiti and S. Ghosh.

(a) *Expression of acyl carrer protein genes ACPSF1 and ACPS2 in the developing seeds of Brassica campestriscy B54 (Agrani).*

We previously reported cloning and sequencing of the two seed expressed ACP genes, ACPSF1 and ACPSF2, including their 5′—flanking, 3′ flanking and coding regions. We constructed two ACPSF1 and aCPSF2 gene specific DNA probes from the downstream regions of their translation stop codons that showed inability to cross hybridize in Southern experiments. It was observed by northern blot experiments using the gene specific probes and mRNA of developing seeds that both the ACP genes expressed specifically in seeds but not in leaves. The maximal expression of ACPSF1 and ACPSF2 genes were found during 22-24 and 14-16 days after flowering, respectively, showing varying temporal regulation.

(b) *Purification of ACP and molecular cloning of the gene from Azospirillum brasilense.*

ACP has now been completely purified from *A. brasilense* showing a single band in non-denaturing gel. Nevertheless, in SDS-PAGE, the purified ACP fraction still showed a minor and a major band in the region of 9-10 kb region. N-terminal amino acid sequencing of both the peptide bands are now being carried out to identify the pure protein. As normal cloning of the *A. brasilense* ACP gene was found almost impossible, we used an inverse PCR technique (using the known 160 bp core sequence of ACP gene, reported earlier, to construct the appropriate primers) to clone the region containing the complate ACP sequence, Sequencing of these inverse PCR clones yielded the complete sequence of the ACP gene of *A. brasilense*.

1. 8. *Studies on the regulation of C-source and N-source utilization in Azospirillum brasilense :* Sudip Chattopadhyay, Asim K Mandal and S. Ghosh.

(a) Global regulation of carbohydrate catabolism in *A. brasilense*.

Usiug a pleiotropic carbohydrate mutant CR17 of *A. brasilense* for complementation studies with genomic clones of the bacterium, a 2.8 kb genomic fragment that complemented the carbohydrate growth defect has now been identified and completely sequenced to identify the *car*R gene (carbohydrate regulation). The sequence analysis showed the presence of a *car*RS operon in the region that constitutes

a two-component ragulatory system for C-source uptake and catabolism. The carR gene has now been shown to play a positive regulatory role for global control of carbohydrate catabolism.

(b) Properties of a novel pleiotropic mutant (N747) showing defects in nitrate assimilalion, N_2-fixation and microaerobic growth.

We isolated a mutant N747 of *A. brasilense* that cannot assimilate N_2, nitrate and nitrite for growth and fails to grow under microaerobiosis. Enzyme analyis showed that the mutant is partially constitutive for assimilatory nitrate reductase (NAS) with no ability to induce assmilatory nitrate reductase (NIS). Extensitve molecular genetic studies indicate that mutant gene causing the above pleiotropic defects is most possibly transdominant.

Institutional Project No. III : Studies on structure, function and dynamics of Biomolecules.

3. 1. *Gene Regulation in E. coli and Mycobacteria* : N.C. Mandal, S. Ray Chaudhuri, Nandan K. Jana, Subrata Sau, Biswendu Chaudhuri, Hirock J. Datta, Lopa Adhikary, Madhumita Basu, Antara Basu, and Prajna Mandal.

The mutant *c*I *ts*2 gene of lambda producing repressor in which lysine at 224 position is replaced by glutamate, has been subcloned in an expression vector under *tac* promoter. This mutant repressor does not bind at all to CM-sephadex but does bind efficiently to QAE-sephadex to the extent of 100%, while the wild type repressor binds to the former very efficiently but to the latter, with around 65% efficiency. Results of biophysical studies indicate that this mutant protein is defective in tetramer formation at 25, 37, and 42°C, while the dimer formation is not affected even at 42°C. Filter binding studies show that even at 20°C, the co-operative binding of this mutan repressor to the operator occurs at a reasonably high concentration of the protein compared to the wild type repressor. All these results suggest that the above change of amino acid within the C-terminal end at 224 position causes an instability in the tetrameric interaction. (Project III ; Collaborators : Prof. B. Bhattacharyya and Dr. S. Roy ; Supported by CSIR).

In order to understand the mechanism of λ *P* gene lethality, *E. coli* mutant resistant to λ P killing was isolated. This mutation, called *rpl* mutaion, has been

mapped around 83 min position of the host chromosome, and is around 93% linked with the *dna*A gene. The *dna*A gene from the above *rpl* mutant *E. coli* was cloned. Study of the properties of this clone suggests that the *dna*A gene is possibly the target of the above *P* gene lethality. Attempt is being made to confirm his (Project III ; Supported by CSIR).

It has been established that of the six DNA*ts* mutations, two are defective in early replication (circle to circle mode of replication), two other in late replication (rolling circle replication), while the remaining two are defective in both early and late replications at 42°C. Of the last two, one has been shown to be defective in positive regulation of the delayed early genes which include also DNA replication genes. The phage with *ts* mutation in this regulatory gene fails to synthesize phage specific mRNA at 42°C. Interestingly, another L1*ts* mutant, in spite of showing normal DNA synthesis at 42°C, has been shown to be defective in the positive regulation of expression of one of the delayed early genes. This suggest a different type of temporal regulation of gene expression during the developmental growth L1.

Several promoters and terminators of L1 have been cloned and efficienceis of their respective functions have been studied in *E. coli*. Some of the terminators have been sequenced. To understand the mechanism of temporal regulation of L1 at molecular level, further studies are being made. (Supported by CSIR).

It was reported earlier that in *Mycobacterium smegmatis* mc²6, glutamate is essential for the induction of galactokinase. It has been shown further that the above regulation occurs at the level of transcription. To understand the role of glutamate in the regulation of *galk* expression, the *Eingut* [*E* (glutamate) *in*dependent *ga*lactose *ut*ilizing] mutants of mc²6 capable of growing on galactose in absence of any amino acid were isolated. These mutants expressed *galK* at low level in absence of glutamate & galactose which was enhanced further in their presence. Exogenous cAMP stimulated the expression *galK* in wild type mc²6 only when grown on galactose in presence of glutamate but not in presence of glutamate alone, and it inhibited the same in the above mutant only when grown on galactose in presence of glutamate. Above results suggest that the expression of *galk* in *M. smegmatis* occurs possibly from two different promoters ; induction from the first is glutamate dependent, while that from the second requires both galactose and glutamate and is positively controlled by cAMP and CRP.

The *galk* gene along with epimerase and transferase genes of M. smegmatis was cloned as a single 6 kb DNA fragment in *E. coil* to get pGKET plasmid. Comparative studies with both pGKET4 (New clone) and pGK6 (cloned earlier) indicated the presence of same *galK* gene in the above two clones. The 1.8 kb insert from the pGK6 plasmid was subcloned in M13mp9 vector and around 360 bp in the region upstrean of the *galK* gene was sequenced by Sanger's method. The analysis of base sequences

in this region indicated the presenee of a potential CRP binding site adjacent to the putative −35 region of a potential promoter. There are two operators each around 12 base pairs long which are separated by approximately 9 base pairs and show more than 80% base sequence homology with the *E. coli gal* opeators. The expression of *gal*K in pGKET plasmid was also cAMP and CRP dependent in *E. coli*. Further studies are being made to know the role of glutamate in this regulation in *M. smegmatis*. (Suppoeted by CSIR).

3.2. *Tubulin substructure and identification of its Structural, Functional and Regulatory domains* : B. Bhattacharyya, Suparna Sengupta, Nabanita Sarkar, Gopal Chakraborty, Pampi Basu and Suranjana Guha.

3.2.1. *Structure-functlon relatlonship of colchicine-tubulin interaction. :*

In continuation of the work on the antimitotic drug binding with tubulin, we made a quantitative binding study of 7-nitrobenz-3-oxa-1, 3-diazol-4yl-colcemid (NBD-colcemid), an environment-sensitive fluorescent analogue of colchicine, to tubulin. Two types of binding site of a colchine analogue on tubulin were detected. Binding of NBD-colcemid to one of these sites equilibrates slowly. NBD-colcemid competes with colchicine for this site. Binding of NBD-colcemid to this site also causes inhibition of tubulin selfassembly. In contrast, NBD-colcemid binding to other site is characterized by rapid equilibration and lack of competition with colchicine. Never theless, binding to this site is highly specific for the colchicine nucleus, as alkyl-NBD analogues have no significant binding activity. Fast reaction-kinetcs studies gave 1.76 x 10^5 M^{-1} S^{-1} for the association and 0.79 S^{-1} for the dissociation rate constants for the binding of NBD colcemid to the fast site of tubulin. Further characteri₂ation of these drug binding properties are in parogress

3.2.2. *Spectroscopic study on Tubulin structure.*

Tublin is a heterodimeric protein consisting of two subunits α and β. There are 8 tryptophan residues in tubulin, 4 each in α and β. The fluorescence emission from these tryptophans was found to be subject to the phenomenon of Red Edge Excitation Shift (REES). As the excitation wavelength was changed from 280 nm to 300 nm, the wavelength of maximum emission (λmax) shifted from 333nm to 339nm, which corresponds to a REES of 6nm. At 50°C or in 7M urea, where tubulin is unfolded, the REES was reduced to negligible extent.

REES was also observed in colchicine bound complexes of tubulin. On changing the excitation wavelength from 280 nm to 300 nm, the max of tryptophan emission shifted 338nm to 343nm. Thus the max of tryptophan emission are red

shifted in the tubulin-colchicine complex compared to free tubulin. This is probably due to quenching of the buried tryptophan(s), near the colchicine binding site on tubulin, by energy transfer to bound colchicine.

When the colchicine moiety in the tubulin-colchicine complex was excited over a wavelength range of 330nm to 370nm, the emission max shifted from 426nm to 444nm. On the other hand, such REES was not observed in bis ANS when bound to to tubulin. These REES effects are due to differentes in polarity of environments to which the tryptophans are exposed or colchicine is bound in tubulin. This results in differential rates of dipole-reorientation relaxation around the excited state fluorophores and hence the observed REES. (Supported by CSIR).

3.3. A study of chromosome replication and segregation in the yeasi S cerevisiae
P. Venkataiah, N. Roy, M. Maitra and P. Sinha (supervisor)

We are studying mcm (minichromosome maintenance) mutants of yeast which destadilize small circular minichromosomes, eaeh carrying an ARS (autonomously replicating sepuence) and CEN (centromere) DNA. It was expected that these mutants would carry lesions in genes whose products act in trans at ARS or CEN sequences of minichromosomal DNA to impair its replication and/or segregation. This search, in earlier work, had identified many genes which affect DNA replication. We have been working with these mutants, with emphasis on one mutant, mcm2. We have shown that this mutant affects plasmid and chromosomal DNA replication by causing underinitiations at their replication origins, leading to DNA damage at chromosomes and their subsequent loss from the cells. The actual mode by which these proteins act at replication origins is not know, Do they bind to ARSs to intiate DNA replication ? We are investigating these problems by studying the binding of these proteins with DNA (in collaboration with Dr. A. Lohia) and in vivo genomic footprinting at ARS elements (in collaboration with Dr. P. Parrack). We are also in the process of identifying chromosomal and plasmid suppressors of the mcm2 mutation to discover genes whose products interact with the mcm2 protein. In this respect we have shown that alterations at ARS1 subdomain (domain B) can suppress the minichromosome loss phenotype of mcm2 and mcm3 mutants of yeast. This result underscores the importance of these proteins in ARS funtion. In other laboratories it has been found that MCM2, MCM3 MCM5 etc. belong to a family of genes which is conserved amongst species ranging irom yeasts to mammals and plants. Therefore, a further charaterization of the protein function would throw more light on the process of initiation of DNA replication in general.

We have also undertaken a study of other mcm mutants which do not affect DNA replication. Size is an important determinant of chromosomal stability.

Perhaps a minimum size of DNA is required for anchorage to nuclear matrix that directs the processes of DNA replication and segregation. We have found that these mutants cause the loss of minichromosomal DNA in a manner that depends ubon its size. Thus, when the size of minichromosome DNA was increased from 15 to 60 kb by cloning lambda DNA into the minichromosome, there was a significant improvement of its maintenance in several of mcm mutants, which was over and above the improvement shown by the wild-type strain. DNA replication initiation mutants, mcm2, mcm3 and mcm7 described in the earlier section, did not show any size-depenqent improvement in minichromosome stability. Two mutants, mcm12 and mcm17, belonging to the size-dependent class, were further characterized as affecting centromere directed segregation of minichromosomes. One of these. mcm12, also showed enhanced sensitivity towards microtubule poisons (such as thiabendazole), increased chromosome loss and loss in spore viability during meiosis. This mutant could be affecting microtubule-associated segregation of chromosomes. Our work also-shows that centromere-diected sgregation, and not initiation of DNA replication by mcm mutants, is affected by the size of the isolation of conditional alleles of these mutations (present alleles are very leaky) to study the required. Tight alleles will also facilitate cloning of these genes which has eluded us till now.

Institutional Project No. V : Studies on Microbes and Parasites for Industrial and Medical Applications

5. 1. *Molecular Genetics of Entamoeba histolytica :* Anuradha Lohia, Sib Sankar Ray, Samudra S. Gangopadhyay and Saumeu Bhattacharya.

We have earlier reported the characterisation of a repetitive DNA family in *E. histolytica* which contains *ARS* consensus sequences from the yeast *Saccharomyces cerevisiae* and functions as a replication origin in yeast. We have now mapped this DNA fragment by two dimensional gel electrophoresis and demonstrated that it is a chromosomal replication origin in *E. histolytica.* Pulsed field gradient gel electrophoresis has shown the presence of 6 chromosome sized DNA molecules opposed to our earlier report of 3-4 chromosomes in *E. histolytica. Eh ARS* has been shown to be present at all the chromosomes.

We have identified several genes regulating growth and proliferation in *E. histolytica* such as cdc2, ras, rho, rac, mos/raf and gamma tubulin. These genes have

been cloned in *E. coli* expression vectors as fusion proteins and antibodies have been raised to them. Functional analysis shows that under nutritional stress such as serum starvation and subsequent serum re-addition the ras super family genes are requlated at the transcriptional level. However, the mos/ras protein shows translational regulation with the appearance of a second, cross hybridising protein after serum addition to serum starved cells. The *Eh* gamma tubulin is the most diverse member of the gamma tubulin homologues isolated to date. Notably, however the polyclonal antibody to the *S. pombe* gamma tubulin cross reacts with this homologue. (Supparted by CSIR and Rockefeller Foundation).

5. 2. *Studies on the Ca^{2+} mobilization from Entamoeba histolyttca by myoinositol tris- and tetrakis-phoshate and the common drugs :* Bhudeb Bhattacharyya and Susweta Biswas.

Most of the Ca^{2+} released from the *Entamoeba histolytica*, the causitive organism for amehiosis has been found to be inositol tris phosphate and tetrakis-phosphate dependent and Ca^{2+} uptake is ATP dependent. Ca^{2+} inophore application disorganizes the cell and ultimately leads to death of the cell. $InsP_3$ activates pseudopods development indicating that Ca^{2+} plays a great role maintaining the cell structure and movement of amoeba. Different drugs like Metronidazole, Nifedipine, Chlorpromazine, Diltiazem, were studied to monitor the ATP dependent Ca^{2+} influx of which Metronidazole has been found to be most effeetive in inhibition the Ca^{2+} mobilization. Calcium release by $InsP_3$ and $InsP_4$ has been found to be mediated in a receptor dependent manner. We at present are engaged in purifying the receptor protein (s) from E. histolytica after solubilizing with triton-X and affinity chromatography in agarose column. (Supported by DBT).

6.1 *Studies on in vitro maturation and fertilization of follicular oocytes collected from ovarics of slaughtered cows and buffaloes :* Gitali Ganguli, Arun K. Ray* and Prabhakar Gupta (Supervisor)

*Head, Animal Physiology Section.

We have used the recent advances in *in vitro* technolagy to produce bovine blastocysts through the fertilization, development and culture of *in vitro* matured oocytes originating from slaughtered animals. Recommended procedures for maturation and fertilization have been compared systematically and complex culture medium buffered with Hepes supplemented with various sera , gonadotropin (FSH and LH) and/or steroid (Estradiol-17β) hormones have been used to study bovine oocyte maturation. Besides, simple techniques were developed to prepare chromosomes of oocytes for analysing the various chromosomal configuration and evaluation of nuclear maturation.

Various methods of sperm preparation and *in vitro* capacitation of bull sperm for IVF have been compared and standardized. Different co-culture techniques were used to overcome the cell block for *in vitro* culture of the zygotes upto morulae/ blastocysts stage. Fluorescent dyes like DAPI, Hoechest 33342 were used to visualize the nuclei of the embryo.

Biopsies of the *in vitro* produced embryos of S-16 cell stage were carried out in microdrops of medium by means of Narishige micromanipulator. Attempts are being made to sex the single blastomere with a sensitive PCR sssay using Y-specific synthetic oligonucleotide primers.

6.2 *Cloning and characterization of the 5′ regulatory regions associated with the milk protein genes of buffalo (Bubalus arnee) :* Purba Mal and Prabhakar Gupta (Supervisor).

a-, β-, k- caseins, whey acidic proteins, a-lactalbumins and β-lactoglobulins are the important milk proteins (MP). MP genes have been characterized in mouse, rat, cattle, sheep, goat and rabbit. It has been shown that the MP genes of different species share common motifs in the first 200 base pairs of the 5′ upstream region and contain similar sequences that encode signal peptide and multiple phosphorylation sites. The 5′ regulatory sequences of buffalo MP genes which remain uncharacterized as yet can be pulled out using these conserved sequences.

cDNA library was constructed using polyA containing RNA by oligo dT cellulose chromatogrophy of total RNA isolated from lactating mammary gland of freshly slaughtered buffalo, collected from Tangra Slaughter house, Calcutta. This cDNA library was screened using mouse a-, β-, casein cDNA probes. Positive clones were taken and insert size was determined to be around 500 bp. The cDNAs were sequenced which comprised part of the coding region and 3' noncoding region. It showed 60% homology with bovine β-casein cDNA over a range of 46 bp, and showed 88% homology with water buffalo k-casein. As mRNA size was determined to be around 0.8 kb, the cDNA was not full length. Polymerase chain reaction (PCR) is bsing performed to pull out the 5′ regulatory sequences using 2 primers (synthetic oligonucleotides). 1) MPC1 : 24 mer (located at -110 bp to -140 bp, known as milk box consensus sequence) ; 2) MPC2 : 25 mer (located at +1.4 kb, signal peptide conserved among the species).

6.3. *Confirmation of transgene integration in pre-implantation embryos for increasing the rate of success in production of transgenic animals :* Arup Indra and Prabhakar Gupta (Supervisor)

Transgenic animals are widely used for the characterization of regulatory elements responsible for tissue-and development specific expression of variety of genes

and also as bioreactors for the production of proteins of biomedical importance. However, the major limitation of this technology is its poor success rate i.e. 2–5%. To circumvent this problem, presence or absence of transgene sequences was confirmed in embryo biopsies using PCR.

Copies of linearized 3.33 kb DNA construct containing whey acidic protein (WAP) 5′ regulatory sequences and intact bovine growth hormone (bGH) cDNA were microinjected in zygotes obtained from superovulated mice. WAP-bGH construct confers the expression of bGH in the mammary epithelial cells only during lactation (Hennighausen et al., 1982). Microinjected zygotes were cultured *in vitro* in CZB media at 37°C, 5% CO_2 and 95% air. A single blastomere was removed from 4-8 cell embryos and PCR was performed using synthetic oligonucleotides specific for the WAP-bGH fusion gene construct as well as sex (X and Y) chromosomal sequences. The resultant products were reamplified using nested primers and analyzed by agarose gel electrophoresis. Only female embryos positive for WAP-bGH sequences transferred to the utero-tubular junction of estrus synchronized recipients. Results of of identical experiments without removal of blastomere were used for comparison.

6.4. *Characterization of a PstI family of repetitive DNA sequence interspered in the genome of farm animals* : Golam Faruk, Sankar Ghosh, Sudit S. Mukhopadhyay and Prabhakar Gupta. (Supervisor)

Repetitive DNAs which are present in excess of 30% in most of the eukaryotes, once called selfish or junk DNA have gained importance in recent times. We have identified a family of 500 bp long PstI repeat in the genome of farm animals viz., cattle, buffalo, goat and sheep. These sequences are interspersed throughout het genome and around 3-5 $\times 10^4$ copies are present per haploid genome. These repeats are recognized by a specific nuclear protein of approx 14 kDa isolated from liver. Sequence comparison indicates an interesting palindrome type sequence in all these species along with a highly conserved pentanucleotide CAAGG. This pentanucleotide sequence has also been reported to be present in the regulatory part of *fushi tarazu* gene in *D. melangester* (Ueda and Hirose, 1991). Chromosomal distribution of these repeats have been studied by *in situ* hybridization. Synthetic oligonucleotides with altered pentanucleotide sequence have been used to define the specificity of DNA protein interaction. Further to demonstrate wether the repeat binding protein (14 kDa) is expressed in a tissue specific manner, isolation and purification of this particular protein from different tissues is in progress. Homology search of the existing sequences in the EMBL DataBank has revealed extensive sequence similarity with bovine acetylcholine a-receptor, β-globin and psi-2 pseudogene. However the function of such repeats remains to be demonstrated.

6.5 *Use of Random amplified polymorphic DNA (RAPD for generating species- and breed-specific genetic markers in farm animals :* Sankar K. Ghosh and Prabhakar Gupta (Supevisor)

Amplification of random regions of genomic DNA using 20 different oligodeoxyribonucleotide primers ranging in size from 10-17 bp has been attempted to differentiate and identify various livestock species/breed-specific genetic makers. Genomic DNAs extracted from peripheral blood samples collected individually from atleast five different cattle, buffalo, sheep and goat were amplified by PCR using single primer of arbitray nucleotide sequence and analysed by polyacrylamide/agarose gel electrophoresis. A reasonable amount of genetic variation was observed using some 10-mers and the 17-mer M13 universal sequencing primer. The size of the amplified product typically ranged between 0.3 kb to 3 kb on agarose gels. The fragment patterns obtained with one 10-mer primer are able to distinguise the species within 200 bp resolution. The species-specific amplified bands are more prominent and reproducible, with characteristic segments of 0.7 kb for buffalo, 1.1 kb for cattle, 0. 8 and 0.6 kb for goat and 0.55 kb for sheep. A limited but easily detectable polymorphism is revealed amongst 8 breeds of goat.

Application of RAPD technique on DNAs isolated from 20 different individuals of Garole breed of microsheep revealed interesting correlation of a specific band with triplet lambing. Results indicate that RAPD markers constitute a powerful for the analysis of genetic variability and will be immensely useful in the genetic improvement of the indigenous livestock species.

F. DEPARTMENT OF BIOPHYSICS

1. *Mycobacterium cell wall constituents critical structural and modelling studies* ; Sampa Pain, Bankim Das, B. N. Das, Sreya Ghosh, Indrani Dey, Bishnu P Mukhopadhyay and Asok Banerjee (Supervisor)

Mycobacterium cell wall constituents are prime targets for chemotherapeutic drugs. The structure and conformations of these cell wall constituents are therefore very important. One major constituent, peptidoglycan have been studied critically and an interesting pseudo two fold symmetry along glycan chain has been observed. This fits very well with the x-ray diffraction data and our study excludes man possible hypothetical models proposed and endorses the model proposed by "Konx & Murthy" which is stereochemically consistant. This interesting result is reported and we hope this will help us better understanding of the interactions of chemotherapeutic agents with peptidoglycan, the cell wall target.

2. *Structural basis of interaction at active site of two enzymes* : (a) Studies on calotropin, a cysteine protease (b) studies on β-lactam-β-lactamase—Sampa Pain, Indrani Dey, Jaba Chakraborty, Bishnu P. Mukhopadhyay, Asim Kumar Bera, Asok Banerjee (Supervisor).

Crystallographic structure solution of Calotropin DII, a novel cysteine protease is in progress by molecular replacement methods with an objective to visualise its difference in substrate specificity with papain,

The mode of interaction of a series of β-lactams to β-lactamase have been studied by molecular modelling and docking procedure. The results are encouraging with prospect of a successful package for receptor based drug design in this field.

3. *Visualization of protein-nucleic acid interaction at atomtc resolution* : Sreya Ghosh, B. P. Mukhopadhyay, Sampa Pain, Indrani Dey, Asok Banerjee (Supervisor).

Protein nucleic acid interactions are ubiquitions and are of fundamental importance in molecular biology. Their complexation, binding & recognition embrace every aspect of cellular DNA function & genetic expression. The molecular description of their nature of interaction are emerging recently in several x-ray structural works of trp-repressor/λ-repressor/lac-rep/cro protein nucleotide complexes. Recently our group have succeeded to cocrystallize & solve the structure of complex of L-senine

with two Inosine 5′-monophosphate in highly hydrated form ($12H_2O$). This potential model, first of its kind reported, throw some interesting findings which are still to be characterised in macromolecular complexes. Water mediated interactions of the partners are found to play a key role in biological recognitions. Several other cocomplexes have been done and are awaiting structure solution, so that the underlying invarient discipline in these interactions can be highlighted.

4. *Quantitative structure activity relation study of several series of specific drugs & analogs by graph theoretical pattern recognition approach* : C. Roychoudhury, P. Bag, G. Biswas, Asok Banerjee.

Interesting developments in concept & programme are emerging and are appreciated in learned societies. Quality publications done are pointer to future success.

(ii) *DNA bending and structural basis of co-operative binding in λ repressor* : Chhanda Mukhopadhyay, Sumita Bandyopadhyay and Siddhartha Roy in collaboration with Prof. B. Bhattacharyya and N. C. Mandal.

We have identified C-terminal tail region of repressor to be an important contact point of dimar-dimer interaction. Recently we have introduced a Cysteine residue in this region by site-directed mutagenesis so that a probe can be attached and direct interaction of the tail region can be studied.

We have also developed a direct specrtroscopic assay of protein induced DNA bending which would be very useful in the study of bending energeties.

(ii) *Structure function relationship of Glutaminyl-tRNA Synthetatases* : Subhra Bhattacharyya, Biplab Kr. Das and Siddhartha Roy.

We have recently shown that binding of tRNAgln to ATP/glnRS complex leads to disorder-order transition in the protein which is coupled to correct reconigtion of the cognate tRNA.

Urea induced unfolding studies of multi-domain Glutaminyl synthetease goes through an intermediate. This intermediate has been shown to be a molten globule state.

(iii) *Spectroscopic studies of ligand-gal repressor interaction* : Sumana Chattopadhyay and Siddhartha Roy.

We have been studying mechanism of transcription induction by small molecule inducers in gal system. We have shown that contrary to the accepted idea binding of the inducer, galactose, does not lead to dissociation of gal rapressor from the operator. Hence, we suggest that prior dissociation of the repressor is not obligatory for initiation of transcription.

(*iv*) *Strncture and folding of tubulin* : Anushree Bhattacharyya and Siddhartha Roy in collaboration with Prof. B. Bhattacharyya.

We have studied structural basis of loss of activity of protoins in dilute solutions, using tubulin as model system. As previously reported this is surface catalyzed. The change of structure is virtually undetectable by most spectroscopic technieues· Only Bis-ANS binding is significantly enhanced, suggesting minor alteration of domain relatione as the cause of loss of activity.

G. ANIMAL PHYSIOLOGY

Institutional Project No. IV : Studies on ecology, environmental pollution and related problem.

A. Environmental physiology and Hormonal Regulation.

1. *Effect of pesticide, carbofuran 75DB technical on growth and maturation of gonads of catfish, Singi (Heteropneustes fossilis* : Sudipta Chatterjee and Rama Ghosh.

In continuation of our earlier demonstration of the inhibitory effects of carbofuran technical (CF) on the growth and maturation of gonads of female Singi fish, we have further monitored the effect of the pesticide on the serum levels of vitellogenin and the estradiol-17-beta levels in serum and ovary. The changes on the lipid contents has also been studied in different organs during pesticide treatment.

The vitellogenic female Singi fish showed a significant ·fall in the estradiol-17-beta levels both in serum and ovarian cytosol, after treatment with different doses of the pesticide. The pre-spawning fish also showed similar type of decrease in the serum and ovarian vitellogenin protein content after the pesticide treatment in comparison to the control animal. Interestingly, the vitellogenin levels remained unaltered in the spawining fish despite the pesticide treatment.

The histological structure of the pituitary gland of the Singi fish in the similar pesticide treatment condition showed reduction in the number and size of GTH cells with reduction in the area of proximal pars distalis. The gonadotrophs were heavily granulated and partially dissoluted after the pesticide treatment.

To understand the role of lipid in relation to gonadal function, cholesterol, total lipid and their fatty acid contents in liver and ovary were estimated. After exposure of the fishes in sublethal doses of pesticide the total cholesterol and total lipid contents of liver increased significantly. But ovarian lipid and cholesterol contents remained unchanged. The fish lipids consisted of more complex spectrum of unsaturated fatty acids in liver and ovary. A higher level of polyunsaturated fatty acids was found in liver than ovary in the control fish. Among the polyunsaturated fatty acids, ecosapentaenoic acid ($C_{20:5}$) which is essential for proper gonadal function, and decosahexaenoic acid ($C_{22:6}$) were absent in the carbofuran-treated fish. The results suggest the inhibitory effect of carbofuran on pituitary gland function, spawning, egg fertilization and embryonic development in Singi fish,

2. *Effect of carbofuran technical 75DB on acetylcholinesterase activity in brain and liver of Labeo rohita (Ham): An in vitro study*: Mousumi Sen, A.K. Dasmahapatra and Rama Ghosh.

It is known that carbofuran inhibits the activity of acetylcholinesterase (AchE) in brain of freshwarer fishes and AchE has been used as an indicator for assessing the toxicity of aquatic environment. In view of these facts the present experiments have been designed to elucidate the mechanism of carbofuran (CF)-induced inhibition of AchE activity of brain and liver of *Labeo rohita in vitro*.

AchE activity was found to be sensitive to temperature and pH. Carbofuran but not dimethyl sulfoxide (vehicle of CF) inhibited the enzyme activity in a dose-dependent manner at 22°C. The enzyme was less active at 2°C than at 23°C in both liver and brain. But at 10° the brain showed more enzyme (AchE) activity than liver. The enzyme activity was totally lost at 37°C. Inhibition of the enzyme activity by CF was markedly affected by temperature in brain than in liver.

3. *The role of protein kinase C in CYP1A1 induction in rainbow trout hepatocyte*: A K. Dasmahapatra and P.C. Lee.

The role of protein kinase C (PKC) in the induction of cytochrome P_{450} 1A1 (CYP1A1) in rainbow trout hepatocytes was investigated *in vitro*. primary cultures of rainbow trout hepatocytes were treated with Beta-naphthoflavone (BNF), a potent inducer of CYP1A1 protein in fish liver, for 24 hrs. It showed an increase in microsomal 7-ethoxyrosorufin-O-deethylase (EROD) activity compared to the cells treated with dimethyl sulfoxide (DMSO), the vehicle. The increase in EROD activity showed a dose-dependent sensitivity to BNF treatment. Western blot analysis of microsomal protein using specific antibody (LM4) against CYP1A1 showed that the changes are parallel with the microsomal EROD activity. Pretreatment of the hepatocyte with 12-0-tetradecanoyl-phorbol-13-acetate (TPA) led to a dose-dependend suppression of BNF-induced EROD activity and CYP1A1 content. TPA alone had no effect on hepatic EROD activity and CYP1A1 level. Staurosporine, a protein kinase C (PKC) inhibitor effectively blocked BNF-induced EROD activity and the rise in CYP1A1 protein suggesting a role of PKC in CYP1A1 gene exprsssion in fish liver.

4. *Induction of triploidy by cold shock in catfish (Heteropneustes fossilis Bloch)*: Basanta K. Tiwari and Arun K. Ray.

In our attempt to induce rapid growth in catfish, induction of triploidy has been made by cold shock. The *in vitro* fertilized eggs in our laboratory were subjected to cold shock for half an hour at different temperatures like 4°C, 8°C and 15°C. Of the different ambient temperatures, 4°C was found to be the optimum for inducing ploidi-

zation in the catfish embryos. Karyotypic analysis and studies on the size of red blood cells confirmed the induction of triploidy in catfish. Further studies are in progress regarding the maturational process of gonads in relrtion to the neuro-endocrine control in triploid fishes and the magnitude of growth promotion.

5. *Role of estrogen in the ovarian development in freshwater prawn Macrobrachium rosenbergii*:

(i) *Characterization of estrogen-inducible hemolymph protein*: R. Kirubagaran, Manik Bhakta, Anuradha Chaudhury and A.K. Ray.

In continuation to our earlier attempt for elucidation of the nature of an estrogen (E_2)-inducible protein in the freshwater prawn further studies revealed that this protein in hemolymph is consisted of two subunits and phospholipo-glycoprotein in nature. Western blot annlysis and immunodiffusion using antibodies raised against both native and one of the subunits of the E_2-inducible hemolymph protein showed their cross-reactivity with hemolymph protein of both male and female prawns and the egg protein.

Simultaneous purification of vitellin from gravid oocytes by ultra-centrifugation and subsequent gel chromatography through seralose 6B and DEAE-cellulose revealed only one form of vitellin in this species. SDSPAGE electrophoresis using this vitellin demonstrated two major and one minor subunits of the protein. Staining characteristics indicated it to be a glyco-lipo-protein in nature.

(ii) *Demonstration of uptahe of the E_2-inducible hemolymph protein by the oocytes in prawn ovary*: R. Kirubagaran, A.K. Ray in collaboration with K.P. JOY (Department of Zoology, Banaras Hindu University).

Using rabbit-antiprawn vitellogenin raised in our laboratory, the uptake of hemolymph vitellogenin by oocytes was demonstrated in the freshwater prawn for the first time. In the previtellogenic prawn, very few terminal oocytes showed weak immunoreactive sites at the periphery. The vitellogenic prawns demonstrated dense immunopositive granules in oocytes. In the post-vitellogenic prawns, however, the cytoplasm remained immunonegative, suggesting the maturational and preovulatory modifications of the yolk-proptein.

(iii) *Establishment of prawn hepatocyte culture*: Debjani Ghosh, A.K. Dasmahapatra and Arun K. Ray.

In our attempt to develop a hepatocyte-oocyte co-culture system for *in vitro* maturation of prawn oocytes, the conditions have been standardized for maintaining the viable hepatocytes in culture up to seven days.

After proper digestion of the prawn hepatopancreas the viable hepatocytes were plated in M199 media supplemented with various antibiotics and L-glutamin. Almost all the cells attached to a substratum prepared from prawn exoskeleton, after 24 hrs of plating. The optimum temperature was found to be 15°C to show viability up to seven days with appreciable LDH activity.

The prawn hepatocyte culture model can be exploited for further study of the hormonal regulation of vitellogenin biosynthesis in prawn at the molecular level and maturation of the prawn oocytes, *in vitro*, as well.

6. *Thyroid hormone regulation of mammalian brain function* : P. K. Sarkar and Arun K. Ray.

In continuation to our earlier demonstration of the presence of specific thyroid hormone binding sites and the thyroid hormone-dependent inhibition of the Na^+—K^+-ATPase activity in the synaptosomal membrane of mature neurone, efforts have been made to elucidate the correlation of the thyroid hormone-binding sites interaction and the degree of inhibition of the enzyme activity.

A graded increase in both the percentage of saturation of synaptosomal membrane-specific T_3-binding sites, and the inhibition of the synaptosomal Na^+-K^+-ATPase activity indicated as the effect T_3 to be mediated through the specific binding sites. A maximum of 72% saturation of the specific T_3-binding sites coincided with the maximum inhibition (35%) of the Na^+-K^+-ATPase activity.

7. *Phenylhydrazine-hydrochloride (PHH)-thyroid hormone intcraction in rat* : Mitali Pramanik and Arun K. Ray.

Our earlier studies showed a protective function of thyroid hormone on the phenylhydrazine-hydrochloride-induced hemolysis in young sexually immature male rats. Efforts have been made to understand the thyroid hormone-PHH interaction at the red cell membrane. Laboratory procedures for obtaining purified red cell membranc have been standardized Signaficant changes in glutathione content and activities of the acetylcholinesterase have been observed in red cell membrane between the PHH and PHH plus thyroid hormone treated animals. The work is in progress.

B. Control of growth and development of silkworn and silk production :

(*1*) *Induced production of siik by estrogen tre itment in silkworm. Bombyx mori L.* :

(*a*) *Induced ovprian growth by estrogcn* : Shantanu Das and Arun K. Ray.

In our earlier studies we have demonstrated important metabolic effects of estradiol-17-beta (E_2) in silkworms, *Bombyx mori* with reduction in the total duration of the life cycle and early emergence of the silk moths. In a subsequent study the growth-promoting effect of E_2 in the silkworm ovary was demonstrated. Different doses of E_2 injected in the 5th instar larvae showed more accumulation of protein and RNA materials in the ovary of the 03 day old pupae, in comparison to the control pupae. Moreover, such increase in the protein and RNA contents was coincided with gain in weight of the ovary in the E_2-treated group.

The oocytes under microscope appeared as single cell containing granular materials encapsulated by the follicular epithelium along with nurse cells. E_2-treatment caused induced development of the oocytes with two-fold increase in the cell arca of the follicle. Even the nurse cell became involuted during the growth of the oocyte after E_2 administration. This produced histological evidence for E_2-induced maturation of silkworm ovary.

(*b*) *Cellular localisatian and kinetic properties of trehalase in different tissues of silkworm Bombyx mori L.* : Bela Keshan and Arun K. Ray (Supervisor).

Trehalase catalyses the metabolism of trehalose, the main sugar utilised as energy source in silkworm, and its activity has been found to be sensitive to many hormones. In our attempt to understand the growth promoting effect of estradiol-17 beta (E_2) on different organs of silkworm we wanted to judge the sensitivity of trehalese to E_2.

During characterisation of the trehalase activity in different organs (midgut, ovary and fat body) of the 5th instar silkworm larvae, a highest activity of the enzyme was found in the midgut tissues. In each organ examinnd the mitochondrial fraction contained the maximum trehalase activity besides the microsomal and cytosolic fraction with a pH optima of 6. 0. The Km values of the enzyme for all the threc fractions have been determined.

H. PLANT MOLECULAR & CELLULAR GENETICS

1. *Genetic engineering through protoplast manipulation :* T. Saha, F. Begum, S. Pal, S. Sikdar, S. R. Sikdar and S. K. Sen

Recovery of somatic hybrids between B85 cultivar of *Brassica juncea* and sexually incompatible *Diplotaxis harra* ; and *Trachystoma aphanoneurum* have been raised. These somatic hybrids have been created in order to introgress desirable characters from wild relatives of mustard plants to the cultivar, to generate novel plant types hitherto not possible to achieve through sexual means. The hybrids are being backcrossed with the *Brassica juncea* parent.

Development of new mustard plant types from advanced progenies of Erussica, the somatic hybrid between *Brassica juncea* and *Eruca sativa*, have been achieved. Water stress tolerance, appressed fruiting habit with large siliqua bearing capacity have been evolved.

Protoplast fusion products between temperate race of a low glucosinolate containing mustard with B85 strain of mustard has yielded progenies with low glucosinolate content. Such progenies need to be further backcrossed to evolve low glucosinolate containing B85 type.

2. *Genetic engineering for conferring insect resistance to crop plants :* A. S. Rishi, T. Johnson, D. Banerjee. S. Kar, A. Nandi, D. Ghosh, D. Das, K. Roy P. Mukherjee, N. Bag, T. Mandal, A. Basu. D. Basu, P. Nayak, S. Das and S. K. Sen.

Development of insect resistant transgenic crop plants figured as our major goals of the programme. Two proven entomocidal gene product viz, the endotoxin gene of *Bacilus thuringiensis* (Bt) and the trypsin inhibitor gene of legume seed proteins have formed the candiate genes for conferring insect resistance. We have determined the specific Bt endotoxin gene products that are toxic to yellow stem borers of rice, bowl worms of cotton, pod borers of chickpea and the leaf rollers of jute. Besides feeding tests, we have also looked into the toxin binding capacity of the receptor binding proteing of the epithelial gut cells of the insect. The genes have been isolated from their native source and chimeric forms of such genes were constructed to make them express in the target plants. A number of plant promoters have been used along with translational enhancers and introns in order to effect enhanced expression in target plant. Transgenic plants with Bt endotoxin gene in rice, mustard and chickpea have been generated. Similarly, transgenic plants with protein inhibitor gene in tobacco

and rice have been generated. The expression of Bt endotoxin gene in plant has not been sufficiently high, as it is known that plant expression of the native form of the Bt endotoxin gene is usually quite low. This necessitated us to generate synthetie forms of the gene by using plant preferred codon usage. Additionally, we have also generated transgenic rice plant with a Btt (*Bacillus thuringiensis* var. *tenebrionis*) ICP gene, which is toxic to coleopteran insects. The expression of this gene in transgenic plant has been found to be higher than the lepidopteran specific ICP genes of Bt. Attempts are now being made to evolve transgenic crop plants with the synthetic form of the Bt genes to improve the expression potential of the trasferred entomocidal gene.

3. *Genetic engineering for modification of plant development characters in crop plants :* N. S. Banerjee, C. Ganguly, D. Basu, P. Nayak. S Das and S. K. Sen.

The *rol* genes contained in the TL-DNA of *Agrobacterium rhizogenes* are known to influence plant developmental pattern by interferring with the endogeneous levels of IAA and cytokinin. Transgenic plants with such genes have shown to influence the plant developmental pattern of mustard plants in a stable manner. The individual *rol* genes are known to have characteristic patterns of influence. It has become fairly clear that the *rol* genes can influence plant development by reducing apical dominance, encouraging branching, delaying senescence, introducting male sterility. Uses of such *rol* genes in transgenic plant production in case of rice, jute, mustard and tea in active state of utilisation to evolve new plant types with desirable developmental characters.

4. *Genetic engineering for development of male sterility lines in rice and mustard :* P. Roychoudhuri, S. Roychoudhuri, S. Pal, S. R. Sikdar, D. Basu, S. Das and S.K Sen.

Understanding of the genes that confer cytoplasmic male sterility in rice and transfer of cytoplasmic male sterility principle from established Cms lines of *B. napus* to *B. juncea* are receiving our active attention. Additionally, attempts to manipulate anther specific promoters to code for antimetabolic gene products for causing cessation of microspore development are being pursued in rice and mustard. Use of antisense RNA to restore the sterility will fulfill the breeders requirement in such a programme.

5. *Genomic organisation of cultivated jute species :* S. Majumdar, N.S. Banerjee, T. Saha and S.K. Sen.

The genomic organisational divergence of the cultivated jute species, *Corchorus olitorius* and *C. capsularis* are being analysed through RAPD analysis. The initial results indicate that the two species are quite divergent from one another. These informations have further strengthened the necessity for development of inter-

specific hybrids between the two sexually incompatible species. The interspecific somatic hybrids developed from protoplast fusion have not yet yielded the much desired plant regeneration, inspite of many attempts.

6. *Tissue Culture of elite clones of Populus* : Aparajita Mitra and Amita Pal.

The following investigations have been completed : (i) Genetic characterization of five commercial clones of *Populus deltoides* using biochemical marker. (ii) Maintenance of clonal fidelity among the *in vitro* raised *P. deltoides* and a hybrid *Populus* species. (iii) Histological studies to elucidate different modes of shoot organogenesis. (iv) Evaluation of genotypic variations among the petiole raised plants of *P. deltoides* clone D121, a hybrid clone 65/27 scrutinizing 14 activity loci of ACP, DIA, PER, PGM and SOD isozymes.

7. *In vitro organogenesis is from callus tissues of Vigna radiata* : Monalisa Chandra and Amita Pal.

A regeneration method has been evolved in the recalcitrant leguminous pulse crop mungbean after a long trial. We are further attempting to enhance the regeneration efficiency controlling the chemical mileau of the nutrient medium.

I. IMMUNOTECHNOLOGY SECTION

Summary of Research Achievements :

Period of Report : 1st January 1993 to 31st March 1994.

The research activites in this newly created laboratbry were initiated about a year ago with bare minimum research facilities in terms of equipment and other infrastructure. This research laboratory has been created to undertake research in advanced areas of immunology and cancer research.

Major areas of research :

1. Development of immunodiagnostics for biotoxins in food and feed.
2. Molecular modelling of anticancer and immunomodulatory agents.
3. Synthesis and functional studies on small peptides having abilities to induce immunological activities.

Progress and Achievement :

1. *Development of immunodiagnostics for biotoxins in food and feed :* (P. K. Ray, S. Raisuddin and A. Subramoniam).

There are many biotoxins (naturally occuring toxins) present in our food causing various types of illnesses including malignancies. Many of the biotoxins induce immuno-suppression. Therefore, a need has beenfelt to develop simple and quick methodologies for their detection in order to properly diagnose them.

Initially we have undertaken studies on 'aflatoxin' (toxin produced by *Aspergillus flavus* group of fungi). Aflatoxin is a potent hepatocarcinogenic compund. Besides, our studies showed that it is also able to induce immunosuppression. We have been successful to develop immunoassay method for aflatoxin detection.

For the development of diagnostics the following approaches are undertaken—

(a) Synthesis of aflatoxin-protein conjingate—Since aflatoxin is a small molecular weight compound. It has to be conjngated with a suitable carrier protein to make it immunogenic. At first aflatoxin-(O-caboxymehtyl)-oxime derivative was prepared. This was then chemically conjugated with BSA. The product was concentrated and purified on Sephadex G50 column. The physico-chemical characterization of the final conjugate was also done.

(b) Antibody Production and Immunoasay-Animals (rabbit) were immunized with this antigen to raise polyclonal antibody against aflatoxin. We have also developed a very sensitive immunoassay to detect aflatoxin at picogram level. In future we wish to develop monoclonal antibody. This methodology will also be commercialized in future which will have an impact on human health.

2. *Molecular modelling of anticancer and immunomodulatory agents :* P. K. Ray and S. Raisuddin).

We are in the process of determining the entire structure of protein A molecule. Initially we have undertaken extensive studies on the homology of protein A with other functionally active proteins using computerized databank. We found that protein A has some sequence homology with DNA binding proteins, epidermal growth factor, transactivating transcriptional regulatory protein, NADPH cytochrome P—450 reductase, DNA polymerase accessary protein, cell divison controlling protein, transforming protein, regulatory protein etc. Further studies to extrapolate this information to the potential activities of protein A in terms of its anticancer and immunomodulatory action are underway.

3. *Synthesis and functional studies on small peptides having immunological activities :* (P. K. Ray and P. K. Datta).

Studies on the synthesis of octapeptides of protein A have been undertaken using peptide synthesizer. We have sucessfully synthesized one octapeptide (NH_2—Glu—Asn—Ala—Phe—Tyr—Glu—Leu—COOH). This peptide has been purified using HPLC. Immunoblotting studies have revealed that it has binding ability with IgG. Further experiments are underway to evaluate functional aspects of this octapeptide.

Facilities Created :

The following facilities have been created.

1. Setting up of a cell culture laboratory and an immunology laboratory.

Future Plan :

1. Production of monoclonal antibody against aflatoxin.
2. Functional studies on octapeptides of protein A.
3. Studies on molecular mechanism of anticancer activity of protein A vis-a-vis signal transduction.

J. ENVIRONMENTAL SCIENCES SECTION

The history of setup of the Environmental Science Section in Bose Institute in actual sense, started from the joining of Prof. P. K. Ray as Director in June 1992, who has contributed a great deal in the Environmental field. Initially, the laboratory started with a small four-wall room on the 3rd floor of the Centenary building with three research projects. Later facilities have been developed to carry out Environmental Impact Assessment, preparation of Environmental Management Plan, Disaster Management, Plan, Environmental Audit, Environmental Budget, and also Toxicological Evaluations, Carcinogenicity assessment, Hazard and Risk Analysis of Chemicals etc.

Project No. 1. (*a*) *Studies on the Environmental Impact Assessment and Environmental Management Plan of 2nd Oil Jetty of Haldia Dock Complex :* (P. K. Ray, U. Banerji and D. P. Modak).

(*b*) *Studies on the Disaster Management Plan of 2nd Oil Jetty :* (P. K. Ray, D. P. Modak and U. Banerji).

The 2nd Oil Jetty of Haldia Dock Complex being an oil halding facility is a source of oil pollution in the surrounding environmental compartments. Impact of the activities of Oil Jetty on the Man and Environment were investigated in details in a 10 kms radius arround the Jetty. To carry out the impact assessment investigations of the Ambient Air Quality, Water Quality, Sediment Quality and Aquatic as well as teresterial ecology were done. Our study revealed that in the course of handling crude oil & other POL products a significant amount is discharged into the estuary which not only adversly eaffects the aquatic environment but also contaminates the ground water resources. Also the untreated ballast water from the tanker causes adverse impacts on the environment. The detailed investigations were then used in the value functional curves *Battle Environmental Evaluation Systems*, where in a scale of 1000 the total impact on the environment was rated to be—122 without Environmental Management Plan. Therefore a detailed Environmental Management Plan including oil spil contaminent and Ballast water treatment plant was prepared. With the proper implimentation of which the environmental impacts would improve from −122 to +21.

Since crude & other POL products are highly inflamable and carries a potential risk of fire hazard and toxic exposures. Therefore a detailed Disaster Managment plan to prevent any envisaged disaster or even to undertake a proper action plan if a disasner occurs.

The above project completed in July, 1994 and report submitted to Haldia Dock Complex.

Project No. 2. Studies on the Pollution Impact of Sediment Dredging in Hoogly River and its Estuarine Region on the aquatic flora and fauna : (P. K. Ray, U. Banerji and D. P. Modak).

In this project the following investigations were carried out :

1. Water Quality, 2. Suspended Sediment Quality, 3. Sediment Quality, 4. Ecological Monitoring, 5. Biological Monitoring and 6. Ecotoxicological Studies. This has been undertaken for a period of one year in the regions where maintenance dredging and dumping of the dredged material is carried out by the Calcutta Port Trust. One-year study out of a 3-year total study period sponsored by Calcutta Port Trust has been completed. The data indicate the deterioration of both biotic and abiotic environment during dredging and dumping operation. The sediment and water is contaminated with highly toxic chemicals like, pesticides, polynuclar aromatic hydrocarbon and heavy metals. The sediment toxicity studies showed an inhibition of catalase, peroxidase and urease activities. The ecological investigations show a depletion of plankton population and benthic fauna. In plate 1. the phytoplankton species normally found in the Hoogly estuary in the areas where neither of the processes are carried out is shown. The bioaccumulation and biomobility studies show a potential risk of the toxic chemicals entering the human food chain. The findings of the 3-year studies will finally be used to workout an ecological risk analysis model.

Project No. 3. Studies on microbial degradation of effluents resulting out of organophosphorous (OP) manufacturing plant : P.K. Ray, U. Banerji, D.P. Modak and B.K. Mohanty).

The effluent characteristics of organo phosphorous pesticides manufacturing unit has been investigated in details. The effluent treatment is actually done in the following steps : (1) Chemical treatmant—acid hydrolysis followed by lime treatment then seperation of calcium sulphates & phosphates by setteling. (2) Anaerobic degradation in 4 oxidation ponds and (3) Finally activated sludge treatment process. After detailed investigations the activated sludge treatment process was found to be the one to be actually not working at all. A laboratory scale activated sludge treatment process was developed at a scale of 10 Its per day using predominantly miked cultures of *Pseudomonas* sp. *Arthrobacter* sp. and *Flavobacter* sp. The study showed 85% reduction

of organic load in effluent bringing down the initial BOD of >600 to <30 mg/L. The process was then upscaled to 40 KL per day in several steps and constructed at the site for 80% O_2 saturation and active biological process. The work is in progress and would be completed by next year.

Service Facilities Developed :

Besides these R & D projects the section has developed facilities to carry out analysis of Polynuclear Aromatic Hydrocarbon, Organochlorie and Organophosphorous Pesticides, Heavy Metals, Polychlorinated Biphenyles and Organohalides.

The section has provided consultancy services to several industries in (1) Air pollution control, (2) Waste water treatment and (3) Waste water analysis.

Future Plan Work :

The following research projects have been submitted for funding.

1. Development of a Sutable Predictive Mathematical Model in relation to Water Quality of Ganga River & Hugli Estuary for Chemical and Biological Pollutants.
2. Studies on the development of a Predictive Model regarding Transboundary Transport of Air Pollutants.
3. Risk assessment of food chain accumulation of pollutants (OC pesticides, PAHs and PCBs).

Sponsored Work :

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2. Environmental Impact Assessment, Environmental Management Plan of Second Oil Jetty of Haladi Dock Complex, Janury, 1994.
3. Disaster Mangement Plan for Second Oil Jetty of Haldia Dock Complex, March 1994.

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63. Mangrove Community as an indicator of changing palaeo shoreline in South Bengal, A.K. Hait, H.K. Das, A.K. Roy, S. Chakraborty, AK Roy and S. Chanda, *Man and Environment*, Annual Volume. p. 6-8, 1994.

64. An account of the dwindling plant species in Sambalpur District, Orissia (India) with reference to ecology and Mode of Pollination S. Panda, A.P. Das and S. Chanda, *Trans. Bose Res. Inst.* , **55**, 3-4, 1992.

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Department of Microbiology

INSTITUTIONAL PROJECT—I

66. Succinate mediated catabolite repression of enzymes of glucose metabolism in rootnodule bacteria : N.C. Mandal and P.K. Chakrabartty, *Current Microbiol.* **26**. 247-251, 1993.

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INSTITUTIONAL PROJECT—IV

69. Incidence of airborne fungi in different areas of Calcutta : K. Sen, T. Banerjee, R. Chakraverty and A.K. Roy Choudhury, *Indian J. Allergy Appl. Immunol*. **5**, 1-9, 1991.

INSTITUTIONAL PROJECT—V

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73. Immunotherapeutic approach in cancer : A. Sinha, S. Chaudury and S.L. Chakrabarty, *Trans. Bose Res. Inst*. **55**, 35-44, 1992.

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Department of Biochemistry

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Department of Biophysics.

98. The crystal and molecular structure of an epoxide, C_3H_5O, Indrani dey, B. P. Mukhopadhyay and Asok Banerjee, *Journal of Chemical Crystallography*, **24**, (6) P. 387-389, 1994.

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102. Structure of A Cu(II) containing peptide, Diaquo-Gly-L-Tyr-Cu(II) Dihydrate [$Cu(C_{11}N_2^{-}O_4H_{13})(H_2O)_2$] $2H_2O$; I. Dey, Asok Banerjee, *J. Cry & Spec. Res.* **23**, (1) 65-68, 1993.

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Animal Physiology

INSTITUTIONAL PROJECT NO—IV

107. Evidence for physiologic responses to estrogen in freshwater prawn, *Macrobrachium rosenbergii*. Debjani Ghosh and Arun K. Ray, *J. Inland Fish. Soc.* India **24** 15-21. 1992.

108. Subcellular action of estradiol-17-beta in a freshwater prawn, *Macrobrachium rosenbergii* : Debjani Ghosh and Arun K. Ray, *General and Comparative Endocrinology* **90**, 274-281, 1993.

109. Estrogen stimulated lipogenic activity in the ovary of the freshwater prawn, *Macrobrachium rosenbergii*: Debjani Ghosh and Arun K. Ray, *Invertebrate Reproduction and Development* **25**, 43-47, 1994.

110. Sodium potassium ATPase activity in developing central nervous system and liver of chick embryo : S. Bandopadhyay, M. palit, A.K. Dasmahapatra and J. N. Medda, *Proc. zool. soc.* Calcutta **46**, 27-31, 1993.

111. Stimulation of acetylcholinesterase activity by triiodothyronine in the brain of Singi fish, *Heteropneustes fossilis* (Bloch) : S. De, A.K. Dasmahapatra and A.K, Medda, *Fish Physiol. Biochem.* **10**, 419-425, 1993.

112. Down regulation of CYPIAI by glucocorticoids in trout hepatocytes *in vitro* : A.K. Dasmahapatra and P.C. Lee, *In vitro Cell. Dev. Biol.* **29A**, 643-648, 1993.

113. Protein Kinase c and CYPIAI induction in rainbow trout (*Oncorhynchus mykiss*) hepatocyte culture : P.C. Lee and A.K. Dasmahapatra, *Comp. Biochem. Physiol.* **106C**, 649-653, 1993.

Plant Molecular and Cellular Genetics

114. Factors influencing efficient pyrethrin production in undifferentiated cultures of *Chrysanthemum cinerariaefolium* Vis., K. Dhar and A. Pal, *Fitoterapia* **LXIV**, 336-340, 1993.

115. Chromosomal stability in callus cultures of *Chrysanthenam cinerariaefolium* as determinant of embryogenesis, Amita Pal *Pyrethrum Post* **18**, 123-131, 1993.

Immunotechnology Section

116. Immusuppressive effects of aflatoxin in growing rats. S. Raisuddin, K. P. Singh, S. I. A. Zaidi, B. N. Paul , and P. K. Ray, *Mycopathologia*, 124, 189, 1993

Environmental Sciences Section

117. Mobile and Bound Forms of Trace Metals in Sediment of the Lower Ganges, D. P. Modak, K. P. Singh, H. Chandra, and P. K. Ray, *Water Research.* **26**, (11), 1541, 1992,

118. Trace Metals Trend Analysis in River Ganges at Kanpur, N. Garg, N. Mathur, D. P. Modak, K. P. Sing, S. A. Murthy, S. V. Chandra, and P. K. Ray, *Environ International*, **18**, 297, 1992.

119. Biological Monitoring of Chlorinated Pesticides Among Exposed Workers of Mango Orchards : A Case Study in Tropical Climate, H, Chandra, B. S. Pangtey, D. P. Modak, K. P. Singh, B. N, Gupta, R. S. Bharti, and S. P. Srivastava, *Bull. Environ. Contam. Toxicol*, **48**, 295, 1992,

Participation In Academic Activities, Conferences/Symposium/Training Programmes/ Awards and Honours.

Department of Physics

Prof. M. H. Engineer was—

(i) invited to act as a member of the Panel of Judges at XI Young Physicists Coloquim of IPA, Sept, 21-22, 1993.

(ii) invited to participate in "A week of Phasey Physics" organised by S. N. Bose National Centre, from January 14-18, 1993.

(iii) invited to give a talk at the Institute of Theoretical Physics, Calcutta at a Symposium on "Modern Trends in Theoretical Physics and Applied Mathematics" Sept. 25, 1993.

(iv) invited to participate in the Indo-French Workshop on "Non-Linearity and Breakdown in Soft Condensed Matter", December 1-9, 1993.

(v) invited to participate in a Seminar on "Causality in Physics and Philosophy", jointly organised by S N. Bose National Centre for Basic Sciences and Centre of the Project of Foundations and Methodology of Theoretical Sciences in the Indian Tradition, 22-23 August, 1993.

(vi) invited to participate in a One-day International Workshop on "Surface Physics" organised by Saha Institute of Nuclear Physics, Calcutta in Feb. 1993.

(vii) attended the International Conference "Bose and 20th Centenary Physics", January 1994 Calcutta.

(viii) invited to Chair a Session of the International Conference on "Astrophysics and Cosmology" organised by S.I.N.P. , Calcutta in connection with the Birth Cent. Celebrations of Meghnath Saha, Dec. 22-23, 1993.

(ix) invited to attend a Seminar on "Urban Waste Recycling", October 13, 1993 organised by Nodal Research Centre and Indian Chamber of Commerce.

(x) invited to attend "Coloquim on S.N. Bose—the Man and his Times" organised by Dept. of Physics, Viswabharati in connection with the International Conference "Bose and 20th Centenary Physics", January 7-8, 1994.

Prof. S. C. Roy

(i) presented paper at the tenth National Symposium of Radiation Physics held at Kalpakkam during August 16 to 21, 1993.

(ii) attended the Physics and Technology of Particle Accelerators and Applications-93 Symposium held at IUCDAEF, Calcutta during November 25 to 27, 1993.

(iii) attended a One day Seminar on Radiation Physics held at VECC, Calcutta on December 8, 1993.

(iv) chaired a session at the Workshop on Atomic Absorption Spectroscopy held at Bose Institute on February 10, 1994.

Dr. B. K. Chatterjee

(i) attended the Physics and Technology of Particle Accelerators and Applications-93 Symposium held at IUCDAEF, Calcutta during November 25 to 27, 1993.

Shri Nirmal Halder

(i) presented paper at the tenth National Symposium of Radiation Physics held at Kalpakkam during August 16 to 21, 1993.

Dr. A. K. Chatterjee

(i) Co-convenor with Prof. B.B. Baliga, Member, Bose Institute Council for Boses' Symposia, second part, which was on Elementary particles and cosmicray physics.

(ii) participated in S.N. Bose and M.N. Saha Symposium organised by I.P.A. , Calcutta Chapter.

(iii) participated in S.N. Bose Centenary Conference organised by S.N. Bose Institute of Basic Research, Calcutta.

(iv) paper-setter in examination of Dept. of Applied Physics, Univ. College of Science & Technology, University of Calcutta. Examiner of B. Tech. Practical Examination.

Aniruddha Deb participated in the Workshop on Bioinformatics organised by D.I.C. , Bose Institute, Calcutta.

Dr. B. Roy

(i) delivered lectures on "Baseline Environmental Status and Identification of Impacts : Noise Environment" in the training programme (for port officers) ; on "Environmental Impact Assessment and Environmental Management Plan for Ports" organised by Indian Institute of Port Management in August 1993.

(ii) presented paper at the National Symposium on 'India's Environment Today and Tomorrow' (27-28th August, 1993) held at Bose Institute, Calcutta.

Dr. D. Home was

(i) awarded Homi Bhabha Fellowship for 1993-94.

(ii) invited to talk at the Intl. conference commemorating S.N. Bose Birth Centenary at Calcutta, Dec. 30, 1993—Jan. 5, 1994.

(iii) invited to talk at the Intl. conference on Non-Accelerator Particle Physics at Bangalore, Jan. 2-9, 1994.

Dr. I. Bose

(i) presented a paper and chaired a session at the regional meeting Condensed Mattar Days held in the Institute of Physics, Bhubaneswer (September 14-15, 1993).

(ii) was invited to participate in the Indo-French Workshop on Nolinearity and Breakdown in Soft Condensed Matter held in the Saha Institute of Nuclear Physics, Calcutta, December 1-9, 1993.

(iii) was invited to give a talk on 'Biologically Inspired Physics' at the Physics Department, Jadavpur University, December 20, 1993.

(iv) gave a set of lectures (Solid State Physics, Special Paper) as invited Guest Lecturer in the M. Sc. Physics Course of Calcutta University.

(v) gave a full course of lectures on Learning condensed matter physics through the examples of high-T_c superconductos as part of the Advanced Course Work Programme for pre-doctoral students of Bose Institute.

(vi) was invited to give a set of lectures in the SERC school on Models and Techniques in Statistical Physics organised by the Institute of Physics, Bhubaneswar and held in Puri, Jan. 24-Feb. 12, 1993-1994.

Dr. S. Raha attened the following international symposia/conferences

(a) Iniernational Symposium on Astronomy and Astrophysics, August 1993, at Saha Institute of Nuclear Physics, Calcutta.

(b) International Conference on Astrophysics and Cosmology, December 1993, at Calcutta and chaired a session there.

(c) International Conference on Bose and 20th Century Physics, January 1994, at Calcutta.

Served as an expert member in selection committees outside Bose Institute.

Served on the Governing Council of Indian Physical Society.

Delivered a colloquium at Saha Institute of Nuclear Physics.

Abhijit Bhattacharyya attended the following symposia/conferences/schools

(i) International Symposium On Astronomy And Astrophysics, August 1993, at Saha Institute of Nuclear Physics, Calcutta.

(ii) International Conference On Astrophysics And Cosmology, December 1993, at Calcutta.

(iii) DAE Nuclear Physics Symposium, December 1993, at Calicut and presented one poster and one talk.

(iv) Workshop on Nuclear Equation Of State, January 1993 at Puri.

Department of Chemistry

Professor Parul Chakrabarti delivered a plenary lecture and chaired a session at the 15th International Lectin Meeting at Szeged, Hungary in August, 1993.

Professor Amitabha Ghosh

(i) visited St. Elizabeth Hospital, Department of Biomedical Research, Tuft University School of Medicine, Boston, U. S. A., for two and half months to work on the "Effect of marine phospholipids on cell growth and protein kinase activity".

(ii) delivered an invited lecture in the All India Seminar Cum Workshop on Chromatography at Taj Bengal on September 29, 1993.

(iii) delivered two invited lectures at the Academic Staff College, Refresher Course in Chemistry, University of Calcutta during March 10—March 31, 1994.

(iv) delivered a talk in the symposium on "Modern Trends in Biology and Biotechnology", organised by Society of Biological Chemists (India) at Haldia during February 11—13th 1994.

Dr. Parimal C. Sen

(i) Offered course to pre-doctoral students at Bose Institute.

(ii) Organized a symposium on "Modern Trends in Biology and Biotechnology" and Scientist (s), Industrialist (s) get-together at Haldia under the auspices of Society of Biological Chemists (I) Calcutta Branch during February 11—13th, 1994.

(iii) Delivered an invited lecture at the 15th National Symposium on Organic Chemistry in Calcutta University.

(iv) Offered a course in the Third Refresher Course in Chemistry for College and University Teachers in the Department of Chemistry, Calcutta University.

Dr. Manas Chakrabarty

(i) Presented a talk in the "National Symposium on Recent Trends of Research in Organic Chemistry" held at the Bhagalpur University, Bhagalpur during November 1—5, 1993.

(ii) Participated in the 30th Annual Convention of Chemists held jointly at University of Calcutta and Bose Institute, Calcutta during December 22—24, 1993.

(iii) Delivered lectures on "NMR spectroscopy and Mass Spectrometry' at the P. G. II (Chemistry) classes at Vidyasagar University, Midnapore in 1993—1994.

(iv) Have been invited to Delivered an invited lecture on the 28th March, 1994 in the 3rd Refresher Course in Chemistry of the Academic Staff College, organised by the Calcutta University.

(v) Was elected a Member of the Publication Committee of the *J. Indian Chem. Soc.*, and a Member of the Finance Committee, Indian Chemical Society for 1993.

(vi) Acted as an External Examiner of the M.Sc., Part I Chemistry Practical Examination (Organic), 1993 of the Kalyani University, Kalyani held on 1st March, 1994.

(vii) Participated in the 15th National Symposium in Organic Chemistry held in the Department of Chemistry, Calcutta University on 22-23rd March, 1994.

Dr. Kalipada Das

(i) Co-chaired a session of Physical Chemistry in the Annual Convention of Chemists held at Bose Institute during December 22-24,1993.

(ii) Acted as a member of predoctoral course committee of this Institute.

Dr. Joyoti Basu delivered a lecture at the 2nd IUBMB Conference on "Bio-chemistry of Cells Membranes" at Bari, Italy in September, 1993.

Dr. Manikuntala Kundu initiated a six-month visit to the University of Leige, Belgium under the collaborative Indo-EC project "Penicillin target sites and beta-lactamase in Mycobacteria" on November 29, 1993.

Shri Amit K. Das presented a paper at the International Conference on Oxygen Radicals and Anti oxidants in Biotechnology and Medicine held in Calcutta in December, 1993.

Shri Dipankar Bhattacharyya presented a paper at the Symposium on Modern Trends in Biology and Biotechnology, organized by SBC(I), Calcutta Branch at Haldia during February 11-13, 1994.

Department of Botany

Prof. S.N. Ganguly presented a paper entitled "Chemistry of Goutamala grass (*Tripsecum Laxum*) and its relation to soil rehabilitation" at the Symposium on Recent Advances in Natural'Product Chemistry at Kuala Lumpur, Malaysia from 8-12 November, 1993. Presented a paper entitled "Efficient countercurrent chromatography for isolation of Natural Products" at the First International Seminar on "Plant Materials as a source of Antidiabetic Agents" from January 8-10, 1994 at Dhaka, Bangladesh.

Prof. Bharati Ghosh was invited to participate in National Seminar on new challenges in Agriculture, Horticulture and. Industry The role of physiologist and biochemist in Bangalore was invited to participate in Second-Asia Pacific Conference on Agricultural Biotechnology and presented a poster in Madras. She also participated in the post doctoral programme in Bose Institute.

Ms. Malabika Roy and Ms. Anindita Bose attended and presented full papers in National Seminar on "New challenges in Agriculture, Horticulture and Industry". The role of physiologist and Biochemist in Bangalore.

Mr. Manas Chatterjee attended Annual General Body meeting of the Society of Biological Chemists (India) held in December 1993, at Madurai, Kamraj University for presentation of paper.

Prof. A.N. Lahiri Majumder participated and presented a paper entitled "Inositol metabolism in rice in relation to salt stress" in the International Second Asia-Pacific Conference on Agricultural Biotechnology, held at Madras in March, 1994. Served as Member, Organizing Committee, and participated in the scientists-indu strialists meet organized by the Calcutta Branch of SBC (I) at Haldia in February, 1994, Served as External Member, School Board of Life Sciences, North Eastern Hill University, Shillong, for a period of two years (1991-93). Taught a full term, 18 lecture course of Plant Physiology in Biochemistry in the Department of Agriculture, Calcutta University as a Guest Teacher. Taught a 4-lecture course on "Photo-synthesis" in the Department of Physiology, Calcutta University. Examined two Ph. D. theses in (i) Life Sciences from the Jawaharlal Nehru University and in (ii) Biochemistry, University of Madras. Selected for award of an Overseas Fellowship by the DBT for working in the University of Arizona, USA for a period of 3 months.

Mr. Aniruddha Ray Chaudhuri (SRF) presented the paper on "Inositol metabolism in relation to salt-stress in plants" (by A Ray Chaudhuri. Sekhar Chakraborty & Arun Lahiri Majumder) in the 62ad Annual Meeting of the Society of Biological Chemists, India held at Madurai. Presented the paper on "Inositol metabolism in rice in relation to salt-stress" (by A. Ray Chaudhuri & Arun Lahiri Majumder) in the Symposium on "Modern trends in biology & biotechnology organized by the Calcutta Branch of the Society of Biological Chemists, India at Haldia in February, 1994,

Ms. Sriparna Bagchi (JRF) presented a paper on "FruP$_2$ases in rice seedlinge : Salinity induced changes'' (by S. Bagchi, Sanhita Bhattacharya and Arun Lahiri Majumder) in the 62nd Annual Meeting of the S. B. C. of India.

Dr. Sanhita Bhattacharya (Adhoc RA, CSIR) attended the workshop or atomic absorption spectroscopy : Principles and practice, organized by RSIC, Bose Institute, as a selected participant, in February, 1994.

Prof. Sunirmal Chanda attended the National Symposium on the International Geosphere-Biosphore Programme from 21-24 April 1993 at Anna University, Madras and Central Leather Research Institute, Madras organised jointly by the Indian National Committee of IGBP, Anna University, Committee on Science & Technology in Developing countries (COSTED). Delivered an invited

lecture on 'Contribution to Palaeoclimate, Environment and Biostratigraphy in Bengal Basin. Attended a symposium on 'Indian Environmental Today and Tomorrow at the Bose Institute, Calcutta on 27-28 August, 1993. Delivered an invited lecture on "Pollen and Allergy" and chaired a scientific session. Attended 8th S. M. Sircar Conference on "Implication of Global Climatic changes on Plant life processes", on 17 September 1993 organised by plant physiology forum, Calcutta and Society for Plant Physiology and Biochemistry held at the Botany Dept., Calcutta University. Delivered an invited lecture on "Origin, Evolution and Diversification of life on earth. Attended as Guest in Chief organised by Tarakeshwar Sanskriti Parishad to felicitate students of Secondary and Higher Secondary Examination in 1993 who obtained first division from the schools situated in Tarakeshwar Block at the Temple Hall on 26 September, 1993. Delivered a lecture on "Education system in European Institute compared with Indian system". Attended the inauguration of Refreshers course in Botany at the Department of Botany, Visva-Bharati. Santiniketan on 27.9.93 as Chief Guest. Delivered an inaugural address on "Significance of Refreshers Course in Botany. Delivered a Refreshers Course lecture on "Origin, Evolution and Diversification of Plant Life through ages" on 27.9.93 under the auspices of Botany Department, Visva-Bharati, Santiniketan. Delivered a second lecture at the Refreshers Course in Botany at Visva-Bharati on "Application of Palynomorphology in Plant on 28.9.93. Attended a Centenary Celebration Conference on S. N. Bose, M. N. Saha, P. C. Mahalanabish, J. C. Ghosh and J. N. Mukherjee, on 13.10.93 at Ramananda College, Bishnupur. Delivered a key-note address on the life and achievements of Prof. S. N. Bose. Attended 7th National Conference on Aerobiology held into the auspices of School of Studies in Botany, Jiyaji Uuiversity, Gwalior held from 6-8 November 1993. Delivered a key-note address entitled "Biodiversity and Aerobiology on 6.11.93. Subsequently chaired three scientific session and plenary session. Attended a Conference on "Recent trends in Botany" held under the suspices of Amarabati University, Amarabati, Maharashtra from 6-8 December 1993. Delivered a plenary lecture on "Role of pollen morphology in synthetic approach to plant taxonomy. Presided over a science day convention at Bishddhananda High School, Hooghly on 8.1.94 and delivered the presidential address on "Problems of Secondary Education in West Bengal". Delivered an invited lecture entitled "Environ-mental Biopollution and its inpact on human health" under the auspices of Agricultural Faculty Club of the University of Agricultural Faculty Club of the University of Agricultural Science, Bangalore on 17.1.94. Attended the 5th group monitoring meeting on SERC Projects in Earth Sciences from 18-20 January 1994 under the auspices of the Department of Science & Technology.

Government of India held at the Marine Geology Division, School of Marine Science, Cochin University of Science and Technology, Cochin. Delivered a lecture on "Palaeoclimate and Environment in Bengal Basin during Holocane". Attended a symposium on "Modern Trend in Biology and Biotechnology" under the auspices of Society of Biological Chemists (India), Calcutta Branch, from 11-13 February, 1994. Delivered two course lectures in the Refreshers Course in Botany (Environment) at Visva-Bharati, Santiniketan, entitled "Implication of pollen morphology in plant taxonomy" on 17.2.94 and "Quaternary pollen analysis and vegetational history on 18.2.94. Attended National Science Day Celebration on 1.3.94 at Ramkrishna Mission Vivekananda Centenary College, Raharah and delivered a key-note address on "Impact of Environmental Pollution on Human Health".

Prof. Chanda has been awarded Dr. D. N. Shivpuri Memorial Oration award by the Indian College of Allergy and Applied Immunology, V. P. Chest Institute, University of Delhi for his outstanding contribution to environmental biopollution and allergy. Prof. Chenda is the first recipient of this award.

Dr. Swati Sen-Mandi delivered an invited lecture entitled "Biomolecutar and physiological studies on hydration-dehydration seed pretreatment : An attempt to overcome constraints of wet seedlings", at the International workshop on "Constraints, opportunities and Innovations for wet seeded Rice", 31 May-3 July, 1994, Bangkok (Thailand) ; hosted by International Rice Research Institute (IRRI), Philippines. Delivered a lecture entitled "Seed Vigour for direct seeded cultivation in Rice", at the Third Annual Meeting of National Rice Biotechnology Network held at M.S. Swaminathan Research Foundntion for Sustainable Agriculture, Madras, 3-5 March, 1994. Attended the Second Asia Pacific Conference on Agricultural Biotechnology held at Madras 6-10 March 1994. Visited Rothamsted Experimental Station, Harpenden, Herts., U.K. to follow up the HED link programme Environmental Biopollution in relation to human and plant disease from 15 March-14 April 1994. Attended one day workshop on demonstration and use of the Burkard Samplers at University of London, Newfield on 12 April 1994, organised by the British Aerobiology Federation.

Dr. Gitai Das attended and presented a poster entitled An Agrotechnique for enhancing seodling growth rate in summer paddy" in National Seminar On Newer challenges in Agiriculture, Horticulture and Industry : The role of physiologist and Biochemist held at University of Agricultural Sciences' GKVK Campus, Banaglore on 11-13 January 1994. entitled "Germplasm screening for seedling vigour in rice : developing biomolecular parameters.

Somen Nandi attended and presented a poster in Second Asia-Pacific Conference on Agricultural Biotechnology held at Madras 6-10 March 1994.

Dr. Syamali Chakraborty, Dr. Gitali Das and Mr. Somen Nandi attended the Third Annual Meeting of National Rice Biotechnology Network held at M.S. Swaminathan Research Foundation for Sustainable Agriculture, Madras, 3-5 March 1994. Dr. Syamali Chakraborti and Dr. Gitali Das attended the Second Asia Pacific Conference on Agricultural Biotechnology, Madras, 6-10 March 1994.

Mr. Somen Nandi received young Scientist Fellowship award to attend 16th IUBMD will be held at New Delhi on 19-22 September, 1992.

Dr. D.N. Sengupta went to Cleveland Clinic in Cleveland USA, working the laboratory of Dr. R.H. Silverman in the Department of Cancer Biology from April' 92, to work on Production of Transgenic Anti-viral plants by Expressing Mammalian anti-viral proteins.

Mr. Sudhiranjan Gupta presented a poster on 'Molecular, analsis of salinity stress inducible gene in rice (*Oryza sativa*) at 62nd Annual Scientific Meeting of Society of Biological Chemists (India) held during 19th to 22nd December 1993 at the School of Biological Sciences, Madurai Kamraj University, Madurai.

Dr. Swati Bhattacharya attended 7th National Conference on Aerobiology from 5th to 8th November 1993 at Jiwaji University, Gwalior, Unnd presented paper. Visited Rothamted Experimental Station to follow-up the HED Link programme on "Environmental biopollution in relation to human and plant diseases" from 15th March to 14th April 1994. Attended one-day symposium on "Airborne pollen and spores" at North London University on 12 April 1994 organised by the British Aerobiology Federation.

Miss. Pampa Chakraborty and Miss Arati Malaker also attended 7th National Conference on Aerobiology at Gwalior University and presented papers.

Department of Microbiolagy

Prof. S.L. Chakrabarty

(i) Nominated as a member of the Ph. D. Committee in Botany of the University of Calcutta since December 1993.

Prof. A.C. Ghose

(i) acted as a member of the Scientific Panel of PRC's of Indian Council of Medical Research.

(ii) acted as a member of SAC of National Institute of Cholers & Enteric Disease, Calcutta.

(iii) acted as a member of the Ph.D. committee in "Medical Microbiology & Parasitology" of Calcutta University.

(iv) was associated with teaching of M.Sc. studenti of the Dept. of Biochemistry, Calcutta University & Dept. of Physiology, Vidyasagar University.

(v) delivered a lecture in a meeting of the Society of Biological Chemists, India (Calcutta Chapter) at IICB, Calcutta.

(vi) participated and delivered a talk in the 29th US-Japan Joint Conference on Cholera & related Diarrhoeal Diseases held in California YSA, December 1-3, 1993.

Prof. Timir B. Samanta

(i) Nominated as a member of the Executive Committee of the Microbial Type Culture Collection and Gene Bank at the Institute of Microbial Technology (IMIECH). Chandigarh.

Dr. P.K. Chakrabartiy

participated in teaching Microbiology to M.Sc. class (Dept. of Physiology) of Vidyasagar University.

Dr. R. Chakraverty

(i) Attended and presented a paper entitled 'Air spora of banana plantation in West Bengal', at the 7th National Conference of Aerobiology held during 5-8th November, 1993 at Gwalior,

Dr. B.K. Mohanty

(i) participated in the 7th course of the International Training Programme in Biotechnology entitled "Introduction to Industrial Biotechnology" held at Gesellschaft fur Biotechnologische Forschung mbH (GBF), Braunschweig, Germany from 6 September, 1993 to 22 October, 1993.

Dr. A.K. Halder

(i) participated in a short term training course in Biohydrometallurgy held at the Department of Metallurgy, Indian Institute of Science, Bangalore from 10 January, 1994 to 15 January, 1994.

Dr. R.P. Mukhopadhyay and Sm. Papia Mitra

Presented papers entitled "Production of a streptomycete keratinase by solid state fermentation" and "Production of actinomycete protease by solid state fermentation and its application in dehairing of goat skin" at the Specialist Group Meeting & Symposium on Solid State Fermentation held at RRL, Trivandrum 23-24 March, 1994.

Dr. Monoranjan Chatterjee

Participated at the 62nd Annual meeting of SBC(I', Medurai, 19-22 December 1993 and presented a paper on "Production of lactic acid by direct fermentation of starchy wastes by an amylase producing *Lactobacillus*"

Department of Biochemistry

R. K. Mandal attended/gave invited talks/chaired session in the following seminers/symosia :

(i) Guha Research Conference a Dalhausie, H. P. on May 17-22, 1993.

(ii) Discussion meeting on Biomolecular Structure, Function and Interaction' at IISc., Bangalore on Sept. 8-10. 1993.

(iii) 'All India Congress of Cytology and Genetics' at Berhampur University on October 15-18, 1993.

(iv) National Symosium on 'Developments in Plant Molecular Biology and Genetic Engineering' at TNAU, Coimbatore on Dec. 29-31, 1993.

(v) National Conference of 'Cereal Process Technology : its status and future' at Calcutta on Jan. 21-22, 1994.

R. K. Mandal was associated with teaching/examination/Board of P.G. studies of Calcutta, Kalyani and Visva-Bharati Universities, served as a member of Research Council of IICB, Calcutta, a member of the Agriculture Committee of DST, Govt. of West Bengal, reviewer of research proposals for CSIR, DST, DBT and DAE and a reviewer of research papers for Sci. & Cult., IJEB, IJBB, Intl. J. Env. Toxicol. and Pakistan JSIR.

Prof. B. Bhattacharyya attended/gave invited talks/chaired session in the following seminers/ symposia :

(i) First Dipta Memorial Lecture : Cysteins of tubulin : A spectroscopic study.

(ii) Invited lecture in "3rd Chandigarh Symposium on New Biology" Carboxy termini of tubulin and Regulation of Colchicine binding Activity.

Prof. N. C. Mandal

(i) Served as a member of the Scientific Advisory Committee for National Institute of Cholera and Enteric Diseases ;

(ii) Served as a member of the assessment Committee for IICB ;

(iii) Delivered courses of lectures to the post-graduate students of Biochemistry and Physiology of the Calcutta University and Vidyasagar University respectively ;

(iv) Chaired a scientific session in the Symposium on Bioinformatics held at Bose Institue ;

(v) Chaired a scientific session in one day symposium organized by Indian Biophysical Society and West Bengal Academy of Sciences held at Saha Institute of Nuclear Physics ;

(vi) Attended the 59th annual meeting of the Indian Academy of Sciences held at IIP, Dehra Dun and delivered a talk ;

(vii) Attended the Golden Jubilee inauguration meeting of Indian National Science Academy at New Delhi on January 7, 1994 ;

(viii) Delivered lectures in the Academic Staff college for the college Teachers at the Department of Botany, Visvabharati ;

(ix) Attended GRC meeting held at Dalhausie, Himachal Pradesh ;

(x) Delivered a talk in the Industrialists-Scientists Meeting organized by the Society of Biological Chemists (Indin) Calcutta Branch, hald at Haldia ;

(xi) Acted as a member of the Ph.D. Committee in Biochemistry of the Calcutta University.

Dr. P. Sinha delivered

(i) A course of lectures was delivered on 'Yeast Genetics' at CCMB, Hyderabad, Nov. 22-27, 1993.

(ii) A course of lectures on DNA replication and Gene expression for Post M. Sc. students of Saha Institute of Nuclear Physics, Calcutta. October to December 1993.

Dr. A. Lohia

(i) Presented poster entitled "Identification of genes regulating growth and proliferation in *Entamoeba histolytica*" at the Gordon Conference on "Molecular Parasitism", New Hampshire, USA. [support from the Rockefeller Foundation]. June 1993.

(ii) Invited talk at "Current of research in Biochemistry and Biophysics in W. Bengal", Feb, 1994.

(iii) Invited talk at the DAE symposium on "Stress and Adaptive responses in biological systems" March 1994.

(iv) Taught advanced course on "Eukaryotic cell cycle" at Dept. of Biophysics Molecular biology and genetics, Calcutta University, April, 1993.

(v) Visited Harvard School of Public Health from April-July 1993 on a Rockefeller Foundation Biotechnology Career Fellowhip.

(vi) Hosted the visit of Dr. Manami Tanaka of Tsukuba University, Japan, to develop the Genome Mapping project of *Entamoeba histolytica*, from 4th Feb-4th March 1994.

Dr. B. K. Padhi, Sarbashri Hirock Dutta, Pampi Basu, Gopal Chakravorty, Rinku Ghosh, Santanu Dasgupta, Nrisingha Dey, Pallab Kundu and Sudip Ghosh attended and presented poster in the 62nd Annual General Meeting of Society of Biological Chemists (India) held in Madurai on Dec. 19-22, 1993.
Dr. B. K. Padhi attented the All India Congress of Cytology and Genetics held at University of Berhampur on Oct 15-23, 1993.

Sudip Ghosh and Biswajit Roy attended the Natl. symposium on 'Developments in Plant Molecular Biology aud Genetic Engineering' held at Coimbatore on Dec-29-31, 1993. Sudip Ghosh and Somenath Bhattacharya attended the Asia-Pacific conference on Agricultural Biotechnology held at Madras on March 6-10, 1994.

Dr. P. Gupta attended/gave invited talks/chaired session in the following seminars/symposia :

1. Delivered an invited tatk on "Physical mapping of genes on the chromosomes for the characterization of Animal Genetic Resources" in the National Seminar On "Animal Genetic Resources and their conservation in April, 1993 at National Institute of Animal Genetics, Karnal, Haryana.

2. Participated in the project screening committee on Meeting Animal Breeding and Genetics of the Animal Science Panel held in June 1993 at ICAR, Krishi Bhawan, New Delhi.

3. Invited to participate in the VIII All India Congress of Cytology and Genetics symposium on "Frontiers of Cytogenetics", October 10-13, 1993 at Berhampur Uaiversity, Orissa.

4. M. Sc. Part I & Part II Examiner in Calcutta Univerity, Honorary lecturer in the Department of Physiology and Biochemistry, Calcutta University for the Academic Session 1993-94

5. Acted asresource person in the DBT sponsored training course on Use of Molecular Genetic methods of the diagnosis of Human genetic diseases" organized by the Vivekananda Institute of Medical Sciences, Calcutta, Jan-March, 1994.

6. Invited to attend the sub-committee meeting of the Task Force on Human Genetics held at CCMB Hyderabad on 16th-17th March, 1994 for discussion on Human Genome mapping.

7. Elected member executive committee of Indian Society of Cell Biology.

Honours and Awards

Prof. N. C. Mandal was elected to the Fellowship of Indian National Science Academy, Delhi and National of Sciences of India (Allahabad).

Shri Sudip Ghosh was awarded the Best Poster Award in the National Symposium on Developments in Plant Molecular Biology and Genetic Engineering, held at Madurai during Dec. 29-31, 1993.

Department of Biophysics

Prof. A. Benerjee and his gronp invited and attended the Asian Region Crystallographic Conference, held in Madras University Dec., 1993.

Animal Physiology Section

1. Professor A. K. Ray attended the 12th National Symposium on Reproductive Biology and Comparative, Endocrinology, held at Pondicherry in January, 1994, for presentation of papers.

2. Dr. Rama Ghosh, Dr. A. K. Dasmahapatra, Mrs. Sudipta Chatterjee and Mrs. Mousumi Sen participated in the Symposium on "India's Environment Today and Tomorrow" held at Bose Institute, Calcutta, in 1993, for presentation of papers.

3. Dr. A. K. Dasmahapatra, Dr. Debjani Ghosh and Mr. P. K. Sarkar attended 1st Annual Conference of SBC (Calcutta Chapter), held at Haldia in February, 1994, for presentation of papers.

4. Dr. R. Kirubagaran and Dr. Anuradha Chaudhury attended "3rd Indopacific and 6th All India Symposium on Invertebrate Reproduction, held in December, 1993, at Sivakashi, for presentation of papers. Dr. Kirubagaran also presented paper at the "12th National Symposium on Reproductive Biology and Comparative Endocrinology" held at Pondicherry, in January, 1994.

5. Sm. Sudipta Chattejee attended 81st Session of Indian Science Congress at Jaipur in January, 1994, for presentation of papers.

Honours / Award :

1. Dr. Debjani Ghosh received Professor P. B. Sen Memorial Medal from The Physiological Society of India, for her research related to induced breeding in prawn.

Plant Molecular & Cellular Genetics Section

Prof. S. K. Sen

(i) delivered an invited lecture on "Gene transfer in tissues of Vigna radiato through microprojectile hombandment in the Symposium on Applications of Plant *In Vitro* Technology, held at the University Pertanin Malaysia, Malaysia.

(ii) Visited National University Singapore, Singapore and participated in a discussion on "*In Vitro* production of tuber rhizome and corm".

Dr. D. Basu, Dr. P. Nayak, Dr. S. K. Sen participated and delivered lectures in the Rice Biotechnology Network Meeting held at M. S. Swaminathan Research Foundation, Madras.

Dr. D. Basu, Dr. P. Nayak, Dr. T. Saha, Mr. A. K. Nandi and Dr. S. K. Sen had attended Second Asia-Pacific Conference on Rice Biotechnology in Agriculture at Madras.

Dr. S. K. Sen and Dr. P. Nayak attended the Annual Meeting of the Tissue Culture Association of India an University of Rajasthan, Joypore, and Dr. S. K. Sen delivered a Plenary Lecture.

Dr. T. Saha had visited John Innes Institute, Norwitch, UK as UNDP Fellow and worked in the laboratory of Dr. Tristan Dyre.

Dr. P. Nayak attended a Workshop on Rice Transformation held at Kasetsart University, Kamphaengsaen, Thailand.

Dr. S. R. Sikdar and Dr. S. K. Sen had attended International Conference on Plant Tissue Culture in Dhakka, Bangladesh and Dr. Sen delivered a Plenary Lecture.

J. C. Bose Unit & Museum

Dibakar Sen deliver invited talks on J. C. Bose and and his work i) at Nabadwip Adharsha Pathagar, on 10th April, 1993, ii) at Bose Institute Lecture Hall on 23rd April, 93 organized by Sutanuti Parisad, Calcutta, iii) Radio talk from Calcutta Radio Station on 29th November, 93, iv) Door Darshan tatkl from Calcutta Door Darshan on 30th November, 93, v) Radio talk from Calcutta Radio station entitled "Gaachheder Aatmarakha on 9th March, 1994, vi) a lecture at Rajnagar Putputia S. C. High School on 19th February, 94 arranged by Pascimbanga Vigyan Mancha, Tomlook Committee, vii) Seminar lecture on "Acharya Jagadis Chandra Bose and Contemporary Scientific Activities In India" in the Seminar Room, Main Campus, Bose Institute on 15.3.1993.

Ph. D. Degree Awarded

Name of the Candidate	Title of the thesis	Name of the Research Guide
Department of Chemistry		
1. Shri Sanat K. Saha	Studies of protease inhibitors from the seeds of plant family Cucurbitaceae.	Prof. N. K. Sinha
2. Shri T. Anoopkumar	Chemical and biological studies on marine organisms.	Prof. P. Chakrabarti
3. Shri Gautam Adhikary	The Interaction of Chlorpromazine with Transport Enzymes in Natural and Model Membrane	Dr. P. C. Sen

Name of the Candidate	Title of Thesis	Name of Research Guide
4. Shri Bikash Baran Ghosh	Studies on Carbocycic & Heterocyclic Compounds.	Prof. A. K. Barua Dr. A. Basak
Department of Botany		
5. Sm. Kajori Lahiri	Nodule senescence in relation to polyamines in *Vigna mungo* L.	Prof. B. Ghosh
6. Sm. A. Selva Meena Rajagopal	Ageing and invigoration of rice seeds/embryos.	Dr. Swati Sen-Mandi
Department of Microbiology		
7. Shri Tapan K. Dutta	Studies on 11-oxygenation of steroid by immobilized spores of *Aspergillus ochraceus* TS.	Prof. Timir B. Samanta
Department of Biochemistry		
8. Sm. Manjari Majumder	Tubulin substructure and identification of its functional domains.	Prof. B. Bhattacharya
9. Shri Dulal Panda	Role of C-termini of tubulin on its subunit dissociation.	Prof. B. Bhattacharya
10. Sm. Alo Roy	Characterization of a mutant that affects the function of autonomously replicating sequences in yeast.	Dr. P. Sinha
11. Shri Amit Maiti	A mutant which affects the maintenance of endogenous 2u plasmid in yeast.	Dr. P. Sinha

Name of the Candidate	Title of Thesis	Name of Research Guide
Animal Physiology Section		
12. Sm. Debjani Ghosh	Physiologic responses of estrogen in freshwater prawn, Macrobrachium rosenbergii.	Prof. A. K. Ray
Plant Molecular and Cellular Genetics Section		
13. Shri Thakurdas Saha	Towards broadening genetic variability in cultivatted jute (Corchorus species)	Prof. S. K. Sen

GRANTS-IN-AID SCHEMES

DEPARTMENT OF PHYSICS

S. D. Project

Principal Investigator : Prof. S.C. Roy

A.E.R.B.

(Atomic Energy Research Board)

Principal Investigator : Prof. S.C. Roy

CSIR Fellows

1. Shri Saurb Gayen
2. Smt. Uma Bhaumik
3. Shri Ashim Kumar Ghosh

K. S. Krishnan Fellow

1. Shri Abhijt Bhattacharyya

DEPARTMENT OF CHEMISTRY

Indian National Science Academy

Title : Studies on the role of fatty acylation of human erythrocyte ankrin (upto November 30, 1993)

Investigator : Dr. Joyoti Basu

Research Fellow : Sri Amit K. Das

Department of Science & Technology

Title : Phospholipid transfer proteins : Physiological roles and use in membrane research (upto November 12, 1993)

Investigator : Dr. Manikuntala Kundu

Title : Biochemical approaches towards the therapy of shigellosis

Investigator	:	Dr. Manikuntala Kundu
Co-investigator	:	Dr. Joyoti Basu
Research Fellow	:	Mr. Jasimuddin Ahmed (from 29.1.94)

Title : Beta-lactam antibiotics and Shigella : Studies on penicillin-binding proteins of Shigella.

Investigator	:	Dr. Manikuntala Kundu
Research Fellow	:	Sri Anindya Sunder Ghosh

Council of Scientific & Industrial Research

Title : Effect of oxidative stress on erythrocyte membrane structure and function in chronic myelogenous leukemia.

Investigator	:	Dr. Joyoti Basu
Research Fellow	:	Sri Indranil Mondal (from 1st June, 1993 to 10th March, 1994)

INDO-EC

Title : Penicillin-binding proteins and beta-lactamase of Mycobacteria.

Investigator	:	Prof. Parul Chakrabarti
Co-investigators	:	Dr. Joyoti Basu Dr. Manikuntala Kundu
Research Fellows	:	Sri Swapnanjan Goswami Sri Sanjoy Mukhopadhyay (from 3rd June, 1993) Sri Sebabrata Mahapatra (from 1st February, 1994)

INDO-US

Title : Functional significance of abnormalities of the erythrocyte membrane in myeloproliferative disorders.

Investigator	:	Prof. Parul Chakrabarti
Co-investigators	:	Dr. Joyoti Basu
	:	Dr. Manikuntala Kundu
Research Fellows	:	Sri Raja Bhattacharyya
	:	Sri P. T. Srinivasan

Emeritus Scientist Scheme (CSIR)

Title : Search for bioactive compounds from Bay of Bengal

Emeritus Scientist	Prof. A.K. Barua
Research Associate	Dr. Sarmila Ray

Department of Atomic Energy

Title : The interaction of drugs with transporte adenosine triphosphatase and lipids in model membranes Part 1 (upto 31st October 1993)

Investigator	:	Dr. Parimal C Sen

Department of Biotechnology

Title : Development of scale up technology for the production of biologically active fatty acids and lectins from marine organisms.

Investigator	:	Prof. Amitabha Ghosh, Bose Institute
Co-investigator	:	Prof. Amalesh Choudhury, Department of Marine Science, Calcutta University
		Dr. Suniti Misra, Department of Marine Science, Calcutta University
Research Fellows	:	Sri Tarun Patra (upto 22nd June, 1993)
		Sri Dipankar Bandyopadhyay
		Sri Chiradip Bandyopadhyay (upto 31st December, 1993)

CPMB (DBT) Project

Investigator	:	Dr. Dolly Ghosh
Junior Research Scientist	:	Dr. Krishnakal Niyogi
Research Fellow	:	Sri Manas K. Pathak

PDF Fellows (Medical Biotechnology)

Supervisor	:	Prof. P. Chakrabarti
P D F	:	Dr. Saurav K. Sarkar (upto 9th September, 1993)
	:	Dr. J. S. Suresh Kumar (from 4th October, 1993)
Supervisor	:	Prof. A Ghosh
P D F	:	Dr. Gautam Chattopadhyay (from 3rd February 1994)

PDF Fellows (Biopolymer Conformation)

Supervisor	:	Porf. N.K. Sinha
P D F	:	Dr. Anupa Bhattacharyya (from 1st June, 1993)
Supervisor	:	Dr. Parimal C. Sen
P D F	:	Dr. Jitendra K. Gupta (from 30th August, 1993)

PDF Fellow (Plant Biotechnology)

Supervisor	:	Dr. Dolly Ghosh
P D F	:	Dr. Sarmila Chattopadhyay (from 20th July, 1993)

PDF Fellow (Microbial Technology)

Supervisor	:	Prof. P. Chakrabarti
P D F	:	Sri Ganesh Gopal (from 18th February, 1994)

C S I R Ad-hoc Fellows

1. Dr. Rita Sikdar, S.R.F.
2. Sri Tapan Choudhury, S.R.F.
3. Sri Umes Chandra Halder, S.R.F.
4. Sri Amit K. Das, S.R.F. (from 1.2.94)
5. Sri Dhiman Basu
6. Sri Alok Kanti Kar
7. Sm. Chaitali Bhattacharyya (from 31.12.93)
8. Sm. Ananya Dan (upto 28.2.94)

CSIR Ad-hoc Research Associate

Dr. Debasis Ghosal

DEPARTMENT OF BOTANY

C S I R

Title : Plant DNA polymerase ; possibility of cloning cDNA(s), characterization and Expaessi on in *E. coli*.

Investigator	:	Dr. Dibyendu N. SenGupta
Research Fellow	:	Mr. M. Sanath Kumar—JRF

Title : Soluble and organelle-bound myoinositol synthase of plant origin : Biochemical & molecular studies.

Investigator	:	Prof. A.N. Lahiri Majumdar
Research Fellow	:	Smt. Sriparna Bagchi

I C A R

Title : Studies of the nature of sink induced senescence and its continued by polyamine.

Investigator	:	Prof. Bharati Ghosh

CSIR Research Associates

1. Dr. Gitali Das
2. Dr. Madhuchanda Chatterjee
3. Dr. Sanghita Bhattacharya
4. Dr. Kajari Lahiri

CSIR Ad-hoc Fellows

1. Shri Saubhik Das, SRF
2. Ms. Sriparna Bagchi, JRF
3. Shri M. Sanat Kumar, JRF

DBT Post-doctoral Fellow

Dr. Syamali Chakraborty

K.S. Krishnan Fellow

Ms. Devashree Dutta

ICAR Fellow

Ms. Anindita Bhattacharya

DEPARTMENT OF MICROBIOLOGY

Burn Standard Co. Ltd.

Title : Biotechnological enrichment of bauxite ore.

Investigator-in-Charge : Prof. A.K. Mishra
Research Associate : Dr. Anup Kumar Halder

DBT-Burn Standard Co. Ltd

Title : Biotechnological enrichment of magnesite ore with antibiotics as bye products.

Investigator-in-Charge : Prof. A.K. Mishra
Research Scientist : Dr. B.K. Mohanty

Department of Biotechnology

Title : Microbial production of enzymes-xylanase and ∝-anylase.

Investigator-in-Charge : Prof. Geeta Nanda
Research Associate : Dr. Subhas Jana
Junior Research Fellow : Ms. Rina Rani Roy
Research Assistant : Sri Amitabha Das

Title : Genetics of *Thiobacillus ferrooxidans* and strain improvement by advanced genetical techniques.

Investigator-in-Charge : Dr. Pradosh Roy
Senior Research Fellow : Sri Chirajyoti Deb
Junior Research Fellow : Sri Pratap Mukherjee
Senior Scientific Assistant : Sm. Keya Banerjee

Title : Development of a non-replicating vaccine against cholerae based on protective agntigen of *Vibrio cholerae*.

Investigator-in-Charge : Prof. A.C. Ghose
Senior Reserch Fellow : Shri Dilip K. Sengapta (upto 04/02/94)
Junior Research Fellow : Miss Sharmistha Mukhopadhyay

Department of Science & Technologey (Govt. of West Bengal)

Title : Application of *Streptomyces* protease in unhairing of hides and skins.

Investigator-in-Charge : Prof. (Mrs.) A.L. Chandra
Junior Research Fellow : Sm. Papia Mitra

ICMR Ad-hoc Research Associates

Dr. Ramprasad Mukhopadhyay, M.Sc., Ph.D.
Dr. Debjani Datta, M.Sc., Ph.D.

CSIR Ad-hoc Fellows

Shri Tapas K. Sengupta (upto 31.1.94)
Shri Ashis K. Ghose
Shri Ranjan K. Nandy
Miss Chandradip Ghosh (from 10.1.94)
Smt. Anupama Saha
Smt. Rittika Chanda
Miss Mousumi Ghose (from 20.1.94)

DBT Post-doc Fellows

Dr. Monoranjan Chatterjee
Dr. Deb Prasad Sikdar
Dr. Anjan Sengupta (from 1.3.94)
Dr. Jharna Dutta (from 8.3.94)

DEARTMENT OF BIOCHEMISTRY

Council of Scientific and Industrial Research

Title : Studies on the gene regulation of temperate myobacteriophage.

Investigator-In-Charge : Prof. N. C. Mandal
Research Fellows : Sri Hirok Jyoti Datta (Upto 28.2.94)

Title : Myoinositol tris and tetrakis-phosphate generated by Phytase action on myoinositol hexakis phosphate and its involvement in signal transduction process in plant cell.

Investigator-In-Charge : Dr. (Mrs.) Susweta Biswas
Research Fellow : Sri Basudeb Dalal (Upto 3.2.94)
Research Associate : Dr. (Mrs.) Mita Sen (From 11.5.94)

Title : Organisation of the Entamoeba histolytica genome.

Investigator-In-Charge : Dr. Anuradha Lohia
Research Fellows : Sri Samudra S. Gangopadhyay

Title : Studies on the Identification and Characterization of Functional Domains of Tubulin.

Investigator-In-Charge : Prof. B. Bhattacharyya
Research Associate : Dr. (Mrs.) Suparna Sengupta

Indian Council of Agricultural Research

Title : A pilot project directed at the expression of proteins of biomedical importance in the milk of farm animals.

Investigator-In-Charge : Dr. Parbhakar Gupta
Co-Investigator : Prof. R. K. Mandal
Research Fellows : Smt Gitali Ganguly (Upto 31.10.93)
Sri Sudit Sekhar Mukhopadhyay (From 30.9.93).

Centre for Plant Molecular Biology (Supported by DBT)

Principal Investigators : Prof. S. K. Sen (PMCO Section)
Prof. R. K. Mandal
Research Fellow : Sri Somenath Bhattachayya

U N D P

Title : Plant improvement using modern biotechnology.

Project Co-ordinator : Prof. S. K. Sen
Project Directors : Prof. S. Ghosh
Prof. R. K. Mandal
Prof. S. K. Sen (PMCG Section)
Research Scholars : Sri Niranjan Das

C.S.I.R. Ad-hoc Fellows

1. Sri Asim Kr. Mandal, M.Sc.
2. Sri Dulal Panda, M.Sc. (Upto 12.5.93)
3. Sri Mahadev Pal, M.Sc. (Upto 28.2.94)
4. Sri Santanu Roychaudhury, M.Sc.
5. Sri Mrinal Kr. Maiti, M.Sc
6. Sri Biswendu Chaudhuri, M.Sc
7. Sri Nandan Kr. Jana, M.Sc
8. Sri Subrata Sau, M.Sc.
9. Sri Sudip Kr. Ghosh, M.Sc.
10. Smt Suparna Sengupta, M.Sc. (Upto 16.3.94).
11. Sri Nrishingha De, M.Sc.
12. Smt Lopa Adhikary, M.Sc.
13. Sri Sib Sankar Roy, M.Sc.
14. Sri Gopal Chakraborty, M.Sc.
15. Sri Biswajit Roy, M.Sc.
16. Dr. Sankar Ghosh, M.Sc.

17. Smt Nabanita Sarkar, M.Sc.
18. Smt Pampi Basu, M.Sc.
19. Sri Pallab Kundu, M.Sc.
20. Smt Mausami Maitra, M.Sc.
21. Smt Suparna Dutta, M.Sc. (Upto 16.8.93).
22. Sri Hirak Jyoti Dutta, M.Sc. (From 1.3.94).
23. Smt Madhumita Basu, M.Sc.
24. Smt Prajna Mandal, M.Sc. (From 3.1.94).
25. Smt Antara Basu, M.Sc. (From 1.9.93).
26. Smt Salmoli Chakraborty, M.Sc. (From 1.11.93).
27. Smt Suroopa Banerjee, M.Sc. (From 1.11.93).
28. Sri Saumen Bhattacharyya, M.Sc. (From 1.10.93).
29. Sri Kausik Ghosh, M.Sc. (From 3.1.93).
30. Smt. Kajari Lahiri, M.Sc. (From 21.1. 94 to 12.2.94)

DBT Post-Doctroal Fellows : Dr. P. Venkatiah, M.Sc., Ph.D.
Dr. Manick Bhakta, M.Sc., Ph.D. (Upto 31.1.94).
Dr. B.K. Padhi, M.Sc., Ph.D.
Dr. Bhudeb Bhattacharyya, M. Sc., Ph. D.
Dr. Pradip Kr. Mahapatra, M.Sc., Ph.D. (From 28.1.94)
Dr. Reba Roy, M.Sc., Ph.D. (Upto 18.11.93)

UGC Fellows : Ms. Purba Mal, M.Sc.
Shri. Samarpan Majumder, M. Sc.

ANIMAL PHYSIOLOGY SECTION

C. S. I. R. Ad-hoc Fellows

1. Dr. Debjani Ghosh, SRE
2. Shri Pradip Kumar Sarkar, SRF
3. Shri Basanta Tiwair, JRF
4. Smt. Bela Keshan, JRF

DBT Post-doctoal Fellows

1. Dr. R. Kirubagaran
2. Dr. Eshan Ahmed Khan (From 31.3.94)

P M C G SECTION

U. N. D. P.

Title : Plant Improvement using modern biotechnology.
Project Co-ordinator : Prof. S.K. Sen

Department of Biotechnology

Title : Centre for Plant Molecular Biology.

Project Director	:	Prof. S.K. Sen
Jr. Research Scientist	:	Dr. D. Basu
Research Associate	:	Dr. T. Saha
Research Fellows	:	N.S. Banerjee
		S. Majumder
		S. Kar
		K. Roy

Indo Bangladesh Cultural Exchange Programme

Ms. Ferdosi Begam

Rockefeller Foundation

Title : Rice Biotechnology
Principal Investigator : Prof. S.K. Sen

CSIR Research Associate

Dr. P. Nayak (From 15.1.94)

CSIR Ad-hoc Fellows

1. Shri T. Saha, SRF
2. Ms. Aparajita Mitra, SRF
3. Ms. Papiya Roy Chowdhury, SRF
4. Ms. Durba Bandyopadhyaya, SRF
5. Shri Ashis K. Nandi, JRF
6. Smt. Soma Paul, JRF

K.S. Krishnan Fellowship, DAE

Shri A.S. Rishi, SRF

UGC Research Associateship

1. Dr. A. Lahiri-Majumder
2. Dr. N.J. Gupta
3. Dr. P. Nayak

LIBRARY

The Bose Institute Library is one of the best Science Reference Library in Eastern India. The Library is primarily meant for the use of its research staff, but it is frequently used and consulted by many research workers and teaching staff of the seven Universities of West Bengal including STM, Medical College, Indian Institute of Chemical Biology (IICB), Central Gless & Ceramic Research Institute (CGCRI), Saha Institute of Nuclear Physics (SINP), Indian Institute of Tcchology (IIT, Kharagpur , BHU, BSI, ZSI and other educational organizations and institutions. A wing of the Library has been opened at Acharya J.C. Bose Centenary Laboratory Building in 1983 with reading and lending facilities.

Library hours

Both campus of the Library are kept open from 9·30 a.m. to 7·00 p.m. on week-days from 10·00 a.m. to 7·00 p.m. on Saturdays (except 2nd and 4th Saturday).

Acquisition-Books & Journals

Library contains 29,302 volumes of Books, bound Journals and Theses upto 31.3.94. Dnring the period under report (93-94), 1145 bound journals, 68 books and 11 theses were added to the stock, Library subscribed 79 journals during 93-94, The Library also received a fairly good number of technical pamphlets, reports etc,

Circulation :

In both the campuses 8016 readers / 4214 (CB)+3802 (MB) / used the library for reference work ; and 289 permission cards were issued to outside readers.

Under Inter-Library loan system, 17 volumes were issued to other institutions, and 5 volumes were taken on loan.

Photocopying services :

1, 12, 920 copies of photocopying (xerox) services were given to faculty and staff of the institute. Another xerox machine has just been installed in the main campus library.

Budget :

Rs. 29, 22, 000 for 1993-94.

Institute Publication :

During 1993-94 following institute publications were published.

A. Annual Report 1992-93, English & Hindi versions.
B. Transactions of the Bose Research Institute V, 55 No. 1-2 ' 3-4, (1992)
C. Bose Institute News No. 1, Nov. 1993.

WORKSHOP

During the year under report the following units of the W/shop e.g. Mechanical, Electrical, Refrigeration, Carpentry, Glass blowing and Drafting in joint collaboration received and attended about 2150 nos. requistions from various departments of the Institute.

Most of them are completed.

The following noteworthy jobs were undertaken and completed during the year under review.

(a) Designing and fabrication of Instruments and gadgets :—

1. 4 nos. Crescograph for Birla Institute of Technological Meseum.
2. Tube Gel Apparatus
3. Plexi Glass Chamber
4. Slab Gel Electrophoresis apparatus
5. T. L. C. applicator
6. Perpex combs
7. Radio Active Chamber
8. Innoculation Tray
9. Appendrop Tube stand.
10. Phtograph's wooden base, wooden pattern, partition with Novopan, Book shelfs with sliding door, working tables fitting with sunmica, wooden base of Crescograph with glass case. etc.

(b) Lot of scientific instruments have been repaird and Maintenance of some electricals instruments used in the different laboratories were undertaken by the workshop. Like Circular stainless still water bath, Pully for cold room, Tulu pump, various types of shakers, Autoclaves, Vacuum pumps Rotary evaporator etc.

(c) Some major electrical works were undertaken by the electrical department of workshop. Some of which are repairing and maintenance of 400 amps, 200 amps, 100 amps and 60 amps Main Switches, several new line drawn at centenary building and main campus. Scholars Hostel at saltlake, electrical maintenance work has been taken departmentaly.

(d) Refrigeration section, in addition to maintaining of cold rooms of the Institute (10 nos) and repairing of Air Conditioners which are sent to us, B. O. D incubator, Refrigerator and Deep freezes have also been repaird here with the fullest satisfaction of the depts. A 'GEL COLD AIR CONDITION MACHINE' have been repaired by us successfuly.

(e) Glass apparatus as per requirement of the scholars and Scientists have been made and lot of repairing of glass apparatus have been done by our highly experienced glass Blower.

(f) Drafting section have under taken graphing, sketching and drawing as per requirement of scholars and scientists for their thesis and papers. Prepare of ammonia printing for Mechanical and civil works have also been done.

(g) Arrangements of lectures and seminars by providing slide projects, Overhead Projectors and public address system were made. About 300 Institute's lectures and seminars were attended to at both the campuses. A number of lectures and seminars organised by outside organisation/agency were attended.

For maintenance of this Institute the materials are housed in the workshop store. The store also meets the requirements of Mechanical, Electrical, Refrigeration shop from their stock. Some times store supply various types of materials as asked by differents departments. Any kind of purchase are made by our store maintaining the purchase rule of the Institute.

Purchase and issue of materials and maintaining of stock are maintained by the modern kardex system, Stock verification by C. A. G. have been made this year.

In addition, the following works were carried out under the supervision of the workshop Supdt.

Internal telephone system are look after by the workshop. New EPABX system have been introuced in both campuses by purchasing EPABX Machine from M/s. CROMPTON GREAVES LTD.

Efforts are being made for purchasing a new Ambassador Car for the use of Director of the Institute and an old Ambassador (Station Wagon No. WMD 4893) had been disposed of through Car Committee. Daily allotments of 5 nos cars were carried out under the supervison of the workshop Supdt. and maintenance, repair also being done.

Maintenance and regular check up of various Fire Fighting Equipment installed in the Institute.

Maintenance and repair of irrigation pumps and Engine at Experimentol Stations and also maintenance of scholars Hostel is being done through Workshop.

RECIONAL SOPHISTICATED INSTRUMENTATION CENTRE

The RSIC continued to provide analytical instrumentation services to users in the region. An overall resume of services provided by the Centre during the year 1993-94 is given in the table.

The Mass Spectrometer, CW NMR, and Gas Chromatograph were in operation with intermittent faults. Servicing work associated with these instruments were affected at times due to non-availability of spare parts. The instruments like EPR Spectrometer, Atomic Absorption Spectrophotometer, Transmission Electron Microscope, Mass Spectrometer and GC provided routine services to the users satisfactorily without any major fault.

A 3-day workshop on Atomic Absorption Spectroscopy was conducted satisfactorily by RSIC in the month of February, '93. The workshop received excellent response from the users not only from the Eastern region but also from other regions of the country.

The Scanning Electron Microscope suffered a major breakdown during the 1st quarter of the year. The fault was repaired by Radon House. The instrument was set back to normalcy during the last quarter of the year.

The upgradation process of the X-ray Diffraction unit is in progress raising hopes of better performance from the unit in the very near future.

A problem in the high voltage unit in the Spectrofluorimeter system hampred its service to users. The problem was tackled in-house by fabrication of the unit indigenously. The system is now under trial runs and is expected to give routine service shortly.

Repair work of the Ultracentrifuge has been initiated and the system is expected to run shortly.

Repair work on the UV-Vis-NIR Spectrophotometer is expected to commence soon.

RSIC / CALCUTTA
RESUME OF ACTIVITIES
(From April 1993 to March 1994)

Instrument	*External User*		*Internal User*	
	No. of samples	Revenue earned	No. of Samples	Revenue (Unpaid)
MASS	15	Rs. 1,800.00	72	Rs. 8,520.00
AAS	358	21,150.00	563	32,100.00
EPR	62	6,400.00	84	4,400.00
HPLC	10	550.00	144	7,200.00
	Time Of Use (IN HRS.)			*Time Of Use (IN HRS.)*
SEM	9	2,418.00	39	7,786.00
FLS	80	4,240.00	71	3,340.00
GLC	239	12,000.00	74	5,000.00
TEM	170	49,860.00	112	24,800.00
		98,418.00		93,146.00

GRAND TOTAL Rs. 1,91,564.00

J. C. Bose Unit and Museum

Acharya J. C. Bose himself started the display of his instruments which, as a continuous process, have made their way into the present Museum. The aim and objective of this Museum is to maintain the original instruments, manuscripts and the collections of Acharya J. C. Bose.

Institute of Radio physics and Electronics, Calcutta University organised in December, 1993 a special course under the Man-power Training Programme on "Millimeter Wave Technology" sponsored by the Department of Electronics, Govt. of India. J. C. Bose Unit and Museum took part in the programme.

The Unit in collaboration with Workshop is actively engaged with the duplication of four sets of J. C. Bose's Portable Compound Lever Crescograph Instrument.

A part of the Film on the Bengal Reniassance in painting by D. Roy Productions, Calcutta was filmed in the Museum. A video film on the Life and Works of Prof. S. K. Mitra was commissioned by Indian National Science Academy. In this film a portion of Acharya J. C. Boses instrument for detecting characteristics of microwave has been included.

The J. C. Bose Museum participated in the Exhibition entitled "Banga Mela", organised under the joint venture of the Dept. of sports and youth services, information and cultural affairs and cottage and small industries, Govt. of West Bengal, to observe the advent of Bengali year 1400 B. S. at Calcutta Maidan from 14.4.93 to 20.4. 93.

An exhibition entitled "100 Years of Science and Technology in Calcutta" was organised by "Sutanuti Parisad" in joint collaboration with J.C. Bose Museum, as a part of Satabdi Baran Utsab at J. C. Bose Museum from 22 April, to 28th April, 1993.

The Museum participated in the Silver Jubilee Exhibition of Bhairab Ganguly College from 8th February to 10th February 1994 with instruments, charts, photographs and manuscripts.

Participation in other exhibitions :

(i) Science and culture Expo '93 organised by North 24 parganas dist. Manimela at Thakur Corner Ground, Sodepur. Exhibition was sponsored by DBT, from September 5 to 12, 1993.

(ii) Khardaha Utsav '93 at Ramakrishana Mission, Rahara from 31st October to 9th November, 1993.

(iii) Calcutta Blind School Centenary Exhibition 1.12.93. to 3.12.93.

(iv) Science and Cultural Exhibition organized by "Projanma" (Science Cultural and Rationalist Organization of India) from 24. 12. 93 to 3o.12.93.

Special demonstrations were arranged to mark the i) Foundation Day 3oth November, 1993 and National Science Day 28th February, 1994.

Besides, the J. C. Bose Unit and Museum furnished informations, photocopies of papers and photographs of Acharya J. C. Bose and the Bose Institute to various organisations/eminent persons on request. During the year, a large number of visitors both from abroad and within the country including students from different Universities visited the Museum.

Distributed Information Centre

This is the 5th year since the inception of DIC at Bose Institute, Calcutta by the Biotechnology Information System (BTIS) of Department of Biotechnology. This centre specializes in the area of *Genetic Engineering* and serves as an information base catering to the needs of the scientific community of the host institute as well as of the neighbouring institutes. The center works as the backbone of the research and developmental activities in various fields like, genetic engineering, biocrystallography, biocomputing, etc. As the previous years were, this year was also full of routine scientific activities as well as several developmental activities, The following is a brief account of such activities taken up by the centre .

1. As a first step for building up an information base, the centre had been augmenting its resources of computerised bibliography. The subscribed databases include MEDLINE, AGRICOLA, BIOTECHNOLOGY ABSTRACTS, TOXLINE PLUS CCOD. Help is provided to the users to retrieve their relevant bibliographic information.

2. Genetic engineering being the thrust area of the centre, several sequence analysis software packages have been procured and installed in the MicroVax II platform. These packages are extensively used by the workers in this field for various purposes like sequence homology, secondary structure prediction, restriction site mapping etc. Using the centre's computing facilities the scientists of Bose Institute had deposited as many as 10 nucleic acid sequences during 1993-94 generated in their laboratory in the databank.

3. Apart from providing the necessary infrastructure, the centre is engaged in different developmental activities as well . One of them is building up and maintenance of specialized databases. The database on methanogenic bacteria developed by the centre in collaboration with the Biophysics department of Calcutta University, METHANOG, has been revised and updated to a completely new version. Another database on the WETLANDS of West Bengal has been developed, which covers the geographic locations, several examples of wise use of wetlands, etc. In collaboration with summer students from North Bengal University, we are in the process of buildiug up a database on rice.

4. There are several groups of biocrystallography in and around this region. Several softwares necessary for the data analysis, refinement etc., have been procured and installed. Molecular modelling being an intergal part of the structural biological

research, the centre is functioning towards enhancing its molecular modelling facilities. Modelling of several proteins and protein-substrate complexes has been undertaken in the centre in collaboration with the scientists of the host institute. To aid visualization and on-scree modelling, enhancement of molecular grapics focility has also been given importance.

5. To serve the user community better, the centre has extended its working hours, the computers are also on round the clock to run the overnight jobs. The E-mail facility has been provided to all the faculty members of the institute. The centre is encouraging the workers to use the network-based facilities for access and retrieval of the latest data deposited in various databanks. Several alert facilities are routinely accessed and information disseminated amongst the users. The centre is bringing out a monthly inhouse newsletter 'Cross Talk' which briefs the institute members with the recent activities, arrivals of databases/books/journals, summary of various interesting scientific articles, etc.

6. The centre has several man-power development programmes. The major one being day-to-day assistance/support provided to the users. Apart from that, courses, lectures, orientation sessions and consultancy services are regularly provided.

The centre had organized a workshop on MEDLARS (Medical literature and Retrieval System) in colloboration with Bibliographic Division, National Informatics Centre, New Delhi from May 18—21st 1994. The number of participants was 25.

The centre had organized a 4 day national symposium cum workshop on BIOINFORMATICS : THE CURRENT SCENARIO" during Jan. 18—21, 1994. The two days symposium involved lectures by eminent scientists of the field from all over India and two workshops on 'Molecular Modelling' and 'Modern Sequence Analysis Softwares' involved lecture-cum-demonstration as well as hands-on sessions. The number of registered participants was 24.

DIC Sicentists had designed and taught a full module (BMB 506) course on "Computer Literacy and Bioinformatics" for postgraduate students of Biophysics, Molecular Biology and Genetics Deptartments of Calcutta University. They also designed a course on "Introduction to PC and Computer Aided Sequence Analysis Methods" for students of Bioscience stream registered for Post M.Sc (M.Phil level) Associateship course at Saha Institute of Nuclear Physics, Saltlake, Calcutta.

The centre organizes lectures by scientists on various topics, this year we had Prof. H. Parish from Leeds University to give a lecture on "Transmembrane Proteins and Bacterial Drug Resistance" and Dr. Indrani Basu, Department of Physics, Bose Institute, gave a set of three lectures on "Neural Networks—Their Applications in Biology."

7. DIC seientist Dr. N. Subbarao had been invited to deliver lecture in a work shop organized by DIC, JNU on "Sequence Analysis" during March 1994.