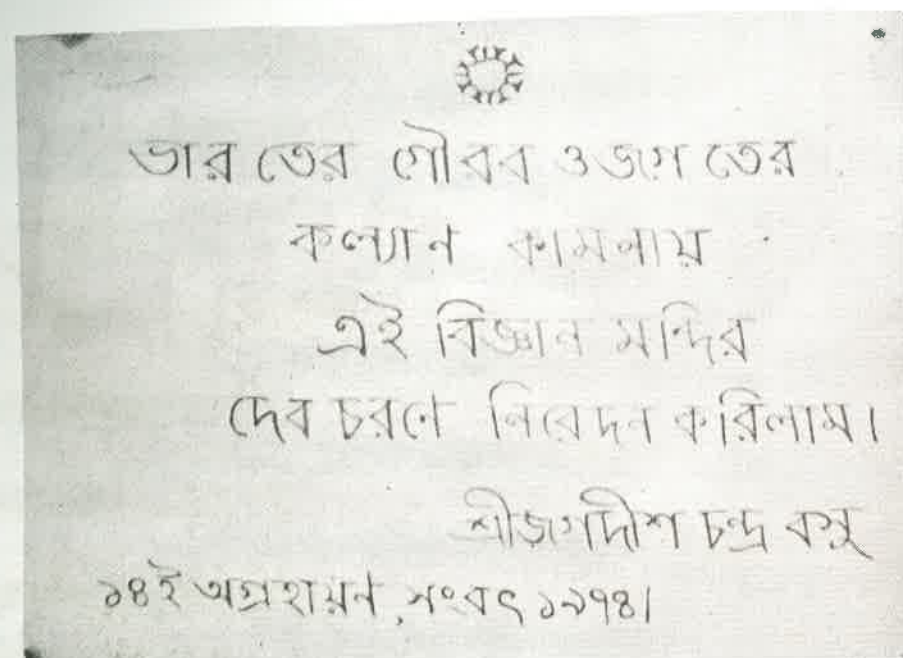




The bronze plaque with the dedication of the Bose Institute to the nation by Jagadis Chandra

ANNUAL REPORT OF THE BOSE INSTITUTE FOR 1996-97



Bose Institute
93/1, Acharya Profulla Chandra Road
Calcutta-700 009

Compiled and edited by the Annual Report
Committee consisting of the following members :

Prof. P. Bhattacharyya—Chairman
Prof. M.H. Engineer
Prof. K.K. Mukherjee
Prof. Pran K. Chakraborty
Prof. Asok Banerjee
Prof. Arun K. Ray
Dr. Pratima Sinha
Dr. Amitai Pal
Dr. N.N. Mondal
Sri Arun K. Dasgupta.

Published by : **Registrar** (Officiating), Bose Institute

Printed by : Jayasree Press, 91/1B, Baithakkhana Road, Calcutta-700 009, 351-4378, 350-4012



Acharya J. C. Bose
The Founder

From the Director's Desk

Dear Friends,



I am extremely happy to present before you the Annual Report for the year 1996-97. Like all the previous years, this year also has been full of activities, enthusiasm, achievements and appreciations. We have started working on

the 9th Five-Year Plan Programmes, which the Institute identified for the period 1997-2002. It is a matter of major concern to all of us as to how our scientific research could make either direct or indirect contributions for the benefit of both Science and the Society. As it is well understood that sometimes the benefits come directly and sometimes it comes in thundering silence in the form of advancement of our knowledge. Our efforts had been directed in both the directions. Since informations through basic and fundamental understanding of scientific truth in all fields of Physical, Chemical and Biological Sciences, pave the way for a better understanding and greater appreciations about the complexities of nature, dissecting out basic phenomena of science has always been a major approach in our scientific endeavours. At the same time, we would like to keep pace with the changing time, and, therefore, with some adjustments and changes in attitude, we have adopted certain areas of activities which are already providing direct benefit to mankind.

I am happy to inform you that one of our drugs for the treatment of heart disease has gone to clinical trial at SSKM Hospital. We have received a request from the Defence Research Laboratory at Jodhpur for supplying a number of both small and large "Superheated Drop Detector." Earlier this mini Reactor was manufactured by the scientists of the Department of Physics in collaboration with our Workshop. The Defence Science Laboratory and BARC had found its usefulness, and so they have approached us with this offer.

Our scientists in the Environmental Sciences Section had done remarkable jobs for a large number of industries in West Bengal. They had worked on several projects to find suitable solutions to enable them to avoid closure due to orders from the Hon'ble Supreme Court of India. This newly developed laboratory has been working for Santaldi Thermal Power Station, Foundries at Howrah, Kancharapara Workshop of the Eastern Railway, etc. Its services and industrial R&Ds have earned significant recognition all around so much so that an increasing volume of work has been coming to them.

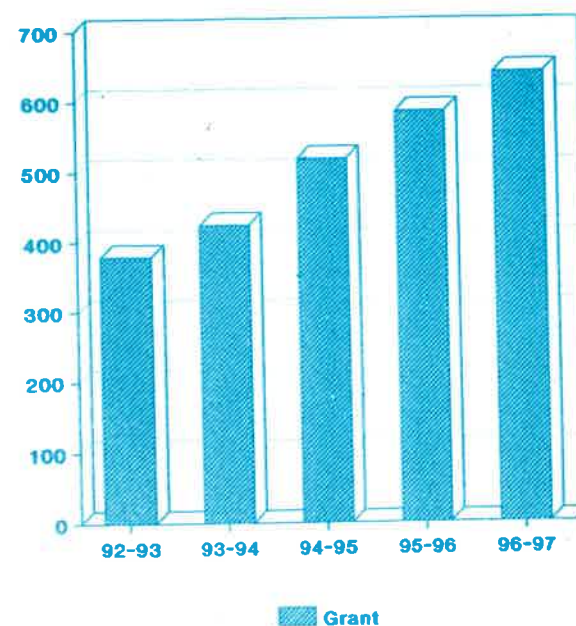
A new patent application has been submitted by the scientists of the Botany Department for isolation of acrylamide from plant sources. An immunomodulator, Protein A, has been found to be effective in field trials to protect chicks from

infection. The collaborative research carried out by two of our scientists from the Department of Physics and Biochemistry resulted in a brilliant paper which was selected as one of the best 5 physical science papers to be mentioned in Encyclopedia Britannica Year Book 95-96, page 241-243.

During the year, one of the significant incidents has been that Sir J.C. Bose's work on millimeter wave was recognised by the world scientific community as the original one, and more appreciations are coming everyday. We, obviously, are extremely proud for the same. This will also inspire the scientists of to-day and tomorrow as to how a scientist without any self-interest had totally dedicated himself for the cause of science, only to bring forth new knowledge for the advancement of mankind.

During the year we undertook a great task for upgrading our facilities with the help of a special fund from the Planning Commission, Government of India. A mammoth programme for the purchase of various sophisticated

**GRANT (Rs. in lakhs)
(Yearwise)**



instruments could be completed within a record short period of time. They were installed and started functioning in various Departments/Sections and the Central Facility of the institute. Some of the very sophisticated equipments had been kept in the Central Facility. For each equipment responsibilities have been given on two scientists. A Management Committee has been formed to look after the smooth functioning of these equipments. They are also in the process of making a charge structure so that outside scientists can come to use those equipments for their benefits as well. Some of the major equipments that we procured are 500 Mhz FT-NMR, FACS Vantage and FACS Calibur, Stop Flow Kinetic Measurement System, Capillary Electrophoresis, Protein Sequencer, Phosphor

Imager, a number of PCR and Ultracentrifuges, Fluorimeter, Infrared Spectrophotometer, High Speed and Table Model Centrifuges, advanced type Spectrophotometers and several others. In fact, every Department/Section has been given 50-60 lakhs of Rupees for upgradation of their facilities.

Library facilities, Computer facilities, Copying facilities etc., had been substantially boosted up. A Local Area Network (LAN) has been planned for connecting various Departments/Sections/Units/Administration/Accounts/Library/DIC

etc., to enable cross-talk in between Departments/Sections/Administration/Library/DIC etc. A massive Computerization programme for Administration, Accounts and various Departments has been undertaken. Library is in the process of computerisation. We are also in the process of connecting our two campuses through a Dedicated Line so that scientists from the Main Campus can have direct access to Administration, Accounts, Library, DIC and other Departments at Centenary Campus. INTERNET activity through VSNL services had been introduced.

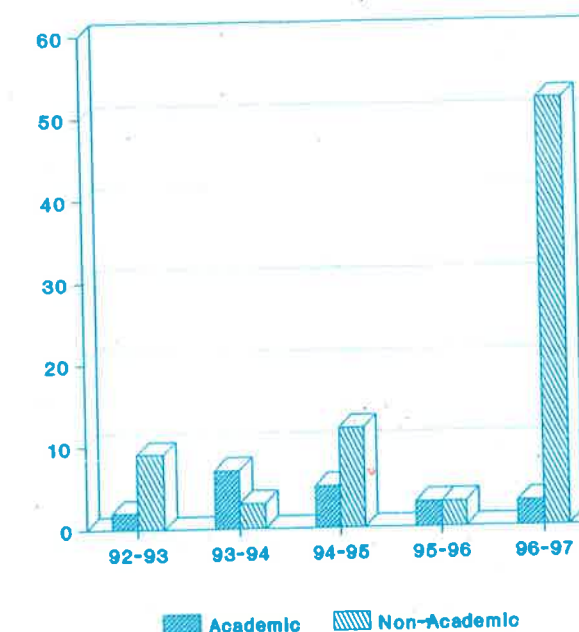
I would like to record my personal appreciation to all those who have done a stupendous job for being able to complete all these programme very successfully. During the interim period we have a change in the Office of our Registrar. A Scientist had been requested to look after the work. A new person has taken over as the Accounts Officer and several new faces have joined in Accounts, Administration, Library and other Departments of the Institute as LDC, Jr. Lab. Asstt., Helper/Bearer etc. A number of new scientists have been appointed. Some have already joined.

The pending promotions upto December 1996 had been given to a large number of our non-academic staff. A modified Promotion Policy for the non-academic staff had come into force. Some outstanding cases could be brought under this modified Policy as well.

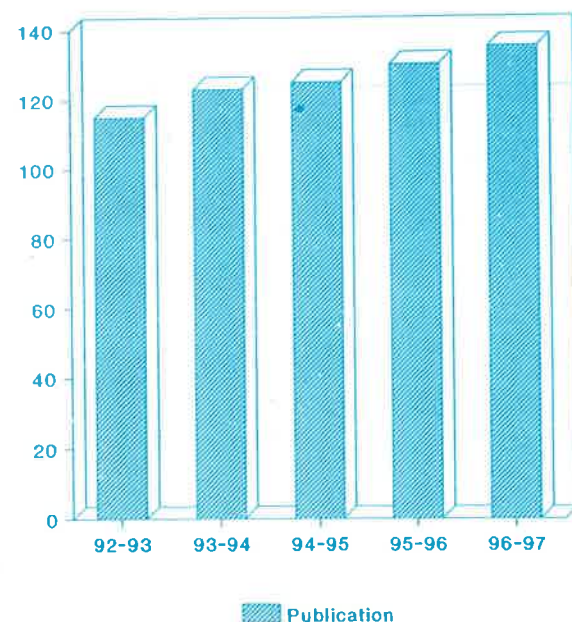
After many years we could initiate repair and remodelling work of Acharya J.C. Bose Lecture Hall, the North Building in the Main Campus, the Buildings at Falta and Darjeeling. This will soon give the entire area a new look and will preserve this national heritage buildings possessed by the Bose Institute. Active work is going on for initiating new constructions for the Annexe Building adjacent to the Centenary Building, staff quarters at Salt Lake and Madhyamgram, extension of the Students' Hostel with a Guest House at Salt Lake premises, and an Animal House at Madhyamgram. The construction of a laboratory building at Madhyamgram is almost complete and a Glass house is ready for use.

The Institute conducted a Symposium on "Science at High Altitude" at Darjeeling which was inaugurated by Shri Subhas Ghising, Chairman, Darjeeling Gorkha Hill Council and was a great success.

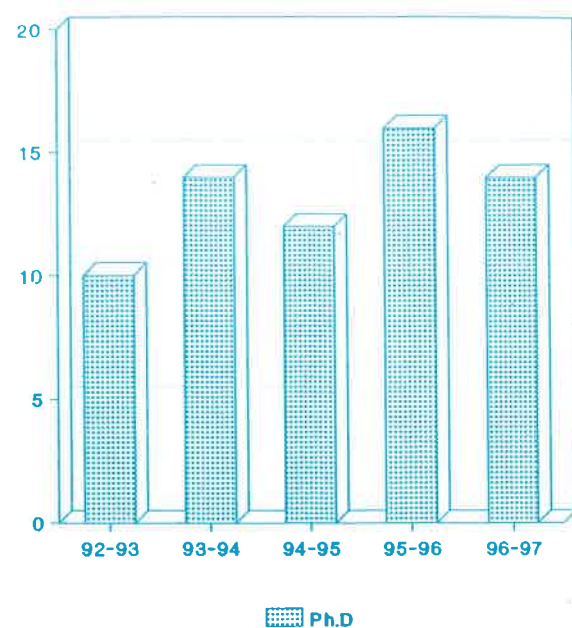
**New Positions Filled
(Yearwise)**



Number of Publications
(Yearwise)



Ph.D. Degrees Awarded
(Yearwise)



The Institute contributed 125 full length publications in reputed scientific journals and had produced a number of Ph.D. students.

I greatly acknowledge all the help, cooperation and support from all corners, especially from the Council and Governing Body of the Institute, DST, Government of India for promoting the cause of this Institute of National and International importance.

Wishing all of you a great year ahead.

November 12, 1997

P. K. Ray
Director, Bose Institute

CONTENTS

	Pages
PHYSICS	1
CHEMISTRY	11
BOTANY	21
MICROBIOLOGY	34
BIOCHEMISTRY	40
BIOPHYSICS	53
ANIMAL PHYSIOLOGY	58
PLANT MOLECULAR & CELLULAR GENETICS	63
IMMUNOTECHNOLOGY	67
ENVIRONMENTAL SCIENCES	70
MADHYAMGRAM EXPERIMENTAL FARM	73
LIBRARY	74
WORKSHOP	75
R.S.I.C.	77
J.C. BOSE UNIT AND MUSEUM	79
D.I.C.	80
PUBLICATION	82
ADMINISTRATION	83
J.C. BOSE MEMORIAL LECTURE	84
LECTURES	84
ACKNOWLEDGEMENT	86
MEMBERS OF THE COUNCIL	86
MEMBERS OF THE GOVERNING BODY	87
MEMBERS OF THE FINANCE COMMITTEE	87
MEMBERS OF THE CENTRE MANAGEMENT	87
COMMITTEE—R.S.I.C., BOSE INSTITUTE, CALCUTTA	87

Physics

Faculty : Prof. S.C. Roy, Prof. M.H. Engineer (Chairman), Dr. A. K. Chatterjee, Dr. S.N. Changdar, Prof. S. Raha, Dr. I. Bose, Dr. D. Home, Dr. B. Roy, Dr. B.K. Chatterjee, Dr. S.K. Saha, Dr. T. P. Sinha.

INSTITUTIONAL PROJECT VI

A. Acoustics

Study of viscous fingering type instability at the interface of vertically driven liquid layers.

B. Roy and M.H. Engineer

For studying the various characteristics of the viscous fingering instability in sufficiently fast vertical flows of acoustically driven liquid layers, the power of driving ultrasonic generator was required to be increased. A Matec model 60 RF impedance matching network has been procured and installed in between the RF generator and the driving transducer. We have extensively tested the new system to see that it produces the desired acoustic power by at various loads and frequencies by matching the transducer impedance to that of the generator of RF power.

B. Nuclear Physics

B.1. *Compton Scattering studies on niobium carbide and niobium nitride :*

A.K.Chatterjee and Aniruddha Deb

An experimental analysis of the Compton profile of polycrystalline niobium carbide using 59.54keV gamma-radiation was carried out. The experimental results were compared with the theoretically calculated Compton profile values based on the LCGO method. An analogous calculation was carried out for niobium nitride. We are justified in comparing the two technologically valuable materials which crystallize in the rock salt

structure, using the same theoretical model as the approximations involved in both the cases will cancel each other to a large extent. From the comparison of the two compounds a change in the non-metal p and the metal d interaction was found. This was discussed in light of the charge analysis and the shape of the Fermi surface. Results were also presented in light of the partial density of states, total density of states and the Compton profile.

B.2. *Compton Scattering studies on Indium phosphate :*

A.K. Chatterjee and Aniruddha Deb

To study the nature of the Fermi surface and the electron momentum density we have experimentally studied the directional Compton profiles along the [100], [110] and [111] directions using 59.54 keV gamma radiation. Our anisotropy results was interpreted in terms of the nature of the Fermi surface. The theoretical results based on the LCGO model showed that InP is a semiconductor, and the total and the partial density of states showed the hybridization of the metals and the non-metal p orbitals. Finally the results were discussed in light of the bonding mechanism.

B.3. *Positron lifetime in polymer :*

A.K. Chatterjee and Aniruddha Deb

Investigation in positron annihilation life time study continued with protein samples. As protein samples are available in minute quantities, we prepared a matrix of protein sample, in this case, bovine serum albumen in a ma-

trix with KIO_3 . The positron life time in this sample has been measured. This latter data together with Doppler broadening result will enable us to have the structure information to characterize any irregularities in the structure. The theoretical approach of M. Alatalo et al (Phys. Rev. B. 54 (1996-II) 2397) is found to be suitable for interpretation of our experimental results. The sample was prepared with the help of the Chemistry Department, Bose Institute.

C. Applied Radioactivity and Liquid Dynamics :

S.N. Changdar and B. Dutta

The sliding cell method developed in our laboratory and based on tracer technique was used to measure diffusion coefficients in some ternary liquid systems using P-32 as the tracer. Studies were continued to observe and explain the effect of coupled flow on the motion of diffusion of ions or molecules.

D. Radiation Physics and Condensed Matter.

D.1. Effect of suspended particles on the viscosity of fluids :

B.K. Chatterjee and Nirmal Halder

To study the effect of the shape of the suspended particles, plant seeds (mustard and poppy) are being used to test the effect of suspensions on viscous fluids.

D.2. Ionic transport and reaction processes in nonpolar liquids :

B.K. Chatterjee

A completely interchangeable set of electrodes, pulsing grids and an accurately positioning holder for the ionic drift apparatus has been fabricated. A copper disc anode for constant ionic current has also been introduced. Solutions of copper sulphate and potassium chloride are being used to generate ions.

D.3. Study on neutron sensitivity of superheated drop samples :

Mala Das, **B. Roy**, **S.C. Roy**, and **B.K. Chatterjee**

In presence of a flux of neutrons the rate of nucleation of superheated drops (ShD)s is proportional to the residual volume of those droplets and the neutron flux. A 3 Curie Am-Be neutron source, provided by the Head, Isotope Division, BARC, Mumbai has been installed in a new laboratory and experiments were carried out for determining the nucleation rate and hence the life time of two types of ShD samples e.g. Freon-12 (b.p. -29.8°C) and Freon-22 (b.p. -40.8°C) in presence of a fixed flux of neutrons. Experiments were performed using the horizontal tube volumetric method (reported in Bose Inst. Ann. Rep. 1995-'96). From the nucleation rate of ShD samples their efficiency of neutron detection was determined, knowing the flux of neutrons and the effective neutron nuclear cross sections.

A comparative study of the two types of ShD samples (Freon-12, Freon-22) revealed that the life time in presence of neutrons for Freon-22 ShDs is less while the neutron efficiency is more compared to Freon-12 ShDs.

D.4. Tabulations of photon-atom elastic scattering cross sections :

B.K. Chatterjee and **S.C. Roy**

Tabulation of the interpolated differential elastic scattering cross section of all elements from $Z = 13$ (Aluminium) to $Z = 104$ (Kruschatovium) at fourteen photon energies between 50 keV to 1500 keV and at 55 angular positions has been completed. The multi-dimensional interpolation is made using state-of-the-art precise cross sections. The tabulated values compares extremely well with the available experimental results.

D.5. Measurement of gamma scattering cross sections :

Swapan K.Saha and **S.C. Roy**

On the basis of the results obtained from the previous experiments, a source holder has

been designed to make better alignment of the beam stopper with the source and detector assembly. The assembly confirms substantial decrease in background and significant increase in the signal to noise ratio.

D.6. Mössbauer study nano- $\alpha\text{-Fe}_2\text{O}_3$ in various glass matrices :

T.P. Sinha in collaboration with T.K. Kundu and D. Chakravorty of IACS, Calcutta.

Nano- $\alpha\text{-Fe}_2\text{O}_3$ in silica and titan is matrices were prepared by sol-gel route. The nanocomposites containing various size of $\alpha\text{-Fe}_2\text{O}_3$ were precipitated by the heat treatment of the dried gel in the range of temperature from $100\text{--}1200^\circ\text{C}$. Differential Thermal Analysis (DTA) of $\text{SiO}_2\text{-Fe}_2\text{O}_3$ system showed four exothermic peaks at temperature 326°C , 348°C , 380°C and 1188°C . These peaks were analyzed in terms of transformation of FeCl_2 into $\alpha\text{-Fe}_2\text{O}_3$ and crystallization of the cristobalite. Whereas the DTA study of $\text{TiO}_2\text{-Fe}_2\text{O}_3$ systems showed peaks of 325°C , 390°C and 730°C . The formation of anatase as well as rutile phase of TiO_2 and the growth of $\alpha\text{-Fe}_2\text{O}_3$ were predicted from the above peak analysis. These results were in agreement with the X-ray diffraction studies. Mössbauer spectra $\text{SiO}_2\text{-Fe}_2\text{O}_3$ nanocomposites heated upto 300°C showed the presence of two tetrahedral Fe^{3+} in silica glass matrix whereas the spectra of the samples heat treated at higher temperatures showed a magnetic sextet with paramagnetic and superparamagnetic doublets. The Mössbauer spectra of $\text{TiO}_2\text{-Fe}_2\text{O}_3$ nanocomposites showed only paramagnetic and superparamagnetic doublets for all the specimens containing nanoparticles of $\alpha\text{-Fe}_2\text{O}_3$. The present study shows that the growth of nanoparticles of $\alpha\text{-Fe}_2\text{O}_3$ in titania matrix is completely different from that in silica matrix. These are believed due to the existence of a nanocrystalline TiO_2 phase in the former case.

D.7. Noise pollution in Calcutta :

B.Roy, **S.C. Santra**, **Debasish Chakrabarty** and **Abirlal Mukherjee** (University of Kalyani)

Immediately after our survey of traffic noise level of several traffic junctions in Calcutta for 24 hours (reported in Bose Inst. Ann. Rep. 1995-96) a study was undertaken to investigate the relation between exposure to various levels of traffic noise and the extent of annoyance in the exposed population. Interview investigations in social survey was performed among the people residing or spending maximum hours of the day within 200 meters of the traffic junctions. The data on the extent of annoyance of the exposed people have been analysed and linear regression equations for the percent of people highly annoyed vs the day-night average level (L_{dn}) of traffic noise or 24 hours equivalent level ($L_{eq(24)}$) have been developed. Similar regression equations were also developed for the mean dissatisfaction score vs L_{dn} or $L_{eq(24)}$. Subjective response of the exposed people to the problem of noise has been studied by using inverse sampling methodology supported by audiometry test and case history. The result showed that 40.64% of the population interviewed got *bilateral sensory neural hearing loss* due to exposure to traffic noise. All these results and those reported earlier have been included in the thesis submitted to the University of Kalyani by Debasish Chakrabarty.

E. Theoretical High Energy Physics, Astrophysics and Cosmology :

E.1.1. High Energy Particle and Nuclear Physics :

(a) Ultrarelativistic Heavy Ion Collisions and Quark-Gluon Plasma :

Prof. Sibaji Raha, in collaboration with Dr. Jan-e Alam, Mr. Pradip Roy, Mr. Sourav Sarkar of VECC, Calcutta and Prof. Bikash Sinha of SINP and VECC, Calcutta

Various aspects of quark-gluon plasma, expected to be formed in ultrarelativistic heavy ion collisions (URHIC), have been investigated. Earlier work on the approach to chemical equilibrium in such collision processes has been refined, by taking into account the thermal masses of the various

constituents, and the conclusion that chemical equilibrium does not obtain on strong interaction time scales has been strengthened. A manuscript with these results has been accepted for publication. Effects of such departure from equilibrium on quark-gluon plasma diagnostics have been studied in detail and a manuscript has been submitted for publication. In a related theme, the role of dissipative processes in the space-time evolution of the excited matter formed in URHIC has been investigated. A paper with these results has been accepted for publication.

(b) *Phenomenological Applications of Finite Temperature Field Theory :*

Dr. Sanjay Kumar Ghosh, Mr. Abhijit Bhattacharyya and **Prof. Sibaji Raha**, in collaboration with Dr. Jan-e Alam of VECC, Calcutta

Studies on the modification of hadronic properties at high temperatures have been continued. Special attention has been paid to the vector mesons, including all their interactions so as to perform a self-consistent calculation as possible. It has been seen that such self-consistency is strongly required in order to obtain reliable results. Work on these problems is in progress.

(c) *Microscopic approaches to hadronization :*

Dr. Sanjay Kumar Ghosh, Mr. Abhijit Bhattacharyya and **Prof. Sibaji Raha**, in collaboration with Dr. Jan-e Alam of VECC, Calcutta and Prof. Bikash Sinha of VECC and SINP, Calcutta

Hadronization in a many-body system of quarks and gluons at a high temperature is one of the outstanding problems of strong interaction physics. There has, to date, been only a few studies aimed at elucidating this very important problem and most of them use semi-classical thermodynamic concepts of bubble nucleation in a first order phase transition scenario. To overcome the limitations of such drastic assumptions, a microscopic model for hadronization is being

developed. Preliminary results indicate that the time scales for hadronization calculated within such a model agree very well with expectations and the assumption of thermodynamic equilibrium is not at all necessary. This study is in progress.

(d) *Hadronic Structure Functions and Quantum Chromodynamics :*

Dr Sanjay Kumar Ghosh and **Prof. Sibaji Raha**

The recent experimental data on hadronic structure functions extracted from deep inelastic scattering off polarized and unpolarized hadronic targets indicate that the confining interactions of Quantum Chromodynamics (QCD) are too important to be neglected, as is the usual practice. Starting from a dynamical picture of colour confinement developed by Raha and collaborators some years ago, the effects of confinement on the branching equations of QCD are being studied.

(e) *Nonlinear Effects in Multiparticle Production Processes :*

Prof. Sibaji Raha, in collaboration with Dr. Devapriyo Syam of Presidency College, Calcutta

Work on elucidating the role of nonlinear maps in understanding multiparticle production in high energy hadronic and nuclear collisions has been continued.

E.1.2. Theoretical Astrophysics and Cosmology :

(a) *Equation of State of Superdense Matter :*

Dr. Sanjay Kumar Ghosh, Mr. Abhijit Bhattacharyya, Mr. Shibaji Banerjee and **Prof. Sibaji Raha**, in collaboration with Prof. S.C. Phatak of Institute of Physics, Bhubaneswar

Various issues connected with the equation of state of superdense baryonic matter have been studied. Particular attention has been paid during the past year to the possibility of Kaon condensation ; calculations

beyond the mean field level have been carried out for the first time, by including the higher order diagrams in the Kaplan - Nelson model. These results have been written up in a manuscript by Bhattacharyya, Ghosh, Phatak and Raha, which has been accepted for publication. Neutrino emissivity of kaon condensed matter is now being looked into by Banerjee, Bhattacharyya, Ghosh and Raha. Also Bhattacharyya and Ghosh have performed a systematic analysis of the equation of state of superdense baryonic matter calculated from various model lagrangians for the sake of comparison. A manuscript has been submitted for publication

(b) *QCD Phase Transition in the Early Universe :*

Prof. Sibaji Raha, in collaboration with Dr Jan-e Alam of VECC, Calcutta, Dr Pijushpani Bhattacharjee of Indian Institute of Astrophysics, Bangalore and Prof. Bikash Sinha of VECC and SINP, Calcutta

We had earlier found that strange quark nuggets, formed in the early universe (during the microcond epoch since the Big Bang) as a consequence of the QCD phase transition could be cosmologically stable only if their mass were larger than a critical value. The smaller nuggets would evaporate, leading to locally overdense regions of space. The evolution of such overdense regions has been studied. It has been shown that neutrino interactions are more important than baryon diffusion at higher temperatures and that the nonlinear effects there are quite sizable. These results are now being written up. On the other hand, it has been shown that the stable nuggets can not only be viable candidates for the cosmological dark matter but they can close the universe without much fine - tuning of the parameters. A manuscript with these results has been submitted for publication.

E.1.3. Observational Astrophysics and Cosmology :

(a) *Study on γ ray and Charged Particle Fluxes during the Total Solar Eclipse of 24 October, 1995 :*

Mr. Abhijit Bhattacharyya, **Dr. Barun K. Chatterjee**, Ms Mala Das, **Prof. M.H. Enginneer**, **Prof. Sibaji Raha**, **Prof. S.C. Roy** and **Dr Swapan K. Saha**, in collaboration with Prof. Sukumar Biswas of TIFR, Bombay, Mr. Pradipta Das and Mr. Tapan Das of SINP, Calcutta, Dr. Tarun De of Bajkul College, Midnapore, Dr. Rabinarayan Mukherjee of Institute of Physics, Bhubaneswar, Prof. A.K.Sen of Institute of Radiophysics and Electronics, Calcutta University, Calcutta, Prof. Bikash Sinha of SINP and VECC, Calcutta and Dr. Debapriyo Syam of Presidency College, Calcutta

The experimental data on γ -ray and charged particle fluxes at sea level, collected at Diamond Harbour during the total solar eclipse of 24 October 1995, have been thoroughly analysed. It has been found that there is a statistically significant decrease in the flux of soft γ -rays but not much change in the charged particle fluxes. These observations have been interpreted as being the first ever observation of a temporary cooling of the upper atmosphere due to the total solar eclipse. A manuscript has been completed and accepted for publication by the prestigious journal *Astrophysics and Space Science*.

E.2.1. Standard quantum mechanics with environment induced decoherence and wave function collapse : Possibility of an empirical discrimination using neutron interferometry :

Dipankar Home in collaboration with Sougato Bose of Laser and Quantum Optics Group, Imperial College, London

A thought experiment is developed in detail with a view to differentiate between standard quantum mechanics incorporating environment induced decoherence effects and a formulation based on a dynamical model of wave function collapse. An appropriate variant of a neutron interferometric arrangement is suggested for this purpose.

E.2.2. Testing a dynamical model of wave function collapse in the cosmological scenario :

Dipankar Home in collaboration with Dr. A.S. Majumdar of S.N. Bose National Centre for Basic Sciences, Calcutta, India

The continuous spontaneous localization (CSL) of baryonic wave functions using a dynamical model of wave function collapse is considered. The total value of the associated energy liberation which contributes to the energy density of the universe in the form of non-baryonic dark matter is calculated from the time of baryogenesis up to the present era. Taking into account the standard cosmological expansion, it is observed that for a suitable choice of parameters, the CSL contribution matches the critical density of the universe.

E.2.3. Quantum Zeno Effect : Relevance for local realism, macroscopic realism, and noninvasive measurability at the macroscopic level :

Dipankar Home in collaboration with M.A.B. Whitaker of Department of Physics and Applied Physics, The Queen's University of Belfast, Belfast, Northern Ireland

Variants of the Quantum Zeno Effect are analysed. It is deduced that the predictions of some variants are incompatible with local realism, and that, provided the laws of quantum theory remain valid at the macroscopic level, all variants of quantum Zeno prediction must be incompatible with noninvasive measurability at the macroscopic level.

E.3.1. Strongly Correlated Systems and Magnetism :

Indrani Bose, Saurabh Gayen, Asimkumar Ghosh and Uma Bhaumik

The $S = 1/2$ Heisenberg antiferromagnet on the $1/5$ -depleted square lattice describes the system CaV_4O_9 . Experiments have shown the existence of a spin-gap in this system. We have constructed a spin model of the system for which the ground state and several excited states can be determined exactly in different parameter regimes. The ground states include the plaquette-resonating-valence-bond (PRVB)

state and the dimer state. One also finds the existence of a singlet excitation in the gap. The exact results have provided a rigorous basis for some conjectures on which earlier theories of CaV_4O_9 were based.

A calculation of the magnetic properties of a partially integrable spin-1 chain has been initiated. The other problems on which work has begun include superconductivity in ladder compounds, calculation of the magnetic susceptibility of a ladder system and dimerization of the magnetically frustrated system CuGeO_3 .

E.3.2. Statistical Physics :

Indrani Bose and Indranath Chaudhuri

The problem of pattern formation in a reaction-diffusion system is of importance because examples of such systems are many in physics, chemistry and biology. We have studied the effect of disorder and anisotropy on the formation of stationary Turing patterns. The study is of interest as real systems in which the patterns form are often disordered and anisotropic. The results are of relevance for diverse problems like neurotransmission, formation of chemical patterns in gel reactors and also morphogenesis. A study of the protein folding problem has been initiated.

E.3.3. Berry's phase and associated problems :

M.H. Engineer and collaborators, S.N. Behera, H. Ghosh and M. Mitra of Inst. of Physics

The properties of quasi one dimensional systems are of great current interest. We have demonstrated that the geometry of the underlying state space drastically modifies the excitation spectrum, both electronic and phononic. Superconductivity, in finite chains, becomes more likely; the cases where superconductivity is absent have also been solved within the BO-approximation. A charge density wave mode is found to be possible, and, its order parameter becomes complex and is enhanced due to quantum geometry. Many other effects

on the order parameter have been included. The effects of electron-electron repulsion on the optical excitation of real, quasi one dimensional materials have been studied.

PUBLICATIONS

1. "Interpolation of elastic scattering cross sections of photons" B.K. Chatterjee and S.C. Roy, *Proc. of Indo-US Workshop on Radiation Physics* (Darjeeling, March 15-22) pp 44-60, 1996.

2. Deb A. and Chatterjee A.K., Compton profile of Cuprous oxide by linear combination of Gaussian orbitals. *J. Phys. Condens. Matter* **8**, 5139, 1996.

3. Deb A. and Chatterjee A.K., Compton scattering studies on niobium carbide and vanadium carbide. *Proc. of the 7th International Symposium on Radiation Physics* (ISRP-7), Jaipur, **RA4**, 92, 1997.

4. Bhattacharyya, A. α and ω with Δ baryon at high temperature. *Int. J. Mod. Phys. E* **5**, 511, 1996.

5. Alam, J., Raha, S. and Sinha, B. Electromagnetic probes of quark - gluon plasma. *Phys. Rep.* **273**, 243, 1996.

6. Bhattacharyya, A., Ghosh, S.K., Phatak, S.C. and Raha, S. In-medium effects on the ϕ meson. *Phys. Rev. C* **55**, 1463, 1997.

7. Home D., and Bose S., Standard Quantum Mechanics with Environment-induced Decoherence and Wave function Collapse : Possibility of an Empirical Discrimination using Neutron Interferometry. *Phys. Lett. A*, 217-209, 1996.

8. Home D., and Ghose, P., The Two-Prism Experiment and Wave Particle Duality of Light. Invited Contribution to the Special Issue of Foundations of Physics in honour of Max. Jammer, **26**, 943, 1996.

9. Home D., and Majumdar A.S., Is Spontaneous Localization Compatible with the Energy Density of the Universe ? *Phys. Lett. A* **220**, 17, 1996.

10. Home D., and Majumdar A.S., Testing a Dynamical Model of Wave function Collapse in the Cosmological Scenario, in Quantum Coherence and Decoherence, edited by K. Fujikawa and Y.A. One, pp. 291-294, Elsevier, Amsterdam, 1996.

11. Hole dynamics in a correlated system with impurity by I. Bose and S. Gayen, *Physica B* **223 & 224**, 628 1996.

12. Antiferromagnetic spin ladders with odd and even number of chains by Asimkumar Ghosh and Indrani Bose, *Phys. Rev. B* **55**, 3613, 1997

13. Effect of randomness and anisotropy on Turing patterns in reaction-diffusion systems by Indrani Bose and Indranath Chaudhuri, *Phys. Rev. E* **55**, 5291, 1997.

14. Exact Methods for Lattice Models : Vertex models, Transfer Matrices and Quantum spin chains by Indrani Bose in Models and Techniques of Statistical Physics ed. by S.M. Bhattacharjee, Narosa Publishing House, 1997.

15. Heisenberg antiferromagnet on the pentagonal lattice by U. Bhaumik and I. Bose, Proceedings of the DAE Solid State Physics Symposium **39C**, 98, 1996.

16. Plaquette Resonating Valence Bond State and Spin Gap in CaV_4O_9 by A.K. Ghosh and I. Bose, Proceedings of the DAE Solid State Physics Symposium **39C**, 100, 1996.

17. Pattern formation in disordered reaction-diffusion systems by I. Chaudhuri and I. Bose, Proceedings of the DAE Solid State Physics Symposium **39C**, 383, 1996.

18. Chakrabarty D., Santra S.C., Mukherjee A., Roy B. and Das P. Status of road traffic noise in Calcutta metropolis, India, *J. Acoust. Soc. Am.* **101** (2), 943, 1997.

19. Sinha, T.P. Mukherjee, M., Chakravorty, D. and Bhattacharyya, M. Mossbauer study of nanocomposite $\text{Fe}_2\text{O}_3\text{-SiO}_2$ prepared by sol-gel method. *Ind. J. Phys.* **70A**, 741, 1996.

20. Sinha, T.P. Roy, R., Mandal, P. and Majumdar, C.K. Magnetic and Mossbauer studies of intermetallic Fe-Mn-Ti alloy, *Solid State Phys. (India)* **39C**, 107, 1996.

21. Kundu, T.K., Sinha, T.P. Mukherjee, M. and Chakravorty, D. Synthesis and characterization of nano-Fe₂O₃ in TiO₂ matrix. *Solid State Phys. (India)* **39C**, 367, 1996.

22. Engineer M, Behera S.N., Ghosh H., and Mitra. M., Quantum fluctuations, Berry's phase and the one dimensional charge density wave, *Phys. Lett. A* **216**, 171-173, 1996.

BOOK

Bhattacharya P.K., and Engineer M. Acharya J.C. Bose - a Scientist and a Dreamer, *Vols I and II, Bose Inst. Publications Divn.* 1996.

Participation in Conferences/Symposia/ Training Programmes/Awards and Honours received.

Prof. M.H. Engineer : 1. Invited to participate in the workshop on "The Foundations of Quantum Theory" at TIFR during September 9 to 13, 1996.

2. Invited to participate in The Asia Pacific Microwave Conference '96 at Department of Electronics Science, University of Delhi, South Campus, New Delhi during December 16 to 20, 1996. Attended the said conference on deputation from the Bose Institute.

3. Invited to participate in the International Symposium on : "Novel Materials" held in Puri during March 3 to 7, 1996.

4. Invited to spend two weeks at the Institute of Physics, Bhubaneswar doing research on quasi one dimensional systems with Prof. S.N.Behera, Director, IOP and Dr. H.N. Ghosh.

5. Delivered, on invitation, the First Dissection Day Memorial Lecture at the Calcutta Medical College, 10th Feb. 1997.

Prof. Sibaji Raha : delivered a colloquium at the Indian Association for the Cultivation of Sciences, Calcutta;

delivered a joint colloquium at the Department of Physics and Astronomy of the University of Delaware and Bartol Research Foundation, Newark, USA ;

attended an International Conference on the State of Physics at the End of the 20th Century at Santa Fe, USA and delivered an invited plenary session talk ;

delivered lectures at the Winter School on Astrophysics of the Eastern Centre for Research in Astrophysics, Calcutta ;

attended the 3rd International Conference on Physics and Astrophysics of Quark-Gluon Plasma at Jaipur, India and delivered an invited plenary session talk ;

served as expert member at various selection and assessment committees;

served as referee for several professional peer-reviewed journals.

Dr. I. Bose Dr. I Bose delivered a talk on Pattern Formation in Reaction Diffusion systems at the Indian Association for the Cultivation of Science (May, 1997; was invited to give a talk in the workshop titled Some Aspects of Theoretical Physics organised by the Indian Statistical Institute, Calcutta (May, 1996); was invited to participate in the Golden Jubilee Theoretical Physics symposium organised by the Tata Institute of Fundamental Research (September, 1996); was invited to give a set of lectures in the Workshop on Percolation Theory organised by the Indian Statistical Institute, New Delhi (December, 1996); was invited to give a lecture at the Indian Institute of Science, Bangalore under the Theoretical Physics Seminar Circuit Programme (March, 1997); was invited to give a talk at the Workshop on Post-graduate Physics Education organised by the Indian Physical Society (March, 1997); has been invited to become an Honorary Associate Editor of the Indian Journal of Physics.

Dr. B.K. Chatterjee : participated and presented two posters in the 7th International Symposium on Radiation Physics held at Jaipur, February 24-28, 1997.

Dr. T.P. Sinha - Dr. T.P. Sinha presented two papers in the meeting "Condensed Matter Days-1996" held at the Department of Physics, Tripura University, Agartala from August 29 to 31, 1996. Dr. Sinha presented two papers in the Annual DAE Solid State Physics Symposium held at BARC, Mumbai from December 27 to 31, 1996. Dr. Sinha participated in the USIC Workshop on NMR Spectroscopy held at University College of Science, Calcutta University, Calcutta from March 4 to 6, 1997. Dr. Sinha presented paper in the Symposium on Current Topics in Physics of Materials held at School of Physics, University of Hyderabad, Hyderabad from March 27 to 29, 1997.

Dr. Sanjay Kumar Ghosh - (i) attended the Golden Jubilee Symposium of Tata Institute of Fundamental Research, Bombay ;

(ii) visited Indian Institute of Technology, Kanpur and Mehta Research Institute at Allahabad under the Theoretical Physics Seminar Circuit and delivered seminars ;

(iii) attended the 3rd International Conference on Physics and Astrophysics of Quark-Gluon Plasma at Jaipur, India and delivered a talk.

Mr. Abhijit Bhattacharyya - (i) attended the Summer School on High Energy Physics and Cosmology at the International Centre for Theoretical Physics, Trieste, Italy;

(ii) visited the Laboratory for High Energy Nuclear Physics at Ecole Polytechnique, Palaiseau, France ;

(iii) attended the 3rd International Conference on Physics and Astrophysics of Quark-Gluon Plasma at Jaipur, India and delivered a talk.

Mr. Shibaji Banerjee - attended the 3rd International Conference on Physics and Astrophysics of Quark-Gluon Plasma at Jaipur, India.

Asimkumar Ghosh, Uma Bhaumik and Indranath Chaudhuri participated in and presented papers at the DAE Solid State Physics Symposium held at B.A.R.C. Bombay (December, 1996). Indranath Chaudhuri also participated in the Workshop on Fortran 90 held at the S.N.Bose National Centre for Basic Sciences, Calcutta (October, 1996).

Ph. D. Awarded

Name	Univ./Subject	Year	Title	Supervisor
Santa Bandyopadhyay	Jadavpur/ Physics	1997	Measurement of Compton profile of transition metal & compounds.	Dr. Arun Kumar Chatterjee

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. S.C. Roy	Fabrication of pressure reactor & electronic circuitry to detect bubble nucleation.	Defence Lab, Jodhpur
Prof. S.C. Roy	Investigations on the use of superheated drop detectors in neutron detection.	Atomic Energy Regulator Board (AERB)
Dr. B.K. Chatterjee	Ionic transport and reaction processes in nonpolar liquids.	CSIR

**RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL
FELLOW/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS**

A. Bhattacharjee, Aniruddha Deb, Sanjay Ghosh, Sibaji Banerjee, Mala Das, Indranath Chowdhury.

OTHER SUPPORTING STAFF MEMBERS

G.R. Paul, N.C. Dey, A.K. Ganguly, K.C. Das, S.P. Singha, S. Basak, Shyam Sundar Mallick (joined on 16.6.97), Subhasis Banerjee (joined on 16.6.97), Manas Datta (joined on 16.6.97), Subrata Das (joined on 19.6.97), Tarun Kumar Maji (joined on 20.6.97), B.P. Ram, B. Dutta, D.K. Thakur, S.K. Basu, Kissan Das, R.K. Mourya, Prabir Halder (joined on 6.6.97).

Chemistry

Faculty : Prof. P. Bhattacharyya (Chairman), Prof. A. Ghosh, Prof. P. Chakrabarti, Dr. P.C. Sen, Dr. S. Misra, Dr. M. Chakrabarty, Dr. K.P. Das, Dr. J. Basu, Dr. M. Kundu, Dr. P. Das.

INSTITUTIONAL PROJECT II

A.1. Survey of indigenous marine oils for industrial utilisation in the large scale manufacture of medicinal EPA & DHA for treating heart diseases.

Prof. A. Ghosh, D. Banerjee, D. Pal and J. Dey

The technology developed for scaling up of EPA from marine resources of coastal regions of West Bengal, could be applied to any marine oil with a certain minimum concentration of EPA in the raw material. After transfer of technology for EPA manufacture to some pharmaceutical concern, large quantities of marine oils which contains minimum initial levels of EPA would be required, as raw material. With a view that whether suitable raw marine oils are available, indigenously, this survey study was taken up to determine EPA contents of some abundantly available marine oils from several sea food industries in South India.

Several marine oil samples, viz, shark liver and sardine oils were procured from several dealers in South India. Upon analysis for EPA contents of samples it was revealed that, 60% of the marine oils were suitable as the raw material for the technology developed. However, further study is necessary to determine the species, collection time and seasonal variation of EPA contents in the samples, such that the production cost could be minimised and transfer of technology would be easier.

A.2. Transmission EPA and DHA from algae to higher trophic levels.

Prof. A. Ghosh, D. Banerjee, D. Pal and J. Dey in collaboration with Prof. A. Chaudhury, S.D. Marine Biological Institute, Sagar Island, 24 Parganas (South)

Our extensive studies during the last 25 years on various marine animals of Sunderbans estuarine complex has revealed the occurrences of high levels of EPA and/or DHA, compared to those of the other parts of the world. This observation promoted us to initiate a study for determining the mechanism of this valuable finding, which could be used for (i) culturing marine animals containing elevated levels of EPA and or DHA, for medicinal use and (ii) conservation of the ecological balance of nature.

Initially we have started to analyse the total fatty acid profiles of some macro-and micro-algae which are abundant and consumed by various herbivorous and omnivorous benthic animals and thus enter into the food chain of the Sunderbans eco-system.

INSTITUTIONAL PROJECT NO. III

A.1. Purification and characterization of a protein kinase from goat spermatozoa.

Parimal C. Sen, Rita Sikdar, Atin K. Mandal and Kausik Ray.

A protein kinase has been purified almost to homogeneity from cytosolic fraction of goat spermatozoa by different column chromatographic separation methods. The kinase phosphorylates histone in presence of unsaturated fatty acids with arachidonic acid shows maximum stimulation. The contaminated cAMP dependent protein kinase (Protein kinase A) in gel filtration column was removed by treatment with micromolar concentration of cAMP followed by High Q anion exchange column fractionation. The molecular weight of the kinase is found to be about 110-120 KDa. This protein kinase is different from PK-C for not activated by Ca and lipids. Divalent metal ions like Ca, Mn and monovalent ions eg Na, K inhibit the activity. The inhibitors of PK-C kinase like staurosporine and H-7 do not have any effect, however it is inhibited by heparin in micromolar range. The kinase phosphorylates certain endogenous proteins including ion transport proteins suggesting its role in cell regulation.

A.2. Purification and functional characterization of a low molecular weight Ca, Mg- and Ca-ATPase modulator protein from rat brain cytosol

Parimal C. Sen and Dipankar Bhattacharyya.

A low molecular weight modulator protein having molecular mass of about 12 kDa has been purified from rat brain cytosol following gel filtration and FPLC/ Mono Q anion exchange chromatographic separation. A number of protein fractions were obtained from FPLC column when eluted with 0.1 M NaCl hold gradient. One fraction (peak no. 5) was found to stimulate Ca, Mg-ATPase but inhibit Ca-ATPase isolated from goat spermatozoa. S_{50} (concentration producing 50% stimulation) and I_{50} were found to be in the nano molar range. The modulator seems to bind to Ca, Mg- or Ca-ATPase a site distal from ATP binding site. The binding to both the ATPases are reversible and non-competi-

tive in nature. The inhibitory activity is found to depend significantly on-SH or NH_2 group(s) of the modulator whereas no appreciable dependency of the stimulatory effect was apparent. The study indicates that it is not a glycoprotein. The CD analysis suggests that the protein exists as an unordered secondary structure. The modulator does not contain any Trp molecule as evident from the Trp fluorescence analysis. Amino acid analysis shows that glycine, serine, and derivatives of tyrosine and phenylalanine are the predominant amino acids. The data suggest that modulator is a negatively charged protein and is a good tool in distinguishing the regulation of Ca, Mg- and Ca-ATPase activities.

A.3. Separation of Mg-independent Ca-ATPase from Mg, Ca-ATPase in goat spermatozoa.

Parimal C. Sen, Amlan Das and Rita Sikdar

We have reported previously the presence of an Mg-independent Ca-ATPase in goat spermatozoa. However both of them were found to be copurified in different purification steps. Solubilisation with detergent ($C_{12}E_8$) followed by column chromatographic fractionation on DEAE cellulose we were partially succeeded in separating these two ATPases.

B. Structure and function of the human erythrocyte membrane.

Joyoti Basu, Amit K. Das, Raja Bhattacharya, Biplab Dasgupta and Pinakiranjan Jana

B.1 Palmitoylation of erythrocyte membrane protein 4.2 :

In order to better understand the role of palmitoylation of protein 4.2 a 9 kilodalton polypeptide derived from protein 4.2 and containing the cysteine residue identified as the site of palmitoylation, was expressed in *E. coli* as a GST-fusion protein. This polypeptide could be palmitoylated by the erythro-

cyte palmitoyl acyltransferase. Scatchard analysis of the binding of the palmitoylated and the non-palmitoylated 9 kilodalton polypeptide with the cytoplasmic domain of band 3 (cdb3), showed that palmitoylation enhances the association of this domain with cdb3.

B.2 Palmitoylation of spectrin :

Different functionally well-characterized polypeptides derived from beta spectrin are being expressed as GST-fusion proteins in *E. coli* in order to study the consequences of palmitoylation of these polypeptides in terms of protein-protein and protein-membrane interactions.

C.1. Chemistry of Plant Products.

Chemical Investigation of *Murraya koenigii* :

Manas Chakrabarty, Amar Chandra Nath and Shampa Khasnobis in collaboration with Dr. (Mrs.) M. Chakrabarty of Bethune College, Calcutta and Prof. Y. Harigaya, Y Konda and K. Komiyama of Kitasato University, Tokyo, Japan

The two new carbazole alkaloids isolated from the chloroform extract of the roots of *Murraya koenigii* were identified as 9-carbethoxy and 9-formyl derivatives of 3-methylcarbazole. The latter was additionally synthesised by the oxidation (by Corey's reagent) of N-hydroxymethyl-3-methylcarbazole which in turn was prepared from 3-methylcarbazole by treatment with potassium carbonate and formaldehyde in a polar solvent.

Both the new metabolites were tested against seven bacteria, both gram-positive and gram-negative, and two cell lines following standard methods. Only the N-formyl derivative displayed weak cytotoxic activity against mouse melanoma B16 cells and adriamycin-resistant P388 mouse leukemia cells. Both the compounds were void of any antibacterial property.

C.2. Synthetic Heterocyclic Chemistry

(i) Studies on Reactions of Carbazoles

Manas Chakrabarty, Amar Chandra Nath and Shampa Khasnobis

It was demonstrated that carbazoles react with formaldehyde and alkali metal carbonates in polar solvents to furnish either the N-hydroxymethyl derivatives of the bis (N-carbazolyl) methanes. The structures of the products were found to depend on the presence or absence of electron donating (CH_3) or electron withdrawing (NO_2) groups at C-3 of the carbazole nucleus as well as on the protic or aprotic nature of the solvents used.

An interesting behaviour of 9-hydroxymethyl-3-methylcarbazole in solution could be traced, which has led us to propose a biogenesis of the two new carbazole alkaloids.

(ii) Synthesis of Condensed Heterocycle :

Manas Chakrabarty and Shampa Khasnobis

After a number of trials, a standard method of preparing the penultimate substrate for preparing pyrro carbazoles, (PCs) could be achieved. The generality of this method is being checked, after which the annulation leading to PCs would be taken up.

Regarding the Hetero Diels-Alder project, it was observed that Michael adducts, instead of D-A. adducts, are formed with the new azadienes derived from the acyl derivatives of pyrrole, thiophene and furan. Attempts are being made to overcome the difficulties in getting successful D-A. reactions by destroying the aromatic characters of the substrate heteroaryl ring by appropriate derivatisation.

(iii) Development of Newer Reagents :

Manas Chakrabarty and Shampa Khasnobis in collaboration with Prof. Y.

Harigaya and Y. Konda of Kitasato University, Tokyo, Japan.

The work on the development of two new reagents, reported last year, one for the deprotection of ketone phenylhydrazones and the other for the N-formylation of various aryl amines is complete. The results are being submitted for publication.

D.1. Thermal unfolding and refolding of bovine β -lactoglobulin :

K.P. Das and Chaitali Bhattacharjee.

The process of refolding of thermally unfolded β -lactoglobulin is being studied by spectroscopic methods. It is found that β -lactoglobulin refolds to a native like secondary structure on cooling after thermal treatment. The tertiary structure of the refolded β -lactoglobulin is characterized by significantly higher surface hydrophobicity as indicated by the enhanced ANS fluorescence emission. Further characterization of the refolded form is in progress.

D.2. Interaction of proteins with biomolecule grafted solid surfaces :

K.P. Das and Anuradha Bhaduri.

Amino acids were grafted to solid surfaces through ethanolamine treatment of the solid followed by coupling of the amino-acids by glutaraldehyde treatment. The adsorption of proteins were measured on this grafted surfaces. Surface adsorption were found not to be significantly dependent on the nature of the amino acid grafted except for tryptophan grafted surface. Tryptophan grafted surfaces showed stronger affinity for water and in most cases protein adsorption was actually negative. Grafted amino acids formed a hairy layer over the solid surface providing channels for proteins to penetrate and reach the solid surface. The analysis of results of protein adsorption on carbohydrate grafted surfaces are in progress.

D.3. Conformational changes in lysine modified proteins :

K.P. Das and Anupa Bhattacharyya.

Lysine modification of β -lactoglobulin was done by acetylation, glycosylation and alkylation. The changes in the secondary and tertiary structures of the modified protein are being studied by fluorescence and CD spectroscopy. Preliminary data indicate that although the secondary structures are nearly unchanged, introduction of various chemical and charged groups affects the stability of the tertiary structure of the protein. Detailed study is in progress.

D.4. Molecular chaperone function of α -crystallin :

K.P. Das

Conformation of substrate proteins bound to α -crystallin has been studied by fluorescence spectroscopy. The fluorescence emission spectra as well as fluorescence quenching data indicate that the bound substrates such as γ -crystallin and rhodanese exist in a conformation very close to that of their native conformation in which most of the native secondary structure and part of the tertiary structure remains intact.

The changes in the conformation of α -crystallin itself on binding substrate proteins are being studied at present.

E.1. Study of Biopolymer mesogen :

Pradip Das

Actin filaments are the major constituent of muscle and non-muscle cells and are important determinants of cellular shape and motility. This protein polymer has been the focus of intensive recent study. In vitro, we characterized the liquid crystal polymorphism of this polymer and rationalized the same in terms of the Onsager theory, the Flory lattice approach and a semiflexible polymer mesogen model of F-actin. A paper on this topic is currently under review in the Physical Review E.

E.2. Study of structure vs mesomorphism in Biopolymer mesogens :

Pradip Das

Biopolymers having uniform α -helicity, e.g. synthetic homopolymers (polypeptides) of amino acids and double-helicity, e.g. polynucleotides such as DNA, and protein polymers with non-uniform α -helicity are currently being studied. Especially interesting is the finding that 100% α -helical polypeptides and 100% double-helical polynucleotides form liquid crystals at a high concentration—500 mg/ml. The protein polymer F-actin forms liquid crystals at concentrations two orders of magnitude lower. We pursue some clues to this mystery.

E.3 Determination of order parameters in F-actin solutions :

Pradip Das and N. Mitra

Polarized fluorescence studies are being planned to quantitate the orientational ordering in actin filaments.

INSTITUTIONAL PROJECT NO. V

A. 1. Antibiotic resistance in *Shigella dysenteriae*.

Manikuntala Kundu, Anindya Sundar Ghosh, Alak Kanti Kar, Jasimuddin Ahamed and Kamlesh Chauhan

(1) Beta-lactamase in beta-lactam resistance of *Shigella dysenteriae* :

An oxacillin hydrolysing β -lactamase of group 2d has previously been purified and characterised from a clinically resistant strain of *Shigella dysenteriae*. The MIC values of oxacillin, ticarcillin and cefotaxime of the resistant strain PB10 were depressed when the antibiotics were used in combination with clavulanic acid, which was found to a potent inhibitor of the purified β -lactamase. Depres-

sion in MIC values were not observed in the case of a sensitive strain which showed a 30-fold reduced expression of β -lactamase. This result strengthens the view that the β -lactamase is one of the factors contributing towards resistance against these antibiotics.

Multidrug resistance in *Shigella dysenteriae*.

Norfloxacin-resistant mutants of *S. dysenteriae* were isolated by adaptation in the presence of norfloxacin. Cross-resistance to chloramphenicol and ampicillin was observed in these mutants. The accumulation of these antibiotics was lower in the mutants compared to the wild type, an effect that could be reversed by the energy uncoupler carbonyl cyanide *m*-chlorophenylhydrazone (CCCP), suggesting that efflux pumps were likely to be associated with low-level antibiotic resistance in these mutants.

Drug target in *Mycobacteria*.

Parul Chakrabarti, Manikuntala Kundu, Joyoti Basu, Sanjay Mukhopadhyay, Seabrat Mahapatra, Dhiman Basu

(i) The high molecular mass penicillin-binding protein I (PBPI) of *Mycobacterium leprae*.

The gene *pon I* encoding the PBPI of *M. leprae*, has been manipulated to express truncated derivatives of PBPI. Deletion of the C-terminal extension of 164 amino acids downstream of the penicillin-binding module, did not effect the penicillin-binding activity or the membrane localization of PBPI. The role of the non-penicillin-binding module on penicillin-binding activity and protein stability is being explored.

(ii) Altered permeability and beta-lactam resistance in a mutant of *Mycobacterium smegmatis*.

Beta-lactam resistance in mycobacteria results from an interplay between the following (i) β -lactamase production, (ii) affinity of

the penicillin-binding proteins (PBPs) for the drugs, and (iii) permeation of the drugs. A laboratory mutant of *Mycobacterium smegmatis* was studied in order to evaluate the roles of these factors in beta-lactam resistance. Mutant M13 was between 7- and 78 fold more resistant than the wild type to cephaloridine, cefoxitin, cefazolin, cefamandole, and cephalothin. Increased beta-lactamase activity toward these antibiotics was not observed in the mutant. The PBP profiles of the wild type and M13 were comparable. However, the affinities of PBPI for the beta-lactams tested were lower for the mutant than for the wild type. The permeation of the drugs measured in intact cells was lower for M13 than for the parent strain. The liposome swelling technique, which could be used for cephaloridine, also supported this view. Reduced permeation was not restricted to the beta-lactams alone. Glycine uptake was also lower in M 13. Taken together, the results suggest that decreased affinities of PBP 1 for beta-lactams combined with the decreased permeability of the cell wall of the mutant, lead to the development of high-level acquired beta-lactam resistance.

(iii) The pon A gene of cosmid L222 of the *Mycobacterium leprae* genome library encodes a multimodular class A penicillin-binding protein, PBPI*. The PBP, labelled with a polyhistidine sequence, has been produced in *E. coli*, extracted from the membranes with CHAPS and purified by Ni²⁺ NTA agarose chromatography. In contrast to the pon 1-encoded class A PBPI, PBPI undergoes denaturation at temperatures higher than 25°C, it catalyses acyl transfer reactions on properly structured thioesters, and it binds penicillin with high affinity.

B.1. Anti-implantation effect of BIM-Studies on brain Na⁺, K⁺ ATPase

Debasis Ghoshal, Dipankar Bhattacharyya, P.C. Sen and P. Bhattacharyya

The immunomodulatory effect of BIM in now well documented. The cytokine recently showed anti-implantation effect when injected in rodent soon after mating but the mechanism is not known. BIM was previously reported to modulate the activity of brain Na⁺, K⁺-ATPase and a definite enzyme activity pattern heralded immunocompetence. Injection of BIM in mated rats induced an enzyme activity pattern similar to that observed in immuno-competant host. Normal pregnant rats, however, showed an enzyme activity pattern similar to that observed in immuno-compromised ones i.e. weak stimulation. The observation further strengthen our previous hypothesis that brain Na⁺, K⁺-ATPase play important role in immune regulation and the experiment also indicate that a bone marrow—brain—uterus axis may be operational in our system.

B.2. Field trial of BIM on poultry

D. Ghoshal, P. Bhattacharyya in collaboration with D. Chakraborty, Gopal Chakraborty* and A. Chatterjee*. Inst of Animal Health and Vet. Biologicals, W.B.

1. Field trial of BIM has now conclusively proved that in poultry it definitely reduces stress and imparts protection against a wide variety of bacterial (*E. coli*) viral (Ranikhet, Gumboro) and protozoal (Cocci)diseases.
2. BIM was found to improve antibody titre in R2 B vaccinated Chicken (mean titre/in 1821) composed to Control (mean titre/in 517) after two weeks, post vaccination.

B.3. Hepatoprotective and immunomodulatory studies of an Indian medicinal plant

S. Datta, S. Sinha, D. Ghosal and P. Bhattacharyya.

The hepatoprotective agent isolated previously from *C. indicus* has been identified as a protein. Characterization and

biophysical properties of the low molecular weight protein is under process. Histological studies and TEM structure of the liver has been done to assess the hepatotoxicity. Studies on humoral and cell mediated immunity are in progress. The immuno-potentiating effect of the protein isolated from the above plant is also being studied.

B.4. Hypoglycemic activity of an Indian Medicinal plant

Neurogenic diabetes were induced in male rats (body wt. 120 +5) by stereotaxic lesion of nodule of the cerebellum. Also the animals were subjected to hypoglycemia by a chemical agent like streptozotocin (STZ). In both the cases animals were treated with a herbal formulation which was found to be hypoglycemic. Glucose oxidase and histological examination of the pancreas confirmed the hypoglycemic effect of the above herbal drug.

PUBLICATIONS

1. K.P. Das M.J. P{etrash and W.K. Surewicz, "Conformational properties of substrate proteins bound to a molecular chaperone a-crystallin". *J Biol Chem*, **271**, 10449-10452 1996.
2. A. Bhaduri, N. Matsudomi and K.P. Das, "Effect of zcetylation of ovalbumin on its adsorption behavior at solid\liquid interface", *Biosci. Biotech Biochem* **60** (10), 1559-1564 (1996).
3. Chakrabarty, M. and Batabyal, A. 'An expedient synthesis of 5,11-dimethylindolo [3,2-b] carbazole, a potential ligand for the receptor for

TCDD. *Synth. Commun.*, **26**, 2015-3023 1996.

4. Purification and biochemiecal characterization of a protein palmitoyl acyltransferase from human erythrocytes. Das A.K., Dasgupta, B., Bhattacharyya, R. and Basu, J. *J. Biol. Chem*, **272** : 11021-11025, 1997.
5. Erythrophagocytosis and its relation to band 3 clustering in chronic myelogenous liukemia. Das, A.K., Sinha, A.K. and Basu, J. *Biochem, Mol, Biol, Int.* **41** : 539-545, 1997.
6. Biochemical characterization of the 49 kDa penicillin-binding protein of *Mycobactertum smegmatis*. Mukherjee, T., Basu, D., Mahapatra, S., Van Beeumen, J. and Basu, J. *Biochem. J.* **320** : 197-200, 1996.
7. Altered membrane phospholipid organization and erythrophagocytosis in Eβ-thalassemia. Srinivasan, P.T. and Basu, J, *Biophys. Acta* **1285** : 65-70, 1996.
8. Lipids of Aspergillus. Chakrabarti, P., Kundu, M. and Basu, J. In *Lipids of pathogenic fungi* (Prasad, R and Ghannoum, M.A., eds) CRC Press, pp. 140-153, 1996.
9. Purification and functional characterization of a low molecular mess Na, K-ATPase inhibitor protein from rar brain cytosol. D. Bhattacharyya and P.C. Sen, *Eur. J. Biochem.* **244**, 829-834, 1997.
10. Bone derived immunomodulator, An invitro study. R.M. Anond Sivaprakash, Rshella Devi, A Namasivayam and D. Ghoshal, *Pharmacantical Sc.* **3**, 157-160 1997.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. A. Ghosh	Production and clinical trial of EPA on patients suffering from atherosclerotic and thrombotic heart diseases.	D.B.T
Prof. A. Ghosh	Cryopreservation in relation to sperm membrane damage (collaborative project with IICB, Jadavpur)	D.S.T
Prof. P. Chakrabarti Dr. J. Basu, Dr. M. Kundu	Penicillin binding proteins and beta-lactamase of mycobacteria.	Indo-EC
Prof. P. Chakrabarti Dr. M. Kundu	Functional significance of abnormalities of the erythrocyte membrane in myeloproliferative disorders.	Indo-EC
Dr. J. Basu	Studies on the role of palmitoylation of human erythrocyte proteins.	D.S.T
Dr. J. Basu	Protein palmitoyl transferase : a potential regulator of dynamic protein palmitoylation.	D.S.T
Dr. M. Kundu	Role of outer membrane proteins in drug resistance of shigella dysenteriae.	C.S.I.R
Dr. M. Kundu	Biochemical approaches towards the therapy of shigellosis.	D.S.T
Dr. P. Das	Quantitation of Orientational ordering in F-action Smectic B phase.	C.S.I.R
Prof. Bhattacharyya Dr. A. Bhattacharyya	Antihepatotoxic agents from Indian medicinal plants.	C.S.I.R
Prof. P. Bhattacharyya Dr. (Mrs).A. Pakrashi	An immunomodulatory approach to fertility regulation studies on a bone marrow derived cytokine in the prevention of Pregnancy in female rodents.	I.C.M.R
Prof. P. C. Sen	Regulation of ion transporting by protein kinase stimulator or inhibitor proteins in goat spermatozoa.	C.S.I.R
Prof. P. C. Sen Dr. P. Nandy	Ion channel in artificial membranes.	D.S.T

Ph. D. Awarded

Name	University	Year	Title	Supervisor
Tarun Kumar Patra	Jadavpur	1996	Studies on the phospholipids of <i>Sting Ray dasyatis bleekeri</i> (Blyta) from the coastal region of west Bengal, India.	Prof. A. Ghosh

Participation in Conferences/Symposia, Training Programme/Awards and Honours received.

Professor Parul Chakrabarti visited the University of Liege, Belgium in connection with the collaborative Indo-EC project "Penicillin-binding proteins and β -lactamase of mycobacteria." She delivered a lecture entitled, "Drug-targets and drug-resistance in mycobacteria" at the Indian Institute of Technology, Kharagpur and a series of lectures for the M.Sc. Course programme of the Biochemistry Department, Calcutta University.

Dr. Manikuntala Kundu delivered a lecture on "Mechanisms of beta-lactam resistance in *Shigella dysenteriae*" in the Third Seminar on Biochemistry and Biophysics organized by the West Bengal Academy of Science and Technology in February, 1997.

Dr. Joyoti Basu delivered a lecture entitled, "Protein palmitoylation in the human erythrocyte" at the Department of Biomedical Research, St. Elizabeth's Medical Center, Boston, U.S.A in May, 1996 and participated in the DST Group Monitoring Workshop held at IIMTECH, Chandigarh in February, 1997.

Dr. Manas Chakrabarty :

(i) delivered an Invited Lecture entitled, 'Carbazole Alkaloids-A Recent Experience' and acted as a Panel Judge for the session on 'Convention of Chemists Award' in the '33rd Annual Convention of Chemists' held during Dec. 26-29, 1996 at Coimbatore;

(ii) delivered an Invited Lecture entitled, 'Hetero Diels-Alder Reactions' on 28th Feb-

ruary 1997 in the 8th Refresher Course in Chemistry, arranged by the Academic Staff College, University of Calcutta, Calcutta.

(iii) participated in the 'Symposium on Natural Products and drug Development' held on 19th March, 1997 in the Department of Pure Chemistry, University of Calcutta, Calcutta;

(iv) acted as a Secretary, Academic Council, Bose Institute for 1996-97 and as a coordinator of one of the courses in the Course Work programme, 1996-97 of Bose Institute.

(v) taught in the M.Sc. part (II) class (Organic spl) in the Dept. of pure chemistry and in the B. Tech 1st gr. class of polymer Sc. & Technology Dept. of the University of Calcutta, Calcutta for 1996-97.

(vi) has been acting as a Member, Board of Associate Editors in the *J. Indian Chem. Soc.*, Calcutta for 1997.

Shampa Khasnobis attended the workshops on 'NMR Spectroscopy' organised by the University Science Instrumentation Centre (USIC) in collaboration with the Chemistry Department, University of Calcutta, Calcutta during 04.03.97-06.03.97 and on 'Molecular Modeling Methods and Applications', organised by the Distributive Information Centre, Bose Institute 17.03.97-21.03.97.

Dr. P. Das : Attended and presented a talk in the 'Discussion Group Meeting' on "Novel Liquid Crystals with special reference to transition metal discotics and smectics" on 08.01.1997 at S.N. Bose Center for Basic Science.

Prof. Parimal C. Sen attended the group monitoring workshop of CSIR at CCMB, Hyderabad; presented paper at the Annual Convention of the Society of Biological Chemists at Bangalore; delivered an invited talk in the Developmental Biology Symposium

at Utkal University, Bhubaneswar, acted as co-ordinator of "Introduction to Cell Biology" course and taught in the same course Ph. D. and Postdoctoral orientation course at Bose Institute.

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOW/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Amiya Maiti, Anuradha Bhaduri, Asis Bhattacharyya, Mallika Roy, Dipankar Bhattacharyya, Anindya Sunder Ghosh, Tapan Mukherjee, Shampa Khasnobis, Sarmistha Dutta, Dr. Debasish Ghosal, Dr. Sarmila Roy, Dr. Anupa Bhattacharyya, Amit Das, Alok Kanti Kar, Manas K. Pathak, Sebadrata Mahapatra, Chaitali Bhattacharyya, P.T. Srinivasan, Raja Bhattacharyya, Atin K. Mandal, Kausik Roy, Dhiman Basu, Dr. Jitendra K. Gupta, Dr. Sarmila Chattopadhyay, Dr. Ganesh Gopal, Dr. Gautam Chattopadhyay, Dr. S. Subramaniam, Dr. Krishnakoli Neogi, Dr. Raita Sikdar, Jasimuddin Ahmed, Swapnanjan Goswami, Sanjoy Mukherjee, Biplab Dasgupta, Swati Sinha.

OTHER SUPPORTING STAFF MEMBERS

Kalyan Basu, Nirmal K. Das, Prasanta Pal, Anirudha Aich, Debaprasad Roy, Sukumar Maitra, Gopinath Mukherjee, Mrityunjoy Gayen, Paresh Bhattacharyya, Alok Kr. Kundu, Pranab K. Dey, Bhabani Prasad Banerjee, Brindaban Ghosal, Chittaranjan Santra, Chittaranjan Ghosh, Debdas Nandi, Eklas Ali, Rama Mukherjee, Gopal K. Biswas, Amarnath Bhatta, Subhash Chandra Pal, Kodan Das.

Botany

Faculty : Prof. A.N. Lahiri Majumder (Chairman), Prof. S.N. Ganguly, Prof. Bharati Ghosh, Prof. S. Gupta, Prof. K.K. Mukherjee, Prof. Swati Sen Mandi, Dr. B.B. Mukherjee, Dr. P.K. Saha, Dr. D.N. Sen Gupta, Dr. S. Bhattacharya, Dr. S. Gupta-Bhattacharyya, Dr. T. K. Ghose.

INSTITUTIONAL PROJECT III

A.1. Plant responses to abiotic stress.

A.1. Effect of abiotic stress on the expression of components of photosynthesis in tolerant and sensitive rice cultivars :

Bharati Ghosh, Anindita Bose and B.S. Tiwari

Osmotic stress significantly damages the chloroplast membrane and thus photosynthesis gets affected. Our observation showed a gradual decrease in CO₂ assimilation rate, activity of photosystem complexes, chlorophyll fluorescence and carboxylase activity of Rubisco in osmotic and thermal stress and the decrease was more pronounced in sensitive cultivars. Observation from Rubisco turnover study also showed the same pattern and northern blot analysis showed degradation of transcripts of Rubisco and PSII complexes in sensitive cultivars. Degradation of Rubisco by proteolytic activity, using purified Rubisco as substrate and antibody of RLSU, depends on its oxidation state. The work on the molecular regulation of nuclear encoded small subunit is in progress.

A.2. Regulation of polyamine and its function in the adaptation to abiotic stress in rice cultivars :

Bharati Ghosh, Manas Chattopadhyay and Anindita Bose (In collaboration with Dr. D.N. Sen Gupta, CPMB Programme)

Comparison of the regulation of polyamine metabolism in two rice cultivars differing in salt

tolerance was further extended. The studies like ADC activity, SAMDC activity also sustained in the tolerant Pokkali cultivar at 200mM salt concentration while the activities of these two decarboxylases declined at this concentration in M-I-48, the sensitive cultivar. The activities of oxidative enzymes, diamine and polyamine oxidase were found to be higher in the sensitive cultivars probably the cause of low level of higher PA. Spd and Spm when added exogenously in the incubation media during salinity stress the inhibition growth loss of chlorophyll contents. PS I, PS II activities and damage of root PM were recovered suggesting a protective role of exogenous PAs during salinity stress. In vivo incorporation of [³⁵S] methionine into polypeptides, Western blot analysis with RubiscoL antibody and northern analysis of transcripts for pbsA, pbsB, PsbE-F and rbcL gene in rice plants further strengthen the protective function of exogenous PAs during NaCl stress particularly in the sensitive cultivars. These results clearly suggest that by overexpression of ADC and SAMDC in salt sensitive and high yielding rice cultivar probably the tolerance to salinity stress could be improved and generation of full length RT-PCR products of oat ADC cDNA is one step towards that goal.

A.3. Inositol metabolism in relation to salinity stress : Implications in the chloroplast function(s) :

A.N. Lahiri Majumder and Sriparna Bagchi

The salt induced inhibition of chloroplastic Fructose 1,6-bisphosphatase (FruP₂ase) activity in the sensitive rice cultivars, can be ameliorated by polyols like inositol, pinitol and other osmolytes *in vitro*. Simultaneously, the tolerant cultivars as well as a halophyte *Porteresia coarctata* exhibited a FruP₂ase which is resistant to salt both *in vivo* and *in vitro* indicating a probable difference in FruP₂ase enzyme structure. Farther, using a PCR generated rice FruP₂ase probe, transcript analysis of FruP₂ase in plants grown under different concentration of NaCl was done. In the tolerant cultivar, a steady state level of the transcript is maintained upto 150 mM salt after which there is a decline in transcript level at 200 mM NaCl. On the other hand, the FruP₂ase transcript level declines between 50-100 mM NaCl in the sensitive variety.

A.4. Salt tolerant line selection in rice (*Oryza sativa* L.) and physiological characterization of the adapted lines :

B.B. Mukherjee and S. Basu

a) *Osmotic stress-markers in rice callus cultures.*

Studies of banding of (peroxidase and esterase) and that in SDS gel of the structural protein of NaCl- and mannitol-adapted calli (Basmati 370 salt sensitive) and SR-26B (salt tolerant) showed the appearance of two new bands of peroxidase and one band of esterase in the NaCl-adapted callus of both the varieties. The intensity of two specific polypeptides increased many-fold in the varieties due to NaCl and Mannitol stresses.

b) *Proline enigma in osmotic stress-tolerance in rice :*

To substantiate an earlier observation of high proline level of unadapted callus of SR-26B and Matla (a tolerant Variety) in comparison to that in Basmati 370 callus (sensitive variety) proline content of seedlings (*in vivo* grown) were measured. It was observed that proline content was significantly higher in seedling of SR-26B and Matla than that in Basmati 370. Seeds when germinated in

presence of NaCl/mannitol, the seedlings of Basmati showed greater accumulation of proline than that in other two varieties. An experiment with short term stress shock indicated that critical proline level of a salt tolerant variety was higher than that in the sensitive variety. Proline content of the plantlets regenerated from NaCl adapted callus of Basmati were found to be higher than those regenerated from the control callus indicating that the formers could be screened for osmotic stress-tolerance. Two isozymic bands, two polypeptides as observed in SDS and high proline level are the makers of stress tolerance in rice.

A.5. Salinity stress and expression of ABRE binding transcription factor in rice cultivar :

D.N. SenGupta, Sudhiranjan Gupta, Piyali Chatterjee, Gouri Majumdar, Kakali Banerjee (In collaboration with Prof. Bharati Ghosh, CPMB Programme)

We have repeated gel mobility shift experiments to find out the probable mechanism of enhancement of complex formation. First, we found that salinity stress also enhances complex formation of 32p-Emla/ABRE DNA with ABRE binding factor (ARBP) from laminar nuclear extract and secondly, the level of ARBP in Pokkali lamina was found to be higher than in salt sensitive IR-29. Kinetics of complex formation in presence of increasing concentration of spermidine showed enhancement of complex formation at 5mM or more. Preincubation of control nuclear extract with ATP or GTP also showed enhancement suggesting phosphorylation could be the mechanism of activation at post-translational level. As spermidine is known to stimulate casein kinase II and heparin is an inhibitor of CKII, nuclear extract was preincubated with GTP alone or GTP with heparin and 50% inhibition of complex formation was noticed. These results suggest that the ABRE binding factor is present in laminar nuclei in presynthesized and inactive form and salinity stress activates the factor, probably through phosphorylation by casein kinase II. 1.0 kbp long cDNA product was obtained by RT-PCR

from total RNA of root of salt treated Pokkali rice plants using oligonucleotides of Rital, abZIP factor that binds to ABRE.

B. Plant breeding and tissue culture.

B.1. Cytogenetical investigations in *Beta* spp. and studying on wild gene pool of *Chenopodium* and *Ipomoea* :

K.K. Mukherjee, S.K. Mitra and S. Das

Phenotypic and genotypic diversities of the recombinant lines of cross between *Beta vulgaris* and *B. palonga* were recorded for selection of desirable lines. Some of the lines manifested delayed flowering time indicating the possibility of further selection for better vegetable yield.

Polyacrylamide gel electrophoresis analysis of total seed protein and four enzyme performed from stem and root of two diploids and one polyploid cytotypes of *Chenopodium album*. Differential stainability and varied mobility patterns of isozymic bands indicate both cytotype specificity and genetic identity. Both genetic diversity and homology among the diploids and between diploids and polyploids are evident from the banding patterns. The data suggest that the wild diploids are plausible progenitors of the semi-cultivated hexaploid *C. album*.

Studies on seedling morphology and isozyme profile of twelve species of *Ipomoea* undertaken with a view to trace the linkage and homology between the species revealed the concordance of morphological findings with biochemical analysis. The trend of clustering in the dendrogram based on isozyme profile revealed two broad clusters or groups. Interrelationships and homology between the species revealed from phytic tree constructed from seedling morphology and from dendrogram on isozyme data were comparable with minor variations.

B.2. Isolation of disease tolerant sesame (*Seasamum indicum* L.) and submergence tolerant rice through hybridization and anther culture :

S. Gupta, G. Gangopadhyay, R. Poddar, Sarat Raj

Objective of the present programme is to isolate genotype resistant to both fungal disease (*Phytophthora* spp) and insects (*Antigastra catanalis*). The local variety (*S. indicum*) is resistant to fungal disease and *S. mulayanum* (a wild variety) is resistant to the insects. The F₁ hybrids derived from *S. indicum* X *S. mulayanum* crosses and the hybrids have been characterized morphologically, agronomically and biochemically. Also, the genetic distance between the cultivated and the wild genotypes were worked out by SEM study of seed-coat morphology and electrophoretic study of seed-proteins. Another culture of F₁ hybrids resulted in a good percentage of androgenic callus formation (2.32% - 3.75%). An efficient and reproducible microporpagation protocol of the different genotypes has also been standardized. Androgenic recombinant lines are being maintained and multiplied in laboratory condition.

Ten submergence tolerant and two high yielding susceptible (FR43B and IET 10,543) rice varieties were successfully regenerated from the scutellar tissues and subsequently transferred into the pots. The previously developed double-haploid submergence tolerant lines (17) and the F₁ population were maintained in the field. F₁ seeds were produced from a cross between IR42 (O₁) and FR13A (O₁). Experiments were done for standardization of anther culture, collecting panicles of hybrids (IR42 x FR13A) from Chinsura Rice Research Farm. W.B. Standardization of DNA isolation and RAPD protocol taking two varieties (IR42 and FR13A) are in process for molecular characterization.

B.3. Genetic approaches for the improvement of aromatic rice suitable for the agroclimatic conditions of West Bengal : mapping of the rice aroma gene (s) :

T.K. Ghose, S. Bhattacharya, S. Gupta Bhattacharya, B.B. Mukherjee, and S.N. Ganguly, T. RayChaudhuri, C. Roy and R. Das

The main objectives of the project are identification and improvement of aromatic rice suitable for the agro-climatic conditions of West Bengal, a non-traditional zone for Basmati quality rice production, through appropriate breeding techniques including anther culture and DNA-marker assisted selection.

The highlights of achievements of this project up to December, 1996 are as following :

- * After screening 300 aromatic cultivars, a world collection, 88 rice lines, including Basmatias, were found to maintain their characteristic scent at Madhyagram (North 24 Parganas, West Bengal) for the last six generations. Partial agro-morphological characterization of these lines has been made.
- * Segregation analysis of F2 leaf samples showed monogenic recessive control of aroma in 15 aromatic/non-aromatic cross combinations, while digenic recessive control operated in one such combination.
- * Androgenic double haploids have been produced from a few parents and hybrids and seeds have been obtained from 24 DH plants.
- * Large scale anther culture from three heterobeltiotic hybrids was initiated in November, 1996, and very high callusing response, more than 100%, has been obtained.
- * GLC analysis against the standard chemical confirmed the presence of 2-acetyl-1-pyrroline in the rice cultivars maintaining aroma at Madhyagram (West Bengal).
- * Protocol for DNA amplification using PCR has been standardized.

B.4. Improvement of oil seed mustard :

P.K. Saha, A. Roy in collaboration with D. Ghosh (Chemistry Dept.) and S.K. Sen (PMCG)

Induction and plant regeneration in two (RLM-198 & RJ-15) Indian cultivars of mustard (*Brassica juncea* Czern. and Coss.) were carried out from both microspore callus and cultured floral parts. Treatment of floral buds at 8-10°C for four days resulted in the highest percentage of androgenesis. On sub-culture, the calli produced plantlets through embryogenesis. The plant regeneration efficiency of the calli induced on 2.4-D supplemented medium was less than that on NAA-supplemented medium; cv. RLM-198 showed a higher percent of callus formation and regeneration potential than did cv. RJ-15. Rooting of shoots was induced by using Gamborg's B5 medium without vitamins but supplemented with 0.5 mg/l NAA.

C. Germplasm screening and seed biology.

C.1. Potential use of RAPD technique to study the genetic diversity in indica rice varieties and its relationship to submergence tolerance :

Swati Sen-Mandi and Somen Nandi

RAPD assay was performed to detect inherent variations and genetic relationship among indica rice varieties of different origin and one *Porteresia* variety. Low level of genetic variability was detected among cultivated genotypes while considerable polymorphism was detected among landraces and *Porteresia*. The dendrogram was constructed using distance methods based on different algorithm of clustering, viz. single-link and complete-link available in NTSYS-pc. Genetic distances estimated from RAPD banding patterns were correlated with those estimated by coefficient of percentage ($r=0.59$, $p<0.001$). Results from this study indicate that despite the lack of direct correlation between the degree of submergence tolerance, genetic diversity forms a very useful guide not only for investigating the relationship among cultivated genotypes but also in the selection of parents for raising submergence tolerance varieties.

C.2. Mapping QTLs for submergence tolerance in rice :

Swati Sen-Mandi and Somen Nandi. (in collaboration with International Rice Research Institute, Philippines)

By combining the Amplified Fragment Length Polymorphism (AFLP) technique with selective genotyping, we constructed a linkage map for rice and assigned each linkage group to corresponding chromosome. Using this AFLP map, a major gene for submergence tolerance was located on chromosome 9. Quantitative trait loci (QTL) associated with submergence tolerance were detected on chromosomes 6, 7, 11 and 12.

C.3. Identification and study of Bio-chemical and ecophysiological components of seed vigour for different seeding cultivation of rice :

Swati Sen-Mandi, Arup Ratan Das and Subhra Talai. (In collaboration with Directorate of Rice Research, Hyderabad.)

Seeds of different lines/varieties were selected depending on their vigour. Different enzymes viz. super oxide dismutase (SOD) and alcohol dehydrogenase (ADH) were assayed on 10% native polyacrylamide gel electrophoresis. Substrate specific staining for SOD and ADH was used for gel assay. Polymorphism in isozyme bands of SOD in some varieties/lines was seen. For isozyme analysis of ADH the method is being standardized. The work is under progress.

C.4. Active oxygen in aged rice seeds :

Swati Sen-Mandi, Somen Nandi and T.P. Sinha

Electron paramagnetic resonance studies of high vigour (99% viable) and low vigour (38%) dry embryos of rice seeds stored under a natural (warm and humid environment) were carried out. Loss in viability due to hot and humid condition was found to be correlated with a decrease in free radical levels. The free

radicals recorded could be carbon-based derived from quinones

C.5. Assessing seeds lot viability and potential performance of *Cassia tora* and *Tephrosia* :

P.K. Saha and S. Biswas (Guest worker) and B. Das

The effect of temperature on the germination response of two categories of morphologically different seeds of *Cassia tora* L. was investigated. Germination response of dormant seeds (category A with close ultrastructures) was not affected by temperature, as 96% of the seeds germinated at all temperature on scarification. On the other hand, non-dormant seeds (category B with open ultrastructures) were temperature sensitive and germinated best at 32°C. However, storage affected the germination responses of both types, while the category A seeds lost moisture gradually with storage time and retained viability for a longer period, i.e. 2 years and the seed viability was retained for only one year. The production of two morphologically and physiologically distinct type of seeds of *C. tora* is probably an ecological adaptation for progressive emergence of the species over long periods in the field.

Different categories (based on testa colour) of *Tephrosia purpurea* seeds showed variation in their germinability despite of belonging to same population. Attempt has been made to isolate pure line population based on testa colour and to study the genotypic polymorphism using seed storage proteins and isozymes as markers.

D. Microporagation of economically important/ornamental plants :

Sabita Bhattacharya and Snaghamitra Bhattacharya

Considerable number of replica of *Jasminum officinale* var *grandiflorum* and *Nyctanthes arborescens*, produced by microporagation technique were grown in soil. Experiments are undertaken with *in vitro*

regenerated plants for better rooting and hardening. Attempts have also been made to increase the rate of the initial response of explants to further growth by minimising/checking browning of explants in case of *N. arbortris* using several anti-oxidants. 2% of both PVP and PVPP were found optimum.

E. Chemistry of Natural Products.

E.1. Isolation and characterisation of a new Triterpene from the roots of *Camellia sinensis*, furano anthracene derivative from *Scoparia dulcis* and growth inhibitors in neem oil (*Azadirachta indica*) :

S.N. Ganguly and Shyamali Banerjee

A new Triterpene, m.p. 239-40°, $C_{29}H_{44}O_2$ (M+424) was isolated from the methanolic extract of the roots of *C. sinensis*. The structure of the compound was established on the basis of physico-chemical evidences.

From the chloroform of the defatted leaves of *S. dulcis*, a new furanoanthracene derivative, m.p. 146°, $C_{18}H_{14}O_2$ (M+262) was isolated. On the basis of IR, MS and NMR the structure of the compound was established.

On rigorous chemical investigation of neem oil, a number of inhibitory compounds including abscisic acid were detected and characterised. Besides a new phenolic compound, $C_{11}H_{12}O_5$ was isolated. On the basis of physical and chemical evidences, the structure of the compound was given.

E.2. Effect of microwave irradiation on aromatic nitration :

S.N. Ganguly.

Aromatic nitration can be effectively done with 10% nitric acid. Interesting feature of this reaction is the replacement of carboxylic acid group in aromatic compound with nitro group. A number of cinnamic acid derivatives were converted to nitro derivatives by microwave irradiation in presence of 10% HNO_3 .

F. Delay of fruit ripening by antisense RNA approach :

Bharati Ghosh, D.N. Sengupta and Mousumi Sengupta

The extraction of RNA from tomato, and mango has been standardised and cDNA—ACC synthase has been amplified by RT-PCR. The methods for regeneration of tomato seedling has been standardized.

INSTITUTIONAL PROJECT III.

A.1. Structure, function analysis of Plant DNA polymerase B :

D.N. Sengupta, M. Sanath Kumar and S. Bakshi

Previously we have reported that a single polypeptide of 67kD size with DNA polymerase β type activity has been purified to near homogeneity from shoot tips of IR-8 rice seedlings. In order to find out its role in DNA repair, enzyme was partially purified from seeds of different age and assayed in activity gel where in situ DNA synthesis is carried out by the renatured polypeptide after denaturing protein gel electrophoresis. Results showed that during the ageing of rice seed germination percentage drops and breaks in genomic DNA enhances, the level of DNA polymerase β also goes up, suggesting its probable involvement in DNA repairing. Using M13ssDNA and two primers with 3 nucleotide gaps the strand displacement ability of the purified rice DNA pol β was observed. Southern blot and northern blot analysis of genomic DNA fragments and total RNA from rice and *Arabidopsis* by the ^{32}P -labelled yeast gene for DNA pol IV (= pol β), presence of homologous DNA fragments and transcript were revealed.

A.2. Plant inositol synthase : Phylogeny and evolution :

A.N. Lahiri Majumder, Aniruddha Ray Chaudhuri and Nitai C. Hait

Comparative characterization of the purified cytosolic and chloroplastic inositol synthase from cyanobacteria (*Spirulina*), algae (*Euglena*), protozoa (*Entamoeba*) and higher plants (*Oryza*, *Vigna*) reveal that the two forms of inositol synthases are identical in their biochemical, immunological and protein subunit characteristics and that they differ only in the organization of the subunits in the native holoenzymes. The present study of inositol synthase in four distinct group in biological kingdom points towards antiquity the enzyme along the phylogenetic line. The presence of inositol synthase in a hitherto unreported cyanobacterial source, may provide interesting clue to the evolution of chloroplastic inositol synthase. The chloroplast inositol synthase may have originated from a cyanobacterium resulting in green algal or higher plant chloroplast forms (primary endosymbiosis) and the *Euglena* chloroplast synthase arose through a secondary endosymbiosis between a green alga and a protozoan like organism in a manner similar to that reported for chlorarachniophytes. An inkling of this is evident in the isolation of a cDNA homologue of Inol cloned and sequenced from *Entamoeba histolytica* (in collaboration with Dr. Anuradha Lohia) and study of the inositol synthase protein.

INSTITUTIONAL PROJECT IV

A. Environmental biopollution in relation to human health :

Swati Bhattacharya, Pampa Chakraborty, Indrani Chowdhury, Arati Malakar, Moonmoon Sen and Atin Adhikari (In collaboration with Prof. S. Chanda.)

A two-year survey of Madhyagram aeropalynoflora recorded a total of 46 angiospermic taxa. The skin-prick test and ELISA study have been done on respiratory allergic patients. The 90 kD allergen, isolated from *Borassus flabellifer* pollen was found to be homogeneous in crossed immunoelectro-

phoresis using rabbit antisera and characterized as a glycoprotein. The presence of common antigenic determinants among the four common airborne palm pollen, *Areca catechu*, *Borassus flabellifer*, *Cocos nucifera* and *Phoenix sylvestris* was confirmed by ELISA inhibition, rocket immunoelectrophoresis and immunoblotting with antirabbit IgG and antihuman IgE probe.

A comparative analysis of the common allergenic components in both the pollen grains and fruits of carica papaya has been done. The process of isolation of such common determinants and their use in immunotherapy are being tested.

50 honey samples had been analyzed palynologically. Palynological analysis reflected the vegetational flora from where honey samples were collected.

An aeropalynological survey at Bardhaman town had been done for one year. Aerobiological survey over a mustard field (*Brassica nigra*) and on a mung bean field at Madhyamgram Experimental Farm had been done. Dominant airborne fungal spores are recorded.

A two-year study on the frequency of airborne fungal spores with allergenic significance in a few indoor occupational and congested environments of Calcutta have provided following data :

Spores of "*Aspergilli*" group and *Cladosporium* sp. showed dominance in both the year. Some viable fungal colonies like various *Aspergillus* sp., *Rhizopus* sp., *Mucor* sp. and *Cladosporium* sp. were dominant. Skin prick test with dominant fungal types on allergic patients showed more than 70% positive response in case of different *Aspergillus* sp. and associated taxa.

B. Sea level scenario in the Bengal basin :

B.B. Mukherjee

Geomorphology of coastal Bengal was reinterpreted in light of the satellite

imageries and correlated with sedimentological biostratigraphie, and recent Sea level data for evaluation of the history of the coastal environment with reference to the coastline changes in the Bengal basin.

OTHER THAN INSTITUTIONAL PROJECT

A. Acoustic characterisation of Fractal Crack Surface :

S.N. Ganguly and Devashree Dutta. (In collaboration with VECC, Calcutta)

Acoustic waves probe deeply into the materials and get scattered from the crack surface. In principle, therefore from the scattered radiation, it is possible to estimate the profile and the fractal dimension of the crack surface. A model is developed which provides insight how the surface irregularities on the crack surface (characterised by the Hurst exponent) affects the intensity of the quasi-monochromatic acoustic pulse after getting diffracted from it.

Firstly, we analytically simulate the crack surface from an ensemble of stationary random self-affine functions. The random functions are assumed to obey Gaussian statistics. The property of self-affinity of the simulated crack surface being characterized by the Hurst exponent.

In the next section using Kirchoff approximation, we study the diffraction of a quasi-monochromatic acoustic pulse from the crack surface. The model provides insight - how the intensity of the scattered acoustic radiation gets influenced by the surface irregularities present on the above described simulated surface (characterised by the Hurst exponent). In the final analysis, the average echo power $I(\tau)$ (where τ is defined as the time delay) is expressed in terms of the Hurst exponent characterising the crack.

B. Physiological and Biomolecular investigations on Tapping Panel Dryness syndrome in rubber :

Swati Sen-Mandi and Gitali Das (In collaboration with Rubber Research Institute).

A systemic study on free radical (FR) estimation by EPR spectrometer in normal tapping and over-exploited rubber plants showed that with progression of tapping there is an increase in amount of free radical. The extent of increase of FR in normal plants is lower than that of over-exploited plants. The isozyme analysis of superoxide dismutase (SOD) in pretreated plants showed that there are five (5) SOD bands : As Hevea latex is cytosolic in nature, the SOD bands may be of Cu-SOD type. This seems that there is a direct correlation between the accumulation of FR and decrease of its scavenging system with over-exploitation. It is the balance between the FR and SOD that controls the extent of FR-associated damage in rubber plants.

Participation in Conference/Symposia/ Training Programme/Awards and Honour received.

Prof. Bharati Ghosh delivered an invited talk in national symposium on "Mangroves and Mangrove ecosystem of the Sunderbans" held on 8-10th Nov. at Calcutta. She delivered an invited talk at Botany Dept. in Calcutta University organised by Plant Physiology Forum. on July 4th, 1996; also delivered an invited talk in symposium in "Plant Physiology for National Development" held at Bose Institute from Dec. 17-19 1996. Prof. Ghosh, B.S. Tiwari and Mr. M. Chattopadhyay participated in 2nd International Crop Science Congress in New Delhi in Nov. 1996 and presented a poster.

Prof. A.N. Lahiri Majumder has been elected Fellow of the National Academy of Sciences: he has also been selected for the Rockefeller Biotechnology Career Fellowship: delivered an invited talk in the Symposium on

'Plant Physiology for National Development' held at Bose Institute in December, 1996.

Prof. Swati Sen-Mandi has attended the 5th Annual meeting of National Biotechnology Network (NRBN) at New Delhi and presented a poster. She also participated in 2nd International Crop Science Congress, New Delhi in Nov, 1996 and presented a poster.

Dr. P.K. Saha delivered an invited lecture on Plant Growth Regulators in the UNDP-ICAR training programme on "Plant Growth Regulators - Status and Perspective" held at N.D. University of Agriculture and Technology, Kumaranj. Faizabad during Feb-Mar. 1997. He also participated in the refresher course of the above training programme. He has been elected as a Member of the Executive Council, National Botanical Society for the period of 1996-1999. **Dr. P.K. Saha**, Mr. A. Roy and Mr. B. Das attended and presented poster in the symposium on "Plant Physiology for National Development" organised by Plant Physiology Forum at Bose Institute, Calcutta during Dec. 17-19, 1996. A Roy attended and presented a poster in the symposium entitled "Recent trends in plant tissue culture and molecular biology" organised by Plant Tissue Culture Association of India at Osmania University, Hyderabad on 29-31, Jan. 1997.

Dr. D.N. Sengupta acted as Convener of a National seminar on "Plant Physiology for National Development" organised by Plant Physiology Forum and partly sponsored by Bose Institute at Bose Institute, Calcutta in Dec. 1996. Mr. M. Chattopadhyay and Mr. Sanath Kumar presented papers in the 12th Annual General Meeting of Plant Physiology Forum on Feb. 3, 1996 at Indian Botanical Garden, Shibpur, Howrah. Dr. B.S. Tiwari, Mr. Anindita Bose, Mr. Manas Chattopadhyay and Ms. Malabika Roy, participated and presented two posters in "National symposium on Plant Physiology for National Development" held at Bose Institute, 1996. Mr. S.R. Gupta, Mr. Sanath Kumar, Ms. Piyali

Chatterjee, Mr. Gouri Majumder also presented two posters in National Symposium on "Plant Physiology for National Development" held at Bose Institute, 1996.

Dr. Swati Bhattacharya attended the workshop conducted by Ministry of Environment and Forests (12-14th Aug. 1996) at Centre for Biochemical Technology, Delhi regarding aerobiological sampling techniques, Dr. Swati Bhattacharya. Dr. Indrani Chowdhary and Ms. Arati Malakar attended and presented papers in 9th Biennial Botanical Conference, organised by Bangladesh Botanical Society at Dhaka from January 8-9, 1997. Mr. Atin Adhikari attended the workshop conducted by Ministry of Environment and Forests (August 12-14, 1996) on aerobiological sampling at CBT, Delhi. He also attended a training a programme in the Aerobiology Laboratory, University of Madras (March 10-19, 1997) to learn identification of airborne fungal spores, Mr. Gaurab Gangopadhyay and Ms. Sangita Basu presented posters in the National Symposium on Plant Tissue Culture organised by Dept. of Mol. Bio. Genetic Engineering and Biochemistry held at G.B. Pant Agri University, Pantnagar, U.P. on April 1996. Mr. Gaurab Gangopadhyay, Ms. Sangita Basu, Mr. Sarat Kumar Raj presented posters in the National Symposium on "Plant Physiology Forum held at Bose Institute on Dec. 1996; and The National Symposium on "Emerging trends in Plant tissue culture and molecular biology" organised by PTCA (India) and Dept. of Genet., Osmania Univ., Hyderabad on Jan. 1997.

Dr. Sabita Bhattacharya attended the workshop of Ethnobotany Medicinal plants and potential ethno-derived drugs helds in IICB. Calcutta on 11-12 Dec. 1996. She attended and presented a poster paper in the 9th Biennial Botanical Conference held in the Dept. of Botany, University of Dhaka, Bangladesh from 8-9th Jan. 1997.

Mr. Aniruddha Roy Choudhury has been awarded the young Scientist Award for the year 1997 from the Indian Science Congress

Association. Ms. Sriparna Bagchi has been awarded the Prof. B.R. Sheshachar award for best oral presentation at the XXth All India Cell Phology Conference in January, 1997.

Ms. Gouri Majumder has been awarded of Senior Research Fellowship of K.S. Krishnan Senior Research Fellowship of DAE, Govt. of

India, Ms. Sangita Basu was awarded with a certificate of Merit in the National Symposium on Plant tissue culture held at Pantnager in U.P. during April 1996. Dr. Malabika Roy, PDF, has received the Rockefeller Foundation Fellowship to work in Cornell University, USA.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. B. Ghosh	Thermal Regulation of Ribulose 1.5-bisphosphate carboxylase in rice.	CSIR
Prof. B. Ghosh/ Dr. D.N. Sengupta	Use of antisense RNA to delay fruit ripening.	DBT
Prof. A.N. LahiriMajumder	Chloroplastic myoinositol synthase from <i>Englena gracilis</i> : Molecular studies and Photoregulation.	
Prof. S. Gupta	Introgression of disease resistance from local cultivar to improve <i>Sesamum</i> through hybridization and other culture.	CSIR
Prof. S. Sen-Mandi	Identification and study of biochemical and ecophysiological components of seed vigour for direct seedling cultivation of rice.	ICAR
Prof. S. Sen-Mandi	Physiological and bimolecular investigations on Tapping funnel dryness syndrome un rubber.	RRII
Dr. D. N. SenGupta	Characterization and cloning of cDNA for plant DNA polymerase.	CSIR
Dr. D.N. SenGupta	Molecular analysis of regulation of salinity stress and abscisic acid inducible genes in rice.	DST
Dr. Swati Gupta-Bhattabharaya	Aeroallergenes and human health-aerobiological studies (All India Co-ordinated Project).	MEF India

Ph. D. Awarded

Name	University	Year	Title	Supervisor
Anindita Bose	Jadavpur	1996	Effect of heat stress on Photosynthesis in rice.	Prof. Bharati Ghosh
Nirmal Gupta Mondal	Bidhan Chandra Krishi Viswavidyalaya	1996	Application of androgenic pant production techniques to evdve genctice variants in rice.	Prof. Sukumar
Sankar Das	Calcutta	1996	Cellular responses of <i>Brassica</i> under salinity stress.	Prof. Bharati Ghosh

PUBLICATIONS

1. Adhikari, A., Bhattacharya, S. and Chanda, S. Aerobiology and allergenicity of indoor fungal spores in Calcutta during summer months. *J. Allergy Appl. Immunol.* **10(1)**. 11-19, 1996.

2. Banerjee, J. and Ganguly, S.N. A new furocounuor in from the leaves of *Camellia sinensis*. *Natural Product* **2**. 1-6, 1996.

3. Basu, S., Gangopadhyay, G., Gupta, S. and Mukherjee, B.B. Physiological changes of *Oryza sativa* L. callus due to salt stress In: Biotechnological Applications of Plant Tissue and Cell Culture. pp. 381-386. Symposium Volume organised by CFTRI, Mysore.1997.

4. Basu, B., Gangopadhyay, G. Gupta., S. and Mukherjee, B.B. Screening for cross tolerance against related osmotic stress in adapted calli of salt sensitive and tolerant varieties of rice. *Phytomorphology* **46(4)** : 357-364, 1996.

5. Bera, B., and Mukherjee, K.K. Comparative studies on isozymes at different tissue level in *Chenopodium album* L. *The Nucleus*. **38 (3)** : 99-104, 1996.

6. Bhattacharya, S., Improved regeneration from mature embryo-derived callus of *Oryza sativa* L. (subspecies indica). *J. Natl. Bot. Soc.* **49**, 115-119, 1995.

7. Bhattacharya, A., Das, B. and Saha, P.K. Studies on breakage of dormancy in the classified seeds of *Cassia tora* L. *Trans Bose Research Institute*. **57** (1-2), 1-4, 1994.

8. Bhattacharya, S. and Bhattacharya, S. Micropropagation of *Nyotantes arbortristis*. In Management of Minor Forest Produce for Sustainability. Eds., M.P. Shiva and Mathur. R. B. Oxford IBH, 149-149, 1996.

9. Chakraborty, P. Gupta, Bhattacharya, S. and Chanda, S. Biochemical and Clinical investigations of a few common airborne pollen

grains from West Bengal India. *J. of Palynology* **31**. 213-220, 1995.

10. Chakraborty, P. Gupta Bhattacharja, S. and Chanda, S. Comparative aerobiology, allergenicity and biochemistry of three palm pollen grains in Calcutta, India. *Aerobiologia* **12**, 47-50, 1996.

11. Chattopadhyay, G., Malakar, A. Gupta Bhattacharya, S. Ghosh, A. and Chanda, S. Pollen and lipid profile of an index multifloral honey sample from the mangroves of Sunderbans. India. *Ann. Agric. Environ. Med.* **3**. 139-144, 1996.

12. Chattopadhyay, S., Maitra, N. Lahiri, K. and Ghosh, B. Retardation of photosynthesis by polyamines during stipule and pod development in pea. *Photosynthetica* **32 (4)**, 629-33, 1996

13. Chattapadhyay M.K., Gupta, S. Sen Gupta, D.N. and Ghosh B. Expression of Arginine decarboxylase in seedlings of india rice cultivars as affected by salinity sress, *Plant Mol Biol.* **34**. 477-83, 1996.

14. Chanda, S. Implication of aerobiology in respiratory allergy, *Ann. Agric. Environ. Med.* **3** 157-164.1996

15. Das, S. Bhaduri, T.J., Bose, A. and Ghosh, B. Purification and partial characterization of arginine decarboxylase from *Brassica compestris*. j. PL. *Biochem. and Biotechnol* **5**. 123-26, 1996.

16. Das. S. and Mukherjee, K.K. Morphological and biochemical investigations on *Ipomoea* seedlings and their species interrelationships, *Annals of Botany*, **79**. 565-571, 1997.

17. Dutta, D. Barat, P. Mukherjee, P. Bondopadhyay, S.K., Wen. P. and Ganguly, S.N. . A Fractal based modal for the characterization of the interface in two phase

polyersatalline materials using acoustic means. *Fractals*. **4**. 501-508, 1996.

18. Gangopadhyay, G., Basu, S. Mukherjee, B.B. and Gupta, S. Effects of an ionic and a non-ionic osmotic stresses on *Nicotiana tabacum* L. var. Jayasri callus lines. *J. Natl. Bot. Soc.* **49** : 95-101, 1995.

19. Gangopadhyay, G. Mukherjee, B.B. and Gupta, S. In vitro cloning of *Michelia champacan* L. (Family Magnoliaceae). In : Management of Minor Forest Produces for sustainability (Eds. Shiva, M.P. & Mathur, R.B.). Oxford IBH. New Delhi. pp. 150-159. 1996.

20. Gangopadhyay, G. Basu, S. Mukherjee, B.B. and Gupta, S. Physiological changes of tobacco callus (*Nicotiana tabacum* L. Jayasri) grown under osmotic stress. In: Biotechnological applications of plant tissues and cell culture. pp 387-393. 1996.

21. Gangopadhyay, G. Basu, S. Mukherjee, B.B. and Gupta, S. Effects of salt and osmotic shocks on unadapted and adapted callus lines of tobacco, *Plant Cell Tissue and Organ Culture* **49** : 45-52, 1997.

22. Mitra, A., Higgins, D.W. Langengerb., W. G. Nie, H. SenGupta, D.N. and Silverman, R.H. A mammalian 2-5A system functions as an antiviral pathway in transgenic plants. *Proc. Natl. Acad. Sci. USA*. **93**: 6780-6785, 1996.

23. Nandi, S., Das, G. and Sen-Mandi, S. Biochemical response to cold acclimatization in rice seeds. *Plant Physiology and Biochemistry*. **23** (2) 199-204, 1996.

24. Nandi, S., Subudhi, P. Senadhira, D. Manigbas, N.L. SenMandi, S. and Huang, N. Mapping QTLs for submergence tolerance in rice by AFLP analysis and selective genotyping *Molecular and General Genetics*. **255** (1) : 1-8, 1997a.

25. Nandi, S., Sen-Mandi, S. and Sinha, T.P. Active oxygen and their scavengers in rice seeds (*Oryza sativa* cv. IET-4094) aged under tropical environmental conditions. *Seed Science Research*, **7** (3) : 253-259, 1997b.

26. Podder, R., A Majumdar, B. Restoration of Gamma ray induced damage by post irradiation treatments in two rice varieties *J. Natl. Bot. Soc.* **49** : 17-20, 1995.

27. RayChoudhuri, A. and Majumder, A.L. Salinity induced enhancement of L-myo-inositol synthase in rice (*Oryza Sativa* L.) *P1. Cell and Environ.* **19**. 1437-1442, 1996.

28. Roy, A. and Saha, P.K. Regeneration from cultured floral parts from two cultivars of *Brassica juncea* (Czern and Coss), *Environ. & Ecol.* **15** : 1-3, 1997.

29. Roy, A. Saha, P.K. Mukherjee, B.B. Gupta, S. In Vitro propagation of cane (*Calamus Rotang* Linn.). Management of Minor Forest Produce for sustainability (Eds. Shiva, M.P. Mathur, R.B.) : Oxford IBH, New Delhi, pp-160-163.1996.

30. Roy, M. and Ghosh, B. Common and uncommon polyamines in rice calli under salinity stress. *Physiol. Plantarum* **98**. 196-200, 1996.

31. Sanath Kumar, M. Ghosh, B. And Sengupta, D.N. Isolation of Mammalian pol β type DNA polymerase in shoot tips of germinated seedlings of IR-8 rice seeds (*Oryza sativa* L.) *Biochem. and Molecular Biology International*. **39** (1), 117-126, 1996.

32. SenGupta, D.N. Sengupta, B. Zhou, A. Mitra, A. and Silverman, R.H. Expression of Mammalian Antiviral enzymes from the 2-5A system in Transgenic Plants. *J. of Biochem and Biotechnol.* **5**, 69-74, 1996.

33. Tiwari, B.B. Bose, A. and Ghosh, B. Photosynthesis under salt stress. *Photosyntheticica*. **34**, 4-9, 1996.

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Sudhir Ranjan Gupta, Aniruddhba Roychaudhuri, Somen Nandi, Manas Kr. Chattopadhyay, Jayasree Banerjee, Sampa Dutta, Sangita Basu, Sanghamitra Bhattacharya, Pampa Chakraborty, Malabika Roy, Biswajit Das, Gourab Gangopadhyay, Srijit Kr. Mitra, Arati Malakar, Alin Adhikari, Moon Moon Sen, Anirudha Das, Budhi Sagar Tiwari, Sriparna Bagchi, Anindita Bose, Amitava Roy, Devashree Dutta, Rashmi Deb, Nitai Chand Hait, M.Sanat Kumar, Prabir Chakraborty, Shyamali Banerjee, Saubhik Das, Sarat Kr. Raj, Tathagata Raychoudhury, Gouri Majumder, Piyali Chatterjee, Indrani Chaudhuri, Subash Ch. Jana, Santunu Pal, Tapan Kr. Chaudhuri, Rinini Sen, Runu Das, Sankar Bakshi, Subhra Talai, Arup Ratan Das, Kakali Banerjee.

OTHER SUPPORTING STAFF MEMBERS

Narendra N. Chaudhury, Dilip Kr. Sanyal, Sankar Basu, Sukumar Majumder, Dr. Ramit Poddar, Chanchal Chakraborty, Chaitali Roy, Subarna Ghosh, Madan Mohan Nath, Subikash Bayen, Sankar Prasad Banerjee, Subrata Basak, Dilip Kr. Chakraborty, Nar Bahadur Rai, Shyamapada Halder, Kalailal Chatterjee, Sukadeb Das, Sudhir Jana, Sasanka Sekhar Bera, Sambhunath Debnath, Dhiren Kumar Das, Rabindra N. Roychoudhuri, Bipul Kr. Nag, Kanan Singh, Munna Turi.

Microbiology

Faculty : Prof. A.C. Ghose (Chairman upto 1.1.97) Prof. Timir B. Samanta, Prof. G. Nanda (upto 31.3.96), Dr. K. Sen, (upto 31.5.95) Prof. P.K. Chakrabartty (Chairman, from 2.1.97) Dr. R. Chakraverty, Dr. P. Roy, Dr. M. Kundu (assigned to the Dept. of Chemistry), Dr. S. Majumdar, Dr. S.K. Dasgupta.

INSTITUTIONAL PROJECT I

A. Interaction of aluminium with iron transport system in rhizobia :

P. K. Chakrabartty, Mousumi Basu

In an iron limiting condition *Rhizobium* strain MO1 of mung produces catechol siderophore containing 2,3-dihydroxybenzoic acid with threonine and glutamic acid as conjugates. Presence of aluminium caused decreased growth and increased siderophore production. Ferric iron alleviated aluminium induced growth inhibition and siderophore production. It appears that both ferric iron and aluminium bind to the siderophore. Using mutants in siderophore production existence of a low affinity transport system for aluminium is also evident.

INSTITUTIONAL PROJECT NO. V

Molecular and cellular basis of bacterial and parasitic diseases :

A.1. Cholera and *V. cholerae* :

A.C. Ghose, Ranjan K. Nandy, Sarmistha Mukhopadhyay and Suman Das

Vibrio cholerae 0139 organisms are characterized by the presence of a truncated (short) form of 'O' side chain polysaccharide (TFOP) linked to lipid A core (LA) and a polysaccharide capsule. An antiserum was raised by immunization of rabbits with the gel-cut material (containing only LA-TFOP) obtained following electrophoresis of 0139 LPS (protein and nucleic acid free). The

antiserum was shown to react with 0139 whole-cell as well as its LPS and recognized TFOP (strongly) as well as capsular polysaccharides (CPS) thereby establishing serological relatedness between these materials. Interestingly enough, the antiserum induced passive protection against challenge with both encapsulated as well as non-encapsulated forms of *V. cholerae* 0139, but not against 01 strains. These results demonstrate that it is possible to engender protection against 0139 cholera by using the truncated form of LPS (devoid of capsular material) as the immunising agent.

A.2. Leishmaniasis :

A.C. Ghose, A. K. Ghosh, Subhajit Dasgupta

The course of *L. donovani* infection in golden hamsters was determined and results were correlated with associated immunological and pathophysiological changes. Massive infiltration of cells (primarily of mononuclear type) and occasional immature granuloma formation were noted in the liver of hamsters during the earlier stage of infection. The splenic parasitic burden showed continued increase till death and observed splenomegaly was accompanied by distention of the red pulp region with concomitant decrease in the white pulp region and obliteration of lymphoid follicular architecture. *L. donovani* infection in hamsters led to gradual impairment of

lymphoproliferative response to in vitro stimulation with ConA, leishmanial antigen and to a combination of PMA and ionomycin and such impairment could be reversed following removal of adherent cells. These results suggest that massive infection in hamsters with *L. donovani* generates a population of cells with adherent properties which nonspecifically suppress their lymphoproliferative response but do not affect antibody production ability.

A.3. Tumour necrosis factor- α (TNF- α) induced cell-death in human neutrophil :

S. Majumdar, S. Das, S. Bhattacharya

Sixty percent loss of neutrophil cell survival as well as degradation of DNA were observed in the presence of 500 and 1000 U/ml of tumour necrosis factor- α .

A.4. Lipoarabinomannan (LAM) induced altered signalling mechanism in peripheral blood mononuclear cells (PBMC) :

S. Majumdar, S. Pal

LAM, a cell wall associated glycolipid purified from *Mycobacterium smegmatis* inhibited the PKC mediated protein phosphorylation in a dose dependent manner and also scavenged superoxide. LAM at 5 and 10 μ g/ml conc. has been found to cause partial fragmentation of chromosomal DNA.

A.5. Equilibrium between the free radicals during leishmaniasis :

S. Majumdar, S. Ghosh, S. Bhattacharya

When cultured intraperitoneal macrophages from Balb/C mice were infected with promastigote form of *L. donovani* AG83 for 24 or 48 hours a significant amount of NO produced with an increase in the ratio of infection while superoxide production was inhibited. This implies a participation of reactive nitrogen and oxygen species in determining the viability of macrophages.

A.6. Investigation into different aspects of mycobacterial molecular biology and development of diagnostics for tuberculosis :

Sujoy K. Das Gupta, Mamta Chawla, Shreyashi Chatterjee, Santanu Chakrabarti.

We have been using the mycobacterial plasmid pAL 5000 as a model system to understand DNA replication mechanisms in mycobacteria. The necessary and sufficient sequences for replication of this plasmid have been determined and aspects of plasmid stability studied in details. Also, for understanding its role in replication, a plasmid coded polypeptide with possible regulatory function has been being over expressed in *E. coli*. In another area effort is being made to construct a COSMID vector for mycobacteria. With this objective the cohesive (COS) ends of the mycobacteriophages L1 has been PCR amplified, cloned and sequenced. Development of peptide based diagnostics for tuberculosis is being done in collaboration with Prof. A.C. Ghose (Dept. of Microbiology) and Prof. F. Hudecz (Eotvos Univ. Budapest, Hungary). In preliminary studies we could detect by ELISA, a strong serological response against the *M. tuberculosis* 16 kDa antigen in human subjects suffering from TB.

B. Industrially important microbial enzymes.

B.1. Biotransformation of organic compounds by microbes :

Timir B. Samanta, Kajori Ghosh and Anjan Pal

Invertase produced by *Aspergillus ochraceus* TS was purified to homogeneity. The pure protein on SDS-PAGE had a M.W. of 69 kDa while its native form exhibited a M.W. of 120 kDa during gel filtration implying that the enzyme is a homodimer. The enzyme is a glycoprotein containing mannose. Km and Vmax of the enzyme with sucrose as substrate were 3.5 mM and 7.1 μ mole per minute respectively. The enzyme has a high content of aspartic acid, glutamic acid, alanine, glycine, valine and lysine, while histidine and arginine contents are low.

Several strains capable of converting cephalosporin C to 7-aminocephalosporanic

acid were isolated. One strain A13 showed very poor cephalosporin C acylase activity but good penicillin G acylase activity. It transforms penicillin G to 6-amino penicillanic acid. The isolate did not exhibit β -lactamase activity which is an added advantage. It is aerobic in nature and exhibited good growth and amidase activity with galactose as carbon sources.

B.2. Microbial protease and β -amylase :

Roma Chakraverty, Rina Rani Ray and Papia Mitra

Syncephalastrum racemosum RR-96, synthesised extracellular β -amylase (EC 3.2.1.2) in presence of starch as sole carbon source. A partially purified enzyme had highest activity at 60°C and pH 5.0. The activity was not increased in presence of exogenous thiols and remains unaffected in presence of heavy metals and thiol inhibitors, indicating the absence of thiols at the active site of the enzyme. *Streptomyces nogalator* (AC 80), a soil isolate capable of dehairing goat skin, showed high proteolytic activity but no keratinolytic activity or collagenolytic activity. Fifty percent of the enzyme activity was lost in 30 minutes at 50°C.

C.1. Molecular biology of *Thiobacillus* :

Pradosh Roy, Pratap N. Mukhopadhyay and Anupama Saha

Following transpositional mutagenesis in a facultative strain of *Thiobacillus* species, nine different chromosomal loci were identified as responsible for sulfur lithotrophy. One of the loci available as flanking sequence of the integrated transposon was cloned and sequenced. Sequence analysis revealed 44.00% similarity and 24.00% identity at amino acid level with the SoxB gene from *Paracoccus denitrificans* GB17.

In an attempt to establish a shuttle vector system in *Thiobacillus*, six different amplifiable, mobilisable, shuttle cloning vectors were constructed with demonstrated ability to function efficiently in *Thiobacillus*.

One of these vectors allow blue-white selection for identifying positive clones in *E. coli* XL1 Blue. This vector is a broad host range and mobilisable and has a high copy number in *E. coli*. Vector pBETU12000 is a lactose promoter strength assay vector for *Thiobacillus* and other gram negative nonenteric bacteria. This vector uses the product of the gene for the green fluorescence protein (GFP) that can be quantitatively assayed by spectrofluometry. Electrotransformation in *Thiobacillus* is established using the constructed vectors.

PUBLICATIONS

1. R.K. Nandy, M.J. Albert and A.C. Ghose. Serum antibacterial and antitoxin responses in clinical cholera caused by *V. cholerae* 0139 Bengal and evaluation of their importance in protection; *Vaccine*, **14**, 1137-1142, 1996.

2. A.C. Ghose. Adherence and colonization properties of *V. cholerae* and diarrhoeagenic *Escherichia coli*; *Indian J. Med. Res.* **104**, 38-51, 1996.

3. C. Ghosh, R.K. Nandy, S.K. Dasgupta, G.B. Nair, R.H. Hall and A.C. Ghose. A search for cholera toxin (CT), toxin coregulated pilus (TCP), the regulatory element Tox R and other virulence factors in non-01/non-0139 *Vibrio cholerae*; *Microbial Pathogenesis*, **22**, 199-208, 1997.

4. M.K. Ghosh, A.K. Ghosh, M. Addy, A. Nandy and A.C. Ghose. Subpopulation of T-lymphocyte in the peripheral blood and lymph nodes of Indian Kala-azar patient; *Med. Microbiol Immunol*, **185**, 183-187, 1996.

5. Tapan K. Dutta and Timir B. Samanta. Novel catalytic activity of immobilized spores under reduced water activity; *Bioorganic and Med. Chem. Lett.*, **7** : 629-632, 1997.

6. Mandal, N.C. and Chakrabartty, P.K. Alcohol metabolism in free living *Rhizobium* sp. and *Bradyrhizobium* sp. *Indian J. Exp. Biol.* **35**, 401-408, 1997.

7. Ray, R.R. and Nanda G. Microbial β -amylases; biosynthesis; characteristics and industrial applications. *CRC Critical Reviews in Microbiology*, **22**, 181-199, 1996.

8. Uddin Naim and Chakraverty Roma, Pathogenic and non-pathogenic mycoflora in the air polyloplane of *Triticum aestivum* L. *Aerobiologia* **12**, 257-268, 1996.

9. Das, S.K. and Mishra, A.K. Transposon mutagenesis affecting thiosulfate oxidation in *Bosea thiooxidans*, a new chemolithoheterotrophic bacterium. *J. Bacteriol.* **178**, 3628-3633, 1996.

10. Das, S.K. Mishra, A.K. Tindall, B.J. Rainey, F.A. and Stackebrandt, E. Oxidation of thiosulfate by a new bacterium, *Bosea thiooxidans* (strain BI-42) gen. nov. sp. nov. : Analysis of Phylogeny based on chemotaxonomy and 16S ribosomal DNA sequencing. *Int. J. System. Bacteriol.* **46**, 981-987, 1996.

Participation in Conferences/Symposia/ Training programme/Awards and Honours received

Prof. A.C. Ghose acted as a member of the Scientific Advisory Committee of the National Institute of Cholera and Enteric Diseases, Calcutta : acted as a member of the Scientific panel of PRC of the Indian Council of Medical Research : participated in the Expert Group meeting on "Leishmaniasis" held at the Department of Biotechnology, New Delhi in October, 1996 : delivered an invited lecture in the 2nd Annual Conference of Indian Association of Medical Microbiologists (West Bengal Chapter) held at the Peerless Hospital on March 16, 1997 : delivered an invited talk in "Leishmaniasis" at the Infar India Ltd. (Ganganagar) in March, 1997 : gave a series of lectures to the M.Sc. (Biochemistry) students of Calcutta University.

Prof. Ghose visited Eotvos Lorand University in Budapest (Hungary) in July, 1997 under an Indo-Hungarian Collaborative Programme and delivered lectures.

Prof. Timir B. Samanta attended the Executive Committee meeting of Microbial

Type Culture Collection and Gene Bank of Institute of Microbial Technology, Chandigarh held on January 31, 1996.

Prof. P. K. Chakrabartty delivered an invited lecture on the topic "High affinity iron transport system in *Rhizobium* sp." on June 17, 1996 at Indian Institute of Chemical Biology, Calcutta under the auspices of the Society of Biological Chemists (I) Calcutta Branch.

Dr. Roma Chakraverty attended and presented a paper entitled 'Fungal diversities' : implications in ecology and environment of Calcutta, in 9th Biennial Botanical Conference, held at Dhaka University, Dhaka, Bangladesh, during January 8-9, 1997. She also delivered an invited lecture in the Ramkrishna Mission Institute, Sagardwip on 12th December, 1996.

Dr. S. Dasgupta visited Dr. Ferenc Hudecz's Laboratory at the Eotvos University, Budapest, Hungary (Sept. Oct, 1996) on an Indo-Hungarian Collaboration Programme : Development of bioconjugates for diagnosis and treatment of microbial infections ; delivered an invited lecture at the SBC, Calcutta Branch meeting on : "Biochemistry and molecular biology of health and diseases" held at Digha on 18-20th April, 1997.

Rina Rani Ray attended and presented a paper "Saccarification of native starches by β -amylase from *Bacillus megaterium*" in "Xth Carbohydrate Conference" held at Indian Institute of Chemical Biology, Calcutta from November 21-22, 1996; attend and presented a paper "An overview of microbial β -amylase" in the "National Seminar on Biology for sustainable development" held at Indian Institute of Chemical Biology from January 16-18, 1997.

Papia Mitra attended and presented a poster entitled 'Production of extracellular protease by *Streptomyces* sp. and its application as dehairing enzyme in the tannery' at the 37th Annual Conference of Association of Microbiologists of India, held at IIT, Madras, during December-96, 1996.

GRANT-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. A.C. Ghose	Characterization of a new type of pilus expressed by pathogenic strains of non-01 <i>Vibrio cholerae</i> and evaluation of its role in intestinal colonization as well as protection.	CSIR
Prof. A.C. Ghose	Use of an immunomodulator protein A in the treatment of visceral leishmaniasis.	ICMR
Prof. A.C. Ghose	Development of bioconjugates for diagnosis and treatment of microbial infections.	DST (Indo-Hungarian Collaborative project)
Dr. Subrata Majumdar	Alteration of the human neutrophil function by tumor necrosis factor (TNF- α) : Influence of apoptosis on signal transduction pathway.	CSIR
Dr. Subrata Majumdar	Signal transduction mechanism in visceral leishmaniasis in mice : Role of Tumor necrosis factor in leishmaniasis.	DAE
Dr. Sujoy Kumar DasGupta	Investigations into the mechanism (s) of extra-chromosomal replication of myco-bacterium plasmid pAL 5000.	CSIR

Ph. D. Awarded

Name	University	Year	Title	Supervisor
Tapas Sengupta	Calcutta University	1996	Identification and Immunological characterization of cell surface proteins responsible for intestinal adhesion and colonization of <i>Vibrio cholerae</i> .	Prof. A.C. Ghose
Nupur Chattopadhyay	Calcutta University	1996	Siderophores of root-nodule bacteria of <i>Cicer arietinum</i> L.	Prof. P.K. Chakrabartty
Rina Rani Ray	Calcutta University	1996	Studies on β -amylase production by a strain of <i>Bacillus megaterium</i> B ₆ isolated from soil.	Prof. Geeta Nanda

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Dr. Anup K. Halder, Dr. Sarmistha Chakrabartty Patra, Dr. Jharna Dutta, Dr. Mousumi Das, Dr. Krisanu Sengupta, Dr. Soumitra Pal, Mr. Santanu Chakrabarti, Sri Subhajit Dasgupta, Sm. Papia Mitra, Sm. Sonali Das, Sm. Mousumi Basu, Sri Pratap Mukherjee, Sm. Saona Sengupta, Sri Ananda Mukherjee, Sri Ranjan Nandy, Sm. Anupama Saha, Sm. Ritika Chandra, Sri Anjan Pal, Sm. Mamta Chawla, Sm. Shreyoshi Chatterjee, Sm. Sarmistha Mukherjee, Sm. Rina Rani Roy, Sri Suman Das, Sri Sandip Bhattacharya, Sm. Sanjukta Ghosh, Sri Asish Ghose.

OTHER SUPPORTING STAFF MEMBERS

Sri B.N. Bose, Sri R.R. Sanyal, Sri S.K. Das (I), Sri S.K. Das (II), Dr. Bandana Banik, Sm. Gita Dey, Sri N.K. Malakar, Sri Debidas Saha, Sri B.N. DeSarkar, Sri B.N. Mandal, Sri P.K. Chattopadhyay, Sri P. Gupta, Mr. S. Gazi, Sri D. Sarkar, Sri Baban Ram, Sri A. Santra, Sri B. Bahali, Sri N. Patra, Sri J. Prasad, Sri R. Prasad, Sri B. Ram, Sri B. Das, Sri S. Das.

Biochemistry

Faculty : Prof. S. Biswas (Chairperson), Prof. R.K. Mandal, Prof. N.C. Mandal, Prof. B. Bhattacharyya, Dr. P. Sinha, Dr. P. Gupta, Dr. A. Lohia, Dr. R. Chattopadhyaya, Dr. P. Parrack.

INSTITUTIONAL PROJECT I

A.1. Seed Protein Quality Improvement and Production of Transgenic Plants :

R.K. Mandal, Biswajit Roy, Surekha Mandal, Pollab Kundu and Somenath Bhattacharyya

Tomato and tobacco plants have been transformed with a trypsin inhibitor gene (precursor 2S protein gene) of *Brassica juncea* var. RLM198 under enhancer duplicated cauliflower mosaic virus 35S promoter. Integration and expression of the introduced gene have been monitored by Southern and Northern blots. T₃ generation transgenic tomato plants var. Pusa Ruby (PR) and Pusa Early Dwarf (PED) expressing TYMV coat protein gene were tested for their foreign gene copy number, sites of integration and physiological performance under contained conditions. Except one transformed PR line which gave smaller sized but larger number of fruits per plant, other lines of both the varieties performed equally well compared to the control. A 2kb upstream promoter of 2S protein gene from *B.campestris* var. Agrani has been cloned and sequenced (EMBL/Genbank Database No. Y13108). Some RAPD-generated molecular markers determining seed number per pod have been identified and used as RFLP marker.

A.2. Expression of reporter gene β -glucuronidase (GUS) under speed specific *Arabidopsis thaliana* promoters (2S) in *Agrobacterium*, yeast & plant :

S. Biswas and Samarpan Mazumder in collaboration with B.B. Biswas

We have already reported the existence of a common trans-acting factor (~16kDa) that is present in *Agrobacterium* yeast & at the flowering stages of transformed tobacco plant. Recently, we have found that this ~16kDa trans-acting factor binds to the G-box (ACGTG) motif present in the 2S promoter and is absent in the leaves of transformed tobacco plant. But prior treatment of the leaves with ABA leads to the appearance of the ~16kDa protein even in the leaves & concomitantly 2S promoter is found to be active again indicating the role of ~16kDa protein as a trans-acting factor.

INSTITUTIONAL PROJECT III

Studies on structure, function and dynamics of biomolecules

A.1. Studies on the Lethal Interaction of Bacteriophage Lambda Replication Gene P with its host *E. coli* :

N.C. Mandal, Lopa Adhikary, and Indrani Dutta

In continuation of the study of the mechanism of instability of pMR45 plasmid in *rpl* mutant, we constructed two different p Λ dv plasmids carrying only phage replication origin one providing unregulated replication and the other regulated replication and a third plasmid carrying pBR322 and λ origins both showing regulated replication. Studying with these plasmids, we established that the



Peptide Sequencer

instability of pMR45 is due to the simultaneous regulated replication from pBR322 origin and unregulated replication from lambda origin resulting from the elevated expression of O & P proteins due to the presence of *hk* mutation in *cro*.

Cloning of the mutant *rpl* gene was attempted in parallel in two different expression vectors, pUC18 and pMZ240 using partial Sau3AI digest of *E. coli* *rpl* DNA. One clone from each of the above two libraries was selected which showed resistance to lambda P gene lethality. Such clone in former plasmid contains 3.6 Kb DNA insert, while that in the latter plasmid contains 8 Kb insert. The results of Southern hybridization analysis showed that both the clones contain common DNA segments in the inserts. Further characterization of these clones are in progress. (Supported by DBT, Govt. of India).

A.2. Studies on Gene Regulation in *Mycobacteria* :

N.C. Mandal, Amibabha Chakraborty, Madhumita Basu and Saurav Pal

In continuation of the study of galactokinase gene regulation in *Mycobacterium smegmatis*, a 300 bp DNA segment from the upstream regulatory region of the *galK* operon was subcloned in between two divergently oriented reporter genes (*phoA*, *lacZ*) in a promoter cloning vector. This clone was introduced in isogenic wild-type, *cya*, and *crp* *E. coli*. Studies of the expression of the reporter genes corroborated the previous observation from *in vivo* studies that at least one *gal* promoter and the *gluP* promoter are positively regulated by cAMP-CRP complex. The fragment containing the regulatory region and the flanking reporter genes from the above clone was further subcloned in an *E. coli*-*mycobacteria* shuttle vector and introduced in *M. smegmatis*. Studies of the reporter gene expression under different conditions in *M. smegmatis* is in progress. RNA polymerase from *M. smegmatis* has been purified. The regulation of transcription from the above three promoters is being

studied *in vitro* using the above RNA polymerase. The presence of the *gal* promoter in the upstream regulatory region has been indicated by gel-mobility shift assay and DNA-foot printing analysis using RNA polymerase.

A.3. Studies on Developmental Regulation in *Mycobacteriophage* L1 :

N.C. Mandal, Prajna Mandal, Chandrani Chattopadhyay, and Rajat Bhattacharyya

Improvement of the steps in purification of L1-coded exonuclease were made. The streptomycin sulfate precipitates were suspended in Tris-HCl buffer, pH 7.0 containing 1 mM 2-ME and 5% glycerol and dialyzed against the same buffer overnight. This was then centrifuged at 10,00 rpm, and the supernatant was then subjected to chromatographic purification using successively heparin-agarose, QAE-sephadex, and Bio-Gel P-60. From the last step, the enzyme fraction still showed five to six protein bands on SDS-PAGE. The host specific exonuclease was separated from the phage enzyme at the heparin-agarose step. Purification of this host enzyme was also standardized on small scale. Further purification of the phage enzyme is being attempted by preparative electrophoresis.

Cloning of five L1 promoters was reported earlier. One of these five promoters, P5 was shown to be a strong early promoter of L1. The size of this promoter containing DNA insert was 2.8 Kb. flanked by BamHI and XbaI sites. Starting from the partial Sau3AI digest of this 2.5 Kb DNA fragment, two subclones were selected by X-gal positive selection which showed strong promoter activity. These plasmids were called pCM1 and pCM8 which contained 1,200 and 700 bp DNA inserts respectively. Characterization of the promoter using 700 bp clone by DNA sequencing, mapping of transcriptional start site are being attempted. In order to sequence the early positive regulatory gene *G27* of L1, this gene in 800 bp segment is being subcloned in pUC vector.

In order to understand the role of *G23* gene in late transcription, an attempt was made to define a second late regulatory gene of L1 which is postranscriptionally regulated by *G23*. In this venture, certain temperature-sensitive mutants of L1 which could not complement L1 *G23*ts23 phage but could make functional exonuclease at 42°C were isolated. One of them had a reversion frequency of 3×10^{-7} . Further characterization of this mutant is in progress. (Supported by CSIR, Govt. of India).

A.4. Studies on a complex and novel NTP-NDPase from *Mimosa pudica* leaflets :

Susweta Biswas, and Rinku Rhosh

The novel enzyme NTP-NDPase isolated from the plant *Mimosa pudica* is a complex of polypeptide and polysaccharide, and this complex formation is mediated through Ca^{2+} . The protein moiety devoid of polysaccharide and calcium is inactive. This Ca^{2+} -modulated activity of NTP-NDPase has been found to be enhanced in the presence of microtubule. This protein is autophosphorylated and in turn it phosphorylates microtubule implicating the involvement of cytoskeletal protein in the downstream network of signal transduction. While characterizing this enzyme further, it has been found that it is associated with a chromophore having absorption in the blue light region. This chromophore is identified as N5,N10-Methylene Tetrahydrofolate having excitation maxima at 350 nm and emission maxima at 450nm. The presence NTPase might be involved in the blue light response of *Mimosa pudica* leaves reported earlier by several authors.

A.5. Tubulin Substructure and Identification of its Structural, Functional and Regulatory Domains :

B. Bhattacharyya and Pampi Basu

Colchicine binding and pyrene excimer fluorescence of tubulin have been used to identify cysteine residue (s) essential for the colchicine binding activity of the protein. We report here that both the colchicine binding

activity and the ability to form pyrene excimers of tubulin decay at an identical rate when the protein ages at 37°C. Glycerol, which stabilizes the colchicine binding site also stabilizes the excimer formation equally. Thus, these two properties of tubulin are correlated and are likely to belong to the same structural domain. In an attempt to identify the excimer-forming Cys residues, we found that incubation to tubulin with N,N'-ethylenebis (iodoacetamide) causes a significant inhibition of excimer fluorescence. Incubation of tubulin with colchicine prior to this treatment fully retains excimer-forming ability. It is known that Cys239 and Cys354 of β -tubulin, which are about 0.9 nm apart in the native structure, are protected from ethylenebis (iodoacetamide) cross-linking by incubation of tubulin with colchicine. These residues must therefore be responsible for the excimer formation of tubulin with pyrene maleimide. Incubation of tubulin with ethylenebis (iodoacetamide) decreases the colchicine binding activity and the excimer formation at an identical rate. Since the alkylation of Cys239 of β -tubulin (responsible for tubulin self-assembly) has no effect on colchicine binding site of tubulin share Cys354 of the β -subunit. Determination of the number of essential Cys residue (s) for colchicine binding activity, using the statistical method of Tsou also shows only one essential Cys residue.

A.6. Structure-Function Relationship of Colchicine-Tubulin Interactions :

B. Bhattacharyya, Suroopa Banerjee, Shalmoli Chakraborty and Pradip K. Mahapatra

The kinetic and thermodynamic parameters for colchicine-tubulin and deacetamidocolchicine-tubulin interactions, under the condition where tubulin is predominantly in its dissociated state (~80% monomer), have been determined. We observe that the kinetic parameters exhibit marked change when colchicine interacts with the monomeric form of tubulin rather than with the dimeric

form of tubulin. The reaction of colchicine with tubulin monomers is characterized by an enhanced association rate which is a consequence of the lowering of activation energy. Colchicine-tubulin interaction which is only poorly reversible, becomes partially reversible under this condition. Differences were also noticed in the thermodynamic parameters : the reaction of colchicine with tubulin monomers is enthalpy driven with small positive entropy, while with tubulin dimers a large positive entropy change was reported. However, no such changes in the binding parameters were observed for the reaction involving deacetamidocolchicine (a colchicine analog devoid of a side chain at the C-7 position of B-ring) with tubulin monomers. We, therefore, conclude that a single subunit of tubulin is capable of binding colchicine and that the unusual properties of colchicine-tubulin interactions such as the slow association rate, high activation energy, and the poor reversibility are due to the possible contact (s) of the C-7 substituent (in the B-ring) of colchicine with the other subunit of tubulin.

A.7. Spectroscopic Studies on Tubulin Structure :

B. Bhattacharyya & Suranjan Guha

The fluorescence emission maximum of a polar fluorophore in viscous medium often shows a dependence on excitation wavelength, a phenomenon which is named red edge excitation shift (REES). We have found that the fluorescence spectra of the tubulin tryptophans exhibit a REES of about 7 nm. Also, their steady state fluorescence polarization and mean lifetimes show a dependence on both excitation and emission wavelengths. These results indicate that the average tryptophan environment in tubulin is motionally restricted. Although the tryptophan (s) responsible for the observed REES effect could not be localized, it could be concluded from energy transfer experiments with the tubulin-colchicine complex that the tryptophan (s) participating in energy transfer with bound colchicine prob-

ably does not contribute to the REES. A REES of 7 nm was also observed in the case of colchicine complexed with tubulin. However, such a REES was not seen in similar studies with the B-ring analogs of colchicine, viz. 2-methoxy-5-(2',3',4'-trimethoxyphenyl) tropone (called AC because it lacks the B ring of colchicine) and deacetamidocolchicine (which lacks the acetamido substituent at the C-7 position of the B ring). There may be two possible reasons to explain these data. (1) Structural differences between colchicine and its analogs may give rise to differences in their excited state dipole moments which will directly affect the extent of REES, and (2) the B-ring substituent, hanging outside the colchicine binding site on the β -subunit of the tubulin dimer, probably makes contact with the α -subunit of tubulin and imparts a rigidity to that region of the protein, which facilitates the REES.

A.8. A study of chromosome replication, segregation and cell cycle control of yeast *S. cerevisiae* :

P. Sinha, Kaustav Sanyal, Atasi Poddar, and Santanu Ghosh

We are continuing our studies with *mcm* mutants which affect chromosome segregation. Several *MCM* genes have been cloned. These are *MCM16*, *MCM17*, *MCM18*, *MCM19*, *MCM21* and *MCM22* (revised nomenclature). All these genes are required for chromosome segregation. Stable maintenance of a dicentric plasmid in mutants *mcm16*, *mcm18*, *mcm21* and *mcm22*, suggests that these genes may be involved in microtubule-kinetochore interactions, which are weakened in the mutants leading to a relatively stable maintenance of a dicentric minichromosome. The deletion of none of these genes causes loss in viability and does not affect cell growth significantly. How these genes affect the fidelity of chromosome transmission is a subject of ongoing studies.

We have a collection of mutants in novel checkpoint genes which allow cells carrying

damaged DNA to enter G1 to start another cell-cycle, instead of staying arrested in S/G2 phase. We have found that while some of the mutants go to G1 via mitosis, there are at least two mutants which bypass mitosis to go back to G1. These mutations are in the *CDC28* gene that codes for the cyclin-dependent kinase in this yeast. It is our aim to determine whether the loss in Cdc28p activity is in its G1, S or M phase activity. That is, which of these activities defines the checkpoint activity of this protein kinase.

A.9. Introduction of a cattle liver nuclear DNA binding protein with bovine PstI SINEs present in the 5' LAR of goat β -globin and 5' flanking region of cattle α -lactalbumin genes

Prabhakar Gupta and Sudit Sekhar Mukhopadhyaya

A stable SINE binding factor (PstI interspersed repeat binding protein or PIRBP) was identified from cattle liver nuclear extract using 489 bp PstI interspersed repeat sequence as probe in gel retardation assay. South-Western analysis using liver nuclear extract from cattle, goat and buffalo revealed the presence of PIRBP like nuclear factor in all the three species belonging to superfamily Bovoidea. Deletion analysis indicated that the binding was restricted only to the 80 bp (337 bp-417 bp) region. The binding was stable at 65°C as well as in the presence of 5 mM EDTA and 0.5 M NaCl. UV-crosslinking analysis clearly indicated that PIRBP is a single and small polypeptide. Nucleic acid database search revealed that the cattle PstI sequence is present in the 5' flanking region of cattle α -lactalbumin as well as in the 5' locus activating region of goat β -globin genes where nuclear factor erythroid NFE-1 and NFE-2 sites are present. Besides, a few conserved motifs were found within the PIRBP binding region.

A.10. Crystallographic studies of modified DNA oligomers :

Rajagopal Chattopadhyaya, Bhaswati Goswami

Syntheses of modified DNA oligomers resulting from oxidative damage, including 8-oxo-dA and abasic site model progressed to a certain stage but placed on hold.

Two decamer and eight dodecamer DNA oligonucleotides were purified extensively by HPLC for crystallographic and biophysical studies of T-T photodimers. Oligomers including abnormal C-T and G-G mispairs were used in crystallization trials. There is some promise of crystal growth but more material needs to be synthesized.

A.11. Crystallographic studies of lipase from *A. Niger* :

Rajagopal Chattopadhyaya, V.M.H. Namboodiri

Scaling up of the lipase purification was continued. The lipase has a molecular weight of 45 kDa as judged from SDS-PAGE. Various kinds of biochemical characterization have been commenced.

A.12. Crystallographic studies of lambda repressor mutants :

Rajagopal Chattopadhyaya, Kaushik Ghosh

Crystals obtained in the previous year were taken to NII for X-ray diffraction experiments and turned out to be salts. Attention has now been turned to purify large amounts of the C-terminal fragments of the repressor. They will be independently tried by crystal growth experiments.

A.13. Structural Basis of Control of Transcription Initiation in *E. coli* :

P.K. Parrack & Jayanta Mukhopadhyay

The cyclic AMP receptor protein (CRP) acts as a transcription regulator in many genes of *E. coli*. However, CRP is active only in its nucleotide complexed form, viz. cAMP-CRP. The binding of cAMP to CRP causes an allosteric change in the structure of CRP, transforming it to an active form. The details of such a change are being studied in this project, with the help of three point mutants of CRP in

the hinge region, which display different phenotypes. Proteolysis, sulphhydryl modification, chemical cross-linking, fluorescence changes and *in vitro* transcription experiments have been carried out with all the proteins, at various concentrations of cAMP. Our results so far indicate a two step change upon complexation with cAMP, which may be correlated to the monoligated and biligated forms of the protein. Such behaviour is not displayed by the cAMP-independent mutant, CRP*, where the change is monophasic.

A.14. Role of upstream sequences in promoter recognition by RNA Polymerase :

P.K. Parrack, Runa Sur & Dipanwita Debnath

RNA polymerase in *E. coli* and other bacteria display a special type of binding to nonpromoter sequences, called "tight binding", characterised by slow association kinetics and resistance to competition by heparin. Such a tight binding site in the galactose operon of *E. coli* has been characterised in terms of affinity ($K_d = 10$ nM) and association rate ($t_{1/2} \sim 20$ mins.). DNase I footprinting of this nonpromoter site has been carried out, revealing the location of this site centered around -100 position, covering 44 base pairs. *In vitro* transcription experiments show that this upstream region has promoter-like activity.

INSTITUTIONAL PROJECT IV

Studies on ecology, environmental pollution and related problems

A.1. Fish Genetic Stock Identification And Conservation :

R.K. Mandal and B.K. Padhi

Mbol satellite DNAs were cloned, characterized and sequenced from *Cirrhinus Mrigala* and *Clarias batrachus* (EMBL / Genbank Database Nos. Y13109 and Y13110). The former is 266 base pairs and latter is 227 base pairs in size. Both are A+T rich having clusters of A's and T's, possess some inverted and direct repeats and have a number of stop

codons indicating that these are not protein-coding sequences. The Mbol satellite of *C. mrigala*, which is present in a high copy number, is inherited uniparentally in the interspecific hybrids of Indian Major Carps. Thus it would be useful as a genetic marker to study genetic introgression and quantifying gene flow between these species.

A.2. Suitability of the follicular oocytes obtained from slaughtered buffalo ovaries and assessment of their nuclear maturation :

Prabhakar Gupta and Gitali Ganguli

Ovaries collected from indigenous breed of buffalo (*Bubalus bubalis*) freshly slaughtered at Calcutta Municipal Corporation Slaughter House showed on an average 10 (ten) visible follicles from which a mean of 8 oocytes were aspirated. The percentage of three different classes of oocytes were 24.3 ± 2.5 compact cumulus oophorus complex (CCOC), 47.8 ± 1.0 scanty cumulus oophorus complex (SCOC) and 27 ± 2.2 nude. Nuclear maturation (84%) was confirmed by whole mount aceto-orcin staining and Giemsa staining of metaphase chromosomes in the CCOC class of oocytes. The use of dispase (neutral protease) helped us to obtain good metaphase spreads in simple and reproducible manner. A fertilization rate of $64.8\% \pm 1.23$ and morulae development of 18.7 ± 2.0 were obtained using buffalo oviductal cell culture.

A.3. Generation of Transgenic mice after pronuclear microinjection of fusion gene construct containing 5' regulatory sequence of mammary specific murine whey acidic protein : Bovine growth hormone cDNA :

Prabhakar Gupta and Arup Kumar Indra

In India, transgenic animal research is still in its infancy. In order to establish a *de novo* pathway for large scale production of biomedically important proteins, studies towards expression of bovine growth hormone in the milk of transgenic mice during lactation were undertaken. A 3.3 Kb fusion gene comprising of 2.45 Kb 5'-regulatory sequence of

murine whey acidic protein and 0.83 Kb bovine growth hormone (bGH) CDNA was injected into the pronucleus of zygotes of FVB/N strain of mice and transferred to pseudopregnant CD1 recipients. Frequency of pups born was much low compared to the microinjected eggs transferred. Three transgenic pups were produced but all of them died within 3-5 days of birth. DNA isolated from the toe as chippings of these pups was restricted and used for Southern hybridization using radio-labelled bGH probes which confirmed single / multiple sites of integration.

INSTITUTIONAL PROJECT V

Studies on microbes and parasites for industrial and medical applications

A.1. Signal transduction pathways operative in pathogenesis of *Entamoeba histolytica* mediated by inositol phosphates :

Susweta Biswas, Ruma Das, Brajadulal Chattopadhyay and Banbehari Giri

Calcium homeostasis in *E. histolytica* plays a crucial role in the progression of amoebic disease. Here, two different calcium pools have been identified which are sensitive to Ins (1,4,5) P_3 and Ins (1,3,4,5) P_4 respectively. Release of calcium from these pools is receptor mediated. The receptors for both Ins (1,4,5) P_3 and Ins (1,3,4,5) P_4 have been isolated, purified and found to be 69 kDa and 64 kDa proteins respectively on SDS-PAGE. Liposome encapsulated purified Ins (1,4,5) P_3 and Ins (1,3,4,5) P_4 receptors were also potent in release of calcium from artificial membrane.

A.2. Survey of β -thalassaemia mutations in Eastern Indian population by amplification refractory mutation system for pre-natal diagnosis and genetic counselling :

Prabhakar Gupta, Dilip Ghosh Dastidar*, Sudit Sekhar Mukhopadhyay and R.N. Dutta*.

*In collaboration with Assembly of God Hospital and Research Centre, 125/1, Park Street, Calcutta-700 0106 (through an ICMR project)

Thalassaemia is one of the major inherited disorders affecting a large number of individuals in eastern India. Prevention of β -thalassaemia major by genetic counselling and pre-natal diagnosis is an important option for couples at risk of having an affecting offspring. The use of polymerase chain reaction has facilitated the detection of mutant genes directly by Amplification Refractory Mutation System (ARMS).

To date, more than 120 different β -thalassaemic mutations have been characterized. Each population tends to have a different group of mutations consisting of a few that are very common and a variable number of rare ones. Since the spectrum of mutations differ in each population it was thought useful to study the distribution pattern of mutation in β -globin gene amongst eastern India population.

DNA samples from 280 children with transfusion dependent thalassaemia originating from Eastern India have been characterized using ARMS. It has been possible to identify the mutation in 481 alleles i.e. 92.5% of the alleles studies. Nine different mutations were identified. Most prevalent was the IVS1 nt5 (G --->C) mutation (> 40%).

A.3. Molecular Genetics of *Entamoeba histolytica* :

Anuradha Lohia, Sib Sankar Ray, Samudra S. Gangopadhyay, Chaiti Ganguly, Anusuya Ganguly

The cell division cycle of *E. histolytica* was studied using multi parametric flow cytometry. Our results showed that *E. histolytica* trophozoites, growing in axenic medium, are made up of a heterogenous population of euploid and polyploid cells. The number of polyploid cells increases with age of the cells in culture. Expression of putative cell cycle and signal transduction markers was studied using specific antibodies and changes in their expression levels have been correlated with changes in the DNA content.

Unusual genome organisation in *E. histolytica* has been shown to lead to over-

lapping transcripts of *Eh MCM3* and *Eh PAK*. Deletion analysis of genomic clones is being used to identify promoter like elements for these two genes. The genes for *Eh MCM2*, *Eh MCM2* and *Eh MCM7* have been isolated and are being sequenced. Antibodies to *Eh MCM3* and *Eh PAK* have been used to study the expression of these proteins during the different cell cycle phases of *E. histolytica*.

Diagnostic methods using the polymerase chain reaction on stool samples have successfully differentiated *E. histolytica* from *E. dispar*. This result is in contrast to the results of the clinical pathological laboratories which are unable to distinguish these two species based upon light microscopy. A glycine rich gene from *E. histolytica* shows subtle differences at the nucleotide and amino acid level with its homolog from *E. dispar*. This gene may be used as a diagnostic probe in future.

PUBLICATIONS

1. Roy, B. and Mandal, R.K. Sequence analysis of signal peptides of seed storage proteins. *J. P1. Biochem. Biotech.* **5** : 113-116, 1996.

2. Mandal, R.K. and Ghogh, S.K. Genes and genetic engineering of Brassica. In *Recent Advances in Oilseed Brassica*, (Eds. S.K. Gupta and H.R. Kalia, Kalyani Publishers, New Delhi). pp. 134-160, 1996.

3. Mandal, R.K., Dasgupta, J., Dasgupta, S. and Ghosh, S.K. : Improvement of oil seed Brassica seed protein quality by modern Biotechnology. In *Agricultural Biotechnology* (Eds. V.L. Chopra, R.P. Sharma, M.S. Swaminathan, Oxford-IBH, New Delhi). pp. 181-191, 1996.

4. Padhi, B.K. and Mandal, R.K. Fishery genetics : An emerging discipline. *Curr. Sci.*, **71** : 97-99, 1996.

5. Padhi, B.K. and Mandal, R.K. Inadvertent hybridization in an Indian carp hatchery as detected by nuclear DNA RFLP. *Fish Biol.* **50** : 906-909, 1997.

6. Sashiprova Das Gupta, Dipak Das Gupta, Aruna Chatterjee, Susweta Biswas and B.B. Biswas. Conformational changes in plant Ins (1,4,5) P_3 receptor on interaction with different myoinositol trisphosphates and its effect on Ca^{2+} release from microsemal fraction and liposomes. *Biochem J.* **321**, 355-360, 1997.

7. Banbehari Giri, Sanghamitra Raha, Bhudev Bhattacharyya, Susweta Biswas and B.B. Biwas. Relative importance of inositol (1,4,5) triphosphate and inositol (1,3,4,5) tetrakisphosphate in *Entamoeba histolytica*. *FEBS Letters* **393**, 109-112, 1996.

8. Suranjan Guha, Satinder S. Rawat, Amitabha Chattopadhyay and Bhabatarak Bhattacharyya, Tubulin Conformation and Dynamics : A red Edge Excitation shift Study. *Biochemistry* **35**, 13426-13433, 1996.

9. Suroopa Banerjee, Gopal Chakrabarti and Bhabatarak Bhattacharyya Colchicine Binding to Tubulin Monomers : A mechanistic Study, *Biochemistry*, **36**, 5600-5606 1997.

10. Pampi Basu Sarkar, Suparna Chandra and Bhabatarak Bhattacharyya, The Colchicine-binding and Pyrene-excimer-formation activities of tubulin involve a common cysteine residue in the β -subunit, *Eu. J. Biochemistry* **244**, 378-383, 1997.

11. A. Bhattacharyya, B. Bhattacharyya and S. Roy, Fluorescence Energy transfer measurements of distances between ligand binding sites and tubulin and its implication for protein protein interaction *Protein Science* **5**, 2029-2036, 1996.

12. Lohia A., Ray A. and Sinha P., Isolation and sequence analysis of mutations in *CEN5* DNA of yeast *J. Genet* **75** : 173-180, 1996

13. Roy, N., Poddar, A., Lohia, A. and Sinha, P., Curr. Genetics (in press) The *mcm17* mutation of yeast shows size-dependent segregational defect of a minichromosome, 1997.

14. Ghosh, S., Lohia, A., Kumar, A., and Samuelson, J. Overexpression of P-

Glycoprotein gene 1 by transfected *Entamoeba histolytica* confers emetine-resistance. *Mol. Biochem. Parasitol.* **82**, 257-260. 1996.

15. Ray, S.S., Gangpadhyay, S.S., Pande, G. and Lohia, A. Characterisation of cell division cycle regulating genes of *Entamoeba histolytica* using flow cytometry *Arch. Med. Res.*, **28**, 122-123, 1997.

16. Samuelson, J., Caplivski, D., Ramirez, K.S., Kretzinger, K., Descoteaux, S.,

Hernandez, G., Vargas, G., Mammo, R., Newton, O., Santos, J., Vega, H.D.L., Robbins, P., Ganguly, C., and Lohia, A. A proposal for a molecular biologic system for classifying isolated of *Entamoeba histolytica* and *Entamoeba dispar*. *Arch. Med. Res.* **28**, 274-275, 1997.

17. Chattopadhyaya, R. and Goswami, B., "A sturdy box design for sitting drop crystallization" *J. Appl. Cryst.*, **30**, 182-183, 1997.

Ph. D. Awarded

Name	University	Year	Title	Supervisor
Sudip Kr. Ghosh	Kalyani University	1996	Plant transformation and expression of genes in transgenic plants.	Dr. R.K. Mandal
Biswendu Choudhury	Calcutta University	1996	Studies on the control of DNA replication of temperate Mycobacteriophage L1.	Dr. N.C. Mandal
Golam Faruk	Calcutta University	1996	Genome organisation of farm animals with special reference to repetitive DNAs.	Dr. P. Gupta
Niranjan Das	Calcutta University	1996	Cloning sequencing and characterization of seed expressed Acyl Carrier Protein genes from <i>Brassica campestris</i> Cv. B-54 (Agrani), and studies of their expression during seed development.	Dr. S. Ghosh
Asim K. Mandal	Calcutta University	1996	Genetic and Biochemical Studies on Nitrogen regulation in <i>Azospirillum brasilense</i> .	Dr. S. Ghosh
Sudip Chattopadhyay	Calcutta University	1996	Genetic and Biochemical studies with carbohydrate mutants of <i>Azospirillum brasilense</i> particularly affecting the expression of <i>fru</i> operon and carbohydrate regulatory genes.	Dr. S. Ghosh

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. Susweta Biswas	Study on signal transduction in plant : Inositol trisphosphate-Receptor from <i>Vigna radiata</i> , its gene cloning and characterization of different domains.	CSIR
Prof. Ssweta Biswas	Signal transduction pathways operative in <i>Entamoeba histolytica</i> & the drug design for Amoebiosis.	CAE
Prof. N.C. Mandal	Studies on the promoters and operators of Mycobacteriophage L1 and construction of mycobacterial expression vectors. (Terminated on 28.02. 97)	CSIR
Prof. N.C. Mandal	Studies on the Lethal interaction of the Bacteriophage lambda replication gene <i>P</i> with its <i>E. coli</i> .	DBT
Prof. B. Bhattacharyya	Studies on carboxy termini of tubulin : Its structural and functional implications	CSIR
Dr. Pratima Sinha	The role of Mcm family of proteins in initiating DNA replication at yeast replication origins.	DAE
Dr. Anuradha Lohia	Development of a PCR based assay to identify pathogenic strains of <i>Entamoeba histolytica</i> .	CSIR
Dr. Anuradha Lohia	Studies on the expression of <i>ras</i> superfamily proteins in <i>Entamoeba histolytica</i> .	DBT
Dr. Anuradha Lohia	Role of tocotrienols as anti-proliferative agents against <i>Entamoeba histolytica</i>	UNESCO
Dr. R. Chattopadhyaya	Crystallographic studies of lipase from <i>A. niger</i> .	CSIR
Dr. R. Chattopadhyaya	Purification and crystallisation of locally available proteins (Terminated on 31.08.96).	DST
Dr. R. Chattopadhyaya	Biophysical characterization of DNA oligomers containing UV induced thymine dimers.	DAE

Participation in Conferences/Symposia/ Training programme/Awards and Honours received.

Prof. R.K. Mandal presented invited talks/chaired session in the following meetings/symposia :

1. National Science Day Programme on Biotechnology, University of Tripura, Agartala on April 6, 1996

2. Fish Sperm Cryopreservation in "Turning Point", Doordarshan National Programme in April 1996

3. Agricultural Biotech. and Life Form Patenting in Science communication workshop by ISNA on June 6, 1996

4. Seminar on Plant Biotech., University of Kalyani on Aug. 30, 1996.

5. Special lecture on Gene Technology in Human Biology and Health in Central Calcutta Soc. for Human Development & Research on Sept. 1, 1996
6. DNA sequencing and Micro satellite DNA in Forensic Science by CFSL on Sept. 1, 1996
7. 'Gene Therapy' on AIR, Calcutta on Sept. 29, 1996
8. Academic Staff College, B.U. on Nov. 7, 1996.
9. Symp. on Plant Physiol for Natl. Dev. on Dec. 17-19, 1996 organised by PPF, Calcutta.
10. Guha Res. Conference on Dec. 23-27, 1996 at Mirik
11. All India Cell Biol Conference on Jan. 13-15, 1997 at Cancer Research Institute, Mumbai.
12. DSA programme in Botany, B.U. on Feb. 21-22, 1997
13. Animal and Human cloning : an interview on AIR Calcutta on March 13, 1997
14. Natl. Seminar on Fish Biology at Visva-Bharati on March 17-19, 1997.
15. 'Of cloning molecules and Man' at Physics colloquim at SINP on March 20, 1997
16. Role of Biotech. in Env. Protection in Acad. Staff College, C.U. on March 22, 1997.

Prof. Mandal also served as a member of the TAC of CRIJAF, Barrackpore and ISI Calcutta. He also served as hony. Lecturer, Papersetter/Examiner and member, Board of P.G. studies of various Universities.

Dr. B.K. Padhi was invited to deliver : i) lecture on 'Molecular and cytogenetic aspects of fish hybridization in a Training Programme on Fish Genetics during 13-20 August, 1996 at Central Institute of Freshwater Aquaculture,

Bhubaneswar. ii) Golden Jubilee Lecture on 'Application of molecular genetics in conservation and management of natural fisheries resources on 9th September, 1996 at Central Inland Capture Fisheries Research Institute, Barrackpore and iii) a lecture on 'Mitochondrial DNA Polymorphism' in a workshop on 'Recent advances in DNA profiling technology' at Central Forensic Science Laboratory, Calcutta on 16.01.1997. iv) Participated in the 'National Seminar on Fish Biology' at Department of Zoology, Visva Bharati, Shantiniketan, March 17-19, 1997.

Surekha Mandal, Pallab Kundu and Somenath Bhattacharyya presented posters at the symposium on Plant physiol. for Natl. Dev. held in Bose Institute during Dec. 17-19, 1996.

Personal Activities of **Prof. N.C. Mandal** :

1. Gave a course of lectures on Molecular Biology to the M.Sc. final year students of Biochemistry Department of the Calcutta University.
2. Gave a course of lectures on Bacteriophage Genetics to the M.Sc. final year students of the Department of Physiology of the Vidyasagar University.
3. Acted as a member of the Scientific Advisory Committee of National Institute of Cholera and Enteric Diseases, Beliaghata, Calcutta.
4. Nominated as a member of the Sectional Committee of Indian National Science Academy for the period, 1997-1999.
5. Gave an invited talk at IICB, Calcutta, organized by the Calcutta Molecular Biology, Biophysics, and Structural Biology Group.
6. Attended Project Monitoring Workshop organized by CSIR at CCMB, Hyderabad.
7. Attended Project Monitoring Workshop Organized by the Department of Biotechnology, New Delhi.

8. Acted on several occasions as member of the Assessment Committee of Indian Institute of Chemical Biology, Jadavpur, Calcutta.

9. Acted as a member of the Ph. D. Committee in Biochemistry of the Calcutta University.

10. Acted as examiner of Ph.D. thesis of different Indian Universities.

11. Organized the Guha Research Conference - 1996 at MIRIK, Darjeeling, West Bengal as Convenor.

12. Chaired a Scientific Session on Molecular Biology in the Symposium Organized by West Bengal Academy of Sciences on the National Science Day (February 28, 1997) at Calcutta.

13. Received Bose Institute Foundation Day Memorial Award for the year 1995.

Meeting Lecture attended by **Prof. S. Biswas** :

1. Attended Symp. on Plant Physiol. for Natl. Dev. on December 17-18, 1996 Organized by PPF, Calcutta.

Meeting/Lecture attended by **Prof. B. Bhattacharyya** :

1. Prof. B. Bhattacharyya gave an invited talk at the Annual SBC meeting at Bangalore.

2. Attended Guha Research Conference held in December 1996 at Mirik.

Meeting Attended by **Dr. P. Sinha** :

1. Attended Guha Research Conference held in December 1996 at Mirik. Was elected as a member.

2. Delivered a colloquium at Saha Institute of Nuclear Physics (1997).

3. Gave lectures on yeast Molecular Genetics for M.Sc. (Biochemistry) and M.Sc. (Biophysics and Molecular Biology) students as a part of their M.Sc. curriculum.

Meeting & Symposia attended by **Dr. P. Gupta** :

Dr. Prabhakar Gupta presented invited talks/chaired session in the following meeting/symposia : -

1. Delivered a course of lectures on Tissue Culture and Biotechnology to the M.Sc. 2nd year students of Physiology Dept., Calcutta University.

2. Acted as DBT nominee for selection of staffs in Department of Zoology, Burdwan Raj College.

3. Participated in the National symposium on Biology for sustainable development organised by the Zoological Society, Calcutta (December 5-7, 1996).

4. Participated in one day symposium on Gene in relation to diseases and Genetic counselling held at BITM, Calcutta on 5.10.96 organised by Centre for Nation Conservation and Human Survival.

5. Examiners of Ph.D. thesis submitted to Bidhan Chandra Krishi Viswa Vidyalaya and Calcutta University.

6. Delivered an invited talk on "Transgenic farm animal Production and its potential use" at Central Institute of Research on Goats, Mathura, April 17, 1996.

7. Delivered an invited lecture on "Use of transgenic mice as model system for molecular pharming in discussion meeting on Animal models in Biology and medicine and Transgenic Technology organised to celebrate the Silver Jubilee year of the Central Animal Facility at Indian Institute of Science, Bangalore (July 10-11, 1996).

Meeting Lecture attended by **Dr. A. Lohia**

Visits abroad and Invited talks :

1. 1996-Invited to give a series of lectures on Molecular Parasitology at the National University of Singapore, Singapore.

2. 1996-Invited talk at annual SBC meeting at IISC, Bangalore.

3. 1997-Invited to give a seminar at the XIIth Amoebiasis meeting at Mexico City.

Dr. P.K. Parrack : Participation in Conferences/Symposia etc.

Dr. Pradip Parrack taught final year M.Sc. students of the Dept. of Biophysics, Kalyani

University, Kalyani W.B. and also acted as a paper setter and examiner for the same. Served on the panel of judges for the "Fifth one day seminar for M.Sc./M.Tech students doing project work/specializing in biorelated subjects" on January 31st, 1997, on invitation from the organizers, viz. Indian Biophysical Society, Calcutta Chapter.

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS.

Dr. B. K. Padhi, Dr. Sk. Abdus Samad, Dr. Prasanta Bag, Dr. Aditya Sengupta, Ms. Kajari Ghosh, Dr. Ruma Das, Dr. Rila Chakraborty, Dr. Monika Mehta, Dr. Pradip Kr. Mahapatra, Dr. Bhaswati Goswami, Dr. Brajadulal Chattopadhyay, Dr. Chaiti Ganguli, Dr. Amitabha Chakraborty, Dr. Indrani Chakraborty, Dr. Dipanwita Debnath, Arup Indra, Atasi Poddar, Rinku Ghosh, Madhumita Basu, Suranjana Guha, Surekha Mandal, V.M.H. Namboodiri, Samarpan Majumder, Samudra S. Gangopadhyay, Nandan Kr. Jana, Nrishingha Dey, Lopa Adhikary, Sib Sankar Roy, Gopal Chakraborty, Biswajit Roy, Nabanita Sarkar, Pampi Basu, Pallab Kundu, Prajna Mandal, Shalmali Chakraborty, Suroopa Banerjee, Saurabh Pal, Runa Sur, Kausik Ghosh, Kaustuv Sanyal, Jayanta Mukhopadhyay, Pradip Sen, Rajat Bhattacharyya, Chandrani Chattopadhyay, Indrani Datta, L. Boominathan, Runu Dey, Santanu K. Ghosh, Anasuya Gangopadhyay, Srikanta Jana, Banabihari Giri.

OTHER SUPPORTING STAFF MEMBERS

B.K. Banerjee, S. Saha, S.C. Deb Roy, D.C. Das, S.K. Das, A. K. Banerjee, N.C. Datta, Susanta K. Das, S. Chakraborty, A.K. Poddar, D. Roy, B. Bez, A. Mollah, S.S. Maiti, B. Ghorui, D.D. Mandal, R. Das, Kaberi Ghosh (nee Basu), Ranjit Das.

Biophysics

Faculty : Prof. A.K. Banerjee (Chairman), Dr. S. Roy, Dr. G. Basu

INSTITUTIONAL PROJECT III

A.1. Structural basis of catalytic mechanism and interaction at active site of two enzymes : a) *Studies on Calotropin DII, a cysteine protease*, b) *studies on β -lactam- β -lactamase interaction :*

Asok K. Pal, Sibani Chakraborty, Sreya Ghosh, A. Seal, Bishnu Mukhopadhyay, Asim Bera, Suparna Bhattacharya and **Asok Banerjee**

Cysteine proteases are involved in various biological processes and they are important and have wide application in medicine and industry. Recently they are implicated in anti cancer and DNA binding activity. We are working on a novel cysteine protease.

The crystallographic structure of this one, Calotropin DII, has revealed itself by molecular replacement method using Papain as phasing model. The refinement and electron density map fitting is progressing with an objective to visualize its substrate specificity, and compare it with papain and other cysteine proteases to rationalize a conclusion. A series of inhibitor complexes are being attempted.

The crystallographic structure of another β -lactam analog has been solved for making complex with the macromolecule and elucidation of its mode of interaction at active site. 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 of the antithiol-agents/blockers/

thiol-protease inhibitor and potent β -lactam analogues.

A.2. Visualization of the role of water molecules in the protein-nucleic acid interaction at atomic resolution :

Sreya Ghosh, B.P. Mukhopadhyay, Sampa Pai, **Asok Banerjee**

Molecular recognition is a subject of widespread interest in organic chemistry, biochemistry and molecular biology and protein nucleic acid interactions are of fundamental importance. Their complexation, binding and recognition embrace many aspect of cellular DNA function and genetic expression. The molecular description of their nature of interaction are emerging recently in several x-ray structural works of trp-repressors/ λ -repressors/lac-rep/pec/cro protein nucleotide complexes. Our group has succeeded to cocrystallize a series of this complexes and has solved the structure of a complex of L-serine with two Inosine 5'-monophosphate in highly hydrated form ($12\text{H}_2\text{O}$). This potential model, first of its kind reported, throw some interesting findings which are still to be characterized in macromolecular complexes. Water mediated specific and nonspecific interactions of the partners are found to play a key role in the recognition. Several other complexes have been done and data collection and structure solution is progressing. What we are looking for is the inherent discipline of interaction mode, the invariant and the novel variant ones in these complexes which may be related to biological function in vivo.

A.3. Structural and modelling studies of
 (i) *peptidoglycan — a chemoreceptive constituent of Mycobacterium cell wall.* and
 (ii) *small molecules of biological importance :*

Sampa Pain, Sreya Ghosh, Bishnu P. Mukhopadhyay and **Asok Banerjee**

(i) The structure and conformations of the cell wall constituents of Mycobacterium are very important since they are prime targets for chemotherapeutic drugs. One major constituent, peptidoglycan, has 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 many possible hypothetical models proposed so far and endorses the model of "Knox and Murthy" which is stereochemically consistent and acceptable. This interesting result help us better to understand the interactions of chemotherapeutic agents with peptidoglycan, the cell wall target. The kinetics and binding affinity studies of the different chemical agents/ligands with model peptidoglycan system has clarified their mode of interaction at molecular level.

(ii) Crystallographic and modelling studies of a series of small molecules of biological interest are continuing with a hope to correlate these structures to biology.

A.4. Quantitative structure activity relation study of several series of specific drugs and analogs by graph theoretical pattern recognition approach :

Asok K. Pal, P. Bag and **Asok Banerjee**

Interesting progress and developments have been made with the lactam series of compounds and on the role of anthracin nucleus as anticancer agents. An expert system program has been written which may be effective in drug design along with molecular modelling. Further development is continuing.

A.5. Molecular Basis of regulation of gene expression :

Siddhartha Roy, A. Shyamala, Sumita Bandyopadhyay, Sumana Chatterjee, Sunanda Dev

The complexity of the process of regulation of genetic information is extraordinarily high. Tens of protein factors are often involved, along with several DNA sites in regulating expression of sometimes, only one gene. For several such regulatory systems, particularly that of prokaryotic origins, components are now well defined and clear patterns of interaction responsible for regulation have begun to emerge. It is now imperative that one or more such systems should be studied from structural and energetic viewpoint, so that a complete physico-chemical understanding of the functioning of a regulatory system may be achieved.

Lytic-lysogenic switching system of bacteriophage λ is one of the most well characterized gene regulatory systems. The main components of the genetic switch are the three operator sites O_R1 , O_R2 and O_R3 and two proteins, *cro* and λ -repressor. One of the most outstanding problems in this area is the nature of the repressor tetramer/ O_R1 - O_R2 complex, and structural and molecular basis of its role in the regulation of the lambda genetic switch.

One of the most important component of the genetic switch is the protein λ -repressor. The repressor is a multi-functional protein, which acts as up regulator, down regulator and binds cooperatively to the operator sites. The binding cooperatively is crucial in the functioning of the switch. In the past we have focused our attention mainly to aspects of repressor structures which have direct relevance to the functioning of the switch. Some of the important achievements are highlighted below.

We have shown that protein-protein interaction is context dependent. The C-terminal tail region of λ -repressor is involved in self-association in the unliganded

state but is not involved in self-association while liganded to single operators or bound to adjacent operators.

We have studied a number of non-cooperative mutants which have been isolated elsewhere. Many of these mutants have native like DNA binding properties, but lacks binding cooperativity. A structural study of these mutants may shed light on the nature of co-operative interaction. The mutants that are being studied intensively are Y210C, S228N and a ts mutant. We have also made a site directed mutant, F235C, which is being used to study the role of the C-terminal tail region in various process.

We are also investigating gal repressor system to study many aspects of small molecule induction. This is complementary to the λ system, since the induction in the λ system is by protease cleavage.

A.6. Molecular basis of recognition and discrimination of cognate and noncognate tRNAs by aminoacyl-tRNA synthetases :

Siddhartha Roy, Anusree Bhattacharyya, Durba Bandyopadhyay, Asim Bothra, Amit Kumar Mandal, Rajat Banerjee

Aminoacylations of cognate tRNAs by aminoacyl-tRNA synthetases require recognition of cognate tRNAs with high specificity, due to low error tolerance in translation. Typically protein-nucleic acid interaction is described in terms of cation, anion and water release. When the protein and nucleic acid are free in solution, they are covered with ions and water for charge neutralization and hydration. When they interact, some cation, anion and water are released. The ion release represents nonspecific components of the binding and water release, on the other hand, represents specific binding. The measurement of these types of interactions between cognate and non cognate tRNAs and synthetase should give insights into how the synthetases discriminate between the two. We have studied two systems, viz., glutamyl-tRNA synthetase-

tRNA^{glu} and glutamyl-tRNA synthetase-tRNA^{glu}. We have measured the numbers of ions and water release to discriminate the cognate and non cognate tRNA-protein interaction for both GlnRS and GluRS. We have shown that upon substrate binding, conformational changes occurs, which plays crucial roles in recognition and specific aminoacylation of cognate tRNA by GlnRS and GluRS.

We are investigating domain-domain interactions of a large number proteins of different mass by solid surface catalyzed denaturation, often called aging. We have shown that solid-surface catalyzed aging produces a new conformation of many large proteins, which differs from the native one by many spectroscopic properties. This conformation is also catalytically active.

A.7. Theoretical Studies of Peptide and Protein Dynamics from a Collective Motion Viewpoint : Protein reorganization energy during electron transfer :

Gautam Basu

Electron transfer is of fundamental importance in biological energy transduction. It is thus extremely important that we understand all the factors that control the rate of electron transfer in proteins. In collaboration with Prof. Nobuhiro Go of Kyoto University, we have undertaken the task of understanding this problem from a theoretical viewpoint. A model for the coupling of collective protein motion to electron transfer has already been developed and a successful application of our model was achieved with the protein cytochrome c. An extension of this model is the next step, where the protein motion will be incorporated as quasi-harmonic principal components.

A.8. Occurance of 3_{10} -helices in the PDB: An analysis :

Gautam Basu and Lipika Pal

Understanding structural principles behind protein architecture from already known

protein structures that are present in the PDB is the general theme of this project. We have initiated work on documenting all the 3_{10} -helices in known protein structures; we are currently looking at micro environments and sequences that give rise to such structures using a fortran code developed by us recently. This will enable us to understand the subtle reason why occasionally the 3_{10} -helix is preferred over the α -helix in proteins and any functional role that they might play.

A.9. A thermodynamic scale for the relative preferences of amino acids between the 3_{10} and the α -helical states :

Gautam Basu and Manasi Ghose

The aim of this experimental project is to establish a relative experimental scale of equilibrium constants for secondary structure formation by amino acids. Through already published model by Basu and Kuki, we would like to establish a thermodynamic scale for the relative preferences of amino acids between the 3_{10} and the α -helical states by experimentally determining the conformation of pre-designed peptides of varying length that contains the amino acid Aib. We have successfully synthesized the first set of peptides and spectroscopic studies are being pursued.

A.10. Studies of short peptide sequences made up of naturally occurring amino acids that form stable 3_{10} -helices.

Gautam Basu and Raja Banerjee

This project involves synthesizing a series of short peptides with sequences taken from proteins that exhibit 3_{10} -helices in the native structure. We would like to study the conformation of these peptides in isolation and as a function of differing micro-environment

(solvent). Along with the results of project A.8, this will also shed light into the factors stabilizing 3_{10} -helices in proteins.

PUBLICATIONS

1. Antistress activity of P-GABA in experimental animals. M. Pandit, M. Pramanik and A. Banerjee, *Ind. J. Exp. Biol*, **34**, 37-40, 1996.

2. Bis (2,4-diaminopyrimidinium) Sulphate monohydrate, $2C_4H_7N_4^+ \cdot SO_4^{2-} \cdot 2H_2O$. A.C. Gomes, G. Biswas, S. Pain, Sreya Ghosh, Dolly Ghosh, Y. Litaka and Asok Banerjee. *Acta Cryst.* **C52**, 2020-2022, 1996.

3. Fluorescence Energy Transfer Measurement of Distances between Ligand Binding Sites Of Tubulin And Its Implication For Protein-Protein Interaction. Anusree Bhattacharya, Bhabatarak Bhattacharyya and Siddhartha Roy. *Protein Science*, **5**, 2029-2036, 1996.

4. Protein-DNA and Protein-Protein Interactions. Siddhartha Roy *Current Science* **71**, 100-106, 1996.

Participation in Conferences/symposia/training programme/Award and honours received.

Prof. A. Banerjee delivered a keynote address at the Molecular Modeling seminar held at DIC, Bose Institute, 1997.

Dr. S. Roy went on a year long sabbatic leave to work at NIH, USA, in the laboratory of Prof. S. Adhya.

Dr. G. Basu delivered a series of lectures at Mahabaleshwar Seminar on Modern Biology (Protein Folding and Design) held at Ooty from December 28, 1996 to January 2, 1997 organized by the National Centre for Biological Sciences, Bangalore.



500 MHz FT-NMR Cryomagnes



Analysis of FT-NMR data on SGI Workstation

Ph. D. Awarded

Name	University	Year	Title	Supervisor
Sumita Bandyopadhyay	Calcutta University	1996	Study of inter and intra subunit interactions in lambda repressor	Dr. S. Roy

GRANT-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. A. Banerjee	Studies on model nucleotide-peptide/peptide ligand complex at atomic level by x-ray Crystallography.	CSIR
Prof. A. Banerjee	Structural basis of differences in catalytic mechanism of different Cysteine Proteases by X-ray Crystallography and molecular modelling.	DBT
Prof. S. Roy	A study of structural and molecular basis of co-operative binding of operator sites of repressor.	
Prof. S. Roy Dr. G. Basu	Molecular basis of recognition of tRNAs by Aminoacyl-tRNA synthetases.	DST
Dr. G. Basu	Theoretical studies of peptides and protein dynamics from a collective motion viewpoint.	CSIR

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOWS/POOL OFFICERS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Dr. B. P. Mukhopadhyay, Dr. A. Seal, Dr. A. Bhattacharyya, Dr. S. Biswas, Dr. I. Dey, Dr. A. Shamlu, Dr. U. Haldar, S. Ghosh, A. K. Bothra, S. Bandopadhyay, A.K. Pal, S. Chatterjee, A. K. Mondal, R. Banerjee, M. Ghose, S. Ghose, S. Dev, D. Mukherjee, L. Pal, R. Chattopadhyaya, S. Bhattacharyya.

OTHER SUPPORTING STAFF MEMBERS

B. Goswami, A. Bhattacharyya, B. Munshi.

Animal Physiology

Faculty : Prof. A.K. Ray (Incharge), Dr. R. Ghosh, Dr. G. Sa.

INSTITUTIONAL PROJECT I

A. Environmental Physiology and Hormonal Regulation.

A.1. Development of cell culture from the kidney of catfish, *Heteropneustes fossilis* (Bloch) :

Rama Ghosh, Ehsan A. Khan and A.K. Dasmahapatra

In continuation to our work on the primary culture of fish cells, specially hepatocytes, efforts were made for development of a permanent cell line from kidney of catfish, *Heteropneustes fossilis*. Isolated kidney cells were cultured in disposable culture dishes (60 mm diameter) with M199 media, cultures were carried out in serum-free media as well as in media with 5% FBS and 10% FBS. Our observation indicated that the cultures maintained with 10% FBS retained better cell morphology, attachment and LDH-activity even after twenty days where as those with serum-free media and 5% FBS exhibited signs of little disruption after twenty days. However, proliferation of cells were not noticed.

A.2. Carbofuran technical induces CYP1A1 Gene in primary cultured hepatocytes of Singhi fish, *Heteropneustes fossilis* (Bloch) :

Rama Ghosh, Manik Ghosh and Swadesh De

Carbofuran (CF) is a well-known carbamate pesticide used in agriculture worldwide. In this study, we have demonstrated that CF induces the activity of detoxification enzyme categorized under cytochrome P450. In our experiment CF induced the Ethoxyresorufin-

o-deethylase (EROD)-a key biomonitoring enzyme under the gene family CYP1A1 in a dose-dependent manner, in primary cultured hepatocytes of catfish at 24 hr. CF-induced EROD activity was inhibited by alpha-naphthoflavone, a known blocker of cytochrome P450. Alternatively, addition of Beta-naphthoflavone into the media significantly increased the EROD activity of the cultured hepatocytes. A synergistic effect of EROD activity was also found when CF and Beta-naphthoflavone were added simultaneously into the media. Thus, we have established for the first time from our experiment that carbofuran induces the cytochrome P450 gene unambiguously.

A.3. Production of triploid and unisex fish: Neuroendocrine pattern in triploid Indian Catfish (*Heteropneustes fossilis* Bloch) :

Arun K. Ray and Basant K. Tiwary

The triploid catfish produced in our laboratory showed better weight gain and high condition factor in comparison to the diploid full-sibs. However, the fishes became sterile. To find out the hormonal basis of sterility in the triploid fishes the levels of gonadotropin releasing hormone (GnRH), gonadotropin (GtH), 17 Beta-estradiol and testosterone were measured by immunocytochemistry and radio-immunoassay.

GnRH-immunoreactivity was observed in hypothalamus and pituitary in both ploidy groups during pre-spawning phase. Diploid individuals displayed more darkly staining cells and beaded fibres in the hypothalamus and

pituitary than the triploid fish. The immunoreactive cell diameter in hypothalamus of triploid fish were reduced to half of that found in diploid counterpart.

In all four phases of annual reproductive cycle the gonadotropin (GtH) level remained significantly lower in triploid fish than the diploid counterpart except in post-spawning or resting phase, where the hormone level was found to be similar in both the varieties.

Basal plasma testosterone and 17Beta-estradiol levels were found to be significantly lower in triploid catfish variety than the normal diploids in both the sexes, in the different phases of reproductive life cycle. The endocrine profile of triploid catfish as revealed by our present study clearly indicates a failure of neuroendocrine functioning as one of the causes for reproductive failure.

A.4. Role of estrogen in the ovarian development in freshwater prawn, *Macrobrachium rosenbergii* : Further development of prawn hepatocyte culture :

Arun K. Ray and Anuradha Chaudhury

The prawn hepatocytes which were subjected to primary culture contained at least four types of cell, such as, E, F, R, and B types. In our venture to separate the cells we have used percoll density gradient separation technique. Through such percoll density gradient we have been able to separate the F, R and B cells. Those cells have been compared morphologically with the cells found in stained sections of hepatopancreas of freshwater prawn.

With the separation of different types of cells it has been possible for us to isolate the estrogen-sensitive vitellogenin-synthesizing hepatocytes of prawn.

A.5. Embryonic development of prawn (*Macrobrachium rosenbergii*) in laboratory condition :

Arun K. Ray, Sarmistha Karmakar and Anuradha Chaudhuri

The present knowledge of physiological regulation of crustacean egg development,

hatchability and larval growth is far from satisfactory. We have developed an egg culture system from *Macrobrachium rosenbergii* in a serum-free medium where the hatchability of the fertilized prawn egg and successive larval development can be studied for three weeks in a viable condition. During 3 days' culture in, Dulbecco's modified Eagle's medium or Ham's nutrient Mix F-32, the eggs demonstrated distinguished characters for being fertilized. The embryo took 12 days in our laboratory condition to become well developed. Further development and growth of body parts continued till hatching upto 19-21 days.

Interestingly enough the embryo showed an induced maturation during 3-8 day period when they were subjected to a medium containing 17Beta-estradiol at different concentrations.

A.6. Thyroid hormone regulation of mammalian brain function :

Arun K. Ray and Nilkanta Chakraborty

Nongenomic action of thyroid hormone (TH) has been well documented in our laboratory through the inhibition of Na⁺-K⁺-ATPase and activation of acetylcholinesterase (AChE) activities in adult rat brain cortical synaptosome. Different doses of thyroid hormone increased Ca²⁺-ATPase up to a maximum of 43% and AChE at 58% in cortical synaptosome in comparison to the untreated control animals. Also, simultaneously with the enzyme activities cytosolic calcium concentration increased after TH treatment.

It appears that TH has a role on cholinergic neurotransmission through Ca²⁺-dependent pathway in adult rat brain.

A.7. Phenylhydrazine-hydrochloride (PHH) - thyroid hormone interaction in rat :

Arun K. Ray and Mitali Pramanik

In our earlier experiment we have demonstrated a significant inhibition of the red cell membrane acetylcholinesterase (AChE) activity both *in vivo* and *in vitro* after treat-

ment with different doses of PHH in juvenile male rats.

However, simultaneous application of thyroid hormone (T_4) either *in vivo*, or *in vitro* in the incubation mixture of the red cell treated with PHH led to 50 to 80 percent counteraction of the PHH-induced inhibition of the red cell membrane AchE activity. Triiodothyronine was (T_3) found to be ten times more potent than T_4 in protecting the AchE activity of the PHH-treated red cells *in vitro*. Triiodoacetic acid (TRIAC) appeared to be less potent than T_4 in the same system.

Further, it was revealed that T_4 inhibited the Heinz body formation in the PHH-treated red cells in a dose-dependent way.

Therefore, it appears that thyroid hormone protection of the red cell membrane AchE activity after PHH treatment, may be due to the inhibition in Heinz body formation that leads to red cell membrane disintegration.

A.8. Thyroid hormone-induced NOS activity in the synaptosome of rat brain :

Arun K. Ray and Swades De

Nitric oxide is a signalling molecule present in rat brain. This is synthesized from L-arginine with stoichiometric formation of L-citulline by the enzyme Nitric oxide synthetase (NOS). The aim of the present study is to demonstrate whether thyroid hormone (T_3) modulates the activity of NOS and thus changes the brain function in hypo- and hyperthyroid condition. We have found that different doses of T_3 stimulates the production of NO through higher activity of NOS in rat brain synaptosome. Conversely, NOS activity has been found to be inhibited in the hypothyroid rat brain. Sodium nitro prusside an inducer of NOS also stimulated the synaptosomal T_3 -induced NOS activity in our experimental system. Administration of L-NMMA an inhibitor of NOS, decreased the T_3 -induced rise in the NOS activity.

The study suggests that T_3 has a stimulatory role on NOS activity in rat brain synaptosome.

B. Control of growth and development of silkworm and silk production.

B.1. Anabolic role of estradiol-17Beta on silk gland :

Arun K. Ray and Bela Keshan

Earlier we have demonstrated the growth-promoting action of estradiol-17Beta (E_2) on silk gland of *Bombyx mori* L. The present study has been undertaken to demonstrate the specificity of E_2 action in silk gland. ICI-182780, a pure and specific antiestrogen, and cycloheximide, a protein synthetic blocker, have been used in this purpose.

ICI-182780, totally suppressed the E_2 -induced rise in silk gland, Protein, RNA and DNA contents as well as the glutamate-pyruvate transaminase activity, when used along with E_2 . Cycloheximide when used simultaneously with E_2 , also blocked the E_2 -induced rise in the fibroin protein content, by about 50% in the posterior part of silk gland.

Thus it appears that E_2 probably acts specifically in a nuclear-mediated way in the posterior part of silk gland.

C. Cell Signalling

C.1. Endothelin follows JAK-Stat pathway to activate differentiation specific genes :

Gaurisankar Sa and Tanya Das (Immunotechnology Section)

Endothelins (ETs) are a class of homologous 22 amino acid regulatory polypeptides that are produced by and elicit various responses in many tissues. In contrast to our knowledge of signal transduction pathway mediating cell proliferation, little is known about the pathways of nuclear signaling responsible for ET-induced cellular differentiation. We have demonstrated that ET-1 elicits a distinct signaling mechanism by which it mediates neonatal rat astrocyte differentiation. The initial event is ligand-induced receptor aggregation, which may involve single or multiple receptor chains. Receptor aggregation concomitantly activates JAK-1 (Janus

kinase-1, a nonreceptor tyrosine kinase) through tyrosine phosphorylation. Phosphorylated and activated JAK-1 then tyrosine phosphorylates p^{91} Stat (signal transducers and activators of transcription) protein. The tyrosine phosphorylated p^{91} Stat is then additionally phosphorylated at the serine residue by p^{42} MAP kinase, activated by ET-1 through other signaling mechanisms. The phosphorylated Stat then homodimerizes forming a sis-inducible factor (SIF), translocates to the nucleus and binds to sis-inducible element (SIE), which is alone sufficient, under certain circumstances to mediate ET-induced transcriptional activation of early responsive genes. This is the only evidence of this kind, which shows that a G-protein coupled receptor follows cytokine receptor signaling pathway.

C.2. Intra-cellular signaling mechanisms in fibroblast growth factor-mediated differentiation specific gene expression :

Gaurisankar Sa, In collaboration with Tanya Das (Immunotechnology Section)

Basic fibroblast growth factor (bFGF) has been shown to stimulate proliferation and differentiation of mammalian cells of different origins. But the molecular mechanisms by which this pleiotropic agent stimulate cell differentiation is not well understood. We have mapped the signalling mechanisms by which bFGF-induced transcriptional activation of differentiation-specific gene expression in FGFR1 overexpressed NIH 3T3 cells. It has been shown that unlike wild type NIH 3T3 cells, FGFR-1 over expressed cells differentiate as a result of bFGF stimulation. Therefore, these cell lines were used to deduce the bFGF-mediated signaling mechanisms for cellular differentiation. It has been shown that upon receptor activation bFGF stimulates tyrosine phosphorylation (through receptor or non-receptor tyrosine kinase) and serine phosphorylation (via, p^{42} MAP kinase) of 90-93 KDa transcription factor (STAT). This phosphorylated transcription factor then homodimerizes and translocates to nucleus where it binds to specific nucleotide sequence (SIE) and activates specific gene transcription.

PUBLICATIONS

1. S. Das and A.K. Ray : Evidence that fat body may be a target organ for estrogen in *Bombyx mori* L. *Sericologia* **36**, 439-446, 1996.

2. S. Chatterjee, A.B. Dutta and R. Ghosh : Impact of carbofuran in the oocyte maturation of catfish, *Heteropneustes fossilis* (Bloch). *Arch. Environ. Contam. Toxicol.* **32**, 1-5, 1997.

Participation in Conferences/Symposia/ Training Programmes/Awards and Honours received.

Prof. Arun K. Ray attended The Fourth Indian Fisheries Forum, held in Cochin from 24-28 November, 1996, and delivered a keynote address. Prof. Arun K. Ray received Prof. H.P.C. Shetty award for 1994-96 from the same forum. He also delivered talks at National Symposium on Reproductive Biology and Comparative Endocrinology held at University of Burdwan during 23-25 January, 1997, and National Seminar on Perspectives of Biotechnology in Animal Research in India, held at North Bengal University, Siliguri, during 12-13 February, 1997.

Dr. Rama Ghosh attended 19th Bangladesh Science Conference, held at Jahangirnagar University, Savar, Dhaka, during 29-31 October, 1996, for presentation of papers.

Dr. G. Sa presented papers at Society of Biological Chemists on "Biotechnology and Molecular Biology of Health and Disease" at Digha, 1997, delivered a lecture on 'Growth factor signalling' at the Structural Biology Meeting in 1996, acted as course Co-ordinator for the course on Cell Signalling for research students at Bose Institute and participated in teaching of Course Work. Dr. Sa received Young Scientist Award from the Department of Science & Technology, Govt. of India, in 1996.

Sri Basant K. Tiwary took part in the Young Scientists Award Programme of Fourth Indian Fisheries Forum, 24-28 November, 1996, at Cochin, National Symposium on Biology for Sustainable Development, 16-18 January, 1997, at Calcutta, XV National Symposium on Reproductive Biology & Comparative Endocrinology, 23-25 January, 1997, at Burdwan, National Seminar on Perspectives of Biotechnology in Animal Research in India, 12-13 February, 1997, at Siliguri, and National Seminar on Fish Biology, 17-19 March, 1997 at Santiniketan.

Mr. Basant K. Tiwary also attended a workshop on Biological Electron Microscopy at Regional Sophisticated Instrumentation Centre, Bose Institute, Calcutta, From February 3-8, 1997

Ms. Bela Keshan attended National Symposium on Biology for Sustainable Development 16-18 January, 1997, at Calcutta and XV National Symposium on Reproductive Biology & Comparative Endocrinology 23-25 January at Burdwan, for paper presentation. Ms. Keshan received 1st prize for best presentation of paper.

Dr. Anuradha Chaudhury attended XV National Symposium on Reproductive Biology & Comparative Endocrinology, 23-25 January, 1997, at Burdwan and National Seminar on Fish Biology, 17-19 March, 1997, at Santiniketan, for paper presentation.

Dr. Sarmistha Karmakar presented paper in National Seminar on Fish Biology, 17-19 March, 1997, at Santiniketan.

GRANT-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Dr. G. Sa	Intracellular signalling mechanisms that mediate endothelin-induced transcription of immediate early genes.	DST
Dr G. Sa	Intracellular signalling mechanisms of basic fibroblast growth factor-stimulated early gene transcription.	CSIR

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POOL OFFICERS/ POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Dr. Anuradha Chaudhury, Dr. Swades De, Dr. E.A. Khan (upto 31.12. 96), Dr. Sarmistha Karmakar (From 01.4.96 to 02.1.97), Mr. Basant K. Tiwary, Ms. Bela Keshan, Mr. Nilkanta Chakraborty, Mr. Manik Ch. Ghosh, Mr. Siddhartha Basu (From 25.4.96 to 10.3.97).

OTHER SUPPORTING STAFF MEMBERS

Dr. A.K. Dasmahapatra, I. Ray, S.K. Ghosh, A.K. Santra, N.C. Jana.



Fluorescence Activated Cell Sorter (FACS) in operation



Capillary Electrophoresis

Plant Molecular & Cellular Genetics

Faculty : Prof. S.K. Sen, Dr. A. Pal, Dr. S. Das, Dr. S.R. Sikdar.

INSTITUTIONAL PROJECT I

A. Generation of insect resistant transgenic crop plants :

S.K. Sen, S. Das, S.R. Sikdar, D. Basu, P. Nayak, A. Basu, D. Ghosh, A. Nandi, S. Paul, D. Das, K. Roy, S. Mishra, N.A. Ramkrishnan, M. Ghosh and Pushpita Mukherjee

R2 and R3 generations of stable transgenic IR 64 indica rice lines have been raised with synthetic Bt toxin genes. The pattern of segregation have been tested in the field. The insect feeding assay have been performed and found to be satisfactory.

Truncated version of cryIA (c) gene have been transformed into chick pea plants. The range of expression level turned out to be 0.002 to 0.003% of total protein which significantly affected the body weight and rate of multiplication of *Heliothis* larvae, the severely damaging insect of chick pea.

Synthetic Bt gene has also been introduced into *Brassica juncea* CV. B-85 through *Agrobacterium* mediated gene transfer. Integration of Bt gene in the transgenic population has been confirmed, and insect mortality bioassay is underway.

A.2. Development of transgenic crop plants with altered plant developmental pattern :

S.K. Sen, S. Das, P. Nayak, and D. Basu

Attempts have been made to generate transgenic plants with rol A, B, C plant developmental genes, either independently or in combination with their own promoter as well as CaMV 35S promoter and transferred into rice cultivars.

The R2 transgenics generated with rol C gene driven by CaMV 35S promoter showed improvement in panicle development.

Basmati 385 transformed with the rol A gene endowed with early flowering characteristics.

A.3. Understanding of male sterility and transgenic approach for generation of nuclear male sterile lines :

S.K. Sen, S. Das, S.R. Sikdar, D. Basu, P. Roy Choudhury, S. Roy Choudhury, S. Paul, S. Rajalakshmi and A. Mondol

Molecular understanding of male sterility was achieved using CMS lines of rice.

Male sterile somatic hybrids were developed by protoplast fusion between *Brassica juncea* CV. B-85 and *B. oleracea* containing CMS Ogura. The R₂ back-cross progenies (back-crossed with *B. juncea*) showed various degrees of male sterility, of which 5 are completely male sterile.

Further progress has been made to generate nuclear male sterile lines in *B. juncea*, with Barnase gene driven by anther specific promoter. In a similar approach, T2 generation of transgenic plants have been raised with Barstar, an inhibitor of Barnase, to restore male fertility. The stability of the Barstar gene and the pattern of segregation have been studied.

A.4. Interrelationship of the two cultivated jute species with special emphasis to the generation of molecular marker :

S.K. Sen, T. Saha and M. Ghosh

Attempts have been made to study the genetic variability between two cultivated jute

species. Analysis have been carried out to develop molecular marker for important qualitative and quantitative character through DNA marker technology.

A.5. Nod-signal induced cell divisions in *Medicago sativa* :

Amita Pal in collaboration with Dr. Attila Feher (Hungarian Academy of Sciences, Szeged, Hungary)

During this investigation, protoplast culture of *Medicago sativa* ssp. *varia* was established from the suspension culture. The mitogenic effect of *Rhizobium meliloti* Nod factor, RM-IV (C 16 : 2, S), was studied. Influence of Nod factor in faster cell wall formation, early induction of cell division, higher amount of RNA synthesis than the control set of cultures indicates possibility of highly stimulated expression of mitotic cyclin.

A.6. Attempts to produce new genetic variants of *Carthamus tinctorius* L. (Safflower) :

Amita Pal and Shamik Das

Shoots were regenerated from calli raised from different explants of four cultivars of Safflower, viz. CVs. Bhima, NS 98, JSF 1 and APRR 3. Highest regeneration efficiency (RE) was recorded in CV. Bhima. The RE varied considerably when the ionic concentration of some of the MS macroelements were altered. Only limited success was achieved in the attempt to induce roots from these regenerated shoots. We have experimentally demonstrated that starch accumulation in the callus cells is a determinant of shoot regeneration.

A.7. Towards production of drought tolerant and disease resistant Mustard :

S.R. Sikdar and S. Paul

Somatic hybrid lines between *B. juncea* X *Diplotaxis harra* and *B. juncea* X *Trachystoma aphanoneurum* were backcrossed with *B. juncea* for the selection of desirable lines having drought tolerance and/or *Alternaria* resistant.

PUBLICATIONS

1. Pal A and Roy A Production and histological aspects of nodal rhizomes of culture raised triploid and tetraploid *Costus speciosus*. *J. Med. & Aromatic Pl. Sci.* **18** : 481-486, 1996.

2. Johnson TM, Rishi AS, Nayak P and Sen SK Cloning of a Cry IIIA endotoxin gene of *Bacillus thuringiensis* var. *tenebrionis* and its transient expression in indica rice. *J. Bioscience* **21** : 673-685, 1996.

3. Kar S, Johnson TM, Nayak P and Sen SK Efficient transgenic plant regeneration through *Agrobacterium*-mediated transformation of chickpea. *Plant Cell Rep.* **16** : 32-37, 1996.

4. Nayak P, Basu D, Das S, Basu A, Ghosh D, Ramkrishnan NA, Ghosh M and Sen SK Transgenic elite indicate rice plants expressing Cry IAc d-endotoxin of *Bacillus thuringiensis* are resistant against yellow stem borer (*Scirpophaga incertulas*). *Proc. Natl. Acad. Sci.* **94** : 2111- 2116, 1997.

Participation in Conferences/Symposia/ Training Programmes/Honours and Award Received.

Dr. Amita Pal visited Hungary for 3 months under Indian National Science Academy/ Hungarian Academy of Sciences, Scientists Exchange Programme.

Ph. D. Awarded

Name	University	Title	Guidence of
Durba Banerjee	Calcutta	Isolation and characterisation of trypsin inhibitor gene from cowpea (<i>Vigna anguiculata</i>) for its ultimate use in controlling insect attack on plants, 1996.	Prof. S. K. Sen
Chaitali Ganguly	Calcutta	Genetic analysis of genes of <i>Agrobacterium rhizogenes</i> through transposon mutagenesis, 1996.	Prof. S.K. Sen
Ferdosi Begum	Calcutta	Introgression of desirable attributes contained in widely related crucifers into <i>Brassia juncea</i> through protoplast fusion, 1997.	Prof. S.K. Sen
Soma Sengupta	Calcutta	Genetic manipulation in oil yielding <i>Brassica</i> sp. 1997.	Prof. S.K. Sen

GRANT-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. S.K. Sen	Plant improvement using modern biotechnology.	U.N.D.P.
Prof. S.K. Sen / Prof. R. K. Mandal	Centre for Plant Molecular Biology.	D.B.T.
Prof. S.K. Sen	Development of transgenic cotton plants resistant against bollworm attack and yield loss.	D.B.T.
Prof. S.K. Sen	Production of transgenic indica rice plants with useful gene.	The Rockefeller Founda-
Prof. S.K. Sen	Generation of genetically engineered tea plant.	Tata Tea Ltd.

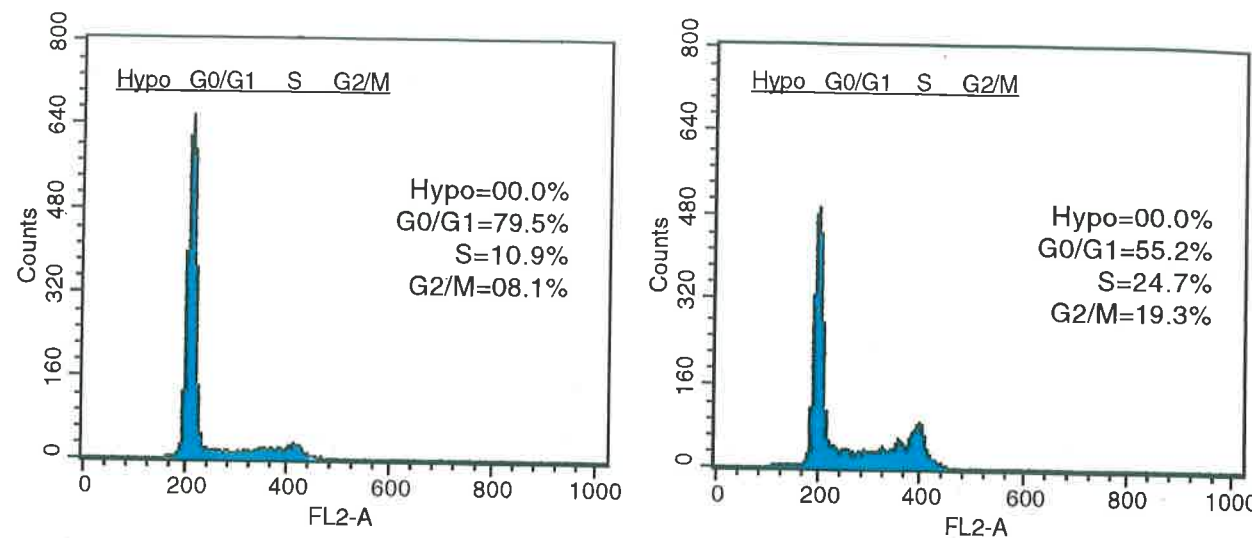
**RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POOL OFFICERS/
POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR
RESEARCH FELLOWS**

Dr. D. Basu, Dr. P. Nayak, Dr. A. Basu, Dr. T. Saha, Dr. J. Tarafdar, Dr. R.P. Mukhopadhyay, Dr. M. Chatterjee, Dr. K. Das, Dr. B.C. Sabata, Dr. N.S. Banerjee, Dipankar Ghosh, S. Roy Chowdhury, K. Roy, S. Mishra, A. Mondal, D. Das, P. Roy Chowdhury, Soma Paul, A.K. Nandi, Ramkrishnan NA, Maloy Ghosh, S. Rajlaxmi, Shamik Das, Anita Roy.

OTHER SUPPORTING STAFF MEMBERS

P. Mukherjee, B.K. Mondal, M. Singh, P. Basu Roy, B.P. Pradhan, G.C. Dey, A.K. Dey, Subal Basak, Satya Brata Jana, P. Manna, Sanjib Das, Sugata Munshi, Tapan Mandal, Manoj Aditya.

Spleenic Lymphocytes



Ehrlich's Ascites Tumor Cells

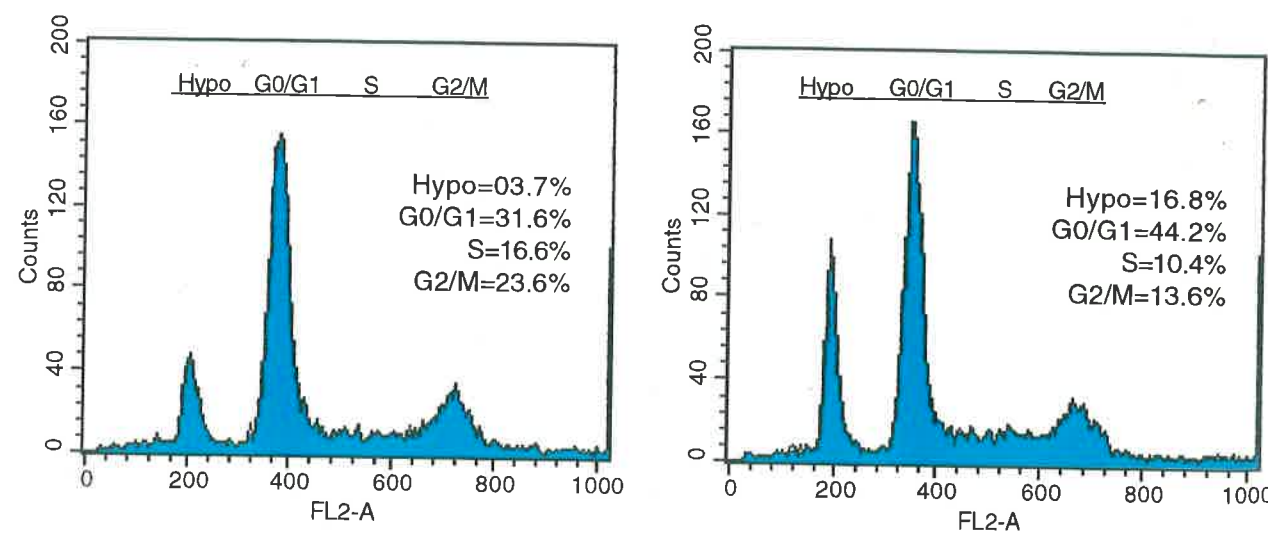


Figure 1. Differential induction of apoptosis by Protein A in Ehrlich's Ascites Tumor cells as against the splenic lymphocytes of tumor bearing mice. Note the increase in hypoploidy status of Protein A-treated EAT DNA in contrast to increased proliferation of lymphocytes after Protein A treatment.

Immunotechnology Section

Faculty : Prof. P. K. Ray

INSTITUTIONAL PROJECT III

A1. Molecular Modelling approach to study proteolytically cleaved peptide fragments of Protein A :

P.K. Ray, J. Sengupta and C. Mukherjee

Protein A (PA) is a unique molecule, being able to induce many immune reactivities when inoculated into an animal. Since PA is a foreign protein, it is assumed that it would be subjected to enzymatic (proteolytic) degradation *in vivo*. The small peptides derived from degraded PA may be responsible to induce various properties.

In our laboratory, computer mediated dissection of PA molecule was made to identify tryptic and chymotryptic fragments of PA in order to generate the smallest possible fragments of this protein still retaining Fc-binding property. Theoretical force field (molecular mechanics) minimization were done to see the stability of each fragment as well as the interaction of each with IgG from energy point of view.

A fragment (tryptic) of 20 amino acids showed binding affinity to IgG to a high extent in comparison to the whole B domain of PA (Fig.1).

A.2. Development of a database on pesticides :

P.K. Ray, J. Sengupta and C. Mukherjee

The pesticides which have been widely used for agricultural and public health purposes are not easily biodegradable and pollute the environment. Residual pesticides enter into the food chain and cause health hazards. Base level data regarding that is needed to assess the impact of individual pesticide or a group

of pesticides. This demands comprehensive electronic database covering all aspects related pesticides.

A database is being made using Foxbase software. Substantial amount of data have been already collected through Medline search and fed into the database.

INSTITUTIONAL PROJECT V

A.3. Induction of Selective Apoptosis in Ehrlich's Ascites Tumor by Protein A :

P. K. Ray, T. Das and G. Sa

Protein A (PA) of *Staphylococcus aureus* on one hand potentiates the immune function of the host and on the other hand possesses antitumor, anticarcinogenic and antitoxic properties. It has also been observed that in the tumor-bearing host, PA simultaneously causes tumor regression and immunopotentiality. Our data convincingly showed that PA induces immunocyte proliferation via tyrosine kinase-phospholipase C-protein kinase C-MAP kinase pathway in normal as well as Ehrlich's Ascites tumor (EAT) bearing mice spleen. Concentrations of PKC, c-fos and c-myc were also increased as a result of PA-treatment.

On the other hand, PA induces apoptosis in EAT cells as elucidated by DNA ladder formation, DAPI staining of nucleus and cell cycle tests (Fig. 1) by flowcytometry. All these results signified the specificity of PA action in tumor apoptosis and immunocyte proliferation. The novelty of this study lies in such differential effect of PA in normal and tumor cells which can well be utilized in designing antitumor drug.

A.4. Involvement of Nitric Oxide in Protein A induced apoptosis :

P.K.Ray, S. Goenka and T. Das

Protein A activates nitric oxide (NO) production in macrophages and lymphocytes. Since NO plays an important role in tumor killing, we studied its involvement in PA-induced cellular functions. It is observed that PA induces NO production via tyrosine kinase-phospholipase C-protein kinase C pathway. Moreover, PA induced apoptosis was blocked by NO synthase inhibitor, indicating the involvement of NO in PA-mediated apoptosis. Further studies are in progress to correlate PA-induced NO production with tumor suppressor protein p53 induction in normal as well as in tumor cells.

A.5. Development of An Enzyme-linked Immunosorbent Assay for Organochlorine Pesticides :

P.K.Ray and Arunima Das

The human system accumulates a large amount of pesticides through contaminated food materials. So our aim is to develop a cheap, affordable ELISA by which the pesticide γ HCH or more specifically lindane can be detected in picogram levels in food stuff.

Since Lindane is a small molecule (290.80Da) it can not itself act as an immunogen. Thus it is necessary to conjugate lindane with a carrier protein e.g. BSA. However, lindane does not have the reactive group which is required for such conjugation. Therefore it is necessary first to prepare some suitable chemical derivative of lindane having reactive group for conjugation. Our TLC and HPLC data indicate that the γ HCH which we are using is pure. Work is in progress to prepare caproic acid derivative by the interaction of lindane and caproic acid.

A.6. Functional Studies on small peptides of Protein A :

P. K. Ray and Pratima Sinha

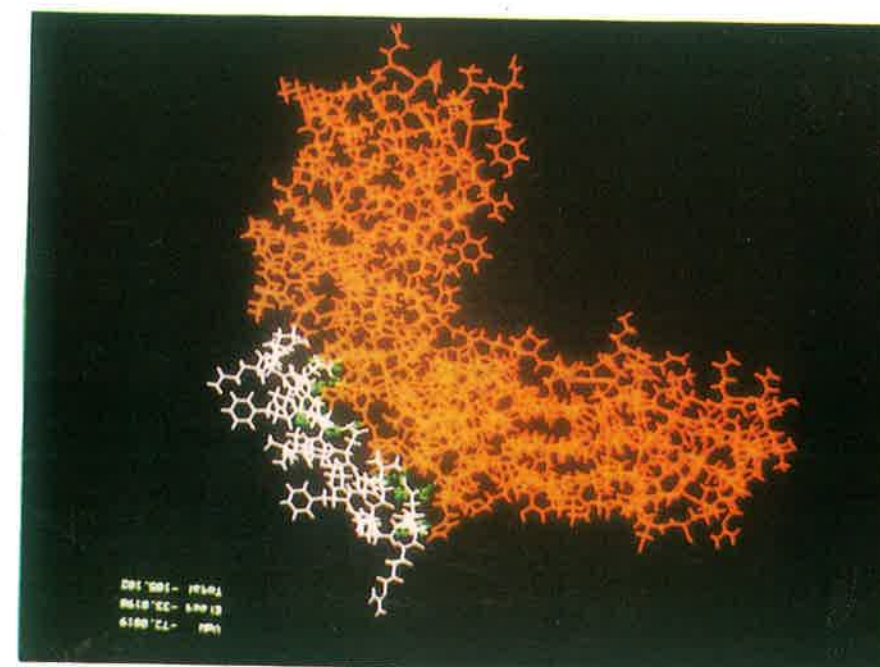
Since PA is a foreign protein, in the injected animal it may be cleaved into smaller peptide fragments by the serum proteases. Thus, the whole molecule of PA may not be required for all of its properties. To dissect out the structural entities responsible for one or the other biological properties, cellular effects of some peptide sequences (Tetra, Octa, Deca & 14 aa) of Protein A were tested *in vitro*. Among these, the deca peptide seems to have the IgG binding property as demonstrated by immunoblot analysis. Further studies are in progress to identify the peptide sequences of PA after protease treatment.

A.7. Molecular mechanism involved in providing resistance to the host against toxic insults caused by AZT and other similar drugs :

P.K. Ray, A.K. Ghosh and V. Subbulakshmi

Till date 3'-Azido 3'-deoxy thymidine (AZT) is the only FDA approved drug of AIDS. But due to its hematological toxicity this drug cannot be used in treatment of AIDS patients, though it potentially inhibits HIV-1 Reverse Transcriptase activity.

From our laboratory, the antitoxic property of Protein A (PA) has already been reported. We are now studying the cellular mechanism of AZT toxicity as well as the amelioration of AZT toxicity by PA. It has already been seen that PA can be used in combination with AZT to ameliorate its toxicity. By flow cytometric analysis it has been seen that there is a significant decrease of blood cell precursors (Stem Cells) in the bone marrow of AZT treated mice. Studies are in progress to find out whether PA can revert back this damaging phenomena. Another approach is going on to combine recombinant cytokines such as stem cell factor (SCF) or recombinant erythropoietine to cope with toxic insults of AZT.



Minimized conformation of the complex of a tryptic fragment (20 amino acids) of protein-A and Fc region of IgG molecule (Van der waals interaction energy: -72 kcal/mole, Electrostatic interaction energy:-33 kcal/mole)

PUBLICATIONS

1. Ray, P.K., Datta, P.K., Das, T., Srivastava, M. and Subbulakshmi V. Structural analysis of Protein A to localize immunomodulatory motifs. *Immunomodulation* (Ed. Upadhyay S.N.) pp. 101-110, 1997.

2. Shukla, Y., Verma, A.S., Mehrotra, N.K. & Ray, P.K. Antitumor activity of Protein A in mouse skin model of two stage carcinogenesis *Cancer Lett.* **103**, 41, 1996.

3. Ray, P.K. & Srivastava, M. An concept in cancer chemoprevention *Cancer J*; **9**, 221-225, 1996.

Participation in Conferences/Symposia/ Training Programme/Awards and Honours received

Dr. Tanya Das gave a seminar on "Induction of selective apoptosis in Ehrlich's Ascite Tumor" at the Society of Biological Chemists' *Symposium on Biochemistry and Molecular Biology of Health and Diseases*, India, 1997.

Shradha Goenka presented a paper on "Nitric oxide acts as second messenger in the Protein A-induced immunostimulating pathway" at the *Society of Biological Chemists' Symposium on Biochemistry and Molecular Biology of Health and Diseases*, India, Abst. D1, 1997.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. P. K. Ray	An approach to develop microbial pesticide degradation technology to reduce burden of long persistent pesticide residues in various food stuff.	DBT
Prof. P. K. Ray	Development of an Enzyme Linked Immunosorbent Assay for organo-chlorine pesticides.	DBT
Prof. P. K. Ray	Development of database on pesticide residue in food materials.	DBT
Prof. P. K. Ray	Development of an immunotherapeutic approach to control aflatoxin mediated death in poultry.	DST & NES Govt. of West Bengal

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Dr. Tanya Das, Dr. Manda Srivastava, Dr. Pratima Sinha, Jayati Sengupta, V. Subbulakshmi, Shradha Goenka, Amiya Ghosh, Arunima Das.

OTHER SUPPORTING STAFF MEMBERS

R. Das. U.K. Ghosh, A. Sen.

Environmental Sciences Section

Faculty : Prof. P. K. Ray

INSTITUTIONAL PROJECT IV

A.1. Development of arsenic selective synthetic/natural Inorganic components for the decontamination of arsenic from drinking water:

P. K. Ray, D. P. Modak and Amiya K. Maiti

Since last decade, West Bengal has been suffering from arsenic pollution in drinking water, using oxides of various metals attempt have been made to adsorbant the As (III) from water. We have seen that the mixed oxides are more efficient to act as a scavenger than the individual oxides with kd values for arsenic $5.0 + 10^4$. The IR, TGA, DTGA and other structural analysis are initiated. A pilot scale study has also been strated.

A.2. Microbial degradation of organochlorine pesticides from food products :

P. K. Ray, N.C. Mandal, P. K. Chakrabrotty, P. Bhattacharyya, D.P. Modak, Amiya K. Maiti, Sujit Ghosh

The organochlorine pesticides are known to be very toxic and appreciable amount is found in food material. We have undertaken a study to reduce the level of contaminated HCH in various food and agricultural crops by using encapsulated microbes. Highly efficient bectrial strains have been isolated by enrichment culture techniques. The test organism grows efficiently on different isomers of HCH as a sole source of carbon. The number of metabolites and intermediate metabolites are being characterized by GC-MS and NMR. Isolation and purification of various enzymes involved in the degradative pathways are being worked out.

On the other hand we have also engaged in isolation of specific gene(s) responsible for degradation process. It has been found that in one bacterial strain (Sg 10), such gene (s) are located in chromosomal portion, instead of plasmid. As a result, subsequent primers will be synthesized and study would be designed for isolation of specific gene designed from studied bacteria. On the other hand, chromosomal insertional mutagenesis study also are in progres. Conjugation with S.17.1 (pS 5011) *E. coli* strain having Tn 5:: Neo found to be unsuccessful as Sg 10 have Neomycin resistance, so we are studyig it with Tn 10::Tet.

Another Gram negative strain, Sg 22 also have the characteristic of gamma-HCH degradation. Insertional mutagenesis Tn 5: Neo through conjugation are also in progress.

A.3. Search of immunomodulatory compounds from exotic Indian plants.

P.K. Ray, M. Chakraborty, P. Bhattacharyya, P. K. Debnath, D. P. Modak,, Goutam K. Datta

For an extended period of time the herbal product has been known for an effective immunomodulator in Ayurved. But the detailed scientific investigation in this area is still lacking. Some of the most important Indian Plants which were used, to be used as potent drugs, are Amlaki (*Emblica officinalis*), Haritaki (*Terminalia chebula*), Mandukaparni (*Hydrocotyle asiatica*), Nagbala (*Sida vernicaefolia*), Pipul (*Piper Nigram*), Vaca (*Acarus calamus*), etc. Recently some small

peptides of microbial origin has also been found in our laboratory as potent immunomodulator. Some synthetic Octa, Tetra, and Nona Peptides have also been investigated from our laboratory for its immunomodulatory effect. Besides IL-1, IL-2, IL-6, IL-8, Gammaglobulin, Phospholipid etc. have a immunostimulatory or immuno suppressing effect.

Most of these products are to be isolated either from organisms or cell culture. For the therapeutic uses, large quantities of extraction and isolation is required.

In this study, we have isolated various chemical constituents for studying their immunopotentiating effects in both *in vivo* and *in vitro* murine system. Studies are in progress.

A.4. Development of an immunotherapeutic approach to control aflatoxin mediated death in poultry.

P. K. Ray, P. Bhattacharyya, D. P. Modak, D. Ghosal, S. Bid.

In India, rapid development of poultry industry has given rise to a huge demend of poultry feed. Improper storage facility, use of low grade oil seeds and warm/humid climate facilitate growth of several toxin producing fungi and other microbes in poultry feed. Birds are dying in poultry farms in thousands because of a feed contaminant called 'Aflatoxin' (AF). This is resulting in huge economic losses in poultry industry in our conutry which is also considered to be a cottage industry. Aflatoxin is a potent hepatocarcinogenic mycotoxin produced by *Aspergillus flavus* group of fungi on food and feed. Besides, it is reported that AF exposure causes decrease in production of eggs in birds. It seems that AF is posing multipronged threat to poultry industry.

To abrogate the toxic effects of AF a prophylactic approach will be introduced with new immunomodulators to immunopotentiate the otherwise immunosuppressed hosts, which even after the withdrawal of the toxin contaminated feed, usually die due to infections caused by opportunistic pathogens (bacteria, viruses and fungi). The immunotherapeutic approach is expected not only to reduce the toxicities but also to immunopotentiate birds enabling them to survive in an otherwise hostile environment.

We have investigated immunomodulating properties of protein A in chick (normal and aflatoxin intoxicated) for three batches of chick at Ashok Nagar, Howrah. The results obtained in this project are encouraging and death rate has been drastically reduced. The work is in progress.

Development of Pesticide Database :

P.K. Ray and Jayati Sengupta

A pesticide data base is being developed with most desired toxicological information, especially focussing attention on food contamination and toxicity in the computer.

PUBLICATIONS

1. J. Datta, S. Ghosh, A. K. Maiti, S.K. das, D.P. Modak, P. Bhattacharyya, A. Ghosh, N.C. Mandal, P.K. Chakrabarty and P.K. Ray. Accepted for presentation for ICFB '92 at Trivandrum, 1997.
2. Shukla Yogeshwar, Verma A.S. Mehrotra N.K. and Ray P.K. Antitumour activity of Protein A in a mouse skin model of two stage Carcinogenesis. Cancer : Letters, 103, 41-47, 1996.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. P. K. Ray	An assessment of Pollution impact of sediment dredging in Hooghly river and its estuarine regions.	Calcutta Port Trust
Prof. P. K. Ray	An approach of develop microbial pesticide degradation technology to reduce burden of long persistent pesticide residues in various food stuffs.	D.B.T
Prof. P. K. Ray	Development of data base on Pesticide residue in food materials.	D.B.T
Prof. P. K. Ray	Development of an Immunotherapeutic approach to control aflatoxin mediated death in Poultry.	D.S.T (Govt. of West Bengal)

**RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POST-DOCTORAL
FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR
RESEARCH FELLOWS**

Prof. P. K. Ray, Dr. D. P. Modak, Dr. Jharna Datta, Mr. Amiya K. Maiti, Mr. Sujit Ghosh,
Dr. G. K. Datta, Ms. S. Bid, Ms Jayati Sengupta.

OTHER SUPPORTING STAFF MEMBERS

Mr. A. Adak, Mr. A. Dalal, Mr. S. C. Jana, Mr. S. Roy, Mr. S. Mandal.



Hybrid Rice Seed Bed at Madhyamgram Experimental Farm



Plant Sciences Laboratory and Green House coming up at Madhyamgram Experimental Farm

Madhyamgram Experimental Farm

Prof. S. Sen-Mandi (Scientist-in-charge)

An Experimental farm at Madhyamgram caters to the need of Scientists interested in transferring the knowledge gained in their research laboratory to the agricultural land and also to raise experimental plant material. Staff members at the farm appropriately prepare land as per need of individual scientist : sow experimental seed, conduct appropriate cultural practices and harvest the crop as per instruction of the scientist. Scientists are also assisted in recording field data of their crops.

Floriculture constitutes another aspect of the farm activities. Flower pots produced in the farm are often used for deautification of the campuses of Bose Institute as and when

necessary. Some pots are also sold for earning revenue for the Institute.

A programme for revenue earning through sale of farm-grown produce has been initiated on parts of unused land within the field. Annual vegetable crops are grown, harvested and sold at a reduced rate to staff members of the Institute. The excess is sold outside at market rate.

Mango, Coconut, Safeda and Jackfruit trees in the farm are given out on lease to the highest bidding party. This also constitutes a part of the revenue earning programme.

OTHER SUPPORTING STAFF MEMBERS

Bimal Chandra Modak, Kachiram Kole, Pulak Kumar Ray, Basudev Jana, Amal Krishna Das, Rakhai Chandra Jana, Dilip Pramanik, Nalini Ranjan Malik, Kalipada Kayal, Tarapada Ray, Chitta Ranjan Mallik, Sukumar Das, Rajkishor Lenka, Sabita Baisya Subhas Senapati, Jagabandhu Nayak, Rabin Talukdar, Lakshmi Kanta Pradhan, Inal Ali, Nodiram Kayal, Tapas Chakrabarti, Sukanta Chakrabarti, Bhanu Kisku, Mahesh Dasgupta, Subrata Banerjee.

Library

Ms. R. Bhattacharya, (Librarian, Acting).

The Library primarily serves the scholars, faculty members and staff of the institute. Researchers and scientists of other institute can be a member of the library with a membership fee. The collection consists of both biological and physical sciences. Library subscribes quite a number of useful journals. Some of the journals are subscribed through Full-text-journal-service (FTJS) of INSDOC for 1997.

Acquisition

Library contains 31,161 volumes of books, journals and theses upto 31.03.97. Library purchases 118 books under a special grant. It subscribes 87 journal titles for the year 1997. Library also receives a number of pamphlets, reports, newsletters, publishers' catalogue etc.

Photocopying services

A new heavy duty machine (RPG RICOH, model NO. FT 5035) with automatic sorter and automatic feeder facilities have been installed at the Centenary Building Library. Photocopying services are provided to institute as well as outside users. 1,13,265 copies in the Centenary Building Library and 62, 211 copies in the Main Campus Library were given during the period. Under inter-library loan system photocopies were also supplied to INSDOC.

Other Supporting Staff Members

R.Mitra, P.G. Das, K.P. Hait, S.K. Paul, P.K. Sarkar, B.S. Chaudhuri, G. Biswas, A. Kolay, G. Mukherjee, S. Bhuiyan, M. Jogsharma, A.K. Nandi, D. Das.

PUBLICATIONS

1. Chatterjee, Chinmoy and Sarkar, Pradip. Electronic copyright and world wide web; a critical analysis in the perspective of the US whitepaper on IPR. *Proc. XVII National Seminar of IASLIC*. 161-166, 1996.

2. Dutta, Namita and Mitra, Rukmini. Impact of information technology in business houses in Calcutta - an evaluative study. *Proc. XVII National Seminar of IASLIC*. 139-142, 1996.

Participation in Conferences/Symposia/Training Programme/Awards and Honours received.

Rukmini Mitra, Banhi Sikha Chaudhuri and Pradip Kr. Sarkar participated in the 17th National Seminar of IASLIC, held at Calcutta on 10-13 Dec. 1996.

Kalipada Hait and Gautam Mukherjee attended the course "Introduction to Computers", held at DIC, Bose Institute on 10-21 September 1996.

Gopa Biswas stood first in the Hindi Praveen examination of November, 1996, conducted by the Hindi Teaching Scheme (Examination Wing), Ministry of Home Affairs, New Delhi.

Workshop

Mr. A Mukherjee, (Superintendent)

The Bose Institute Workshop has Mechanical, Electrical, Refrigeration, Carpentry, Glass Blowing, Electronic and Drafting Units. The Workshop received about 2150 requisitions during the year from various departments and sections.

The important job was to design and fabrication of several instruments and gadgets. Some of these were Cell Harvester, Crystallisation Box, Horizontal gel electrophoresis apparatus, Target Holder, Radio active shield, Drum of Burkard Volumetric Sampler, Changing arrangement of Microscope, repair of Vacuum pump, Water bath, Shaker, Autoclave etc. The Carpentry unit has completed the interior decoration work of the Immunotechnology section successfully in this period. For Museum setup at Darjeeling, one Crescograph and one Microwave apparatus has also been prepared recently.

Scientific instruments were repaired and maintained by the Workshop personnel.

The Electrical unit at both campus has undertaken several Electrical work including A.C. machine lines, complete wiring of Instrument room etc and for Centenary Building sub-station the new 500 KVA Transformer has been installed to meet the enhanced load.

Work is still going on for several instrumentation facility in the Institute.

Electrical renovation work at Darjeeling Field station was completed very recently including the illumination of Museum there. The Refrigeration section maintained various cold rooms and repaired A.C. machines upon request.

Glass apparatus as required by Scientists were made by the Workshop. The drafting section helped students and scientists in preparing their thesis and manuscripts. Arrangements for projection and microphone system during seminars were managed by Workshop personnel. The Workshop store is keeping stock of various items frequently needed, purchased according to Institute rules. Internal telephone system are looked after by the Electronic unit with satisfactory in this period and also new internal directory table was introduced.

One 118NE (Fiat) car and one Tata Sumo car were purchased for the Institute vehicle fleet under the supervision of the workshop Supdt. in this period. Services to Madhyamgram Field Station and Scholar Hostel at Salt Lake has been extended as usual.

OTHER SUPPORTING STAFF MEMBERS

Mrinal Chandra Roy, Sk. Abdul Rezzak (Retired on 31st Jan '97), Dipak Dutta, Ashutosh Sarkar, Samar Dutta, Sisir Ghosal, Sithil Mukherjee, Sisir Sarkar (Retired on 28th Feb '97), Anil Sengupta, Tarapada Das, Dipen Sen, Subhas Chakraborty, Jogendra Nath Das, Basanta Kr. Shit, Bholanath Saren, Sourendra Nath Chakraborty, Abdul Rahaman Molla, Panchanan

Santra, Panchugopal Karak, W.D' Rozario, Sk. Md. Raffick, Rajkumar Das, Pranab Banerjee, Lochan Shee, Sm. Sairun Begum, Gopal Ch. Das, Sk. Md. Farruck, Kishori Mohan Saha, Brahmadeo Prasad, Kalachand Sen, Thakur Gond, Nageswar Das, Nirdhan Chandra Das (Retired on 31st Jan ' 97), Kalipada Das.

CENTENARY BUILDING

Pitambar Patra, Bankim Dutta, Sk. Md. Ehia Hossain, Tapan Mondal, Ashit Banerjee, Murari Mohan Shee, Swapan Jogosharma, Baidyanath Murmu.

Regional Sophisticated Instrumentation Centre

Dr. A. Chatterjee (Scientist-in-Charge)

The RSIC continued to provide data to users in the Institute as well as in the region, maintaining the instruments in the best possible manner. The resume of activities are shown in the table. Attempts to acquire a new Scanning Electron Microscope continue but still remain unfulfilled.

A workshop on "Biological Electron Microscopy" was organized during February 3-8, 1997. Twenty three participants from different parts of the country were given hands-on training in sample preparation techniques for Transmission Electron Microscopy.

Consultancy services to public and industrial organization continued to be provided as in the past.

RSIC personnel also conducted lecture courses in Calcutta and Jadavpur Universities.

PUBLICATION

1. A. K. Sen, Computer aided letter writing in Electronics for You, New Delhi in August 1996.

2. A. K. Sen, Basic Radio Transmitter Design & Construction in Electronics for You, New Delhi in November 1996.

Participation in Conferences/Symposia/ Training Programmes/Award and Honours received

Dr. S. Chaudhuri, participated in a training programme on Single Crystal X-ray Diffractometry at Delft, Netherlands from 4-7 November, 1996. Guest worker at the University of York, U.K. Visited X-ray laboratory of the University of Oxford, U.K.

Sri A. Biswas, Sri S. Mukherjee, Sri S. Maikap and Mrs. T. Modak (Dhar) participated National Conference of the Electron Microscope Society of India held at IACS, Jadavpur, Calcutta, during December 5-7, 1996.

Sri S. Mukherjee & Sri A. Sen participated in training programme on AAS conducted by Lab India Instruments Pvt. Ltd. in Pune during February 17-19, 1997.

RESUME OF ACTIVITIES — FROM APRIL 1996 TO MARCH 1997

Outside Users			Bose Institute Users	
Name of Instrument	No. of Samples	Revenue Earned	No. of Samples	Revenue Earned
MASS	34	Rs. 4315/-	121	Rs. 6825/-
X-RAY DIFF	4	6460/-	NIL	NIL
EPR	93	7050/-	249	12450/-
AAS	100	9725/-	25	6100/-
HPLC	1	600/-	110	22314/-
TIME OF USE (IN HRS)			TIME OF USE (IN HRS)	
SEM	114	18800/-	71	14132/-
GLC	179	9650/-	29	1400/-
FLS	43	2000/-	186	15520/-
TEM	234	27510/-	288	18272/-
TOTAL 86110/-			TOTAL 97011/-	
			Grand Total Rs. 1,83,121/-	

OTHER SUPPORTING STAFF MEMBERS

Dr. Dilip Kumar Mukherjee, Dr. Siddhartha Chaudhuri, Arabinda Biswas, Tapan Dutta, Jaideb Chattopadhyay, Chitra Ganguly, Arup Kumar Sen, Samir Kumar Mukherjee, Pradip Kumar Karmaker, Jaganmoy Guin, Subhas Chandra Maikap, Pathik Ranjan Roy, Alakananda Sarkar, Tanima Modak Dhar, Manisha Banerjee, Debabrata Polley, Sankar Santra, Sanjoy Santra, Saraswati Sen, Shyam Sundar Kundu, Gobinda Das, Amit Kumar Mahinder.

J.C. Bose Unit and Museum

Mr. Dibakar Sen (In-Charge)

J.C. Bose Unit and Museum took the responsibility of duplication of J.C. Bose's Crescograph instruments with Bose Institute Workshop. After its built up, Shri Dibakar Sen, In-charge. J.C. Bose Unit and Museum brought it to working condition. Eventually as per schedule it was delivered to B.I.T.M.

During the current year a good number of visitors both from abroad and home visited the Museum. Besides, the J.C. Bose Unit and Museum furnished information regarding Acharya J.C. Bose and his works to various organisations, eminent persons on request.

Special demonstrations in the Museum were arranged to mark the anniversary day of the Institute on 30th November, 1996 and on 28th February 1997 to observe "Science day."

Participation in conference/Symposium/Training Programme/Award and Honour received

Dibakar Sen delivered "Shive priya Memorial lecture" on 11th April 1996 at Bangiya Bijan Parisad. On a special invitation from Vice-Chancellor, Visva Bharati University, Shri Sen spoke at Santineketan on "Scientist and Poet—Jagadis Chandra and Rabindranath" during "Rabindra Saptaha" on 11.8.96. Shri Sen also delivered lecture in the

20th and 21st orientation programme at the Academic Staff College, Burdwan University on 16.11.96 and 13.3.97 on the topic "J.C. Bose—Doyen of Modern Indian Science". Demonstration were given by Shri Sen with original Microwave Instrument of Acharya J.C. Bose on generation, transmission and reception of microwaves in the HAMFEST INDIA '96 at Yuba Bharati Krirangan, Salt Lake on 19.12.96 which Director, Bose Institute, inaugurated and in the Training Programme in Millimeter wave Technology and Wave propagation, sponsored by the Govt. of West Bengal on 29th January 1997 at the CAS building, IRPE, C.U. on 23rd February 1997. Shri Sen attended a seminar to speak on Acharya J.C. Bose at Indira Gandhi National Open University (IGNOU) at Kanchrapara Technical School. Federation Hall Society arranged "Acharya J.C. Bose Oration 1997" on 14.3.97 in their auditorium where Shri Sen was the speaker.

In fine, Paschimbanga Bijan Mancha published a Bengali Book "Jagat Savay Bijnani Jagadis Chandra" authored by Dibakar Sen which was released by the Vice-Chancellor, Calcutta University on 13th February 1997 at U. B. I. Auditorium of Calcutta Book Fair.

OTHER SUPPORTING STAFF MEMBER

N. Das

Distributed Information Centre

Dr. C. Mukhopadhyay (In-Charge)

The Distributed Information Centre at Bose Institute was formed under Biotechnology Information Systems (BTIS) programme of the Department of Biotechnology (DBT), Government of India and started functioning in May 1988. This centre specializes in the areas of Genetic Engineering and Molecular Modelling.

Setting up of the National Biomolecular Modeling Facility at DIC, Bose Institute :

The Molecular Modeling Facility has recently been augmented by the incorporation of a Silicon Graphics Indigo2 workstation housing InsightII software package for Molecular Modeling.

Development of Inhouse Data-Base/Programmes

1. **Loop Database of Proteins :** A database of loop sequences had been prepared and categorized into different groups. A program had been developed for this purpose which reads PDB CDROM data and collects the loop informations. This program has been deposited to Protein Data Bank and is under their scrutiny.

2. **Protein Data Bank Browser (for PC) :** A Protein Data Bank browsing software package had been developed to search PDB entries by Compound, Source and Author fields and to display the secondary structure linearly. This package had also been deposited to Protein Data Bank and is under their scrutiny.

Workshops/Symposiums/Seminars :

1. A training of in-house employees on Introduction to Computers was organised

during Sept'96. The number of registered participants was 20.

2. A workshop on **Molecular Modeling Methods and Applications** was organised during 17th to 22nd March '97. Lectures by Dr. D. Bhattacharya (SINP), Dr. C.N. Mandal, Dr. C. Roychaudhuri (IICB), Dr. C. Mukhopadhyay and Dr. G. Basu (BI) were organized. Elaborate hands-on training was given to the participants. Number of registered participants was 21 and workshop was highly appreciated.

Manpower Training Programmes :

1. **Course Work Organized :** DIC had organized two courses. Introduction to PC and Sequence Analysis for the In-house research students and associates. The courses had been included in Bose Institute's course work curriculum as core and elective courses.

2. Two B. tech students from NERIST, 5 D.C.A. students from RCC (Jadavpur) had completed their projects in DIC under the supervision of DIC personnel.

New Systems Added to DIC :

1. **4 Digital Venturis 486** machines with 4 to 16 MB RAM, 840 MB to 1.2 GB hard disk have been added to the existing PC range in DIC. The machines are going to be used as Network server, Email Server, Printer Server, etc.

2. Two existing 386 and one 286 machines had been upgraded to 486 DX4 machines with 4 MB RAM and 1.2 GB hard disk. These machines are being used for database development work, Bibliographic Search and



The Indigo2 Workstation at National Facility for Molecular Modeling at DIC



Students taking Practical Sessions at the Molecular Modeling Methods and Applications, Workshop during 17th to 22nd March, 1997 at DIC

Word Processing.

3. Another 2 GB hard disk had been added to the existing 3 GB hard disk of the Dec Alpha Server.

4. GCG Version 9.0 had been procured and been successfully installed in Dec Alpha. This package is now being extensively used by the scientists for Sequences Analysis.

Participation in Conference/Symposia/ Training Programme/Awards and Honour received.

1. Dr. C. Mukhopadhyay, delivered a lecture on "Modeling the effect of

Glycosylation in Protein" in the One day Seminar on "Modelling of Biological Process", on 20th January, 1997 at I.I.C.B., Calcutta.

2. Dr. C. Mukhopadhyay, delivered a lecture on "Molecular Dynamics Simulation of Complex Carbohydrates from IgG and IgM" at the Xth Carbohydrate Conference, on 21-22nd, November, 1996 at I.I.C.B., Calcutta.

3. Mr. T.K. Bhattacharyya & S.K. Gupta attended a workshop on "Networking and Biological Data Analysis", during 4-6, February, 1997, at Central Institute of Freshwater Aquaculture, Bhubaneswar.

OTHER SUPPORTING STAFF MEMBERS

V. S. Sundararajan, T. K. Bhattacharyya, C. Mukhopadhyay, T. C. Ghosh, S. Majumder, S. K. Gupta, J. Mondal.

Publication

Mr. A.K.Das Gupta (Superintendent)

Since its start in 1980, the Publication Section has been doing all sorts of Publications of the institute with due success, i.e. Transactions of the Bose Research Institute (four issues in a year); Annual Report (both English and Hindi versions); Memorial lectures; Director's Report; Folders ; Booklets ; Posters and Leaflets of Symposium and Training Programmes, etc.

On 30th November, 1996 two valuable books entitled (i) **J.C. Bose—Scientist and Dreamer**, Vol. I & II, edited by Prof. P. Bhattacharyya and Prof. M.H. Engineer and (ii) **Science and Society—Reflections** edited by, Prof. P. Bhattacharyya, A.K. Das Gupta and Mrs R. Mitra have been published.

To meet the increasing demand of photocopying one RPG RICOH heavy duty copier machine with auto reverse document feeder and shorter facility has been installed and functioning well.

OTHER SUPPORTING STAFF MEMBER

C.K. Sasmal



Celebration of 50 years of Independence



Attempts to beautify Main Campus

Administration

Prof. P. K. Ray (Director)

Prof. Prantosh Bhattacharyya (**Registrar, Officiating**)

Mr. K. Chaudhuri (**Asstt. Registrar-I**), Mr. R.K. Kundu (**Asstt. Registrar-II**)

Mr. S. Pal (**Accounts Officer**)

OTHER SUPPORTING STAFF MEMBERS

Centenary Campus

R.N. Bhattacharyya, S.P. Sit, P.K. Barman, A. Bera, P. Das, Ankur Dutta, S.R. Dechoudhury, A.K. Sengupta, T. Mukherjee, E. Pal, T. Chakraborty, N. Roy Ghatak, S. Kar, Subir Sen, A. Chakraborty, Debidas Saha, A.K. Ghosh, R.R. Pandey, M.S. Mitra, Dhruvajyoti Sen, Sujut Kr. Ghosh, B.K. Mondal, M.C. Das, Rita Nath, Sisir Chakraborty, Swapan Kr. Singha, Rubi Sarkar, Sudam Jana, P. Mullick, R. Chakraborty, Rina Das, Sanjay Kr. Chaki, Debashis Koley, Somnath Das, A. Bhowmik, Sujata Pandit, Sukumar Das, S. Chatterjee, R.C. Sarkar, Dipak Dutta, Ranjit Ghosh, K. Sur, S. Devi, C. Rangwa, T.K. Banerjee, K. Turi, S. Turi, K. Basar, N. Yadav, Md. K. Ansari, S. Guchait, Kanai Hazra, P. Bhunya, Nemai Das, Kanak B. Hazra, Duryodhan Nayak, Sanjib Das, Bablu Mondal, Kashinath Pul, Kamala Turi.

Main Campus

Arun Kumar Das Gupta (**Superintendent**), Samar Chakraborty (**Overseer**), Sankar Nath Sinha, Rina Roy, Sanat Kr. Dey, Mahendra Nath Shee, Santosh Patra, Ramani Kanta Jana, Tarun Chakraborty, C. K. Sasmol, R. Ram.

Acharya Jagadis Chandra Bose Memorial Lecture

The 58th Acharya Jagadis Chandra Bose Memorial Lecture was delivered by **Prof. G. Padmanaban**, Professor of Biochemistry and Director Indian Institute of Science, Bangalore, on "Principles of Gene Therapy".

Lectures

1. **Dr. Kali Pada Das**, Department of Chemistry, Bose Institute, Calcutta, "Alpha-crystallin as a molecular chaperon", August 2, 1996.
2. **Dr. B. Gopalakrishnan**, University of Cambridge, U.K. "Dissection of the folding of a beta-sandwich protein by NMR studies of peptide fragments", August 9, 1996.
3. **Dr. Jharna Roy**, Department of Molecular Genetics, Cornell University, USA, "Retinal Pigment Epithelium—A model system to study molecular basis of lysosomal storage disease and correction by gene therapy", August 23, 1996.
4. **Dr. B.K. Chatterjee**, Department of Physics, Bose Institute, Calcutta, "An unusual spark breakdown in gas", August 23, 1996.
5. **Professor Sukhamoy Lahiri**, Department of Physiology, University of Pennsylvania School of Medicine, Philadelphia, USA, "Oxygensensing in the carotid-body", August 30, 1996.
6. **Dr. Ursula Kara**, Molecular Parasitology Laboratories, National University of Singapore, Singapore, "Malaria research at the molecular parasitology laboratories of the National University of Singapore", September 6, 1996.
7. **Dr. Partha P. Mukherjee**, M.D., Department of Medicine, R.G.Kar Medical College, Calcutta, "AIDS -- symptoms, precautions and home-based management", September 13, 1996.
8. **Dr. Dibyendu Sengupta**, Department of Botany, Bose Institute, Calcutta, "A mammalian 2-5A system functions as an antiviral pathway in transgenic plants", September 20, 1996.
9. **Dr. Gautam Bandyopadhyay**, V.A. Medical Center, University of Southern Florida, USA, "The post-receptor signalling pathways for insulin action : role of protein kinase C in glucose transport", September 27, 1996.
10. **Mr. Sobhen Banerjee**, M. Tech.(IIT/KGP), Ex-industrialist, "Experiences of a technical entrepreneur", October 11, 1996.
11. **Dr. Sampa Das**, PMCG Section, Bose Institute, Calcutta, "A transgenic approach with Bt ICP genes for insect pest control", November 8, 1996.
12. **Dr. Ranjan Mukherjee**, Senior Research Scientist, Ligand Pharmaceuticals, San Diego, USA, "Role of intracellular receptors in diabetes", December 13, 1996.

Annual Report

88

13. **Prof. Bijay K. Pal**, California State Polytechnic University, Pomona, California, USA, "Hammerhead ribozyme : therapeutic approaches to retrovirus-induced diseases", December 20, 1996.
14. **Dr. Elizabeth Bik**, National Institute of Public Health, Bilthoven, Netherlands, "Vibrio cholerae 0139 BENGAL and 037 SUDAN strains : a molecular perspective", January 31, 1997.
15. **Prof. M.M. Sayeed**, Department of Physiology, Loyola University Medical Center, Chicago, USA, "Calcium-signalling in leukocytes in patho-physiological conditions", February 7, 1997.
16. **Prof. Salil K. Bhattacharya**, Pharmacology Department, Benares Hindu University, Benares, "Oxidative free radicals in health and disease", February 7, 1997.
17. **Dr. G. C. Kundu**, Development Genetics Section, NICHD/NIH, Bethesda, Maryland, USA, "Invasion of the extracellular matrix by NIH3T3 cells : role of the high affinity phospholipase A2 receptor", February 14, 1997.
18. **Prof. Bernard Mechler**, German Cancer Research Centre, Heidelberg, Germany, "Networking a tumor suppressor in drosophila : cytoskeletal dynamics and nuclear events", February 17, 1997.
19. **Dr. Sudhakar Yarlagadda**, Solid State and Molecular Physics Division, Saha Institute of Nuclear Physics, Calcutta, "Quasiparticle properties of two-dimensional electron gas", February 21, 1997.
20. **Dr. Ashok Kumar Chakraborty**, School of Medicine, Yale University, New Haven, USA, "Melanocyte : its function and response to UVB radiation", March 7, 1997.

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 agencies 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 several forms. The Council also record its thanks to the British Council, Federal Republic of Germany, United States of America, the Rockefeller Foundation, the ECU and other for their support in several forms, 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
2. Prof. S. Bose
3. Shri Debabrata Bose
4. Prof. R. N. Chakraborty
5. Prof. (Mrs.) Debi Chakraborty
6. Mr. Somnath Sanyal
7. Prof. S. N. Chatterjee
8. Secretary, Department of Science & Technology, Government of India, or his nominee
9. Director General, CSIR or his nominee
10. Joint Secretary and Financial Adviser, Department of Science and Technology, Govt. of India 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, Representative of the Calcutta Municipal Corporation
15. Director, Bose Institute - Ex-officio
16. Deputy Director, Bose Institute - Ex-officio
17. Prof. Sandip K. Basu
18. Prof. G. Padmanaban

Nominees of the
Governing Body

Two scientists from
outside West Bengal

Registrar, Bose Institute - Secretary

- Invitees :
1. Representative of the Academic Council
 2. Representative of the 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. Banerjee
8. Prof. B. B. Baliga
9. Prof. S. N. Chatterjee
10. Shri Somnath 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. Joint Secretary and Financial Adviser to the Department of Science and Technology, Govt. of India, or his nominee
4. Principal Accountant General (A & E), West Bengal
5. Director, Bose Institute - Ex-officio

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

1. Director, Bose Institute, Calcutta—Chairman
2. Head—RSIC, Bose Institute, Calcutta—Member-Secretary
3. Representative of DST, Govt. of India
4. Prof. S. C. Roy, Deptt. of Physics, Bose Institute, Calcutta
5. Prof. B. Bhattacharya, Deptt. of Bio-chemistry, Bose Institute, Calcutta
6. Prof. N. Chatterjee, Saha Institute of Nuclear Physics, Calcutta
7. Dr. R.B. Singh, Director, Forensic Sc. Lab., Mahanagar, Lucknow
8. Prof. S. K. De, Rubber Technology Centre, Kharagpur
9. Prof. K.S. Mukherjee, Department of Chemistry, Viswa Bharati University, Calcutta.

We condole the untimely death
of
Shri Amaresh Jana (Administration),
Shri Naresh Talukdar and
Shri Mahabir Prasad (Bldg. Maintenance),
Ms. Chitra Ganguly (RSIC),
Shri Bindaban Ghosal and
Shri Chittaranjan Santra (Chemistry).

,vgolc

sttuol

sttuolc



20

20

20

20

20

20

nt p