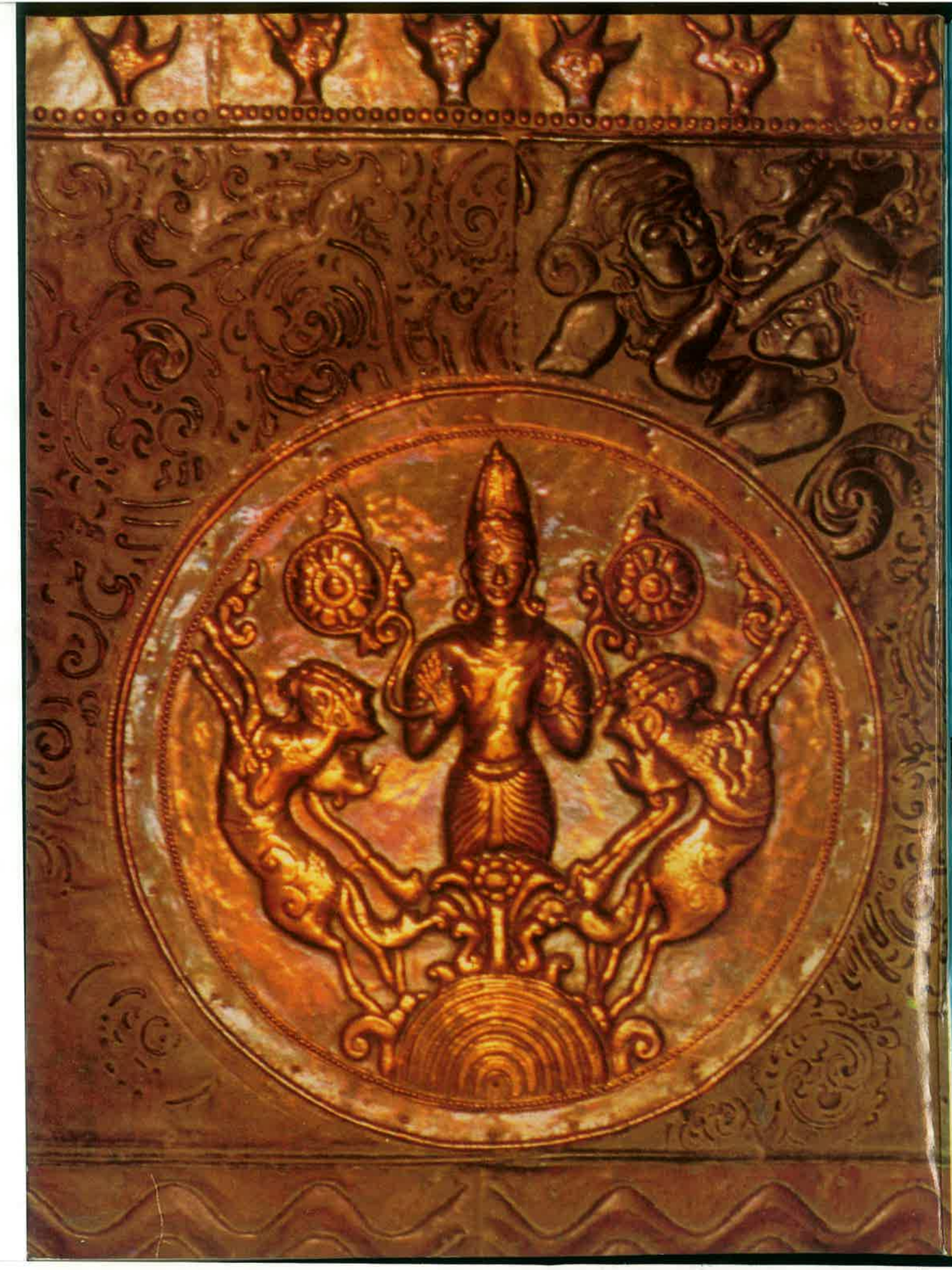
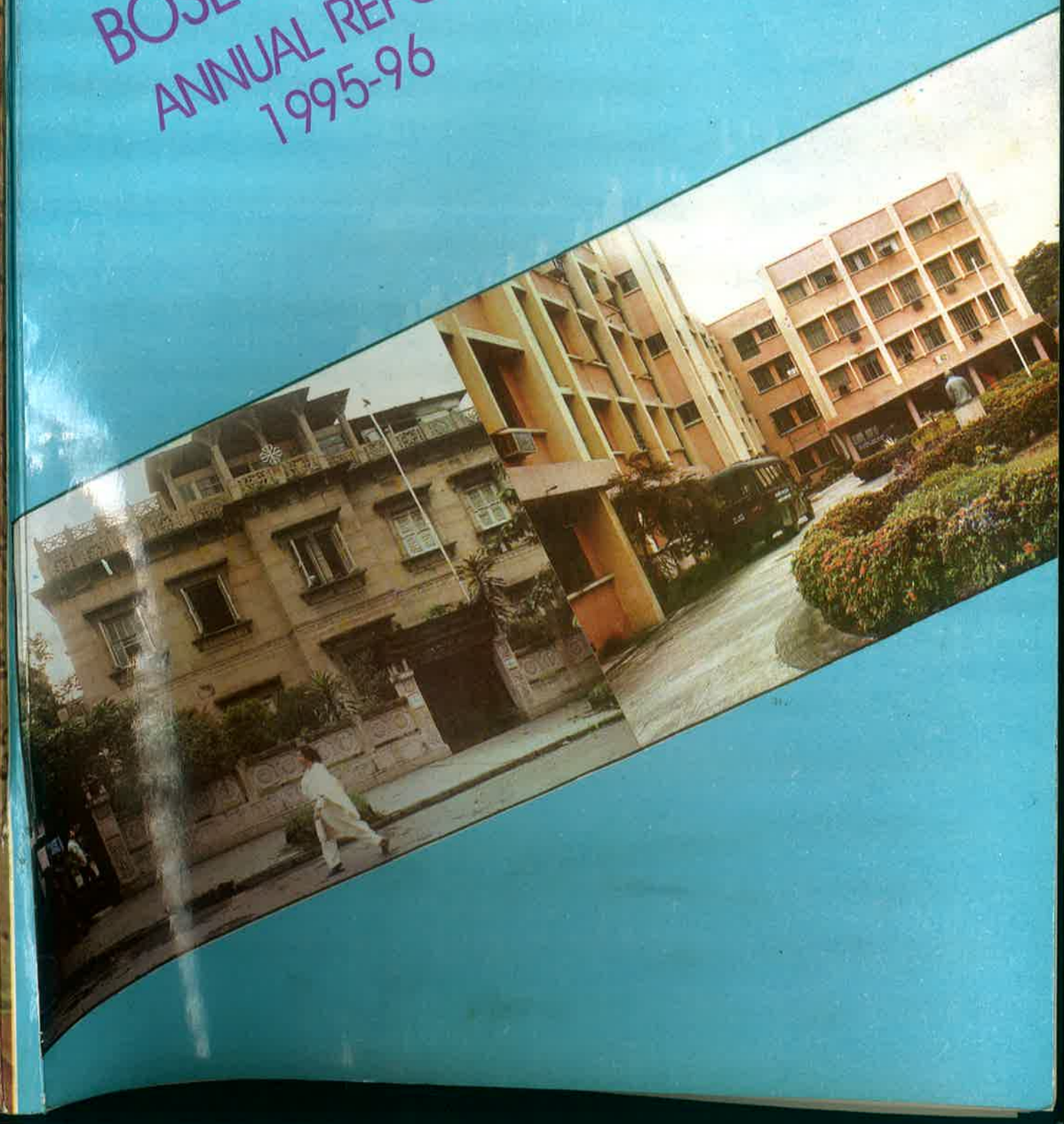


BOSE INSTITUTE
ANNUAL REPORT
1995-96



From the Director's Desk

Dear Friends,

It is again with a great pleasure I present before you the Annual Report for the year 1995–96. It has been a year full of activities and achievements, recognition and appreciations and making preparations to set the targets for the future. Planning the activities and programmes for the Ninth five year plan (1997-2002) keeping in mind the National priorities and to fulfill the expectations of the nation and its people, to meet the hopes and aspirations of our scientists and staff members, and above all to make a detailed exercise to initiate research projects which are in the frontier areas of modern science and at the same time are of much significance from the point of view of national needs of focussing an attention towards problem solving areas, had been our major preoccupation in which a considerable period of our time was spent.

Being able to convince the National authorities about the potentiality of the Institute, and the fact that without upgrading the facilities of the Institute and at the same time its core funding, it is not possible to compete with the rest of the world and to produce world class science. During the past few years, our continuous endeavours had been to provide increasing support to each department and/or section in terms of both manpower by filling up of vacant posts of scientists and to increase the quantum of recurring grants. An effort was made also to fill up some of the vacant posts of non-academic staff, administrative, finance and accounts personnel, so that the institute could function in a better way and could cope up with the increasing work load. We are very grateful to the Government of India, and particularly the Department of Science and Technology of the Ministry of Science and Technology, together with the Planning Commission of the Government of India to help us by increasing funds under the Plan head and by providing a block grant of Rs.8.0 Crores for the upgradation and modernisation of Bose Institute. We are also very thankful to the West Bengal Government, Ministry of Higher Education for according all the help and courtesy to receive the central grant on our behalf and forwarding the same to us. This has been an event of much significance so far as the history of the Institute is concerned. The Institute which had to only satisfy itself with meagre amount of funds of which 75-80% were to be spent for providing salary and other benifits to the staff. Funds for research were a very poor insignificant amount. This to a large extent hampered the growth and development of the institute. We now have come a long way from a period of living hand-to-mouth, to a period when the Institute has consolidated itself in terms of its funding. Apart from the core grants-in -aid from the Government of India, a large number of funded projects are now coming to the institute which has given our scientists a little more flexibility and ease of doing their research. As a result, the quality of their work has been improving steadily. The number of first grade research papers published in high impact factor journals are also increasing. Research results of two of our scientists Dr. Siddhartha Roy of Biophysics Department and Dr. Sukumar Gupta of Botany Department received the acclaim of being chosen to be on the cover page of two international journals.

The outstanding publication in Physical Reviews by two of our young scientists, Drs. Dipankar Home and Rajagopal Chattopadhyay has opened up the possibility of Schrodinger's prediction coming true. Erwin Schrodinger wrote a book in 1940 "What is life ?" which was an attempt to

use quantum physics to explain the stability of genetic structure. This information was instrumental to set Francis Crick to go to discover the structure of DNA with James Watson in 1953. The absurdity that Schrodinger wished to empahasize was the part of quantum theory that says that the outcome of any quantum experiment is not real until it has been observed, or measured by an intelligent observer. Many times such experiments are not easy to do. But the experiment proposed by Dipankar Home and Rajagopal Chattapadhyay of Bose Institute really can be performed. This is the most innovative part of it. The experiment they proposed is to direct a gamma ray photon into caesium iodide crystal, producing a shower of photons with wavelengths in the UV region around 250 nanometers. The photon shower should then be passed through a solution containing DNA and an enzyme known as photolyase. Any DNA molecule that is damaged by absorption of UV photon will change its shape in such a way that molecules of photolyase would bind to it. In such an event, the enzyme bound could then be measured. They argued that an individual DNA molecule could be regarded as definitely either damaged or not damaged regardless of whether or when an experimenter chooses to find it out. Thus in their views some other interpretation to quantum physics was required. Almost sixty years later if Schrodinger would have been alive to day he would have been delighted to see which way the quantum wind was blowing. Ladies and gentlemen, this work of two of our scientists have been chosen as one of the three most outstanding work in Physical sciences finding place in Encyclopedia Britannica Yearbook 1995-96, pp 241-243. Our heartfelt appreciations go to all of them. Let us congratulate them and wish them success in their future endeavours. I am quite sure that in the near future many such spectacular inventions and discoveries will come out of Bose Institute.

The Institute had filed several Patent applications on the development of an immunomodulator, an antiamoebic drug, an anticholesterolemic drug, a proteinase enzyme, etc. A water filter for providing bacteria free, pesticide free, toxic heavy metal free and arsenic free drinking water is in the making. An ELISA method for detection of minute quantity of food toxin, Aflatoxin has been developed. These are going to be patented soon. A microbial technology for the degradation of organochlorinated pesticides and an ELISA for the detection of pesticides in food and feed are being developed.

Two units of Crescographs have been manufactured and supplied to Birla Institute of Technology and Museum, and two others are going to be manufactured.

The Institute has undertaken a massive upgradation, renovation and reconstruction programme. Every department and/or section is going to be upgraded in terms of equipment facilities amounting Rs. 40-50 lakhs, some major equipments are going to be placed in the central facility, such as FACSVANTAGE and FACSCAN, Capillary Electrophoresis, Phosphorimager and Image analyzer, Fast flow Kinetic measurement system, Peptide synthesizer, Protein Sequencer, Nanosecond Spectrophotometer, CD machine. A national facility for NMR studies on macromolecules is going to be set up by installing a 500 MHz Ft-NMR. A National Facilty on Interactive Graphics Computer System for Molecular Modelling, Molecular Dynamics and Structures has been set up in DIC. Advanced model of Silicon Graphics facility has been installed, and Mainframe Decalpha 2000 Server with terminal server and associated workstation has been procured. A twenty line Computer workstation has been installed. A new single crystal X-ray Diffractometer has been procured for RSIC. Also an Atomic Absorption Sepctrometer is being added to RSIC. The Library is going to be equipped with computerised facilities, connected through a Local Area Network System with DIC and both the Main Campus Science Departments and library and all the Departments and Sections in the Centenary Campus. All these are going to be connected with DIC through a dedicated line, so that the Scientists can use the Library and DIC facility from their own laboratory. We are very soon connecting ourselves to the INTERNET system, which will also be made available to each scientist for bringing the world information at their fingertips. FAX and e-mail facilities have now been extended to both of our campuses. Both the administration and accounts are also being connected through LAN system and will be hooked to DIC mainframe.

Plans to create new space by adding an Annexe Block of Four Floors by the side of Centenary Building, some staff quarters at our salt lake premises (52 quarters to start with), an extension of the students Hostel with some Guest House facilities, a Research Animal Breeding and maintenance house facility, a Field laboratory at Madhyamgram Farm along with a containment facility are now receiving active attention, the actual construction of which will start within a month or so.

Repair, reconstruction and renovation work of the Lecture Hall, and various Laboratory Buildings are also going to be undertaken soon. I would like to express my gratitude to the Hon'ble members of the Governing Body, the Council, the Secretary DST, the Financial Advisor, DST, the members of various internal committee and other committee, the members of the Scientific Advisory Committee and of the Research Area Panels to help us in carrying out this stupendous task of rebuilding our Institute, at this phase so as to enable us to meet the challenges of the 21st Century.

During the year the Institute published 95 research papers in reputed journals, and 23 students submitted their Ph.D theses. About 20 Post-Doctoral Trainees have successfully completed a National Course in Biotechnology. Several trainees from Japan. China, Thailand, Korea and Bangladesh had come to Bose Institute to obtain further training in Plant Biotechnology, Molecular Biology, Structural Biology, Immunobiology etc. It is heartening to mention that this new trend of foreign scientists coming to Bose Institute to pursue their graduate, postgraduate and post-doctoral studies is a new phenomenon. We are very happy in this development.

The institute published two important Books–"Patrabali", edited by Shri Dibakar Sen which is a collection of about 80 letters between Kabiguru Rabindranath Tagore and Acharya Jagadish Chandra Bose. The other volume on "J.C. Bose and Microwaves—A Collection", jointly edited by Prof. Prantosh Bhattacharya and Prof. M.H. Engineer was published on the occasion of the 100th Anniversary of Sir J.C. Bose's discovery of millimeter wave, which was celebrated in our Institute and different parts of the Country.Acharya J.C. Bose and his discovery were rememberd with much pride and admiration by the scientists, technologists and communication experts. The journal Current Science had published a special issues on Sir J.C. Bose's work and profusely acclaimed his novel and original discovery made by him way back in 1896. We are extremely proud to remember him with reverence and with the feeling of the same excitement as he himself felt during his discovery of millimeter wave of 5mm wave-lengths which paved the way of development of a whole generation of communication technology, the benefit of which is being enjoyed today by mankind all over the world.

Dear friends, we are looking forward to brighter tomorrow, with the experiences of the past, commitments of the present and a whole lot of preparations for the future. We are trying to equip ourselves to meet the challenges of the 21st century, and above all to meet the expectations of the people of our nation to uplift the standard of their living through scientific and technological innovations. I am sure your help, guidance and good wishes will always be with us.

Wishing you all a very healthy, prosperous and productive year ahead of us .

P. K. Ray
Director, Bose Institute
Calcutta

CONTENTS

Physics

Faculty : Prof. S.C. Roy (Chairman), Prof. M.H. Engineer, Dr. A.K. Chatterjee, Dr. S.N. Changdar, Dr. S. Raha, Dr. I. Bose, Dr. D. Home, Dr. B. Roy, Dr. B.K. Chatterjee, Dr. S.K. Saha, Dr. T.P. Sinha (From 28.6.1995)

INSTITUTIONAL PROJECT VI

A. Acoustics

A new viscous fingering type instability at the interface of liquid layers.

B. Roy and **M.H. Engineer**

We had earlier reported on a fluid dynamical instability present in steady flows in which gravity is perpendicular to the main direction of steady flow of a pair of flowing fluids. We have now observed that the character of the instability changes if the direction of gravity is kept along the direction of steady flow. Both the pattern of acoustically driven steady flow, in a oil-water system consisting of a mixture of castor oil and Carbon Tetrachloride kept above a layer of water (the interface between the two being made highly labile by use of a water soluble surfactant), and the sudden emergence of a "fingering" instability for sufficiently fast flows were observed and photographed. Very interesting patterns of flow were also observed in the regime just preceding the transition to unsteady flow. On the other side of the instability a long finger of the more viscous liquid tunnels into the less visous one. Such "fingers" are a common occurrence in oil-gas flows (and oil-water flows) taking place when oil is produced from underground oil fields the world over : such fingers are bad news for efficient oil recovery ! Viscous fingers have also been observed in the lab. in two dimensional flows, and, it was hiterto believed that instabilities of this kind do not exist in fully three dimensional flows. Our observations show this belief to be without foundation.

B. Nuclear Physics

B.1. *Compton profile of cuprous oxide by linear combination of Gaussian orbitals.*

A.K. Chatterjee and Aniruddha Deb

A theoretical study on the Compton profile of cuprous oxide has been carried out, using the linear combination of Gaussian orbital (LCGO) method. The theoretical results are in excellent agreement with the earlier reported experimental work. With the same wavefunctions the partial density of states of copper and oxygen and the total density of states of cuprous were calculated to establish the nature of bonding and the charge transfer in cuprous oxide.

B.2. *Compton profile of vanadium carbide and vanadium nitride.*

A.K. Chatterjee and Aniruddha Deb

A self-consistent, all electron calculation was carried out for vanadium carbide and vanadium nitride using the linear combination of Gaussian orbital method. Results were presented and discussed in the light of the existing theoretical and experimental data for the partial density of states, total density of states, charge analysis and Compton profile. From the comparison of the two compounds a pronounced change in the non-metal p and vanadium d interaction is found, and discussed in connection with the binding mechanism and directional anisotropies.

B.3. *Compton scattering studies on scandium oxide and scandium nitride.*

A.K. Chatterjee and Aniruddha Deb

The Compton profile of polycrystalline scandium oxide using 59.54 keV gamma-radiation from a ^{241}Am source. The experimental results were compared with theoretically calculated Compton profile values. An analogous calculation was also carried out for scandium nitride. From a comparison of the two compounds a change in the non-metal p and scandium d interaction was found, which was discussed in connection with the binding mechanism. The similarity in the nature of the fermi surface and fermi necks was also established. Results were also presented in the light of the existing theoretical and experimental data for the partial density of states, total density of states, charge analysis and compton profile.

B.4. *Positron lifetime in polymer.*

A.K. Chetterjee and Aniruddha Deb

We measured the life time of positron in ethylene polyvinyl and found the value to be 965 psec. We are analyzing the data for finding defects in the polymer sample.

We are now measuring the life time of positron in protein samples in an inorganic matrix.

B.5. *Charge exchange effect in scattering of analog nuclei.*

Swapan K. Saha, in collaboration with A. Roy, A.K. Sinha of Nuclear Science Centre, New Delhi

It has been argued that the elastic scattering between analog nuclei at energies near Coulomb barrier could produce strong resonance as a consequence of the exchange of last nucleons in the two nuclei. Every system where this could be tested involves one radioactive nucleus. A project was submitted last year at the Nuclear Science Centre, New Delhi where elastic scattering between ^{7}Be and the analog nuclei ^{7}Li would be studied at energies near Coulomb barrier. A total of 96 hours of accelerator beam time has been alloted. Fabrication of a gas target holder has been done. Fabrication of a flange to hold a target and two detectors is presently under way.

C. Applied Radioactivity and Liquid Dynamics.

S.N. Changdar and Bidyarthi Dutta

The sliding cell method developed in our laboratory and based on radioactive tracer technique was used to measure diffusion coefficients in some liquid systems using Hg-203 and Tl-204 as the tracers. Studies in ternary systems were continued to observe and explain the effect of coupled flow on the motion of the diffusing ion.

D. Radiation Physics and Condensed matter.

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

B.K. Chatterjee and Nirmal Halder

Our earlier work showed that whether the suspended particle is large (silicon powder and glass powder experiments) or of the size of cross linked polymers the variation of viscosity is similar. The viscosity variation of polymeric liquids upon addition of larger polymers (simulating dimers, etc.) is studied. This provides understanding of the nature of viscosity degradation upon energetic irradiation and allows us to infer the variation of dimer population with irradiation dose.

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

B.K. Chatterjee

A gas carbon anode, multipart cathode and grids have been constructed for a new and more accurate ionic drift apparatus. A holder to accurately position the electrodes is under construction.

D.3. *Study of stability of Superheated drops.*

B. Roy and **S.C. Roy**

A new horizontal tube volume measuring device which eliminates the effect of change in atmospheric pressure have been tested. This provides a more accurate measurement of volume of nucleated drops.

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

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

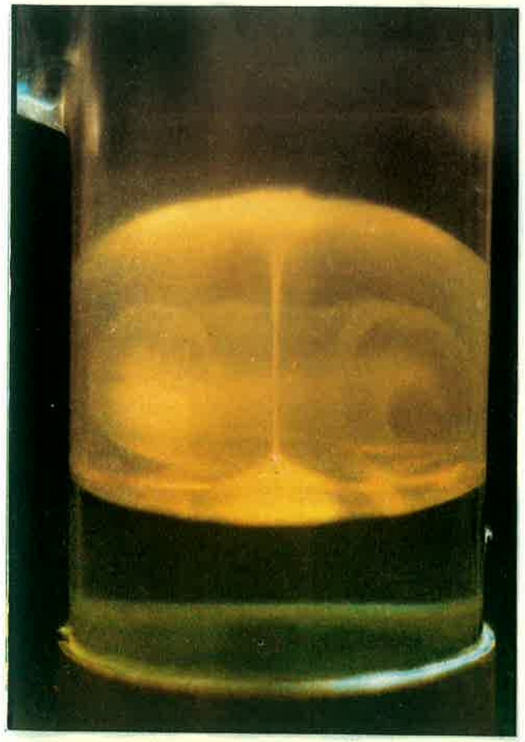
A computer code has been developed to do a multidimensional interpolation of the elastic scattering cross section using the state-of-the-art precise cross sections. This provides an accurate perdiction of the elastic scattering cross section for all elements, angles and energies (except near the K-edge).

D.5. *Role of exact and approximate theories of coherent scattering cross sections in the estimation of photoelectric cross sections.*

B.K. Chatterjee, **B. Roy** and **S.C. Roy** in collaboration with North Bengal University

Role of coherent scattering cross sections obtained from 'exact' S-matrix calculation and other approximate theories in estimating the photoelectric cross sections from the measured total photon attenuation has been examined. It has been found that a change in 5% in total mass attenuation occurred when exact

At higher driving power



Flow pattern with convective rolls, characteristic of a vertically driven water-oil (castor oil + CCl_4 mixture) system just beyond instability. The thin viscous finger of water is clearly visible at the center, tunneling into the oil above

theoretical coherent scattering cross sections have been used.

D.6. *Measurement of γ-scattering cross section.*

Swapan K. Saha, B.K. Chatterjee and **S.C. Roy**

A setup for measuring γ-scattering cross section using improved geometry has been made. Fabrication of a 90° scatterer with an optimum direct beam stopper designed by us has been done.

D.7. *Mössbauer and magnetic studies in inorganic systems.*

T.P. Sinha in collaboration with M.Mukherjee and D. Chakravorty of IACS, Calcutta, D. Das of IUC-DAEF, Calcutta, M. Battacharya of SINP, Calcutta and C.K. Majumdar of SNBNCBS, Calcutta

^{57}Fe Mössbauer study of nano-composite Fe_2O_3-SiO_2 system prepared by sol-gel method showed the presence of paramagnetic phase up to 300°C (amorphous X-ray pattern); a mixed phase of para-, superpara-and ferromagnetic from 400°C to 600°C; and superpara-and ferromagnetic phase from 800°C to 1200°C. The electron paramagnetic resonance spectra showed the magnetic hyperfine pattern of the system heated at 600°C with g-values lying between 1.86 and 2.17 (Fe^{3+} in low spin). The magnetization of the system increased with the increase of particle size showing that more and more particles transformed from superparamagnetic to ferromagnetic phase. The temperature dependence of Mössbauer quadrupole splitting of Fe^{2+} ($3d^6$, ^5D) ions in chlorite containing siderite (green shale rock) was analysed by invoking orbit-lattice interaction.

D.8. *Noise pollution in Calcutta.*

B. Roy, S.C. Santra and Debasish Chakraborty (University of Kalyani)

Data on road traffic nosie level survey of several traffic junctions in Calcutta for 24 hours with simultaneous data of vehicular flow have already been collected during the summer of 1993 and winter of 1994. Analysis of those data revealed that the variation of hourly equivalent continuous noise level with time of the day showed a dip around the time of 3:00 a.m of the day. The number of measurement sites were subgrouped into 5 zones according to the land use, and regression equations connecting ambient noise level and the traffic density have been developed.

D.9. *The geometric phase in condensed matter systems.*

M.H. Engineer

The optical absorption spectra of many quasi one dimensional materials are anomalous in that they show a long "tail" below the absorption edge that persists down to the lowest accessible temperature (currently around a few degrees above absolute zero). Such a structure is not explained by charge density wave theory, although a charge density wave does develop in many materials. I have attempted an explanation based on a use of the Franck—Condon principle, treating the electron phonon interactions in the continuum approximation, but, keeping all quantum geometrical effects. It appears that the qualitative features of the spectra can be so understood.

E. Theoretical Physics

E.1. *High Energy Physics, Astrophysics and Cosmology.*

E.1.1 *Studies on Quark-Gluon Plasma.*

Sibaji Raha in collaboration with Jan-e Alam, Pradip Roy and Saurav Sarkar of VECC, Calcutta and Bikash Sinha of VECC and SINP, Calcutta

Earlier work aimed at studying the approach to equilibrium in ultra—relativistic heavy ion collisions within the framework of a QCD—motivated kinetic theory model has been extended to include the effects of particle production through a source term in the master equation. The detailed numerical work required to solve the problem is in progress.

E.1.2. *Nonlinear Aspects of Multipaticle Production Processes.*

Sibaji Raha in collaboration with Debapriyo Syam of Presidency College, Calcutta

A nonliner map suitable for application in multiparticle production processes in strong interaction has been derived earlier from

the collective model. Various experimental quantities sensitive to fluctuations have been studied within this model and are now being compared with the corresponding data.

E.1.3. *Phenomenologial application of Finite Temperature Field Theory.*

Abhijit Bhattacharyya and **Sibaji Raha** in collaboration with Jan-e Alam of VECC, Calcutta, Bikash Sinha of VECC and SINP, Calcutta and Sanjay Kumar Ghosh and Sashikant C. Phatak of IOP, Bhubaneswar

Modification of hadronic (baryonic as well as mesonic) effective masses at high temperature and density has been studied from a newly proposed relativistic many-body theoretic model of nuclear matter called the Zimanyi-Moskowski model. Finite temperature changes in the electromagnetic form factor of the pion and their effects on the dilepton spectra in heavy ion collisions have been investigated. It has been found that the apparent suppression claimed by other authors does not survive when one takes proper account of the space-time evolution of the system and hence would not be observable in actual experiments. Finite temperature changes in the effective masses of various pseudoscalar mesons (π, κ and η) from the nonlinear σ model have been studied. Further, the in-medium effects on the mass and decay width of the ϕ meson have been studied from the nonlinear σ model. It has been shown that contrary to popular belief, the decay width of $\phi \kappa \bar{\kappa}$ increases (rather than deccrease) with temperature and the primary ϕ peak would survive in the dilepton spectra. Implications of this conclusion for quark—gloun plasma diagnostics have been explored. The possibility of *kaon condensation* in superdense nuclear matter is being looked into, including higher loop effects.

E.1.4. *QCD phase transition in the Early Universe.*

Sibaji Raha in collaboration with Jan-e Alam of VECC, Calcutta, Pijushpani Bhattacharjee fo IIA, Bangalore and Bikash Sinha of VECC and SINP, Calcutta

Work on investigating the role of neutrino inflation in governing baryon inhomogeneities in the early universe has been and is being continued.

E.1.5. *Investigation on γ rays and neutrons from the solar region during total solar eclipse :*

Abhijit Bhattacharyya, **Barun K. Chatterjee, M.H.Engineer, Sibaji Raha, Suprakash C. Roy and Swapan K. Saha** (in collaboration with Bikash Sinha of SINP and VECC, Calcutta, Debapriyo Syam of Presidency Collage, Calcutta, Tarun K. Dey of Bajkul College Midnapore and Rabi K. Mukherjee of IOP, Bhubansewar)

During the total solar eclipse (TSE) of October 24, 1995 which was visible from Diamond Harbour, the measurement of γ rays coming from the general direction of the Sun in the energy range of 0.3 —3.0 MeV was carried out at Diamond Harbour over fixed time intervals of 14 mins each, covering the entrie period of occultation. It was found that at the totality of occultation, the total number of γ rays in the said energy domain was substantially lower (` 20 – 25 %) than the average number measured with the noraml Sun. Detailed analysis of the collected data for smaller energy intervals within the total range is almost complete. Passive Solid State Nuclear Track Detectors (SSNTD), in particular CR-39 covered with thin Aluminium foils to induce (n, α) reactions, were also exposed during the same time period. Microscopic analysis of the recorded tracks as well as necessary calibrations are under way.

E.2. *Foundations of Quantum Mechanics.*

E.2.1. *DNA Molecular Cousin of Schroedinger's Cat : A Curious Example of Quantum Measurement.*

Dipankar Home and **R. Chattopadhyaya**

It is shown that ultraviolet absorption by a DNA molecule (which gets biochemically attached to nearby photolyase enzyme so that the effect of uv avbsorption becomes macroscopically discernible) constitutes an intriguing example of quantum measurement paradox in the hitherto unexplored arena of biological measurement. It is pointed out that this does not merely illustrate the quantum measurement paradox in the hitherto unexplored arena of biological macromolecules, but is also instructive in highlighting specific difficulties inherent in various approaches to the measurement problem.

E.2.2. *Quantum Nonlocality of Single Photon States.*

Dipankr Home in collaboration with G.S. Agarwal of National Physical Laboratory, Ahmadabad

A testable example using single photon states is formulated which shows an incompatibility between quantum meachanics and any local deterministic ontological model of photons in terms of "particle" coordinates. This demonstration is independent of Bell's inequalities or other arguments showing quantum nonlocality hitherto discussed in the literature.

E.2.3. *Incompatibility Between Quantum Mechanics and Classical Realism in the Strong Macroscopic Limit.*

Dipankar Home in collaboration with A.S. Majumdar of SNBNCBS, Calcutta.

Considering a states of N correlated particles, each with spin j, the quantum expectation value of an arbitrary dynamical variable A is evaluated. This is found to exceed a bound on A obtained from considerations of classical realism. It is indicated from numerical results that this contradiction between quantum mechanics and classical realism persists in the "strong" macroscopic limit, i.e., when the values of both N and j are arbitararily increased. In this argument, the notion of classical realism embodies the twin assumptions of locality (on action at a distance) and noncontextuality (a measurement simply reveals the preexiting value of a observed quantity).

E.2.4. *The Inadequacy of Effective Incoherence Interpretations of Quantum Theory, as demonstrated by Analysis of EPR Measurements.*

Dipankar Home in collaboration with M.A.B. Whitaker of Queen's University, Belfast (Nothern Ireland)

Interpretations of quantum theory which use effective incoherence are criticised, using analysis EPR experiments, and studying actual rather than idealised distributions of results. It is shown that such interpertations are inconsistent ; some of their consequences neither duplicate the predictions of collapse, nor agree with empirically testable aspects of the quantum formalism

E.2.5. *An Analysis of the Aharonov-Anandan-Vaidman Model.*

Dipankar Home in collaboration with P. Ghosh of SNBNCBS, Calcutta

It is demonstrated that the recently proposed and much discussed Aharonov-Anandan-Vaidman model by using the notion of so-called "protective measurements" cannot claim to have dispensed with the "collapse of the wave function" because it does not succeed in avoiding the quantum measurement problem. The claim to be able to distinguish between two nonorthogonal states is also shown to be fallacious.

E.3. *Condensed Matter and Statistical Physics.*

E.3.1. *Strongly correlated systems*

Indrani Bose and Saurabh Gayen

The coupled-chain (CC) model, described by a t-J -type Hamiltonian, has been studied when doped with non-magnetic and magnetic impurities. The effect of these impurities on the dynamics of a single hole has been determined by exact analytical and numerical methods. The hole can form both bound and antibound states with the impurity. In a certain range of J,t values, bound states of different symmetry coexist. In the case of magnetic impurity, binding of the hole to the impurity is less favourable.

E.3.2. *Magnetism*

Indrani Bose. Uma Bhaumik and Asimkumar Ghosh

The study of the spin-1/2 Heisenberg antiferromagnet on the frustrated pentagonal lattice has been initiated. Frustration, in general, leads to disordered ground states. We have however, identified a parameter regime in which the ground state is ordered. The calculation of the excitation spectrum and average magnetization are in progress.

The compound $Sr_{n-1}Cu_{n+1}O_{2n}$ (n=3, 5, 7, 9,.....) can be described by m-chain spin ladder with m = (n+1)/2. Experiments have shown that the excitaion spectrum has a gap (is gapless) if m is even (odd). We have constructed an exactly-solvable antiferromagnetic ladder model for which we are able to show the above effect in a rigorous manner in a particular parameter regime. A mean-field theory based on the bond operator formalism has been formulated to study the model in a general parameter regime.

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

Prof. S.C. Roy delivered invited lecture in the Regional Meeting on Radiation Physics held at Bose Institute in November 1995 to mark 100 years of discovery of X-rays, Participated in a symposim on 100th Anniversary of the discovery of Microwaves by Sir. J.C. Bose at Bose Institute in December 1995, Participated and Chaired one session in the INDO-US Workshop on Radiation Physics : *New directions in the study of interaction of energetic photons with Matter* at the University of North Bengal & Loreto College, Darjeeling, in March 1996, Serving as a member of the Technical Programme Committee and National Organizing Committee of the 7th International Symposium on Radiation Physics, Serving as a member of the Technical Programme Committee of the National Conference on Radiation Shielding and Protection.

Prof. S.C. Roy, Dr. S. Raha, Dr. B.K. Chatterjee praticipated in the experiment at Diamond Harbour on the observation of solar gamma rays during solar eclipse on October 24, 1995.

Prof. M.H. Engineer was invited to present a special talk on "Microwave researches of Sir J.C. Bose" at the National Symposium on Recent Advances in Microwaves and Lightwaves" held at the University of Delhi, Dept. of Electronic Science during Dec 4-Dec6, 1995); Participated by invitation in the "School on Surface Physics held at SINP, Calcutta from Aug 12th to Aug 18the 1995; Delivered an invited talk at the sympoium held at Presidency College in December 1995 to celebrate Fifty years of the Indian Physics Association; acted as Convenor of a one day Symposium held to celebrate the 100th Anniversary of the discovery of Microwaves by Sir J.C. Bose at the Bose Institute on Dec. 22nd 1995; Participated in the Regional Meeting on Radiation Physics held at the Bose Institute on November 16-17, 1995; acted as Co-ordinator of a scientific team comprising scientists from Bose Inst., SINP, Presidency College, Calcutta Univ., IOP, Bhubaneshwar and Bajkul College to observe solar gamma rays during the total solar eclipse of Oct 24, 1995 from Diamond Harbor.

Dr. A. K. Chatterjee participated in the Regional Meeting on Radiation Physics held at Bose Institute in November 1995; Attended the 100th years of discovery of Microwave, at Bose Institute in December 1995 ; Attened the DAE sponsored Solid State Symposium at Indian Association for the Cultivation of Science in December 1995.

Dr. Sibaji Raha attended and delivered an invited plenary session talk at the 4th International Workshop on Relativistic Aspects of Nuclear Physics at Rio de Janeiro, Brazil during August 1995, visited the Dept. of Mathematical Physics of the Institute of Physics, University of Sao Paulo, Brazil as an invited professor during August–October 1995, Delivered colloquia at the Physics Department, University of Campinas, Campinas, Brazil, Institute of Theoretical Physics, State University of Sao Paulo, Sao Paulo, Brazil and Physics Department, University of Virginia, Charlottesville, Virginia, USA during October 1995, Delivered a set of lectures at the ECRA school on Basic Astrophysics at Calcutta during November 1995, Attended and deliveredan invited talk at the International Workshop on Phase Transitions in the Early Universe and Quark-Gloun Plasma at Puri during December 1995, attended and delivered an invited talk at the international Nuclear Physics Symposium (INPS—95) at Bombay during December 1995,

Attended and chaired a session at the National sympoium on Nuclear Astrophysics at Kalyani during February 1996, also served as a member of the organizing committee for the same, Served as Vice President of the Indian Physical Society.

Dr. I. Bose delivered two invited lecture on the percolation model and neural networks at the Inter University Consortium for DAE Facilities, Calcutta Centre in July, 1995 ; Dilivered an invited talk at the International Conference on Dynamics of Complex Systems organised by J.N.U. (August 6-11, 1995) ; Delivered theree invited lectures in the Winter School on Integrable Systems and Low-Dimensional Many Body Problems at Bharathidasan University, Tiruchirapalli (Dec. 18-23, 1995), Delivered an invited talk at the International Conference on 70 years of quantum mechanics and recent trends in theoretical Physics held at the Indian Statistical Institute (29.1.96—2.2.96); Delivered an intvited talk at the Eastern Regional Seminar on Undergraduate Physics Teaching : Problems and Suggestions organised by the Indian Physical Society at R.K. Mission Residential College, Narendrapur (March 2-3, 1996) ; Presented a paper at the International Conference on Strongly Correlated Electron Systems organised by T.I.F.R. at Goa, India, September 27-30, 1995 ; Served as a Local Organising Committee member of the Annual D.A.E. Symposium (Solid State) held in I.A.C.S., Calcutta, Dec. 27-31, 1995; Has been invited to become a member of the Regional Council of the Indian Association of Physics Teachers; Has been selected as a Theoretical Physics Seminar Circuit Speaker (financed by D.S.T.) for the year 1995-96 ; Has taught in the M.Sc., Physics Course of Calcutta University as an invited Guest Lecturer.

Dr. B. Roy participated an presented a paper in the Regional Meeting on Radiation Physics (Bose Institute, Calcutta, November 16-17, 1995); Participated in a Symposium on 100th Anniversary of the Discovery of Microwaves by Sir J.C. Bose at Bose Institute in December 1995.

Dr. B.K. Chatterjee participated in the Regional Meeting on Radiation Physics (Bose Institute, Calcutta, November 16-17, 1995); Dr. Chatterjee participated and served as a Joint Secretary in the one day symposia 100th Anniversary of the Discovery of Microwaves by Sir J.C. Bose (Bose Institute, Calcutta, December 22, 1995); Dr. Chatterjee participated in the Workshop on Rectification of Errors in Physics Text Books (Presidency College, Calcutta, February 24, 1996); Dr. Chatterjee participated and presented an invited paper in the INDO-US workshop on radiation physics New Directions in the stydy of Interaction of Energetic Photons with Matter (University on North Bengal & Loreto College, Darjeeling, March 16-22, 1996).

Dr. S.K. Saha organised a Regional Meeting on Ratiation Physics to commemorte 100 years of discovery of X Ray at Bose Institute, Calcutta during November 16-17, 1995. Attended and delivered an invited talk in the celebration symposium of 25 years of Indian Physics Association, Presidency College, Calcutta on December 8, 1995, Participated in the symposium on 100th Anniversary of the discovery of Microwaves by Sir J.C. Bose at Bose Institute in December 1995.

Dr. T.P. Sinha presented paper in the meeting 'Condensed Matter Days-1995' held at the Institute of Physics, Bhubaneswar from August 29 to 31, 1995 and delivered an introductory talk on the nano-structure materials in the meeting. Dr. Sinha participated in the Regional Meeting on Radiation Physics held in the Institute from November 16 to 17, 1995. Dr. Sinha served as joint secretary of the '100th anniversary of discovery of microwaves by Sir J.C.Bose' symposium held at the Bose Institute on December 22, 1995. Dr. Sinha presented paperes in the Annual DAE Solid State Physics Symposium held at IACS, Calcutta from December 27 to 31, 1995 and served as a local organising committee member of the symposium. Dr. Sinha participated in the Workshop on Rectification of Error in Physics Text Book held in Presidency College, Calcutta on February 24, 1996.

Mr. Aniruddha Deb participated and gave an oral presentation in the Eleventh National Symposium on Radiation Physics (NSRP-11) held at Patiala (Punjab), October 1995 ; Attended the Regional Meeting on Radiation Physics, held at Bose Institute in November 1995 ; Attended the 100th Universary of discovery of microwaves at Bose Institute in December 1995.

Uma Bhaumik and Asimkumar Ghosh presented papers at the meeting 'Condensed Matter Days' at the Institute of Physics, Bhubaneswar during August 29-31, 1995.; also participated in the Winter School on 'Integrable Systems and low Dimensional Many Body Problems' at the Bharathidasan University, Tiruchirapalli, India (December 18-23, 1995) ; Asimkumar Ghosh participated in the SERC School on 'Computational Condensed Matter Physics' held in Shimla (October 30-Nobember 18, 1995).

Nirmal Halder participated and presented a paper in the Regional Meeting on Radiation Physics (Bose Institute, Calcutta, November 16-17, 1995).

Abhijit Bhattacharyya visited Institute of Physics (Bhubaneswar) and delivered a lecture there during August 1995 under the Theoretical Physics Seminar Circuit (TPSC) scheme of the Department of Science and Technology (DST); Visited Indian Institute of Astrophysics (Bangalore) during September 1995 and delivered a lecture ; Visited Indian Institute of Technology (Kanpur) during September 1995 and delivered a seminar there under the TPSC scheme; vistied Institute of Physics (Bhubaneswar) during December 1995; attended "Workshop on Quark Gluon Plasma and the Early Universe" at Puri during December 1995 and delivered a seminar; attended DAE Nuclear Physics Symposium held at Bombay during December 1995; attended "Symposium on Nuclear Astrophysics" held at Kalyani during February 1996; visited Bhabha Atomic Research Centre (Bombay) during February 1996 and delivered a seminar there under the TPSC scheme; visited Tata Institute of Fundamental Research (Bombay) during February 1996 under the TPSC scheme.

Sri Bidyarthi Dutta attended and presented his paper at 11th Radiation Physics Symposium (NSRP-1) held at Punjabi University, Patiala from 26-29 Oct., 1995.

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

A. Bahttacharyya, S. Gayen, A. Deb, U. Bhaumik, A.K. Ghosh, B. Dutta form April 3, 1995).

OTHER SUPPORTING STAFF MEMBERS

B. Bhaskar, G.R. Paul, K.P. Das (up to June 1, 1995), C.R. Paul (up to January 31, 1996), N.C. Dey, A.K. Ganguly, K.C. Das, S.P. Singha, B.P. Ram, D. Deo, B. Dutta, D.K. Thakur, S.K. Basu, Kissan Das, R.K. Mourya

GRANT-IN-AID SCHEMES

Principal Investigator	Title	Financed by
Prof. S.C. Roy	Fabrication of pressure reactor & electron circuitry to detect bubble nucleation	Defence Laboratory, Jodhpur
Prof. S.C. Roy	Investigations on the use of super-heated drop detectors in neutron detection	Atomic Energy Regulator Board (AERB)
Dr. B.K. Chatterjee	Ionic transport and reaction Processes in nonpolar liquids	CSIR

Chemistry

Faculty : Prof. P. Bhattacharyya (Chairman from 01.01.1996), Prof. A. Ghosh (Chairman till 31.12.1995), Prof. P. Chakrabarti, Dr. P.C. Sen, Dr. S. Misra, Dr. M. Chakrabarty, Dr. K.P. Das, Dr. J. Basu, Dr. M. Kundu (Assigned from Microbiology department), Dr. P. Das

INSTITUTIONAL PROJECT II

A.1. *Preparation of ether linked lipids from marine organisms for studying their biological activities.*

S. Misra, A.Ghosh, D. Banerjee, T.K. Patra and D. Pal

Previous studies which indicated the occurrences of some novel and unique ether linked lipids with glycerol backbone and having ether linkages at carbon-1, we have isolated and purified these compounds in quantities from several marine organisms, with a view to study their biological activities.

A.2. *Preparation of EPA and DHA in large scale for clinical trials on patients suffering from atherosclerosis and thrombosis.*

A. Ghosh, S. Misra, D. Banerjee, D. Pal, P.K. Pal and T.K. Patra

Utilising the scale up technology developed in the Lipid Chemistry Laboratory about 3 kg of Eicosapentaenoic acid (EPA) with a concentration of 50% has been prepepared for initiating the Clinical Trials on cardiac patients suffering from atherosclerosis and thrombosis, in two different hospitals at Calcutta. Necessary permission to conduct Clinical Trial on volunteer patients has been obtained from the Drug Controller of India.

INSTITUTIONAL PROJECT III

A. *Role of ether linked phospholipids neutral lipids from marine organism on PI 3-kinase activity and cloning of PI 3-kinase catalytic site from marine sponge.*

Suniti Misra and **Amitabha Ghosh**

Phosphatidylcholine (PC) from marine invertebrates is enriched in ether-linked forms and we have recently described novel ether-linked PCs and neutral lipids present in mammalian cells also. Recently we have isolated and characterised a series of ether-linked triacylglycerols and ether-linked phosphatidylcholine, phosphatidylethanolamine and phosphatidylserines from ray fish and many marine invertebrates, with the help of physical methods. Metabolism of PCs enriched in etherlinked species leads to production of 1-0-alkenyl-and 1-0-alkyl-2acyl glycerol which also could have significant effects on mammalian cell growth.

PI 3-kinase was isolated and detected from marine sponges. The activity of this enzyme was found to be inhibited by a potent inhibitor Wortmannin. The product of this enzyme activity were resolved by TLC; analysed by HPLC and were found to be PI 3P, PI 3, 4, 5 P_3. Further work will be carried out to clone this enzyme catalytic site.

B.1. *Identification and partial purification of a protein kinase from goat spermatozoa.*

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

A protein kinase has been identified, partially purified 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 cAMP followed by anion exchange column fractionation.The molecular weight of the kinase is found to about 110-120 KDa. This protein kinase is different from PK-C for not activated by Ca and lipids. In fact Ca inhibits the activity. The kinase is found to phosphorylate certain endogenous proteins including ion transport proteins suggesting its role in cell regulation.

B.2. *Purification and characterisation of a low molecular weight Na, K-ATPase inhibitor protein from rat brain.*

Parimal C. Sen and Dipankar Bhattacharyya in collaboration with S. Biswas (Biochemistry Dept.) and S.K. Nagdas (Vanderbilt University, USA)

An Na, K-ATPase inhibitor protein of molecular weight approx. 12,000 was purified from rat brain cytosolic fraction. A protein obtained from 0.1 M NaCl elution (peak no. 4) was found to be a potent inhibitor of Na, K-ATPase. The I_{50} was in the nanomolar range. The inhibitor binds to ATPase at a site distal from ATP binding site, binding is non-competitive with respect to ATP, does not compete with ouabain (a potent and specific inhibitor of Na, K-ATPase). The protein does not contain any Trp as evident from Trp fluorescence and amino acid analysis. The amino acid analysis indicates that the protein is negatively charged hydrophobic in nature. The circular dichrosim study indicates that the binding of the inhibitor to ATPase lead to conformational change of the ATPase.

B.3. *Phosphorylation and dephosphorylation of Mg-independent Ca-ATPase from goat spermatozoa*

Parimal C. Sen. K. Ray, A. Mandal and Rita Sikdar

Recently we were successful in isolating the phophorylated intermediate under control conditions i.e. in presence of low concentration of Ca and/or high temperature lead to dephosphorylation. Based on our observation, we proposed a scheme comparable to that of Mg, Ca-ATPase. This findings strengthened our previous report that this Mg independent Ca-ATPase is involved in Ca transport and Ca uptake like Mg, Ca-ATPase.

C. *Synthesis of organosulfur and heterocyclic compounds*

P. Bhattacharyya and A.K. Maiti.

Considering the importance of β-ketosulfone as intermediate in organic synthesis, various β-ketosulfones have been prepared by the oxidation of β-OH sulfone using CrO_3-Clay k-10 reagent. Considering the significant biological activity of Bisindolylmethane and Bisindolylethane various bisindolyl ethane and Bisindolyl ethane have been prepared by Montmorilonite clay catalysed condensation of indole with carbonyl compounds and epoxide under normal condition.

D. Synthetic heterocyclic Chemistry

D.1. *Synthesis of Condensed Heterocycles.*

M. Chakrabarty and Shampa Khasnosis

(i) As a part of synthetic efforts towards anticancer and/or antidiabetic pyrrolocarbazoles stated earlier, the synthesis of an important intermediate has been accomplished and the product characterised by spectral studies.

(ii) In connection with ongoing hetero Diels-Alder project, a few new azadienes have been synthesised. We have been able to demonstrate that certain Lewis acids are a necessity in the successful hetero Diels-Alder reactions of these azadienes with standard dienophiles.

D.2. *Development of Newer Reagents.*

Manas Chakrabarty and Shampa Khasnobis

(i) A new method for the deprotection of ketone phenylhydrazones have been developed. The reagent is inexpensive, the isolation procedure is simple and the yields of the isolated ketones are good to excellent. In the cases of certain ketones, an alternative reaction pathway was observed. The implications of this observation and the analysis of the overall results are near completion.

(ii) N-formylation of amines is a frequent necessity in synthetic methodologies. In view of the shortcomings of the extant procedures available for N-formylation of amines, a very simple and extremely efficient method for the N-formylation of diaryl and hetaryl amines have been developed. With a little modification in the reaction conditions, the method proved to be equally effective even in the cases of weaker amines of like o-and p-nitroanilines.

E.1. *Physico-chemical studies on the stability of β-lactoglobulin at acidic pH and formation of protein microcapsules.*

K.P. Das and Chaitali Bhattacharjee

The stability of the protein β-lactoglobulin has been measured against urea, Gu-SCN, SDS, Tween-20, MTAB by fluorescence technique at various pH including pH 2.0.

Methods have been standardized to produce heat cross-linked and chemically cross-linked microcapsules from β-lactoglobulin. The size distribution of these spherical and porous microcapsules have been measured by Scanning Electron Microscope. Microcapsules from other proteins have also been prepared. Attempts are being made to entrap model drug compounds such as acetyl salicylic acid, penicillin-G etc. into these microcapsules.

E.2. *Grafting of biomolecules on solid surfaces and interaction of proteins with grafted surfaces.*

K.P. Das and Anuradha Bhaduri

Apart from various amino-acids, several carbohydrates, proteins, hydrophobic silanes were grafted on solid alumina and silica powder. The interaction of protein on these surfaces are being investigated.

E.3. *Structural changes of lysine modified proteins.*

K.P. Das and Anupa Bhattacharyya

Several proteins (β-lactoglobulin, MC-2) were glycosylated at the lysine groups with lactose followed by reduction with sodium cyanoborohydrate. The extend of glycosylation was assessed by TNBS method. CD and fluorescence spectra of the modified and unmodified proteins are now being compared. The stability of these proteins against thermal stress and chemical denaturant will also be compared.

E.4. *Molecular chaperone function of α-crystallin*

K.P. Das in collaboration with Dr. W.K. Surewicz (University of Missouri, USA)

α-Crystallin has been found to act as an extremely efficient chaperone by preventing heat induced aggregation of substrate proteins. From fluorescence spectroscopic study it was shown that there was a positive correlation between temperature induced exposure of hydrophobic sites of α-crystallin and its chaperone activity. It was also found that although α-crystallin can prevent the aggregation of proteins during thermal unfolding, it cannot prevent aggregation of the same proteins during refolding from completely unfolded form. This observation is of substrate specificity of α-crystallin is in sharp contrast to that of GroEL, which prevents aggregation of proteins both during unfolding and refolding.

F. Studies on biomembranes : Structure and function of the human erythrocyte membrane.

Joyoti Basu, Amit K. Das, Raja Bhattacharya, P.T. Srinivasan and Biplab Dasgupta

F.1. *Erythrophagocytosis in E-beta thalassemia*

Increased erythrophagocytosis in E-beta thalassemia was shown to be associated with increased exposure of PS on the outer surface of red cells. Slower transbilayer movement of PS was partly responsible for the above. Loss of phospholipid asymmetry therefore appears to be one of the underlying causes behind the accelerated destruction of erythrocytes in the bone marrow and in the peripheral circulation in the beta-thalassemias.

F.2. *Characterization of the protein palmitoylacyl transferase of human erythrocytes.*

A protein palmitoyl acyl transferase (PAT) of Mr 70,000 was purified from human erythrocytes. PAT acylates the beta subunit of spectrin, as well as protein 4.2. Palmitoylation was shown to proceed via formation of a palmitoyl-enzyme intermediate.

F.3. *Palmitoylation of erythrocyte membrane protein 4.2.*

In order to better understand the role of palmitoylation of protein 4.2 in its interaction with band 3, the site of palmitoylation of 4.2 was characterized. Protein 4.2 was palmitoylated at cysteine 173 in the 23 kDa N-terminal, band 3-binding domain, CNBr cleavage of this domain generated a 14 kDa non-palmitoylated N-terminal peptide, and a 9 kDa palmitoylated peptide containing cys 173. In blot overlay assays, neither of these peptides appeared to interact with the cytoplasmic domain of band 3 to the extent of the 23 kDa polypeptide. Attempts are being made to express these three polypeptides in large amounts in order to characterize their band 3-binding properties in detail.

G. Structure, Function and Dynamics of Biomolecules

G.1. *Strate of Aggregation of Filamentous Actin with or within Binding Proteins.*

P. Das, M. Ganguly and M. Sarkar

Filamentous actin which occurs ubiquitously in muscle, non-muscle cells and cytoskeleton, and which is responsible, at least in part, for the unusual shape and motility of cells, is a semi-flexible, mesogenic biopolymer. This protein polymer extracted from chicken skeletal muscle cells by standard techniques. Previous studies established the existence of as many as five liquid crystal states in pure actin solution, some of these being observable in the I-band of muscle. Equally interesting is the finding that F-actin, when present in association with binding proteins as in the cytoskeleton, forms a gel state.

G.2. *Understanding actin filament aggregation.*

P. Das

Theoretical effort is on to rationalize the state of aggregation of F-actin on the basis of intra- and interfilament interactions. Attempts are now being done to incorporate hard-core repulsions and anisotropic dispersion interations in the Flory lattice model in order to explain the observed lyotropic polymorphism.

INSTITUTIONAL PROJECT IV

A.1. *Immunocontraceptive effect of BIM in rodents.*

P. Bhattacharyya, D. Ghoshal and A. Pakrashi (ES, ICMR)

Blastocyst implatation is associated with immuno-suppression. As BIM was known to upregulate suppressed immune system, it is injected soon after mating in female rodents. It was observed that BIM prevented implantation and the effect is reversible. It is suggested that the anti-implantation effect of BIM is primarily immunologic and mediated via macrophage activation.

A.2. *Field trial of BIM in Chicken.*

P. Bhattacharyya, D. Ghoshal in collaboration with D. Chakraborty, D. Misra, G. Chakraborty, S. Chakrabarty, (Institute of Animal Health and Veterinary Biologicals, Govt. of West Bengal).

Field trials were conducted on more than 13,000 birds at private as well as state poultry farms (Gobordanga and Krishnanagar). It was observed that 3 nasal dosage of BIM significantly reduced the mortality rate to less than 5%. Antibody estimation against Ranikhet Virus vaccination showed that BIM treated birds had a mean titre of 1821 as against 517.7 observed in Control, 15 days post R_2B vaccination.

A.3. *CCl_4 induced hepatotoxicity in rats/mice and the effect of a crude protein derived from the leaves of Cajanus indicus*

P. Bhattacharyya, S. Datta, S. Sinha in collaboration with Dr. A. Bhattacharyya

Rats (120-150 gms body weight) and mice (30-32 gms body weight) were both subjected to hepatotoxicity by a single dose of CCl_4 (dose - 25 µl ip). Hepatotoxic animals were treated with crude protein isolated from *Cajanus indicus*. It was observed that after the treatment with protein fraction for 7 days, 14 days, 21 days respectively serum bilirubin, SGPT, SGOT, Alkaline phosphatase, lactate dehydrogenase were reduced significantly ($P< 0.001$) compared to CCl_4 and control. Histopathological studies of liver revealed improved cytoarchitecture.

INSTITUTIONAL PROJECT V

A. *Beta-lactam resistance and penicillin-binding proteins of Mycobacteria.*

Manikuntala Kundu, Joyoti Basu, Parul Chakrabarti, Sebarata Mahapatra, Tapan Mukherjee, Dhiman Basu and Sanjoy Mukherjee

A.1. *Expression of PBP1 and PBP1* of Mycobacterium leprae in Escherichia coli (in collaboration with the University of Liege, Belgium).*

Two genes pon 1 and pon 2, encoding two high molecular mass PBPs, PBP1, and PBP1*

were identified in cosmid libraries of *M. leprae*. PBP1 and PBP1* were expressed in *E. coli*. While PBP1 was highly resistant to beta-lactams, PBP1* was sensitive to beta-lactams. Deletion of pseudo-signal sequence and of a C-terminal portion of PBP1 did not affect penicillin binding. Efforts to express these truncated constructed of PBP1 in the periplasm by placing the gene downstream of a pel B leader peptide, were not successful.

A.2. *The 49 kDa of M. smegmatis.*

This PBP was kinetically characterized with respect to its interaction with peptides, thiol esters and beta-lactam antibiotics. The k_{+2}/K values for acylation by different beta-lactams, showed that the PBP had high affinity for imipenem, amoxycillin, flomoxef, moxalactam and cefoxitin. Attempts to clone the gene for this PBP have so far not been successful.

A.3. *Purification and Characterisation of a porin from M. semgmatis.*

A porin of Mr 40,000 has been purified from the cell wall of *M.smegmatis*. The purified porin facilitated uptake of small molecules much as sugars and amino acids and also permitted uptake of beta-lactam antibiotics. Its N-terminal sequence did not show any similarity with that of other known porins. The possible involvement of this porin in drug permeability and development of drug resistance in mycobacteria is being investigated.

A.4. *Studies on the mycolic acid defective mutant of M. smegmatis.*

Mycolic acid biosynthesis is inhibited by the frontline antituberculous drug, isoniazid (INH). Since the biosynthetic route to mycolic acids remains largely unknown, the precise target(s) of INH has not been identified yet. A mycolic acid defective mutant which synthesizes the precursors (shorter chain fatty acids) of mycolic acid is INH-resistant while the parent strain is INH-sensitive. Introduction of the genomic library of the parent strain into the mutant by electroporation has resulted in isolation of a few INH-sensitive transformants. Biochemical and genetic analyses of these transformants and the mutant are being carried out to elucidate the route to mycolic acid biosynthesis and to identify INH-targets.

B. Beta-lactam resistance in Shigella dysenteriae.

Manikuntala Kundu, Anindya Sundar Ghosh, Alak Kanti Kar, and Jasimuddin Ahmed

B.1. *Expression of new high molecular mass PBPs associated with beta-lactam resistance in S. dysenteriae.*

A laboratory mutant resistant to beta-lactams, showed the appearance of two new high molecular mass PBPs. Both these PBPs were immunologically related to the PBP 1b of *E.coli*. Their apparent molecular masses were lower than the PBP1 of the parent strain, suggesting that these PBPs could represent deletion mutants of PBP 1b. The PBP1-specific antibiotic cefsulodin, showed a lower k_{+2}/K value for these PBPs compared to the PBP1 of the parent strain. Cefsulodin resistance therefore appeared to be related to increased resistance of these PBPs towards the antibiotic.

B.2. *Characterization of an oxacillin-hydrolyzing beta-lactamase from S. dysenteriae.*

A constitutive beta-lactamase of Mr 23,000 had previously been purified from a beta-lactam-resistant clinical isolate of *S. dysenteriae*. This enzyme was kinetically characterized, and shown to belong to the family of enzymes caterogized as Class D enzymes, which hydrolyze oxacillin and cloxacillin and are inhibited by sodium chloride.

B.3. *Imipenem permeability and imipenem resistance in S. dysenteriae.*

A clinical isolate M2 which was resistant towards a battery of beta-lactams, showed sensitivity towards the carbapenems imipenem, meropenem and panipenem. M2 lacked the major porin of M 43,000. This raises the possibility that carbapenems may use an alternative channel in *S. dysenteriae* rather than the non-specific porin channels. A 30 kDa porin with homology to Omp A of *E. coli* was purified and shown to allow perneation of carbapenems. Its possible role in carbapenem uptake is being investigated in detail.

PUBLICATIONS

1. Adhikary, G., Chandra, S., Sikdar, R. and Sen, P.C. The phase behaviour of L-α-phosphatidyl choline in presence of chlorpromazine under different experimental conditions. *Colloids and Surfaces*, **4**, 335-339, 1995.

2. Ai, Z., Misra, Suniti, Sura, M., Varticovski, L. and Cohen, C.M. Phosphatidylinositol 3-kinase activity in murine erythroleukemia cells during DMSO-induced differtiation. *Expt. Cell Res.*, **219**, 454-460, 1995.

3. Basu, J., Mahapatra, S., Kundu, M., Mukhopadhyay, S., Nguyen-Disteche, M., Dubois, P., Joris, B., van Beeumen, J., Cole, S.W., Chakrabarti, P. and Ghuysen, J.-M, Identification and overexpression in *Escherichia coli* of a Mycobacterium leprae gene, pon 1, encoding a high-molecular-mass class A penicillin-binding protein, *PBP1. J. Bacteriol.*, **178**, 1707-1711, 1996.

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Participation in Conference/Symposia Training Programe/Awards and Honours received.

Dr. Joyoti Basu : (i) participated in the Gordon Research Conference on Red Cells in Plymouth, New Hampshire, U.S.A. and the FEBS Meeting in Basel, Switzerland, in August, 1995. (ii) delivered an invited lecture on Palmitoylation of erythrocyte membrane proteins in the second symposium on Biochemistry and Biophysics organised by the West Bengal Academy of Science and Technology. (iii) participated in the Annual Meeting of the INSA Young Scientist Awardees in October, 1995, at New Delhi.

Dr. Manikuntala Kundu : (i) participated in the DST group monitoring workshop at Indian Institute of Science, Bangalore in November, 1995.

Prof. Parul Chakrabarti : Chaired the session on "Lectin-Cell Surface Interaction" in the 4th International Symposium on Biochemical Roles of Eukaryotic Cell Surface Macromolecules and delivered an invited lecture in the same session at New Delhi in January. 1996. She was also invited to deliver a series of lectures for the M.Sc. Course Programme of the Biochemistry Department, Calcutta University.

Prof. Amitabha Ghosh delivered two lectures on (i) "Gas Chromatography Principles and Applications" and (ii) "Analysis of Drugs" and Chaired two sessions in the Workshop on "Analytical Applications of GLC" organised by RSIC, Bose Institute on Feb. 14-16, 1996.

Dr. Parimal C. Sen as a joint secretary participated in the "International Symposium on Recent Trends in Microbiology" held at Calcutta. Dipankar Bhattacharyya, Kausik Ray and Atin K. Mandal participated in the International symposium on Trends in Microbiology held at Calcutta.

Dr. Manas Chakrabarty : Attended (i) IICT Golden Jubilee Celebration on Frontiers in Chemistry and Chemical Technology', held in March - April, 1995 at IICT, Hyderabad. (ii) as a Member of the Sc. Committee 'Inter-

national Symposium on Trends in Microbiology', held in December, 1995 at Calcutta ; (iii) Seminar on Synthesis and Stereochemistry of Organic Compounds, held in December, 1995 at the University of Calcutta on the occasion of 70th Birth Anniversary Celebration of Prof. D. Nasipuri. (iv) the symposium 'Challenges in Organic Synthesis', held in January, 1996 at I.A.C.S., Jadavpur, Calcutta on the occasion of the 65th Birth Anniversary of Prof. U.R. Ghatak; (v) was re-elected an Associate Editor of the *J.Indian Chem. Soc.* for the 2 year-term, 1996-1997; (vi) was elected a Member, Publication Committee of the *J.Indian Chem. Soc.* for 1995.

Ms. Shampa Khasnobis presented a paper at the 32nd Annual Convention of Chemists, held in December, 1995 at the University of Rajasthan, Jaipur and attended both the Symposia held on the occasions of 70th and 65th Birth Anniversaries of Prof. D. Nasipuri (Dec., 1995 at Calcutta University) and Prof. U.R. Ghatak (January, 1996 at I.A.C.S., Calcutta), respectively.

Ph.D. Awarded

Name	University/Subject	Year	Title	Supervisor
Dipankar Banerjee	Jadavpur/ Chemistry	1995	Studies on the phospholipids of the esterian mud skipper, *Boleophthalmus boddaerti* from Sunderbans mangrove region of West Bengal, India	Prof. Amitabha Ghosh

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

Amiya Maiti, Anuradha Bhaduri, Asis Bhattacharyya, Mallika Roy (upto 6.11.95), Dipankar Bhattacharyya, Anindya Sunder Ghosh, Tapan Mukherjee, Shampa Khasnobis, Sarmistha Dutta, Dr. Debasish Ghosal, Dr. Sarmila Roy (upto 31st October, 1995), Dr. Anupa Bhattacharyya, Amit Das, Alok Kanti Kar, Manas K. Pathak (upto 23rd February, 1996), Sebabrata Mahapatra, Chaitali Bhattacharyya, P.T. Srinivasan, Raja Bhattacharyya, Atin K. Mandal, Kausik Roy, Dhiman Basu, Dr. Jitendra K. Gupta (upto 29th August, 1995), Dr. Sarmila Chattopadhyay (upto 19th July, 1995), Dr. Ganesh Gopal (upto 8th May 1995), Dr. Gautam Chattopadhyay (upto 2nd February, 1996), Dr. S. Subramaniam (upto 30th April, 1995), Dr. Krishnakoli Neogi, Dr. Rita Sikdar, Jasimuddin Ahmed, Swapnanjan Goswami, Sanjoy Mukherjee, Biplab Dasgupta (from 12th July, 1995), Swati Sinha (from 5th February, 1996)

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, Gour Chandra Biswas (upto 31.1.96), Brindaban Ghosal, Chittaranjan Santra, Chittaranjan Ghosh, Debdas Nandi, Eklas Ali, Rama Mukherjee, Gopal K. Biswas, Amarnath Bhatta, Subhash Chandra Pal, Kodan Das.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Dr. Joyoti Basu	Studies on the role of palmitoylation of human erythrocyte membrane proteins.	D.S.T.
Dr. Manikuntala Kundu	Beta-lactam antibiotics and Shigella : Studies on penicillin-binding proteins of Shigella.	I.C.M.R.
Dr. Joyoti Basu	Effect of Oxidative stress on erythrocyte membrane structure and function in chronic myelogenous leukemia.	C.S.I.R.
Prof. Parul Chakrabarti, Dr. Joyoti Basu, Dr. Manikuntala Kundu	Penicillin binding proteins and beta-lactamase of Mycobacteria.	Indo-EC
Prof. Parul Chakrabarti, Dr. Joyoti Basu, Dr.Manikuntala Kundu	Functional significance of abnormalities of the erythrocyte membrane in myeoproliferative disorders.	Indo-EC
Dr. Manikuntala Kundu	Biochemical approaches towards the therapy of shigellosis.	D.S.T.
Prof. P. Bhattacharyya Dr. A.Bhattacharyya	Antihepatoxic agents from Indian medicinal plants.	C.S.I.R.
Prof. P. Bhattacharyya Dr. (Mrs.) A. Pakrashi	An immuno modulatory approach to fertility regulation studies on a marrow derived cytokine in the prevention of Pregnancy in female rodeuts.	I.C.M.R.

Botany

Faculty : Prof. A.N. Lahiri Majumder (Chairman, from 1.12.95) Prof. S.N. Ganguly, (Chairman, upto 30.11.95), Prof. B. Ghosh, Prof. Swati Sen-Mandi, Dr. S. Gupta, Dr. B.B. Mukherjee, Dr. K.K. Mukherjee, Dr. P.K. Saha, Dr. D.N. Sengupta, Dr. S. Bhattacharya, Dr. S. Gupta-Bhattacharya, Dr. T.K. Ghose.

INSTITUTIONAL PROJECT I

A. Plant responses to abiotic stress.

A.1. *Effect of abiotic stress on the expression of components of Photosynthesis in salt tolerant and salt sensitive rice cultivars.*

Bharati Ghosh, Anindita Bose, B.S. Tiwari, and S. Dutta.

Activity of RuBPcarboxylase was found to be reduced significantly in leaves of salt sensitive IR29 by salinity stress whereas no such decrease was noticed from the leaves of salt tolerant Pokkali. S35-methionine incorporation into RuBISCO also showed same effect of salinity stress. Northern analysis detected salinity stress induced significant decrease of transcripts for rbcL and cytochrome oxidase in IR-29 but not in Pokkali.

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

Bharati Ghosh, Manas Chattopadhyay and Malabika Roy (In collaboration with **D.N. Sengupta**)

Northern analysis revealed salinity stress induced accumulation of transcript for arginine decarboxylase (ADC) in shoots of both salt tolerant Pokkali and salt sensitive M-1-48 rice cultivars. Transmission electron micrography showed the damage of plasma-membrane of root cells by salinity stress. Exogenous application of spermidine at 1 mM concentration during salinity stress was found to maintain normal integrity of the membrane.

Salinity stress induced decrease of transcripts for chloroplast genes like psbA, psbB of PSII Complex and rbcL was detected and exogenous application of Spd and Spm was found to abolish that salinity stress induced down regulation. High regeneration from scutellum-derived rice callus was obtained and high temperature stress was found to be inhibitory more in heat sensitive IR-8 than heat tolerant, N-22, rice cultivars. Spd and Spm were found to induce rhizogenesis in scutellum derived callus in absence of rooting hormone like Indole butyric acid.

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

A.N.Lahiri Majumder, Sriparna Bagchi and Aniruddha Roychoudhury

Enhanced activity of chloroplast and cytosolic inositol synthase in salt-tolerant rice cultivars under NaCl-growth leads to increased production of the cyclitol. Further, the decline in the photosynthetic activity of the salt-sensitive varieties of rice under NaCl-stress can be attributed at least in part, to the inhibition of chloroplast and cytosolic fructose-1, 6-bisphosphatase ($FruP_2ase$) activities. Although both salt-sensitive and salt-tolerant varieties accumulate equal amounts of Na in the leaves or chloroplasts, $FruP_2ase$(s) of the salt-tolerant cultivars or that from *Porteresia coarctata* (a salt-tolerant wild rice), exhibit lesser susceptibility towards *in vitro* inhibition by NaCl than that from the sensitive ones indicating probable structural differences among the $FruP_2ase$(s) from such sources. Additionally, *in vitro* inhibition of $FruP_2ase$(s) from the sensitive rice cultivars can be obliterated by prior incubation of the enzyme by inositol and methylated inositols suggesting a mechanism for protection of $FruP_2ase$(s) by activation of inositol synthase *in vivo* during salinity stress.

A.4. *In vitro selection of NaCl tolerant somaclonal line of rice (Oryza sativa L) cv. Basmati 370.*

B. B. Mukherjee and Sangita Basu

Production of salt tolerant somaclonal line of Basmati rice was continued to find out the

optimum condition of regeneration from salinity adapted (128 mM NaCl) rice Calli. Maximum regeneration (55%) was found only when calli were grown in R2 B5 basal medium containing IAA and Kinetin but without NaCl. Presence of NaCl in the medium was found to reduce regeneration significantly. Proline content of the plantlets regenerated from salinity adapted Calli was found to be about four times higher than the plants regenerated from unadapted Calli. Organogenesis and somatic embryogenesis of the differentiated NaCl adapted callus were studied by Scanning Electron Microscopy.

A.5. *Salinity stress and expression of transcription factor that recognises abscisic acid responsive element in rice cultivars.*

D. N. Sengupta, Sudhiranjan Gupta (In collaboration with **B. Ghosh**)

Northern analysis of RNA isolated from root, sheath, and lamina of control and salt treated rice plants of salt tolerant Pookkali and salt sensitive IR-29 cultivars using the cDNAs for salT or EmBPI was continued. While salinity stress induced accumulation of transcript for salT was detected in roots and sheath in both cultivars, accumulation of transcript of EmBPI homologous factor was detected only in roots but not in sheath and lamina. Presence of factor in nuclear extract that binds to abscisic acid responsive element (ABRE) was detected by gel mobility shift assay and activation of factor by spermidine or proline was revealed.

B. Plant Breeding and tissue culture

B.1. *Genetic approaches for the improvement of aromatic rice suitable for the agro-climatic conditions of West Bengal.*

T.K.Ghosh, S.N. Ganguly, S. Gupta, B.B. Mukherjee, K.K. Mukherjee, P.K. Saha

Aromatic rice (Basmati and others) genotypes (300 in number) were grown in field in Madhyamgram and 88 lines found to retain aroma for the last five generations. Partial agromorphological characterization of these lines has been made.

A single recessive gene has been found to control the expression of aroma in 15 aromatic/nonaromatic cross combinations, while digenic recessive control was observed in one such combination. Analyses of F3 population further confirmed the monogenic recessive nature of aroma. A number of hybrids are aromatic signifying the allelic nature of the fragnance gene. A basmati restorer has been identified for a widely used IRRI-bred cms line (IR 62829A). Androgenic haplodiploids have been raised and successfully transferred to the field. Seeds have been obtained from 28 lines derived from four cultivars and three lines from two hybrids. Routine advancement and directed crossings have been carried out.

B.2. *Introgression of disease resistance from local cultivars to improve Sesamum through hybridization and anther culture.*

S.Gupta, G. Gangopadhyay, R. Poddar

To transfer disease resistance trait to high yielding cultivars of *Sesame*, four high yielding cultivars and one local disease resistant cultivar were selected for breeding after evaluation of agronomical parameters. Hybridization experiments have been made and seeds obtained from F_1 population.Micropropagation with multiple shoot initiation and androgenic calli cultures were standardized.

B.3. *Genetics of submergence tolerance in rice.*

S. Gupta, Nirmal Mandal and Aniruddha Das.

Activities of different isoenzymes before and after submergence were compared in submergence tolerant and sensitive cultivars of rice. One extra distinct esterase band was detected in tolerant cultivars. Submergence induced enhancement of alcohol dehydrogenase was detected in sensitive type than in all seven tolerant cultivars. Higher peroxidase level was detected in sensitive cultivar in comparison to tolerant cultivars.

To transfer the submergence tolerance to high yielding rice cv. Pankaj inter specific crossing was made with *Oryza rufipogon Griff* (Submergence tolerant) and anther culture of hybrid plant was done. Plants were further analyzed. Of the 931 regenerated pollen plants, double haploids (DH), haploids, and hyperloids

were 73.3%, 24.8%, and 2.9%, respectively. In the field 696 DH plants survived upto maturity and showed 1:1 segregation of the traits for most of the qualitative characters studied.

B.4. *Cytogenetical investigations on Beta spp. and studies on wild gene po'ol of Chenopodium and Ipomoea species.*

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

The genotypic variabilities of the selected lines of hybrids between *Beta vulgaris* and *B. palonga*, are bing assessed for finalizing the process of selection.

Analysis of total protein and four isoenzymes of different cytotypes of *Chenopodium album* suggest that the wild diploids are plausible progenitors of the semi-cultivated hexaploid *S. album.*

Defatted extract of *Ipomoea quamoclit* was further extracted with organic solvents and after chromatography and spectral analysis compounds like stigmasterol, β-sitosterol, taraxerol, a-amyrin, taraxerone, erythrodiol, cucurbitacin-G and n-triacontanol were identified.

B.5. *Development of insect tolerant oilseed Brassica identified through in vitro technique.*

P.K. Saha, A. Roy

Intervarietal crossing of *Brassica juncea* cv. RLM-198 and RJ-15 was made and androgenic plants alongwith F2 populations were evaluated for insect tolerance in field condition. Plants showing relatively high tolerance will be studied further.

C. DNA damage and repair.

C.1. *Studies on chromatin bound DNase activity in relation to DNA integrity in dry embryos.*

Swati Sen-Mandi, Somen Nandi, Gitali Das

During early imhibition of aged rice seeds, a large extent of single stranded DNA damage was detected. Extraction of chromatin bound DNase from dry embryos of differentially aged and fresh seeds revealed decline of DNase activity with ageing, thus rule out as the cause of DNA damage. Balance between free radical accumulation and superoxide dismutase activity has been found to probable cause of DNA damage.

C.2. *Plant DNA polymerase : Possibility of cloning cDNA and characterization of their structure and function.*

D.N. Sen Gupta, M. Sanath Kumar, and T. Chaudhury

The rice DNA pol β of 67 kDa size that we have reported earlier was purified to large extent for determination of amino acid sequence. As pol β is known to involved in mismatch repair and inducible by alkalyting agents in mammalian system we checked the effect of EMS treatment of rice seedling on the activity of pol β . Result indicate enhancement of Pol β activity after treatment of EMS (1%) for 8 hr., after that decline was detected. Mismatch repair assay will be tested with the purified enzyme. The yeast gene for DNA polymerase IV equivalent to pol β, has been amplified by polymerase chain reaction using sequence specific oligonucleotides. The PCR product will be used to identify homologous gene in rice.

D. Germplasm screening and seed biology.

D.1. *Biomolecular markers for submergence tolerance in rice.*

Swati Sen-Mandi and Somen Nandi

To select appropriate parents for breeding submergence tolerance a number of indegenous rice varieties have been evaluated using physiological and biochemical parameters. Varieties like FR 13A and Jalamagra have been confirmed. In collaboration with Dr. Neng Huang, Genome mapping laboratory, IRRI, Somen Nandi has located a major gene for submergence tolerance trait on chromosome 9 of FR13A rice by AFLP mapping.

A three year field trial of differentially aged and unaged rice seeds was performed to understand the relation between seed vigour and field emergence/yield. Data recorded from the experiments showed that early seedling vigour not only influences crop stand establishment but also has an effect on tillering efficiency and yield of individual plant. Thus under direct seeding conditions a seed stock of low vigour statuse reduces productivity by bringing about

(a) reduction in plant population in a given field area and (b) reduction in tillering and seed production per plant.

D.2. *Dormancy of Legume seeds and regulation of water uptake during germination*

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

Studies on dormancy in different legume seeds were extended by analyzing the seed structures by SEM and regulation of water uptake. The architecture of seed coat, hilum, micropyle and the lens (strophiole) were found to act as important factors in water uptake and dormancy of seeds.

E. Micropropagation of economically important/ornamental plants

S. Bhattacharya and Sanghamitra Bhattacharya

Regeneration of multiple shoots from the cotyledons of *Nyctanthes arbortrisis* cultured in vitro was found to be maximum in well balanced MS medium containing BAP, NAA, and kinetin at proper concentration.

Rooting of multiplied shoots of *Jasminum* sp. was obtained by addition of NAA or IBA in the medium.

F. *Chemistry of Natural Products*

F.1. *Isolation and structure elucidation of a new triterpene from leaves of Scoparia dulcis.*

S.N. Ganguly and Shyamali Banerjee

From the methanolic extract of defatted leaves of *Scoparia dulcis*, a new triterpene acid was isolated as its methyl ester. On the basis of physical measurement and chemical evidences, the structure of the compound was given.

F.2. *Isolation and structure elucidation of a new tritergene from Vitex negundo.*

S.N. Ganguly and Jayashree Banerjee

From the methanolic extract of the leaves of *Vitex negundo*, three triterpenes were isolated out of which one is found to have insect repellant character. Due to paucity of the material full characterisation of the above compound was not possible. Further work on isolation of more compounds and its full charactersation is in progress.

F.3. *Synthesis of organotion compound.*

S.N. Ganguly and Bibhuti Maji.

We synthesised Tropinyl 2-isoprophylbenzo (b) thiopene-3-carboxylate, $C_{20}H_{25}NO_2S$, an analogue of the parasympathomimetic neurotransmitter acetyl choline, with the expectation that it may have a wide range of pharmocological effects. The structure of the compound was confirmed by IR, ^1H NMR and MS. Further confirmation of the above structure was confirmed by X-ray analysis.

F.4. *Delay of fruit ripening by antisense RNA approach.*

D.N. Sengupta, Bharati Ghosh and S. Dutta

The extraction of RNA from tomato fruit has been standardized and cDNA of ACC synthase has been amplified by RT PCR. The PCR amplified DNA is being characterized.

INSTITUTIONAL PROJECT III

A.1. *Regulatory properties of brain Fructose-1, 6-bisphosphatase.*

A.N.Lahiri Majumder, Sanghita Bhattacharjee and Sriparna Bagchi

Brain fructose-1, 6-bisphosphatase, a Zn^{+2} containing protein undergoes modification in its catalytic and regulatory properties on subtilisin digestion. Such changes include change in pH optimum from neutral to alkaline range; loss of inhibition by 5'-AMP, an allosteric regulator, and generation of a 4kDa S-peptide. In addition, intrinsic tryptophan fluorescence of the subtilisin-digested protein is enhanced several-fold by Mn^{+2}/Zn^{+2}, suggesting structural changes of the protein upon such treatment.

A.2. *Plant inositol synthase(s): Characteristics of the cytosolic and chloroplast forms.*

A.N. Lahiri Majumder, Aniruddha Raychoudhury, Nitai Chand Hait and Rashmi Deb.

Biochemical, immunological and structural studies of the cytosolic and chloroplast forms of inositol synthase(s) from *Englena, Oryza* and *Vigna* revealed identical characteristics of the two forms of the enzyme except in the organization of the (58-67) kDa subunits in the cor-

responding holoenzyme(s). In addition, a single form of inositol synthase has been characterized from a hitherto unreported cyanobacterial source (*Spirulina platensis*), suggesting that the plant inositol synthase(s) might have evolved from ancestral prokaryotic progenitor(s).

INSTITUTIONAL PROJECT IV

A. Environmental biopollution in relation to human and plant health.

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

Phoenix sylvestris, the date sugar palm was found to be highly allergenic through skin prick test (SPT) and using ELISA technique. On SDS-PAGE, the allergen extract was separated into twenty bands, of which eight were found to be allergenically active in immunoblotting.

An allergenically active component was isolated from Borassus flabellifer using $(NH_4)_2SO_4$ fractionation and gel filtration. This component was found to be homogeneous in PAGE having M.W. 90,000.

A comparative study was made to determine the allergenic relationship between the four common palm pollens. Out of 63 patients tested by SPT, *Phoenix sylvestris* elicited maximum reactivity (44.4%) followed by *Areca catechu*, *Cocoa nucifera* and *Borassus flabellifer*. The majority of the patients showed markedly positive skin reaction and specific IgE level to more than one palm pollen extract. Immunoelectrophoresis with rabbit antibody also revealed the presence of shared antigenic components in the four palm pollen extract.

After completion of one year sampling in different indoor environments, sampling has been started in a more comprehensive way using volumetric samplers. The dominant fungal types having established allergenic significance during rainy season and winter are *Cladosporium* sp., *Chaetomium* sp. *Alternaria* sp., *Nigrospora* sp. *Curvularia* sp. etc.

After completion of ecofloristic survey of Burdwan district, aerobiological survey has been initiated in terms of frequency and diurnal periodicity of airborne pollen grains in Burdwan town. The dominant pollen types found are the grasses, *Trema orientalis*, *Psidium* sp., *Cassia* sp. and pollen grains from Cheno-Amaranthaceae.

Eight honey samples collected from different biozones of West Bengal (Darjeeling, Madhyamgram, Sunderbans) have been analysed palynologically and chemically. Carbohydrate, protein, lipid, Vit, C and minerals have been estimated in relation to pollen content. There is no remarkable variation in carbohydrate, protein, lipid, vit C and minerals due to change in pollen spectra and amount of pollen grains.

Through ^{14}C dating the current knowledge of the age of Pleisto-Holocene sediments of Bengal Basin is extended from 7000 to 32000 YBP accompanied by 57 foraminiferal species and by mangrove elements denoting estuarine-fluviatile condition. the mangrove swamp phase was extended north wave upto 120 km (Dankuni) from present day coast line.

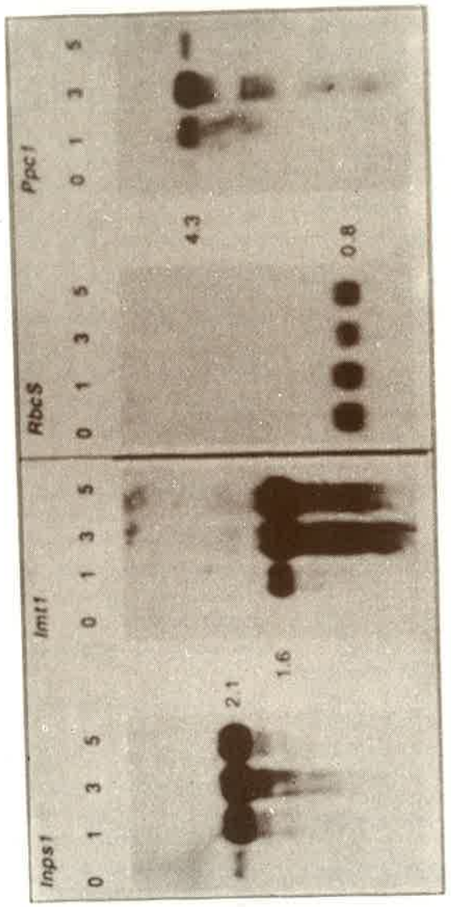
OTHER THAN INSTITUTIONAL PROJECT

A. Use of ultrasonic techniques for investigation of microstructure of metal alloys.

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

Quality assurance of materials demands increasing knowledge about its microstructure. Ultrasonic technique is primarily used as a nondestructure method to investigate this microstructure by the measurement of attenuation commonly by pulse echo method. Howwver, this conventional measurement ignores the back scattered signals sandwiched between the backwall echoes. these back scattered signals possess more interinsic information about the microstructure. Hence better understanding of microstructure can be achieved by proper analysis of the back scattered signals.

For the anyalysis of the back scattered ultrasonic signals, a broad band ultrasonic probe with central frequency of 5 MH_2 (crystal diameter of 12.5 mm) for Cu and a broad band probe of central frequency of 10 MH_2 (crystal



RNA blot hybridization of stress-regulated transcripts in the ice plant.
RNA (20 µg total RNA per lane) was isolated from 4-week-old plants which were either unstressed (0), or stressed for 1, 3 and 5 days (labeled 1, 3, and 5, respectively). Probes used were *Ppc1* (3.3 kb; stress-induced CAM-form of phosphoenolpyruvate carboxylase; Cushman and Bohnert, 1989); *Imt1* (1.6 kb; Ins-*O*-methyltransferase; Vernon and Bohnert, 1992), *RbcS* (0.8 kb; coding region of *RbcS* encoding SSU of Rubisco; DeRocher and Bohnert, 1993), and *Ins1*

diameter of 6mm) was used. the probe was excited by a pulser receiver unit to generate a short duration ultrasonic pulse in the plane parallel specimens of Cu (50 mm x 50 mm x 10 mm) and (50 mm diameter, 7.56 mm thickness).

Scattered ultrasonic signals starting from the first backwall echo from these materials was captured by the same probe and were sampled at a sampling rate of 10 ns for 512 data points. The position of the probe on the sample was changed at random and the back scattered signals of 512 data points from each location was captured. These eight individual scattered signals (each being a representative of the microstructure of a particular location along its thickness was then joined together to form the entire signal of 4096 data points. The analysis of this signal would certainly give the global information of the microstructure. The fractal dimension for these scattered discrete ultrasonic signals from Cu and KCl are found to be 1.5297 and 1.5454 respectively. These are two unique distinct values representing the respective microstructure.

Quite recently, the concept of fractals have proved useful in characterization of crack surfaces. In fact, this new concept turns out to be a more referred tool of fracto graphic analysis. In deed, a self-affine glometry has been evidenced in many cracks, with various materials, loading models, fracturing conditions and sample sizes.

No attempt has so far been made to characterize these crack surface using a custic means. For the first time, a model is developed which studies the dependence of the average echo power I (7) (where 7 is the time delay) resulting from the differentiation of a gause nonchromatic acustic pulse from a multiscale randon crack surface modelled as a fractal with Hansdoff. Besicoitch dimension between 2 and 3. The final analysis gives the fractal dimension of the crack surface from the expression for the average echo power.

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

Swati Sen-Mandi and Gitali Das

In collaboration with Rubber Research Institute of India

The activity of superoxide dismutase has been studied in newly tapped and over tapped rubber trees. The polyacrylamide gel electrophoretic assessment of SOD Isolated from lutoids showed three bands. Preliminary experiment reveals that both mitochondrial and cytosolic SOD bands are present in newly tapped plants, the bands gradually disappear with appearance of Tapping Panel Dryness syndrome, a disorder caused by over tapping/ stimulation.

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

Prof. B. Ghosh has been elected a member of the Executive Council in the Society for Plant Physiology and Biochemistry, New Delhi. She has delivered an invited talk on "Molecular analysis of Polyamine metabolism and its action in plants during abiotic stress" in the National Symposium entitled "Modern Trends in Plant Physiology" held at G.G. Pant University of Agriculture & Technology, Pantnagar, Nainital on March ' 96.

Prof. A.N. Lahiri Majumder deliverd the Shadakshara Swamy Award lecture in the Annual Meeting of the Society of the Biological Chemists held in Oct. 1995 at Lucknow. He also participated in the Guha Research conference at Alibagh as an invitee.

Dr. P.K. Saha, Dr. Sabita Bhattacharya, Amitava Ray, Gaurab Gangopadhyay, Sangita Basu, Nirmal Mandal and Ramit Poddar attended the Seminar entitled "National Seminar on Recent Advances in Plant Sciences" held in April 1995 in the Department of Botany, University of Calcutta, and presented papers. Amitava Roy, presented poster in "All India Symposium on Recent Advances in Biotechnological Application of Plant tissue and Cell Culture " held in June 1995 ; CFTRI, mysore.

Dr. Swati Bhattacharya visited IARC-Rothamasted, Herpenden, U.K. October 1995 and also attended 29th Annual Convention of Indian College of Allergy and Applied Immunology held at Bose Institute in December 1995. She has been elected Joint Secretary of the Indian Aerobiological Society for the next four years. Pampa Chakraborty, Indrani Chaudhury, Arati Malakar, Atin Adhikari and

Moon Moon Sen also participated and presented papers in the Annual Convention of I.C.A.I. Pampa Chakraborty has been awarded gold medal in P.H. Gregory Memorial Competition 1996 at 8th Indian Aerobiological Conference held at Pune.

Dr. Sabita Bhattacharya has a delivered a talk on "Rapid multiplication of *Jasminum officinale* by *in vitro* culture of nodal explant" in 2nd International Plant Tissue Culture Conference held at Dhaka University, Dhaka, Bangladesh on December 12-14, 1995.

Dr. D. N. Sengupta has attended the Annual Meeting of the Society for Biological Chemists held at Lucknow in Oct. 1995 and presented poster paper. He has also delivered a talk on salinity stress.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. B. Ghosh	Thermal Regulation of Ribulose 1, 5-bisphosphate carboxylase in rice	C.S.I.R.
Prof.A.N. Lahiri Majumder	Chloroplastic myoinositol synthase from *Englena gracilis*. Molecular studies and photoregulation	D.S.T.
Prof. S. Sen-Mandi	Identification and study of biochemical and ecophysiological components of seed vigour for direct seedling cultivation of rice.	I.C.A.R.
Dr. S. Gupta	Introgression of disease resistance from local cultivar to improve *Sesamum* through hybridization and anther culture	C.S.I.R.
Dr. D.N. Sengupta	Characterization and cloning of cDNA for plant DNA polymerase	C.S.I.R.
Dr. D.N. Sengupta	Molecular analysis of regulation of salinity stress and abscisic acid inducible genes in rice.	D.S.T.
Dr. Swati GuptaBhattacharya	Aeroallergenes and human health-aerobiological studies (All India Co-ordinated Project)	M.E.F. India

Ph.D. Awarded

Name	University	Year	Title	Supervisor
Malabika Roy	Jadavpur	1995	Heat induced cellular events in rice (*Oryza sativa* L)	Prof. Bharati Ghosh
Bibhuti-bhusan Maji	Calcutta	1996	Preparation, characterisation, microbiological property and an approach towards the understanding of structure activity relationship (SAR) of some tri-organostannyl 2(Aryl azo) benzene carboxylates.	Prof. S.N. Ganguly

Phytomorphology, 46(2), pp. 99-107, 1996

STUDIES ON HISTOMORPHOLOGICAL COURSE OF EVENTS DURING ANDROGENESIS OF RICE (*ORYZA SATIVA* L.)[1]

N. MANDAL & S. GUPTA
Tissue Culture Laboratory, Department of Botany, Bose Institute,
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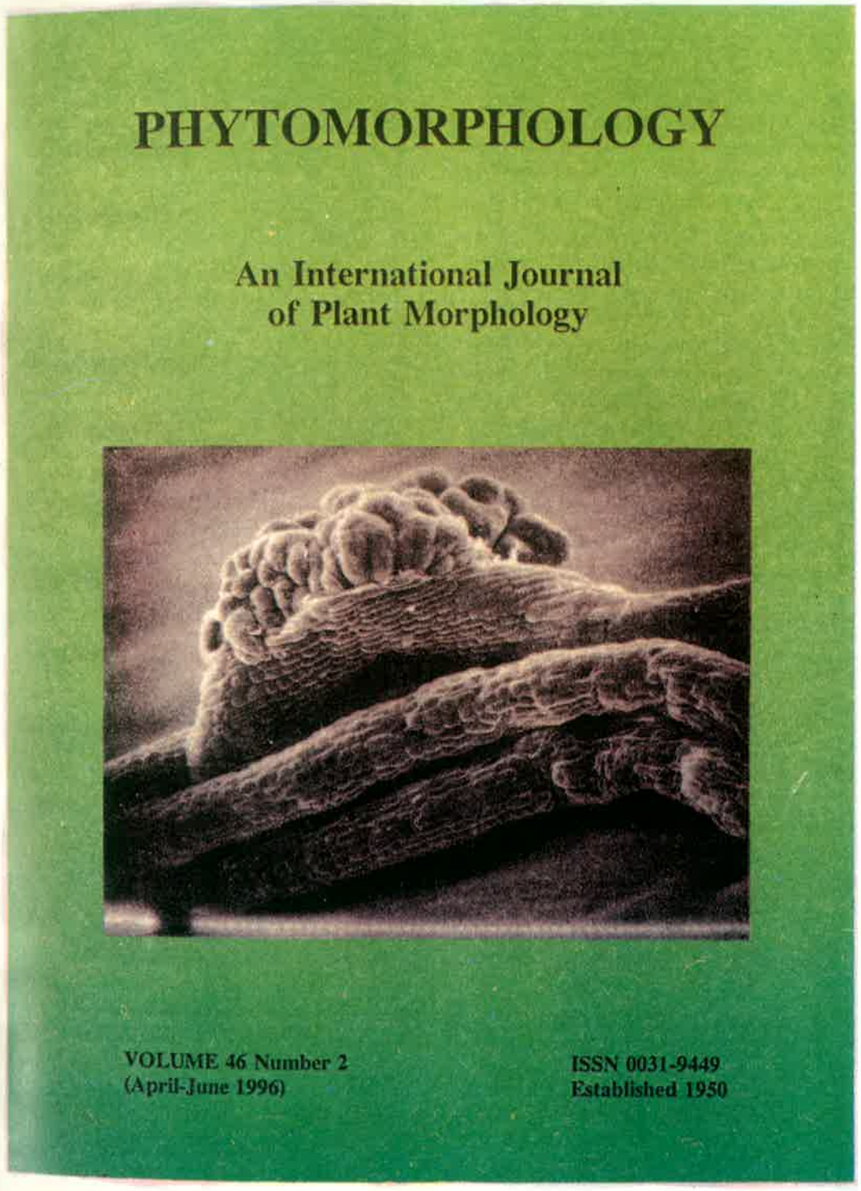

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PUBLICATIONS

1. Basu, S., Gangopadhyay, G., Gupta, S. and Mukherjee, B.B. Establishment of callus cultures and regeneration of plantlets in three indica varieties of rice (*Oryza Sativa L.*) *J. Natl. Bot. Soc.* ***48***, 1-6, 1995.

2. Biswas, S. and Saha, P.K. SEM studies on seed coat morphology and water uptake patterns in the seeds of Crotolaria Striata Linn. *Trans. Bose Res. Inst.* ***56***, 43-50, 1993.

3. Bose, A. and Ghosh, B. Response of photosynthetic apparatus in rice cultivars under heat stress. *Photosynthetica* ***31***, 625-30, 1995.

4. Chanda, S., and Gupta Bhattacharya, Swati Pollen allergy in India - an overview. *Ind. J. Allergy & Appl. Immunol.* ***7***, 3-11, 1993.

5. Chattopadhyay, P., Roychoudhury, A., Pal, R., and Majumder, A.L. Evaluation of algal biomass quality cultivated at rural level by low cost method. *Ind. J. Expt. Biol.* ***34***, 226-231, 1996.

6. Das, B.C., Pain (Biswas), S., Biswas, C., Ganguly, S.N. Banerjee, Asoke, Duax, W.L., Maji, B.B. and Ghatak, K.L. Tropinyl 2-iso-propylbezo[b]thiophene-3-carboxylate $C_{20}H_{25}NO_2S$. *Acta Cryst.* ***C51***, 2386-2388, 1995.

7. Das, S., Mitra, S.K. and Mukherjee, K.K. SEM studies on seed coat of some species of *Ipomoea* (Convolvulaceae). *Phytomorphology* **45**, 113-125, 1995.

8. Das, S. and Mukherjee, K.K. Biochemical studies on *Ipomoea* pollen to understand species homology. *Grana* **34**, 332-337, 1995.

9. Das, S. and Mukherjee, K.K. Comparative study on seed proteins of *Ipomoea* spp. *Seed Sci. Technol.* **23**, 501-509, 1995.

10. Gangopadhyay, G., Basu, S., Mukherjee, S.P., Poddar, R., Gupta, S. and Mukherjee, B.B. Water, Salt and Freezing stresses : Effect on relative water content, viability and banding patterns of some isozymes in *Brassica juncca* (L.) Crean. Callus. *Ind. J. Plant Physiol.* **38**, 41-44, 1995.

11. Ganguli, S. and Sen-Mandi, S. Embryo rescue from non-viable seeds for preservation of wheat (Triticum aestivum) germplasm. *Ind. J. Agri. Sci.* **65**, 781-84, 1995.

12. Ishitani, M. Majumder, A.L., Bornhouser, A. Michalowski, C.B. Jensen, R.G. and Bohnert, Hans J. Coordinate transcriptional induction of myo-inositol metabolism during environmental stress. *Plant J.* **9**, 537-548, 1996.

13. Mandal, N. and Gupta, S. Cytological studies on some partially sterile intervarietal and interspecific rice hybrids. *Ind. Biologist* **38**, 47-51, 1995.

14. Mandal, N. and Gupta, S. Effect of abscisic acid on androgenesis of rice (*Oryza sativa L.*) *Phytomorphology* **45**, 65-71, 1995.

15. Mandal, N. and Gupta, S. Effect of genotype and culture medium on androgenic callus formation and green plant regeneration in indica rice. *Ind. J.Expt. Biol.* **33**, 761-765, 1995.

16. Mandal, N., Sinha, S. and Gupta, S. Androgenesis in rice breeding. *I.R.R. N.* **20**, 6-7, 1995.

17. Roy, A., Poddar, R. and Saha, P.K. Salinity induced changes on some cultivars of rice. *J. Natl. Bot. Soc.* **49**, 21-25, 1995.

18. Roy, M. and Ghosh, B. Response of thermal stress in calli of rice (*Oryza sativa L.*) genotypes. *Plant Physiol. Biochem.* **22**, 2-8, 1995.

19. Roy, M., Ghosh, S. and Ghosh, B. Plant regeneration from embryogenesis calli of tolerant and sensitive rice cultivars under thermal stress. Physiol. *Mol. Biol. of Plants* **2**, 59-66, 1996.

20. Saha, P.K., Biswas, S., Das, B. and Ganguly, S. N. Studies on seed viability of *Shorea robusta* Gaertn.f. *J. Non-Timber Forest Product* **2**, 61-62, 1995.

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

Sudhi Ranjan Gupta, Aniruddha Roychaudhuri, Somen Nandi, Manas Kr. Chattopadhyay, Jayashree Banerjee, Nirmal Mandal, Sangita Basu, Sanghamitra Bhattacharya, Pampa Chakraborty, Malabika Roy, Biswajit Das, Gourab Gangopadhyay, Srijit Kr. Mitra, Arati Malakar, Atin Adhikari, Moon Moon Sen, Shyamali Chakraborty, Aloke Kr. Bera, Dr. Aniruddha Das, Dr. Budhi Sagar Tiwari, Chaitali Roy, Subarna Ghose, Sriparna Bagchi, Anindita Bose, Amitava Roy, Devashree Dutta, Rashmi Deb, Nitai Chand Hait, M. Sanat Kumar, Prabir Chakraborty, Saubhik Das, Dr. Sanghita Bhattacharya, Dr. Madhuchandra Chatterjee, Dr. Kajari Lahiri, Gouri Majumder, Piyali Chatterjee, Madan Mohan Nath, Subikash Bayen, Dr. Indrani Chaudhuri, Dr. Subhas Ch. Jana, Dr. Tapan Kr. Chaudhuri.

OTHER SUPPORTING STAFF MEMBERS

Narendra N. Chaudhuri, Sudhindra K. Chakraborty, Asoke Gupta - (retired on September '95), Dilip Kr. Sanyal, Sankar Basu, Sukumar Majumder, Dr. Ramit Poddar, Chanchal Chakraborty, Sankar Prasad Banerjee, Subrata Basak, Dilip Kr. Chakraborty, Nar Bahadur Rai, Shyamapada Halder, Kanailal Chatterjee, Sukdeb Das, Sudhir Jana, Sasanka Sekhar Bera, Sambhunath Debnath, Dhiren Kumar Das, Rabindra N. Roychoudhuri, Dilip Kr. Chakraborty, Bipul Nag, Kanan Singh, Munna Turi.

Microbiology

Faculty : Prof. A. C. Ghose, (Chairman from 1.3.96) Prof. Timir B. Samanta (Chairman upto 29.2.96), Prof. G. Nanda, Dr. K. Sen, Prof. P.K. Chakrabartty, 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. *Enhancement of nodulation and nitrogen fixation by associative microorganisms.*

P.K. Chakrabartty, Mousumi Das, and Mousumi Basu.

Rhizobium nodulates and fixes atmosphere nitrogen in symbiosis and provides its host with nitrogenous nutrient. Chickpea grown in field soil was nodulated by indigenous rhizobium. *Rhizobium* strain 27A8, as seed coat inoculum at 10^8 cells/gm seed increased nodulation, nitrogen fixation as well as shoot biomass of its host *Cicer arietinum* (Chickpea) grown in the same soil. A further two-fold increase in both nitrogen fixation and shoot biomass was observed when *Bacillus cereus* or *Pseudomonas putida* was used as coinoculant at 100-fold excess with 27A8.

In a separate study moong bean seeds coated with *Rhizobium* strain MO1 did not improve nodulation and nitrogen fixation over indigenous strains in the field soil. However, a mixed inoculum of MO1 with excess of a siderophore producing mutant of chickpea *Rhizobium* resulted in almost two fold increase in nodule number and nitrogen fixation. These studies indicate a role of siderophore production in soil and consequent iron availability in the processes of nodulation and nitrogen fixation.

INSTITUTIONAL PROJECT IV

A. *Airborne fungal allergens.*

Roma Chakraverty, and Naim Uddin

The fungi associated with spore dust during threshing operations (as reported earlier) were employed for clinical tests. The hyphal mat extracts as well as the culture filtrates of *Alternaria solani, Drechslera* sp. and *Helminthosporium oryzae* were used for skin prick test on susceptible individuals ; of which 17.5%, 17.1% and 18.1% showed positive dermal reactions to the above fungi, respectively. With *Alternaria solani* and *Drechslera* sp. there was no marked difference in the allergenicity the extracts from hyphal mat and culture filtrates. In *Helminthosporium oryzae* culture filtrate extract showed stronger allergenicity than the hyphal mat, as evident from clinical tests.

INSTITUTIONAL PROJECT V

A. Molecular and cellular basis of bacterial and parasitic diseases.

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

A.C. Ghose, Ranjan K. Nandy, Sarmistha Mukhopadhyay, Chandradipa Ghose

The role of mannose-sensitive haemagglutinin (MSHA) of *V. cholerae* 01 (ElTor) strain in the intestinal adherence and colonization was investigated by *Tn pho A* mutagenesis experiments. Results indicate that the phenotypic expression of MSHA partly contributes to the adhesion/colonization property. *Tn pho A* insertions were also shown to affect genes involved in the assembly/ transport of protein(s) responsible for MSHA expression.

Screening of non-01/non-0139 *V. cholerae* strains for virulence associated genes by PCR assay revealed the presence of three important virulence associated genes (*ctxA, tcpA and toxR*) in some of these strains. Southern hybridization analysis of their chromosomal DNA fragments using probes demonstrated the presnece of, at least, two complete copies of the CTX genetic element (tandemly repeated in two strains). Further, the presence of additional copies of incomplete 'core region' with *Zot* and *ace* genes, but not *ctxA*, was also documented.

A.4. *Microbial protease.*

Roma Charaverty and Papia Mitra

A soil isolate *Streptomyces* sp. (AC 80), produced extracellular protease, which dehairs goatskin within 18 hours of treatment. A solid state fermentation technique was adopted with wheat bran as the substrate. A temperature of 28°C and pH8 were found to be most suitable for the enzyme production. Maltose and $NH_4H_2PO_4$ enhanced the specific activity of the enzyme.

The isolate produce aerial mycelium with chains of spores. Spore chains are of retinaculiaperte type and the spore surface is smooth.

A.5. *Impairment of neutrophil function by tumour-necrosis factor-a.*

S. Majumdar and Sonali Das

In many cell types including neutrophil, tumor necrosis factor-a (TNF-a) at a very high concentration causes DNA fragmentation and apoptosis. To understand the relationship between apoptosis and signal transduction mechanism we demonstrated the dose dependent effect of TNF-a on increased cytosolic protein kinase C (PKC) activity with little or no translocation of PKC to the membrane. TNF-a at 100 and 200 U/ml concentration significantly stimulated the PKC dependent phosphorylation but 200 U/ml TNF-a caused impairment of PKC dependent phosphorylation. Moreover, TNF-a dose dependently altered the expression of PKC isotypes in which increasing doses of TNF-a enhanced the expression of -PKC but not B-PKC, indicating that TNF-a might be involved in regulating the PKC isotypes in neutrophil above the critical concentration. We have also studied the changes in signaling parameters during mycobacterium-neutrophil interaction.

A.6. *Characterization of the origin of replication of a mycobacterial plasmic pAL5000.*

S.K.Das Gupta and Mamta Chawla

In order to develop a more effecient plasmid based transformation system for mycobacteria, we are studying the mechanism of replication of a mycobacterial plasmid pAL5000 (4.8 Kb). Previously we reported the cloning of 2.2Kb. TaqI and 2Kb AluI fragments from pAL5000 which represented the minimum sequences required for replication. We have now derived a minimal 1.8 Kb TaqI-AluI fragment that could support autonomous replication. The copy number of the fragment remained the same as that of pAL5000 but structural instability was encountered. Such instability was found to be due to transposition of IS1096 a *M. smegmatis* transposable element.

A.7. *Development of a cosmid vector for mycobacteria.*

S.K.Das Gupta and Shreyashi Chatterjee

Cloning and identification of virulence genes from pathogenic mycobacteria require the development of a cosmid vector for mycobacteria. To develop such a vector the L1 phage of mycobacteria is being utilised. The cohesive (COS) ends of L1 phage have been located by restriction mapping.

A.8. *PCR based diagnostics for tuberculosis.*

S.K. Das Gupta and Santanu Chakrabarty

In order to develop PCR based diagnositic tools for screening TB patients in and around Calcutta, preliminary investigations have been started. Sputum samples from TB patients (sputum positive cases) from a local hospital were processed using commercially available glass powder (Gene Clean) and the purified DNA obtained was subjected to PCR for detection of *M.tuberculosis.* In the preliminary study four out of five sputum positive cases were also found to be positive by PCR.

B. Industrially important microbial enzymes.

Timir B. Samanta, and Kajari Ghosh

B.1. *Invertase*

The purification and biochemical properties of invertase of *Aspergillus ochraceus* TS were described in the previous report (Annual Report 1994-95). Rabbit antiserum was raised against the purified invertase. Immunoprecipitation bands were observed in ouchterlony plate with the purified protein used as antigen. The purity of the invertase was also checked by dot blot analysis. Invertase activity of also the spores of the organism was tested by immobilization. The immobilized spores germinated *in situ* had the capacity to convert sucrose to the extent of 80 percent.

B.2. *Cephalosporin C acylase.*

Timir B. Samanta and Anjan Pal

In continuation of our study on penicillin acylase attempts were made to develop strain (s) for conversion of Cephalosporin C to 7-aminocephalosporanic acid - the key intermediate for the synthesis of semi-synthetic cephalosporins since the latter are used as broad spectrum antibiotics and are resistant to B-lactamase. Several strains were isolated by enrichment technique using Cephalosporin C as the sole carbon source. They were individually tested *in vivo* for transformation of Cephalosporin C. Some of them showed the potency to transform Cephalsporin C.

B.3. *Saccharolytic enzymes.*

Geeta Nanda, Rina Rani Ray and Jharna Dutta

Bacillus megaterium B6, a soil isolate produced B-amylase in presence of starch as the sole carbon source. Glucose, although faciliated growth of the strain but severely hampered B amylase production possibly through carbon catabolite repression. The inhibitory effect of glucose was not overcome by cAMP or cGMP, but surprisingly, was relieved in presence of exogenos GMP.

Bacillus megaterium B6 also produced extracellular xylanase, when grown in a medium containing oat spelt xylan as the sole carbon source. The enzyme was optimally active at 85°C and at pH 7.5. The xylanase production was highest in the jute stalk supplemented medium. The strain had high saccharifying potential and no cellulolytic activity.

Alkali pretreated ground jute stalk when treated with xylanolytic enzymes from *Aspergillus ochraceus* 42 resulted in 40% saccharification within 48h. xylose was the main product. Subsequently xylose could be converted to xylitol (80% conversion) by the yeast, *Pachysolen trannophilus*, to xylitol.

C. Molecular Biology of Thiobacillus.

P. Roy. Chirajyoti Deb, Ranadhir Chakraborty, Pratap N. Mukherjee, Anupama Saha and Anjan Sengupta.

Studies on the molecular genetics of *Thiobacillus ferrooxidans,* a lithoautotrophic microorganism with high potential in biohydrometallurgy have been continued.

A high copy number insertion element from *T. ferrooxidans* which was cloned has been fully sequenced. The IS element named as IST*445* is 1219 bp long and bears 54.4% identity with *ISAE1* of *Alcaligenes eutrophus.* The entire sequence was analysed by GCG package, amino acid sequence of the translated putative protein coded by ORF's were matched with other sequences from EMBL databank. An unique IS typing of the *T. ferrooxidans* strains was done and genomic relatedness amongst them were deduced.

The genome of the novel Thiobacteriophage TPC-1 was completely characterised. The ends of the linear genomic DNA of the phage was found to be 5' protruding, thus cos site was detected. Transduction was successfully performed with temperature sensitive mutant of TPC-1 phage.

A polymerase I independent origin of replication from an indigenous plasmid of *T. ferrooxidans* was cloned in a mobilizable vector. The resultant recombinant could replicate in Polymerase I independent mode and possess the potential to shuttle between *T. ferrooxidans* and E. coli.

Adhension of cells to minerals is a prerequisite for bioleaching of metals from ores. To see whether chemotaxis has any role in selective and physical adhension, several chemotaxis defective mutants were isolated. The percent adhension of the mutants to chalcopyrite were significantly less than that of the wild type *T.ferrooxidans.* In hydrophobicity test experiments it was found that the wild type *T. ferrooxidans* retained 12% more cells in the aqueous phase than compared to chemotaxis defective cells.

PUBLICATIONS

1. Datta, J., Dutta, T.K. and Samanta, T.B. Microbial glutathione S-transferase (GST) isozymes in Aspergillus ochraceus Ts : Introduction by 3-methyl cholenthrene.

Biochem. Biophys. Res. Commun. **203**, 1508-1514, 1994.

2. Ghose, A.K., Dasgupta, S. and Ghose, A.C. Immunoglobulin G subclass specific antileishmanial antibody responses in Indian Kala-azar and post Kala-azar dermal leishmaniasis. *Clin. Diag. Lab. Immunol* **2**, 291-296, 1995.

3. Halder, A.K. and Chakravartty, P.K. Constitutive nitrate and nitrite reductase activities of Rizobium in relation to denitrification. *J. Basic Microbiol.* **35**, 233-239, 1995.

4. Mitra, P., Chakraverty, R. and Chanda, A.L. Production of proteolytic enzymes by solid state fermentation — An overview. *J. Sci. Ind. Res.* **55**, 439-442, 1996.

5. Mukhopadhyay, S., Ghosh, C. and Ghose, A.C. Phenotypic expression of a mannose-sensitive hemagglutinin by a *Vibrio cholerae* 01 ElTor strain and evaluation of its role in adherence and colonization. *FEMS Microbiol. Lett.* **138**, 227-232, 1996.

6. Ray, R.R., Jana, S.C. and Nanda, G. B-amylase from *Bacillus megaterium* B6. *Folia Microbiologica* **39**, 567-570, 1994.

7. Ray, R.R., Jana, S.C. and Nanda, G. B-amylase production by immobilized cells of Bacillus megaterium B6. *J. Basic Microbiol.* **35**, 113-116, 1995.

8. Ray, R.R., Jana, S.C. and Nanda, G. Induction and catabolite repression in the biosynthesis of B-amylase by *Bacillus megaterium* B6. *Biochem. Mol Biol. Intl.* **38**, 223-230, 1996.

9. Ray, R.R., Jana, S.C. and Nanda, G. Immobilization of B-amylase from Bacillus megaterium B6 on gelatin by Crosslinking. *J. Appl. Bact.* **79**, 157-162, 1995.

10. Ray, R.R., Jana, S.C. and Nanda, G. Optimization of physico chemical conditions for improved production of B-amylase of Bacillus megaterium. *Acta Microbiol. Polonica.* **44**, 15-21, 1995.

11. Uddin, N. and Chakraverty, Roma. Airspora measured in a paddy field in West Bengal, India. *Grana* **34**, 345-349, 1995.

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

Prof. A.C. Ghose acted as a member of SAC of National Institute of Cholera & Enteric Diseases, Calcutta ; participated in a group meeting on "Cholera" held at the Dept. of Biotechnology, New Delhi in September, 1995 ; acted as Convenor, Scientific Committee, of the International Symposium on "Trends in Microbiology" held in December 1995 at Bose Institute : attended and presented an invted paper in the symposium on "U.N. Brahmachari & perspective of the Kala-azar research" held at the IICB, Calcutta in November, 1995 ; Chaired a scientific session in the Annual Convention of the Indian College of Allergy & Applied Immunology held in December, 1995 at Bose Institute : Chaired a scientific session in the A.K. Chandra Memorial Symposium on "Recent Trends in Microbiology" in February, 1996 at the Calcutta University.

Prof. Timir B. Samamta acted as Organising Secretary of the International Symposium "Trends in Microbiology" held during December 5-8, 1995 ; attended the Executive Committee meeting of Microbial Technology (IMTECH), Chandigarh ; delivered an invited talk. in the DBT sponsored National Conference on Colloids and Emulsions of Natural and Synthetic Systems held at the Dept. of Chemistry Tripura University, Agartala.

Prof. Geeta Nanda attended the International Symposium on "Trends in Microbiology", held in December 1995, at Bose Institute, Calcutta : attended A.K. Chandra Memorial symposium on "Recent Trends in Microbiology", held in February, 1996, in the University of Calcutta, Calcutta.

Prof. P.K. Chakravarty attended and presented a paper in the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute, Calcutta : attended and chaired a scientific session in the A.K. Chandra Memorial Symposium on "Recent Trends in Microbiology" in February, 1996 at the Calcutta University.

Dr. Roma Chakraverty attended the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute : attended and presented a paper in the National Symposium on "Frontiers in Applied environmental Microbiology : held in December, 1995 at Cochin University, Cochin : attended A.K. Chandra Memorial Symposium on "Recent Trends in Microbiology" held in February, 1996, in the Calcutta University.

Dr. P. Roy attended the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute : acted as Joint-Secretary of the A.K. Chandra Memorial Symposium on "Recent Trends in Microbiology" held in February, 1996 at the Calcutta University.

Dr. S. Majumdar attended the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute, Calcutta : attended and presented a paper at the XIIth All India Cell Biology conference held at IICB, Calcutta in February, 1996 ; presented a paper in the XIth Annual Conference NESA (an International Symposium) held at Brabourne College and Indian Science Congress in March, 1996.

Dr. S. Dasgupta attended the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute, Calcutta : attended A.K. Chandra Memorial National Symposium on "Recent Trends in Microbiology" held in February, 1996 in the Calcutta University.

Krishanu Sengupta, Asis K. Ghosh, Anjan Pal, Dr. Mousumi Das, Mousumi Basu attended and Subhajit Dasgupta, Ranjan Nandi, Sarmistha Mukhopadhyay, Chandradipa Ghosh, Dr. Debjani Dutta, Rittika Chandra, Rina Rani Ray, Papia Mitra, Ranadhir Chakrabarty, Chirajyoti Deb, Anupama Saha, P.N. Mukherjee, Sonali Das, Mamta Chawla attended and presented posters in the International Symposium on "Trends in Microbiology" held in December, 1995 at Bose Institute, Calcutta.

Rina Rani Ray, Papia Mitra, Chirajyoti Deb, Ranadhir Chakrabarty, P.N. Mukherjee, Sonali Das, Mamta Chawla attended and presented papers at A.K. Chandra Memorial Symposium on "Recent Trends in Microbiology" held in February 1996 in the Calcutta University.

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

Dr. Deb Prasad Sikdar, Dr. Anjan Sengupta, Dr. J. Dutta, Dr. Mousumi Das, Dr. Krisanu Sengupta, Dr. Debjani Dutta, Dr. Soumitra Pal, Mr. Santanu Chakrabartty, Ranadhir Chakrabarty, Sumana Majumder, Subhajit Dasgupta, Kajori Ghosh, Papia Mitra, Sonali Das, Mousumi Basu, Ashis Ghosh, Ranjan Nandy, Anupama Saha, Rittika Chandra, Chandradipa Ghosh, Mousumi Ghosh, Anjan Pal, Mamta Chawla, Shreyashi Chatterjee, Dr. Subhas Jana, Rina Rani Roy, Pratap Mukherjee, Sarmistha Mukherjee, Tapas Kumar Sengupta, Saona Sengupta, Suman Das, Sandip Bhattacharyya.

OTHER SUPPORTING STAFF MEMBERS

B.N. Bose, A.N. Pal, R.R. Sanyal, S.K. Das (I), S.K. Das (II), Dr. B. Banik, G. Dey, N.K. Malakar, D. Saha, B.N. DeSarkar, B. Mandal, P.K. Chattapadhyay, P. Gupta, S. Gazi, Debashish Sarkar, B. Ram, A. Santra, B. Bahali, N. Patra, J. Prasad, R. Prasad, B. Ram, A.K. Shaw.

GRANTS-IN-AID SCHEMES

Investigator/ Co-investigator	Title	Financed by
Prof. A.C. Ghose	Development of a non-replicating vaccine against cholera based on protective antigen on *Vibrio cholerae.*	DBT
Prof. A.C. Ghose	Characterization of a new type of pilus expressed by pathogenic strains of non-01 *Vibrio cholerae* and evaluation of its role in intestinal colonization as well as protection.	CSIR
Prof. G. Nanda	Microbial production of enzymes Xylanase and B-amylase.	DBT
Dr. S. Majumdar	Alteration of the human neutrophil function by TNF-a ; Influence of apoptosis on signal transduction pathway.	CSIR
Dr. S. Dasgupta	Investigations into the mechaisms extrachromosomal replication of Mycobacterium plasmid pAL5000.	CSIR
Prof. A.C. Ghose, Dr. S. Majumdar & Dr. S. Dasgupta	Development of bioconjugates for diagnosis and treatment of microbial infections.	DST

Ph.D. Awarded

Name	University	Year	Title	Supervisor
Ramkrishna Sadhukhan	Calcutta	1995	Studies on extracelluar activity of *Myceliophthora thermophila* D-14, a thermophilic fungus.	Prof. S.L.Chakrabarty
Alok Dhar	Calcutta	1996	Studies on biological hydro-xylation catalysing conversion of C21 steroid to its C19 derivative.	Prof. Timir B. Samanta
Subrata Kr. Das	Calcutta	1996	Isolation, characterization and mutational studies of a new bacterium Bl-12 capable of degrading sulfur compounds.	Prof. A.K. Mishra
Suparna Ghosh	Calcutta	1996	Studies on some aspects of microbial silica solubilization from various ores.	Prof. A.K. Mishra
Amitabha Das	Calcutta	1996	Studies on the anaerobic growth on elemental sulfur coupled to dissimilatory iron reduction and its importance in metal leaching by chemoautotrophic *Thiobacillus ferrooxidans.*	

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, Somenath Bhattacharyya, Nrisingha Dey, Biswajit Roy, Pallab Kundu and Surekha Mandal

A trypsin inhibitor from *Brassica* was shown to be identical to precursor of 2S seed storage protein. A cloned 2S protein gene from *B. juncea* (Var. RLM198) was expressed in *E. coli* using pET3a vector. 2S protein precursor synthesized in *E. coli* was not processed and also showed the trypsin inhibitor activity. The cDNA for a 2S albumin with balanced amino acid composition from *Chenopodium album* (Bethua Sak) has been cloned and expressed in *E. coli* as a fusion protein using pGEX 2T vector. The deduced amino acid sequence showed some structural homology with *Brassica* and other 2S proteins. A general method for regeneration and Ti plasmid-mediated transformation of *Solanaceae* plants like tobacco, tomato, brinjal, etc., has been developed. Transgenic tomato plants with TVMV coat protein gene are in the third generation now and are awaiting field testing for potyvirus-resistance.

RAPD-generated molecular markers have been identified for some quantitative traits in cultivated varieties of *Brassica campestris* (var yellow sarson B-9 and NC-1).

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

S. Biswas and Samarpan Majumder, in collaboration with **B.B. Biswas**, Dept. of Biophys. Mol. Biol. & Genetics, Calcutta University

An attempt has been made to find a common trans-acting factor in the three systems, namely *Agrobacterium*, yeast and plant. By performing a South-Western experiment using 0.8 Kb DNA as the probe, one common factor (~ 16 KDa) has been detected in yeast, *Agrobacterium*, as well as in the flower of transformed tobacco. This 16 KDa protein is absent in the leaf or root of the tobacco plant. The appearance of this factor in the plant is found to be developmentally controlled.

A.3. *Studies on a novel ATPase/NTPase from Mimosa pudica leaflets.*

S. Biswas and Rinku Ghosh

The Ca^{2+} ion is needed to maintain a requisite conformation of NTPase enzyme present in Mimosa pudica leaflets. This is supported both by flourimetric and CD studies. There is a considerable difference in the accessibility of tryptophan residue present in isoform I when Ca^{2+} is removed and added back alone or with polysaccharide (f_a values for denatured and reconstituted enzyme with Ca^{2+} and Ca^{2+} and polysaccharide were found to be 0.5, 0.41 and 0.31 respectively). Isoform II has shown a similar trend. Ca^{2+} induces changes in the a-helical and β-sheet structure of the isoform I for the possible interaction with the polysaccharide. Since it is a Ca^{2+} binding protein and its activity is regulated by Ca^{2+}, it is likely that these isoforms participate in the downstream network of signal tranduction process.

A.4. *Cloning of Ins (1, 4, 5)P_3 receptor gene from mung bean (Vigna radiata).*

S. Biswas and Aditya Sengupta, in collabroation with **B.B. Biswas,** Department of Biophysics Molecular Biology, Genetics, University of Calcutta

In vivo expression of IP_3 receptor has been found to be regulated by intracellular myoinositol, Ca^{2+} ion and inorganic phosphate. IP_3 receptor expression has become maximal in presence of both inositol and Ca^{2+} ion, whereas inositol or Ca^{2+} alone do not show this stimulation.

In order to clone and characterize the IP_3 receptor gene from *Vigna radiata*, a cDNA library has been constructed in pBlueScript KS$^+$ and screening for the IP_3 receptor gene is in progress.

INSTITUTIONAL PROJECT III

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

While studying the properties of the *rpl* mutant of *E. coli* which is resistant to *P* gene lethality, it was observed that the plasmid pMR45 is very unstable in the above mutant while other plasmids like pBR322, pMR32 pMR58, and pMR451 were all stable. Also, the pMR45 is stable in a lysogen in the above *rpl* mutant. Excepting pBR322, all the other four plasmids carry both pBR322 and lambda origins. However, while pMR45 produces elevated levels of O and P proteins in absence of *N* gene function (due to the presence of *hk* mutation in the *cro* gene), pMR58 carries a defective *P* and pMR451 has internal deletion in *P*; so these latter two plasmids cannot replicate from origin. The plasmid carrying origin and functional *O* and *P* genes as well as the *hk* mutation in *cro* but no pBR322 origin is quite stable in the above *rpl* mutant. From these results, we conclude that the instability of pMR45 in *rpl* mutant is due to the simultaneous occurrence of normal replication from pBR322 origin and unregulated replication from lambda origin.

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

N.C. Mandal, Madhumita Basu and Saurav Pal

In continuation of the study aiming at understanding the role of glutamate and cAMP in the regulation of expression of galactokinase in *Mycobacterium smegmatis*, a 300 bp DNA segment flanked by BamHI and SspI at the upstream regulatory region of the galK operon was subcloned in a promoter cloning vector pTAC3437 which have two reporter genes, *lacZ* and *phoA* oriented away from the multiple cloning site. In such clone, the two *galK* promoters would regulate the expression of *phoA*, while the divergent *gluP* would control the expression of *lacZ*. the expressions of β-galactosidase and alkaline phosphatase from such plasmid were measured in *crp*$^+$ and *crp*$^-$ *E. coli* both having *lacZ* deletion in the chromosome. The results suggest that the *gluP* as well as one of the two *galPs* are positively regulated by cAMP. Attempt is being made to study this regulation by *in vitro* transcription using mycobacterial *RNA* polymerase and cAMP-CRP and to determine the transcription start sites from all the above three promoters.

A.3. *Studies on Developmental Regulation of Mycobacteriophge L1.*

N.C. Mandal, Hirock J. Datta, Prajna Mandal, Chandrani Chattopadhyay and Rajat Bhattacharyya

As part of studies on the temporal regulation of mycobacteriophage L1, it has been established that the gene *G27* is the key regulator of the temporal regulatory circuit which acts at the transcriptional level ; while two delayed early genes, *G23* and *G25*, regulate the expression of late genes. The properties of *G23ts23* mutant suggest that this gene regulates the expressions of exonuclease and a second late regulatory gene at postranscriptional leavel, while G25 regulates the expression of two different subsets of late genes. To understand the mechanism of action *G27* gene product, this gene has been cloned in a 0.8 kb DNA segment.

A.4. *Tubulin Substructure and Identification of its Structural, Functional and Regulatory Domains : Structure-Function Relationship of Protein-Drug Interactions.*

B. Bhattacharyya, Pradip Mahapatra, Gopal Chakraborty, Pampi Basu and Suroopa Banerjee.

N-(7-nitrobenz-2-oxa-1, 3-diazol-4-yl)-colcemid (NBD-colcemid), a fluorescent analog of colcemid (N-deacetyl-N-methyl-colchicine), exhibits specific binding to liver alcohol dehydrogenase. The dehydrogenase bound NBD-colcemid in a time-dependent manner, enhanced the fluorescence intensity, and caused

a large blue shift of the emission maximum of the free drug. The specificity of binding was determined for both the colchicine nucleus and the NBD moiety. The binding was not affected by the presence of alcohol or NAD in the reaction mixture. Preincubation of horse liver alcohol dehydrogenase with colcemid inhibited the binding to a considerable extent. NBD-colcemid inhibited the enzymic activity of alcohol dehydrogenase in a mixed-type noncompetitive mode with a K_i value of 32 uM, whereas colcemid showed noncomptitive inhibition with a K_i of 100 uM. The association rate constant of NBD-colcemid binding with liver alcohol dehydrogenase was 587 M^{-1} s^{-1} at 25°C. The stoichiometryand dissociation constant of the binding reaction were 0.62/dimer and 12 uM, respectively. Donor quenching experiments showed that both tryptophans of alcohol dehydrogenase transfered energy to the bound NBD-colcemid. Thus, this study reports the binding of a colchicine analog to a protein other than tubulin with high affinity. It is concluded that NBD-colcemid binding ot dehydrogenases is a general phenomenon. However, the common structural element(s) existing among tubulin and dehydrogenases and responsible for the binding activity are yet to be determined.

A.5. *Spectroscopic studies on Tubulin strcucture.*

B. Bhattacharyya, Nabanita Sarkar, Suranjana Guha and Shalmali Chakraborty

The fluorescent probe bis (8-anilino-1-naphthalenesulfonate) (bis-ANS) has been used to monitor the time- and temperature-dependent aging of tubulin, whereby new hydrophobic binding sites of lower affinity are generated on the protein. We carried out a detailed analysis of this phenomenon and found that in addition to antimitotic drugs like colchicine or vinblastine, other parameters. viz., low temperature and protein stabilizers (e.g., glycerol and sucrose) inhibit the extent of enhanced binding of bis-ANS. Moreover, the generation of additional bis-ANS binding sites are also suppressed at high concentrations of tubulin. Cleavage of the carboxytermini of tubulin (bound to bis-ANS) by subtilisin cause a significant reduction in the enhanced fluorescence, but has no effect on the high-affinity binding site of bis-ANS. All of these observations can be explained by the correlation of the presence of additional binding with the dissociation of heterodimeric tubulin into monomers. Enhanced binding of bis-ANS is due to tubulin dimers that have undergone dissociation, resulting in a loosening of its tertiary structure with the generation of a plethora of hydrophobic sites.

A.6. *A study of chromosome replication, segregation and cell cycle control of yeast S. cerevisiae.*

P. Sinha, Kaustuv Sanyal, Atasi Poddar and L. Boominathan

We are studying *mcm* (*M*ini*C*hromosome *M*aintenance) mutants of yeast which destabilize small circular minichromosomes, each carrying an *ARS* (*A*utonomously *r*eplicating *s*equence) and *CEN* (centromere DNA). It was expected that these mutants would carry lesions in genes whose products act in *trans* at *ARS* or *CEN* sequences of minichromosomes to impair their replication and/or segregation. This search, in earlier work, had identified many genes which affect DNA replication, notably the *MCM* family of proteins. We are working with these mutants, with emphasis on one mutant, *mcm2*. We have shown in earlier work that this mutant affects plasmid and chromosomal DNA replication by causing under initiations at their replication origins, leading to DNA damage at chromosomes and their subsequent loss from the cells. In more recent work we have shown that the *mcm2* defect can be suppressed by alterations at replication origins which reduce the helical stability of DNA, thereby suggesting that the Mcm2p may be involved in DNA unwinding at the replication origins.

Regarding chromosome segregation, we have shown that two other *mcm* mutants, *mcm12* and *mcm17*, do not affect DNA replication but affect centromere-directed segregation of minichromosomes in a size-dependent manner. In order to understand better the way by which Mcm12 and Mcm17 proteins affect segregation of chromosomes, we have cloned the wild-type *MCM11, MCM12, MCM13,*

MCM16 and *MCM17* genes. These are being analysed further.

In collaboration with Dr. U. Surana (IMCB, Singapore), a number of mutants have been isolated which allow the entry of *cdc13* cells, carrying damaged DNA, into either mitosis or directly to 'START' (*cdc13* cells should otherwise halt at G2/M in response to damaged DNA). Some of the mutations are in previously defined checkpoint genes such as *RAD9*, *RAD17* etc., while the other mutations define novel genes. It is our aim to identify the genes which govern cell-cycle progress and checkpoint controls in yeast cells.

A.7. *Characterisation of a novel PstI family of short interspersed nucleotide elements (SINEs) in the genome of farm animals which is recognised by a 33 kDa bovine liver nuclear factor.*

P. Gutpa and Sudit S. Mukhopadyay

Interspersed repetitive sequences are highly abundant in the mammalian genome and their role is still obscure. A new PstI family of small interspersed nucleotide elements (SINEs) has been characterized in the genome of several farm animals viz; cattle, goat and buffalo. The size of all the members of this family ranges between 489-505 bp comprising about 4% of the haploid genome. By south-western assay it appears that all the PstI repeats are recognised by a liver nuclear protein. Gel retardation assay with restriction enzyme fragments of the cattle PstI sequence (BTIRDNA, 489 bp) showed its binding specificity and it was also retained by a truncated 80 bp Sau3A-HinfI fragment. A 33 kDa molecular mass of nuclear protein has been identified from the cattle liver by UV-induced DNA-Protein Crosslinking (DPC) experiment.

A.8. *Crystallographic studies of modified DNA oligomers.*

Rajagopal Chattopadhyaya, Bhaswati Goswami

Synthesis using organic synthetic methods of modified DNA oligomers resulting from oxidative damage is under way. Two of the modified nucleotides being synthesized include 8-oxo-dA and a model compound representing abasic sites. Incorporation of these into otherwise normal DNA will be attempted.

Two decamer and a dodecamer DNA oligonucleotides were synthesized by our departmental DNA synthesis machine and were stringently purified. Crystallization of these is in progress. These oligomers include abnormal C-T and G-G mispairs, which have not yet been studied by X-ray crystallography.

Several oligomers have been synthesixed as part of crystallographic and biophysical studies of thymine-thymine photodimers.

A.9. *Crystallographic studies of lipase from A. niger.*

Rajagopal Chattopadhyaya, and V.M. Haridasan Namboodiri

The lipase has been successsfully purified in a small scale, yielding about 0.5 mg pure protein from a litre of culture. Since crystallographic studies repuire 10-50 mg of pure protein, scaling up of the same methodology will be attempted shortly. The lipase has a molecular weight of about 33 kDa as judged from SDS-PAGE.

A.10. *Crystallographic studies of lambda repressor mutants.*

Rajagopal Chattopadhyaya, and Kausik Ghosh

Both mutants of lambda repressor protein have been crystallized. They appear isomorphous upon examination under a microscope. They will be examined shortly for x-ray diffraction at the Saha institute of Nuclear Physics. Calcutta.

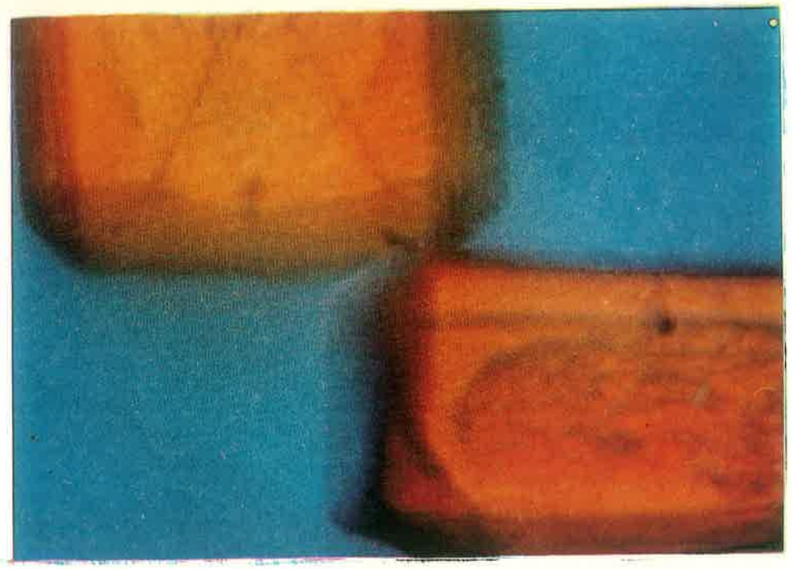
A.11. *Structural Basis of Control of Transcription Initiation in E coli.*

P.K. Parrack and Jayanta Mukhopadhyay

The cyclic AMP receptor protein (CRP) and three of its phenotypic hinge mutants were isolated from E. coli strains and purified. The conformations of these proteins are being studied in the presence and absence of cAMP, using UV absorption and fluorescence spectroscopy.

A.12. *Role of upstream sequences in promoter recognition by RNA Polymerase.*

P.K. Parrack and Runa Sur



Crystals of a mutant of lambda repressor protein grown in Dr. R. Chattopadhyaya's laboratory observed by a phase contrast microscope with DI contrast

A plexiglass box designed by Dr. R. Chattopadhyaya for macromolecular crystallization, manufactured at the Bose Institute Workshop

RNA polymerase in E. coli and other bacteria often bind to nonpromoter sequences. Such a nonpromoter sequence in the upstream region of galactose operon has been identified in E. coli. RNA polymerase exhibits "tight binding" to these sites, characterised by slow kinetics of association, resistance to heparin challenge and altered affinity.

A.13. *Foundations of Quantum Mechanics and Biological Structures.*

Rajagopal Chattopadhyaya, in collaboration with **Dipankar Home**, Department of Physics [also under Institutional Project VI]

A fundamental problem of measurement in quantum mechanics was addressed. It is argued that ultraviolet absorption by a DNA molecule (which gets attached to nearby photolyase enzyme so that the effect of UV photon absorption is rendered macroscopically discernible) constitutes an intriguing example of quantum measurement. This does not merely illustrate the quantum measurement paradox in the hitherto unexplored area of biological macromolecules, but is also instructive in highlighting specific difficulties inherent in various approaches to the measurment problem.

INSTITUTIONAL PROJECT IV

A.1. *Fish genetic stock identification and conservation.*

R.K. Mandal and B.K. Padhi

That undesirable intergeneric hybridization between three major carps (Catla, Rohu and Mrigal) do take place has been ascertained from field samples collected from a hatchery practising mixed spawning by RFLP of ribosomal RNA gene. A species-specific tandemly repeated Hae III sequence useful as a genetic marker has been identified and cloned from C. mrigala fish. The ribosomal RNA gene copy number, repeat length and RFLP has been analysed in three species of Channa and implicated with the evolution of these species.

A.2. *Recovery of collicular oocytes from slaughtered zebu cows for in vitro production of embryos at low cost.*

Prabhakar Gupta and G. Ganguli

The ovaries of slaughtered zebu cows (Bos indicus) were collected under sterile conditions in normal saline solution supplemented with antibiotics. By aspiration, on an average 19 oocytes were recovered from each ovary which were classified on the basis of surrounding investments and diameter of the oocyte. A total of 3780 oocytes were recovered of which 65% were compact cumulus oophorus complexes (CCOC), 21% scanty cumulus oophorus complexes (SCOC), and 14% nude i.e., devoid of any investment. When these oocytes were matured separately, CCOC of larger diameter showed higher percent of nuclear maturation (88.8+4.958) in comparison to other classes of oocytes. Five different commercially available media were used for maturation of the immature oocyte complexes and it was found that fertilization rates of the three media viz. McCoy's 5A, Medium-199 and Minimum Essential Medium (MEM) were similar i.e., 76%, 78% and 80% respectively whereas RPMI 1640 and F-10 were significantly low i.e., 63% and 68% respectively. The medium used for maturation affected the development was observed when oocytes were matured, fertilized and cultured with the endogenous cumulus cells along with oviductal epithelial cells.

A.3. *Sex determination in farm animals and Human by PCR using bovine Y-chromosome specific repetitive DNA.*

Prabhakar Gupta and Arup Kumar Indra

Control of sex ratio is of great commercial importace to livestock industry. We have reported for the first time a fast, reliable, one step process of sex determination in bovine, ovine as well as human using oligonucleotides specific for Y-chromosome repeats. DNA was isolated either from embryo biopsy in case of cattle and buffalo or from peripheral blood in sheep and human. A male specific 181 bp amplified band was confirmde by autoradiography after electrophoresis on a 8% native polyacrylamied gel and 6% denaturing sequencing gel which contradicts the report of Machaty et al., 1993 who reported a size of 216 bp in bovines using the same set of primers.

INSTITUTIONAL PROJECT V

A.1. *Relative importance of Inositol (1,4,5) trisphosphate and Inositol (1, 3, 4, 5) tetrakisphosphate in Entamoeba histolytica.*

Susweta Biswas, Banabihari Giri, in collaboration with **B.B. Biswas**, Dept. of Biophys. Mol. Biol. & Genetics, Calcutta University

[^{3}H]– Inositol tetrakisphosphate {Ins (1, 3, 4, 5)P_4} binding sites were detected in membrane fractions of E. histolytica which were poorly displaced by unlabelled Inositol (1,4, 5,) trisphosphate {Ins(1, 4, 5) P_3}. Similarly, unlabelled Ins (1, 3, 4, 5)P_4 was 30 fold less efficient in displacing [3H]-Ins (1, 4, 5)P_3 binding. pH sensitivities of binding of the two isomers were markedly different. Scatchard analysis of the data revealed single binding sites and similar receptor densities for each of the two isomers. Formation of both Ins (1,4, 5,)P_3 and Ins (1, 3, 4, 5)P_4 in *E. histolytica* was also demonstrated. Calcium released studies showed that after treatment with a saturating dose of either Ins(1, 4, 5)P_3 or Ins(1, 3, 4, 5)P_4 the other inositol polyphosphate could partially revive the response to a subsequent addition of the first inducer. Our data clearly demonstrate that Ins (1, 4, 5)P_3 and Ins(1, 3, 4, 5)P_4 are two equally important but independent second messengers in *E. histolytica.*

A.2. *Molecular Genetics of Entamoeba histolytica.*

Anuradha Lohia, Sib Sankar Ray, Samudra S. Gangopadhyay, and Chaiti Ganguli

To study the cell cycle of *Entamoeba histolytica*, two new genes have been isolated and characterised in the past year. The two genes are *Eh MCM3* and *Eh PAK.Eh MCM3* is possibly involved in the initiation of DNA replication and *Eh PAK* is a homolog of the p21 activated kinase. The p21 activated kinase is linked to the *MCM3* gene is amoeba and expression of the two genes is regulated at the transcriptional level. Another study has shown two transcripts which are regulated by serum factors. These transcripts are believed to be involved in the stress response of amoeba cells. A PCR based DNA diagnostic assay has been developed. A novel Glycine rich gene has been isolated whose primary structure is reminiscent of malaria antigens since it is made up of tandem repeats of 9 amino acids each

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11. Indra, A.K. and Gupta, P. Transgenic farm animals : an overview. *Proc. Zool. Soc.* Calcutta. **48**, 49-58, 1995

12. Lohia, A and Samuelson, J. Heterogeneity of Entamoeba rac proteins. *Gene.* **170**, 1996.

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14. Ray, A. and Sinha, P. the mcm2–1 mutation of yeast causes DNA damage with a RAD9 requirement for repair. *Curr. Genet.* **27**, 95-101,1995

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Ph. D. Awarded

Name	University/subuect Year	Title	Supervisor
Subrata Sau		Studies on the gene regulatory elements of temperate mycobacteriophage L1	Prof. N.C. Mondal
Sankar Kr. Ghosh		Chromosomal distribution of some repetitive DNAs and genes of economic importance of the livestock.	Dr. P. Gupta

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

Prof. R. K. Mandal delivered lectures on Agricultural Biotechnology and gene patenting: Indian Perspective at Paschim Banga Vijnan Mancha on June 17 and on 'Gene Patenting' over All India Radio, Calcutta, on July 27, 1995; on 'Issues on Agriculture and Patenting at the Symposium on India in the World Trade Regime, organised by Federation of Scientists, Engineers and Technologists, India, on Sept. 24, 1995 in Calcutta, on 'Plant and Animal Biotechnology in the P.G. Dept. of Botany, Darjeeling Govt. College on Dec. 04, 1995. Chaired a session and presented a poster in the International Symposium on 'Trends in Microbiology' held in Calcutta on Dec. 05, 1995 ; Presided over the Annual General meeting and a scientific session of Plant Physiology Forum in Sibpur Indian Botanic Garden on Feb. 3, 1996 ; an invited talk and chaired a session in the 19th All India Cell Biology Conference held at IICB, Calcutta on Feb. 23-25, 1996 ; Acharya P.C. Ray memorial Lecture on 'Light and Life' at R. K. Mission Residential College, Narendrapur on March 07, 1996 ; on 'RFLP and RAPD analysis in Plant Sciences' in the symposium on Molecular Genetics organised by Botany Dept. Special Assistance Programme, Kalyani University on March 22, 1996.

Prof. Mandal also gave talks on 'Biotechnology in Aquacultue', Genes : Yesterday, today and tomorrow' and 'Evolution of Bio-

logical Thought' in the Academic Staff Colleges Organized by Visva-Bharati ; Plant Tissue Culture and Biotechnology' in Science Communication workshop by Indian Science News Association 'Evolution and Ecology' and 'Molecular Taxonomy and germplasm Conservation' in two Academic Staff College of C.U. ; 'Photosynthesis, Photorespiration on Plant Productivity' and 'Science and Technology Today : Is the Society Prepared' ? In the Academic Staff college by Burdwan University. He also served as Vice-President of Society of Biological Chemists (India), President of Plant Physiology Forum, Calcutta, Editor of J. Plant Biochem. Biotechnol., New Delhi and a number of Technical Advisory Committees (TAC) of Indian Statistical Institute, Calcutta.

Dr. B.K. Padhi delivered a series of invited lectures on 'Fishery Genetics' at Central Institute of Fisheries Education, Bombay in Oct., 1995, Dr. Padhi and Prof. Mandal's Work on Cryopreservation of catfish spermatozoa' was featured in the T.V. programme "Turning Point", broadcast on March 19, 1996.

Dr. B. D. Chattopadhyay and M.R. Chatterjee attended and presented poster in the Symposium' Trends in Microbiology' Calcutta; Pallab Kundu and Surekha Mandal attended and presented posters at the National Symposium on Currrent Trends in Plant Biochemistry & Biotechnology held at Hisar on Feb. 23-25, 1996 ; Biswajit Roy attended the S.M. Sircar Memorial Conference and PPF Meeting at Indian Botanical Garden on Feb. 3, 1996; Somnath Bhattacharya gave a talk on 'Molecular Markers' for some quantitative traits in *Brassica campestris* in the one day symposium of SBC (I), Calcutta Chapter held at Bose Inst. on Feb. 03, 1996

Prof. Susweta Biswas delivered a lecture on a Unique NTPase from *Mimosa pudica*, in Saha Institute of Nuclear Physics arranged by SBC, Calcutta Chapter on 10th May, 1996.

Edited jointly a Volume (Vol. 26) of Sub Cellular Biochemistry, Plenum Press, New York & London on myo-Inositol phosphates, phosphoinositides and signal transduction, 1996.

Prof. N.C. Mandal attended the 4th Asian Conference on Transcription and Indo-Japan Workshop held on March 30 to April 2, at Hayama, Japan. Participated in the International Symposium on "Trends in MIcrobiology" held at Bose Institute on Dcember 5-8, 1995 ; Participated in the DBT sponsored Work-shop on "Infectious diseases, Diagnostics, prophylactics, and therapeutics" held on December 21-22, 1995 at National Institute of Immunology, New Delhi, sponsored by DBT, Government of India; Attended 61st Annual Meeting of Indian Academy of Sciences held at Madras on November 10-12, 1995. Attended 59th Annual Meeting of Indian National Science Academy held at Amritsar on December 25-28, 1995. Delivered a lecture by invitation at Institute of Microbial Technology, Chandigarh on December 29, 1995.

Co-ordinated a pre-doctoral course on Biophysical and Biochemical Techniques and took part in teaching of the same at Bose Institute. Gave a course of lecture on Molecular Biology to the M.Sc. final year students of Biochemistry Department of the Calcutta University. Gave a course of lecture on Bacteriophage Genetics to the M.Sc. final year students of the Department of Physiology of the Vidyasagar University. Acted as a member of the Scientific Advisory Committee of National Instituve of Cholera and Enteric Diseases, Beliaghata, Calcutta.

Acted on several occasions as a member of the Assessment Committee of Indian Institute of Chemical Biology, Calcutta. Acted as member of the Ph.D Committee in Biochemistry of the Calcutta University. Acted as examiner of Ph.D. thesis of different Indian Universities.

Attended the Guha Research Conference held on January 20-23, 1996 at Alibag, Bombay. Chaired a Scientific Session of the Second seminar on Biochemistry and Biophysics held at IICB, Calcutta on November 24, 1995 sponsored by West Bengal Academy of Science & Technology.

Prof. B. Bhattacharyya attended the International Meeting on "Cytoskeleton and Cancer" at Marshelle, France, and the Foundation Day Symposium of Molecular Biology Unit, Banaras Hindu University, Varanasi.

Was elected Fellow, Indian National Science Academy (New Delhi); and Fellow, National Academy of Sciences (Allahabad). Prof. B. Bhattacharyya has been awarded the first Foundation Day Award of the Bose Institute (1995).

Dr. Pratima Sinha attended the seminars "Pasteur's Heritage" held in Chandigarh (organised by IMTECH) in September 27-29, 1995; and "Trends in Microbiology" held in Calcutta Dec. 04-08, 1995.

Dr. P. Gupta chaired a session and presented a lead paper on Transgenesis and its scope in sheep and goat industry in the National Symposium on "Embryo transfer and genetic engineering technologies in Small Ruminant held at Central Institute for Research on Goats, Makhdoom, Farah (May 7-8, 1995); was invited for a formal presentation in the interactive meeting for developing a programme on Transgenic farm animals organized by the Department of biotechnology, N. Delhi (June 29-30, 1995). Organised as Course Director DBT sponsored short term training course on "Polymerase Chain Reaction in Biological analysis (Sept. 04-22, 1995) at Bose Institute. Served as an external expert nominated by ICAR for Staff Research Council of the National Institute of Genetics and National Bureau for Animal Genetics Research, Karnal, Haryana. Acted as Resource person for the workshop on "DNA fingerprinting of plant genome" organised by Prof. Rajat Choudhuri, Botany Department, University of Calcutta (Oct. 10-30, 1995). Participated in the 3rd North-South Human Genome Conference jointly organised by UNESCO & ICGEB at N. Delhi (Dec. 5-7, 1995). Invited to act as resource person for "Hands on training course on DNA fingerprinting" organised at CCMB, Hyderabad (Jan 16-Feb 04, 1996).

Delivered an invited talk on "Use of farm animals as bioreactions" in the Animal Reproduction and Biotechnology Session of the XIX All India Cell Biology Conference held at IICB, Calcutta (23-25 Feb. 1996). Acted as external examiner M.Sc. practicals at Dept. of Zoology, Banaras Hindu University M.Sc. Part I & Part II, Dept. of Biophysics, Mol. Biology & Genetics and Dept. of Biochemistry, Univ. of Calcutta. Participated in the two day conference on Internet organised by DIC, Bose Institute (March 25-26, 1996).

Mr. Sudit Sekhar Mukhopadhyay attended the Mahabaleswar Seminar on Modern Biology "Nucleic Acids Protein Interaction" held at Ooty (Dec. 17-23, 1995). Mr. Arup Kumar Indra presented a poster in the International Symposia on "Eucaryotic Expression Vector System" held at NII, New Delhi (Feb 04, 1996).

Dr. Anuradha Lohia gave an invited talk at the Global Meet on Parasitic diseases, New Delhi, Feb. 1996.

Dr Rajagopal Chattopadhyaya and all members of his laboratory participated in the International Symposium of Macromolecular Crystallographic Data held at SINP during November 16-20, 1995. Dr. Bhaswati Goswami attended the Winter School on NMR in Structural Biology held during November 5-14, i995 at TIFR, Bombay.

Dr. Pradip Parrack took classes on protein structure and protein-DNA interactions for final year M.Sc. students of Dept. of Biophysics, Kalyani University, Kalyani, W.B. Acted as course co-ordinator for the course on "Basic Biophysical Chemistry" for research students of Bose Institute, and participated in the teaching of the above and two other courses at Bose Institute. Delivered a lecture on "DNA Hybridisation" at the DBT workshop on "DNA Fingerprinting" organised at the Dept of Botany, Calcutta University, in October 1995.

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

Dr. B.K. Padhi, Dr. Sk. Abdus Samad, Dr. Prasanta Bag, Dr. Aditya Sengupta, Ms. Kajari Ghosh, Dr. Mita Sen, Dr. Bhudeb Bhattacharyya, Dr. Pradip Kr. Mahapatra, Dr. Bhaswati Goswami, Dr. Sumita Sinha, Dr. Brajadulal Chattopadhyay, Dr. Chaiti Ganguli, Arup Indra, Atasi Poddar, Rinku Ghosh, Madhumita Basu, Suranjana Guha, Sudit S. Mukhopadhyay, Gitali Ganguly, Surekha Mandal, V.M.H. Namboodiri, Purba Mal, Samarpan Majumder, Hirok Jyoti Datta, Samudra S. Gangopadhyay, Somenath Bhattacharyya, Nandan Kr. Jana, Nrishingha De, Lopa Adhikary, Sib Sankar Roy, Gopal Chakraborty, Biswajit Roy, Nabanita Sarkar, Pampi Basu, Pallab Kundu, Mausami Maitra, Prajna Mandal, Shalmali Chakraborty, Suroopa Banerjee, Saumen Bhattacharyya, Saurabh Pal, Runa Sur, Kausik Ghosh, Kaustuv Sanyal, Jayanta Mukhopadhyay, Pradip Sen, Rajat Bhattacharyya, Chandrani Chattopadhyay, Indrani Datta, L. Boominathan.

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.C. Mandal, R. Das, Kaberi Basu.

Grants-in-aid Scheme

Investigator/Co-investigator	Title	Financed by
Prof. Susweta Biswas	Myoinositol tris and tetrakisphosphate generated by Phytase action on myoinositol hexakis phosphate and its involvement in signal transduction process in plant cell.	C.S.I.R.
Prof. Susweta Biswas	Study signal transduction in Plant : Inositol trisphosphate, Receptor from *Vigna radiata* its gene cloning and characterization of different domains.	C.S.I.R.
Prof. N.C. Mandal	Studies on the promoters and operators of Mycobacteriophage L1 and construction of mycobacterial expression vectors.	C.S.I.R.
Prof. N.C. Mandal	Studies on the Lethal interaction of the Bacteriophage lambda replication gene *P* with its host *E. coli*.	D.B.T.
Prof. B. Bhattacharyya	Studies on carboxy termini of tubulin : Its structural and functional implications.	C.S.I.R.
Dr. Pratima Sinha	The role of Mcm family of proteins in initiating DNA replication at yeast replication origins.	D.A.E.
Dr. Anuradha Lohia	Identification of pathogenic strains of *Entamoeba* by a PCR based diagnostic assay.	C.S.I.R.
Dr. Anuradha Lohia	Studies on the expression of *ras* superfamily proteins in *Entamoeba histolytica*.	D.B.T.
Dr. R. Chattopadhyaya	Crystallographic studies of lipases from *A. niger*.	C.S.I.R.
Dr. R. Chattopadhyaya	Purification and crystallisation of locally available proteins.	D.S.T.
Dr. R. Chattopadhyaya	Biophysical characterization of DNA oligomers containing UV induced thymine dimers.	D.A.E.

Biophysics

Faculty : Prof. A. K. Banerjee (Chairman), Dr. S. Roy, Dr. G. Basu (from 28.09.95)

INSTITUTIONAL PROJECT III

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

Asok Banerjee, Asok K. Pal, Indrani Dey, Sreya Ghosh, Sampa Pain, A. Seal,•Bishnu Mukhopadhayay and Asim Bera

Cysteine proteases are involved in various biological processes and they have importance 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 is in progress with an objective to visualize its substrate specificity, and compare it with papain and other cysteine proteases to rationalize a conclusion.

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.

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

Asok Banerjee, Sreya Ghosh, B.P. Mukhopadhyay, Sampa Pain and Indrani Dey

Protein nucleic acid interactions are of fundamental importance in molecular biology. 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-repressor/λ-repressors/lac-rep/pec/cro protein nuceotide complexes. Our group has succeded 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 from ($12H_2O$). 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 a peptidoglycan — a chemoreceptive constituent of Mycobacterium cell wall.*

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

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.

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

Asok Banerjee, C. Roychowdhury, Asok K. Pal, P. Bag and G. Biswas

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. Further development is continuing.

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

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

The repressor is a multi-functional protein, which acts as up regulator, down regulator and binds cooperatively to the operator sites. The binding cooperativity 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 achievments 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-assocation whiile 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 of tRNAs by aminoacyl-tRNA synthetases.*

Siddhartha Roy, Anusree Bhattacharyya, Durba Bandyopadhyay, Asim Bothra, Amit Mandal and 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. The aminoacyl-tRNA synthetase has to choose between many tRNA species in the cell that has very similar fold. Such difficult problems of recognition may have given rise to the mechanism of recognition, which may be fundamentally different from the "normal" enzyme-substrate recognition. Very little is known about such processes, although recently some speculations have been made about such recognition processes. It has been suggested that tRNA distortion and coupled conformational changes may play a crucial role in the recognition processes. Glutaminly-tRNA synthetase-$tRNA^{gln}$ is one of the best systems to study these problems, and as co-crystal structure has recently been elucidated. Both the enzyme and the tRNA can be purified in large quantities and the molecular weight of the enzyme is relatively small (64,5000 daltons).

We have shown that conformational changes induced by the cognate t-RNA is not induced by a non-cognate tRNA. We have also studied the nature of the conformational changes using difference CD spectroscopy and binding thermodynamics.

We are investigating domain-domain interactions of this protein by solid surface catalyzed denaturation, often called aging. We have shown that solid-surface catalyzed aging produces a new conformation 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.*

Gautam Basu

A model for the coupling of collective protein motion to electron transfer has already been developed and currently computer simulations are in progress. An extension of this model is the next step, where the protein motion will be incorporated as quasi-harmonic principal components. The other part of the project is dynamics of short peptides. Currently we are studying how a 3_{10}-helix,/3_{10}-helix transition equilibrium as a function of temperature.

A.8. *Experimental Studies of Conformation and Dynamics of Short Helical Peptides.*

Gautam Basu and Manasi Ghose

This project has been designed to experimentally address factors that are responsible for stability of short helical peptides including those that contain non-natural amino acids like Aib. Currently two subprojects have been launched, the first is designed to establish a thermodynamic scale for the relative preferences of amino acids between the 3_{10} and the α-helical states, and the second is to study short peptide sequences made up of naturally occuring amino acids that form stable 3_{10} helices.

PUBLICATIONS

1. Bandyopadhya, S., Mukhopadhya, C. and Roy, S. Dimer-dimer interfaces of the lambda repressor are different in liganded and free states. *Biochem.* **35,** 5033-5040, 1996.

2. Bhattacharyya, A., Bhattacharyya, K., Bhattacharyya, B. and Roy, S. A study of aggregation of 9-(dicyanovinyl) julolidine. *Ind. J. Biochem. Biophys.* **32,** 442-446, 1995.

3. Biswas, G., Ganguly, S.N. and Banerjee, A. Tropinyl 2-iso-propylbenzo[b]thiophene-3-carboxylate, $C_{20}H_{23}NO_2S$. *Acta Cryst.* **C51,** 2386-2388, 1995.

4. Dey, I. and Banerjee, A. 7b-8b-epoxy-friedelane. *Acta Cryst.* **C51,** 119-121, 1995.

5. Mukhopadhyay, B.P., Ghosh, S. and Banerjee, A. Role of water molecules in protein-nucleic acid interaction : Visualization of a model highly hydrated complex structure of Inosine 5—monophosphate and L-Serine ($2C_{10}H_{13}P.C_3H_7NO_3.12H_2O$) at atomic resolution. *J. Chem. Cryst. USA.* **25,** 405-413, 1995.

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

7. Sengupta, S., Roy, S. and Bhattacharyya, B. Interaction of fluorescence analog of Colcemid with liver alcohol dehydrogenase. *Eur. J. Biochem.* **232,** 844-848, 1995.

8. Zhou, Y.N., Chatterjee, S., Roy, S. and Adhya, S. The non-inducible nature of super-repressors of the gal operon in E.Coli. *J. Mol. Biol.* **253,** 414-425, 1995.

Participation in conferences/symposia/ training/programme/Award and Honours received.

Prof. A. Banerjee delived two invited talks entitled "Structural aspects of a cysteine protease, Calotropin DII" and "Artificial intelligence approach to structure activity relation of compound" at the Biophysics Congress, Indian Biophysical Society, AIIMS, New Delhi, 1996, and the National Codata Seminer, Pune, 1996, respectively.

Dr. G. Basu visited Kyoto University for four months from December, 1995, for collaborative work with Prof. N. Go and presented a poster at the International symposium on Electron Transfer held at Kanagawa, Japan (March 17-20, 1996).

Ph.D. Awarded

Name	University	Year	Title	Supervisor
Anusree Bhattacharyya	Calcutta	1995	Fluorescence spectroscopic study of structure of tubulin.	Dr. S. Roy
Indrani Dey (Sarkar)	Calcutta	1996	Characterization of few organic compounds of Biological interest by X-ray crystallography and computer modelling studies of a protease system and its complexes.	Prof. A. Banerjee
Sampa Biswas	Calcutta	1996	Three dimensional structural characterization of some modified β-lactam analogs and their mode of interaction with bacterial cell wall component leading to structure-activity correlation by biophysical methods and computer modelling.	Prof. A. Banerjee

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

Dr. B. P. Mukhopadhyay, Dr. S. Bhattacharya, Dr. A. Seal, Dr. A. Bhattacharyya, Dr. S. Biswas, Dr. I. Dey, Dr. A. Shamla, S. Ghosh, A.K. Bothra, S. Bandopadhyay, A.K. Pal, S. Chatterjee, A.K. Mondal, R. Banerjee, M. Ghose.

OTHER SUPPORTING STAFF MEMBERS

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

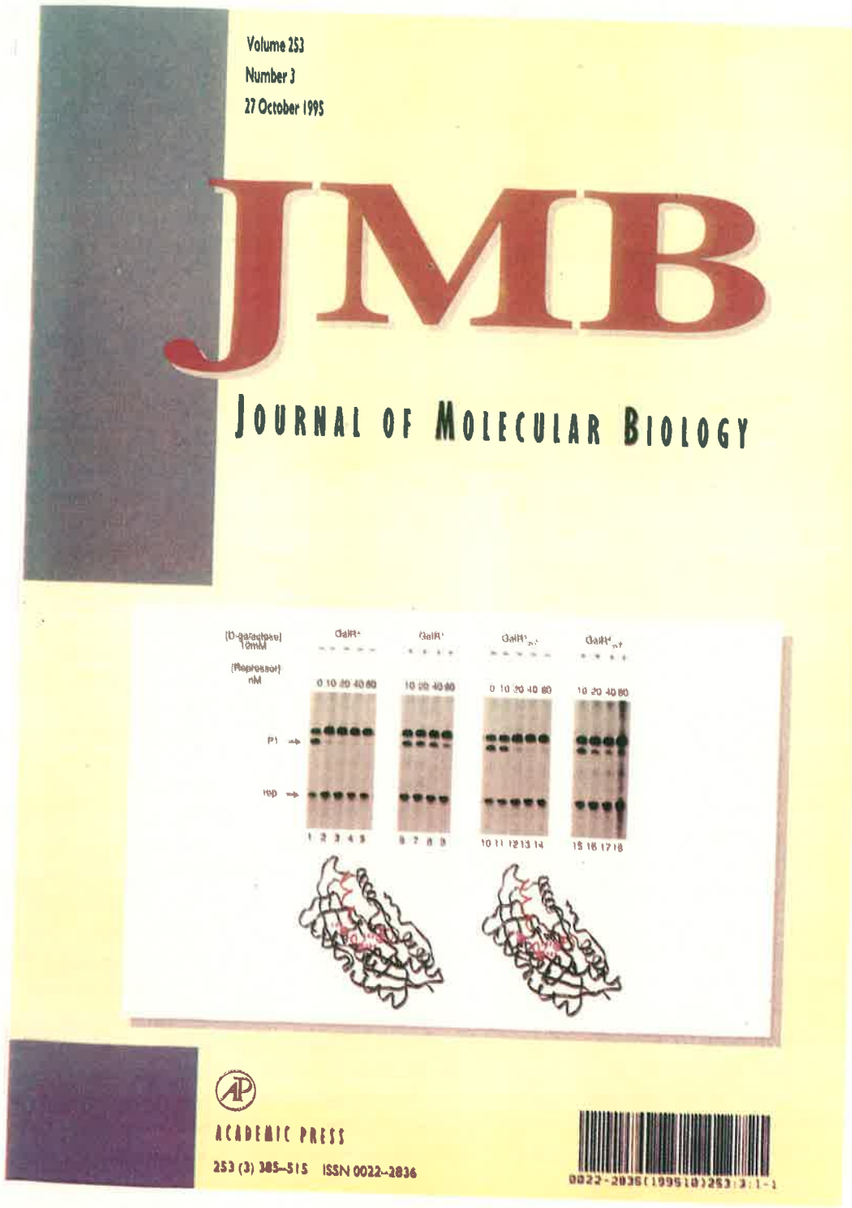
GRANTS-IN-AID SCHEMES

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
Dr. S. Roy	A study of structural and molecular basis of co-operative binding of operator sites of repressor.	CSIR
Dr. S. Roy	Nuclear magnetic studies of structure and dynamics of bent DNA.	DST

J. Mol. Biol. (1995) **253**, 414–425

The Non-inducible Nature of Super-repressors of the *gal* Operon in *Escherichia coli*

Yan-Ning Zhou[1], Sumana Chatterjee[2], Siddhartha Roy[2] and Sankar Adhya[1]*



Animal Physiology

Faculty : Prof. A.K. Ray **(In-charge),** Dr. R. Ghosh, Dr. G. Sa

INSTITUTIONAL PROJECT IV

A. Environmental Physiology and Hormonal Regulation.

A.1. *Introduction and inhibition of vitellogenesis in catfish hepatocytes in vitro.*

Rama Ghosh, Ehsan A. Khan, A. K. Dasmahapatra, and R.K. Mandal (Dept. of Biochemistry)

In continuation to our work on primary culture of hepatocytes from catfish, *Heteropneustes fossilis* (B1.) and their response to exogenous agent, we have studied the influence of carbofuran, a carbamate group of pesticide used in agriculture, on vitellogenin (Vg) synthesis in estradiol-17B treated hepatocytes *in vitro.*

Estrogen alone induced vitellogenin synthesis up to 3 fold compared to control culture. Carbofuran together with estrogen reduced vitellogenin content by about 33% within 48 hours of treatment. When fishes primed with estrogen were used for all culture it showed 4-5 fold increase in Vg synthesis compared to the unprimed fish cells. Carbofuran also inhibited Vg syntheses when added with estrogen to primed cell culture. The present findings clearly indicated that catfish hepatocytes *in vitro* respond to estrogen much more in primed than regular (non-primed) condition ; and secondly carbofuran has significant inhibitory influence on *in vitro* vitellogenesis both in primed and regular hepatocytes.

A.2. *Evaluation of skin extract from Labeo rohita and Heteropneustes fossilis as an alternative to attachment factor for in vitro hepatocytes culture.*

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

Attachment factors are pre-requisite for short-term primary culture as well as long-term culture of fish cells. We have developed suitable attachment factors from the skin of carp, *Labeo rohita* and catfish, *Heteropneustes fossilis* and evaluated their attachment efficiency for cells. It was observed that the culture plates maintained at 20°C was better than that at 17°C. The cells seeded well in extracts prepared at both power pH (2.0 and 4.0) and finally the skin extract of carp (*Labeo rohita*) is better than that of catfish for the culture of catfish or carp hepatocytes with respect to their attachment efficiency as well as maintenance of LDH-activity.

A.3. *Induction of malic dehydrogenase enzymes in the liver of Rohu fish, Labro rohita (Ham.) by carbofuran.*

Rama Ghosh, Manik Ghosh, and A.K. Dasmahapatra

Earliar observation showed that carbofuran was able to enhance total lipid content of liver of Singhi fish, *Heteropneustes fossilis* (Bloch) in a dose-dependent manner. In connection with the fact we have extended our studies to the activities of malic dehydrogenases (ME) a group of lipogenic enzyme, in response to carbofuran treatment in carp.

Labeo rohita of about 100g BW were injected CF intraperitoneally. It was observed that cytosolic NADP dependent ME activity (E.C.1.1.1.40) in CF treated fish increased about 2-fold compared to vehicle injected animal whereas NAD dependent ME (EC 1.1.1.37) increased about 1.5 fold. Mitochondrial NADP dependent ME and NAD dependent ME did not increase significantly. The results suggest that CF is able to induce ME activities by activating gene regulation. Further works are in progress.

A.4. *Zinc toxicity in fish.*

Rama Ghosh and Soumendra Talapatra (in collaboration with Department of Zoology, Ranchi University, Ranchi)

The impact of zinc (heavy metal ion) on growth and reproduction of fish were evaluated in our laboratory by using Singhi fish as a model. Singhi fish, *Heteropneustes fossilis* (Bloch) were exposed to 30 ppm zinc nitrate

solution for 30 days in glass aquaria in laboratory conditions. Liver, Ovary and Muscle were analysed for accumulation of Zn by Atomic absorption analysis. It was observed that Zn accumulation was highest in the liver and least in the muscle.

Histological studies of the liver and ovary of zinc exposed fish showed that the liver cells become vacuolated forming clumps. In ovary, follicular atresia with some mature (Stage III) oocytes were observed after zinc exposure.

A.5. *Production of triploid and unisex fish.*

Exogenous androgen causes paradoxical faminization and precocious ovarian maturation in Indian Catfish (Heteropneustes fossilis Bloch).

Arun K. Ray, and Basant K. Tiwary

Indian catfish (*H. fossilis*) is a suitable species for aquaculture due to higher protein and low fat content in muscles. Major problem associated with culture of this fish is non-availability of adequate seedlings. Females of this fish mature at the end of first year of life under natural conditions. Immersion treatment of newly hatched sacsfries in testosterone for one month resulted in 100% paradoxical faminization i.e. induced faminization after treatment with the androgen. 70% of females showed fully matured ovary filled with ripe ova at the age of seven months. Matured fish were capable of producing viable eggs, as judged by their capability for successful induced breeding in laboratory. This technique may be utilized for out-of-season availability of hatchlings for culture purpose, thereby extending the normal breeding period (July-August) of this fish by three months.

A.6. *Role of estrogen in the ovarian development in freshwater prawn, Macrobrachium rosenbergii*

Modification of the prawn hepatocyte culture.

Arun K. Ray, and Anuradha Chaudhury

In our attempt to prolong the viability of the cells in culture, the prawn hepatocytes were subjected to a medium containing fetal bovine serum or prawn hemolymph serum. By such procedure the viability of the hepatocytes were increased up to about three weeks, as judged by Trypan blue exclusion test and LDH measurement. The hepatocytes cultured in modified M199 medium remained viable only for ten days. Trials are going on to modify the hepatocyte primary culture to a permanent cell line.

A.7. *Thyroid hormone regulation of mammalian brain function.*

Arun K. Ray, and Nilkanta Chakrabarty

Although the nature of responsiveness of the adult mammalian brain to thyroid hormone (TH) is thought to be of non-genomic nature, the actual site of action of the hormone in the neurone remains unclear. As cerebral cortex is rich in cholinergic neurones the role of TH on the acetylcholine (Ach) release has been studied through as assessment of the neuronal acetylcholinesterase (Ache) enzyme activity.

Treatment of the adult male rats with the dose of TH which showed inhibition of Na^+ - K^+-ATPase activity earlier, demonstrated about 38% increase in the AchE activity in the cerebral cortex in comparison to the corresponding control animals. The propylthiouracil (PTU)-treated hypothyroid rats also showed a 25% rise in the enzyme activity. TH treatment to the hypothyroid rats effected to 60% increase in AchE activity after 24 hours and 36% increase after 48 hours of the hormone treatment in comparison to the only hypothyroid animals.

Our data indicate involvement of TH with neurotransmitter release and paradoxical effect on the enzyme activity during hypothyroidism. In hypothyroidism, apart from the TH influence mediation of some stress factors might have occurred.

A.8. *Phenylhydrazime-hydrochloride (PHH)-thyroid hormone interaction in ract.*

Arun K. Ray, and Mitali Pramanik

In order to understand the red cell membrane profile in different magnitudes of oxidative stress originating from PHH treatment, the membrane acetylcholinesterase (AchE) activity of red cells were demonstrated *in vitro*. A dose-dependent inhibition of membrane AchE was observed when the red cells were incubated *in vitro* at 37^0 in a medium containing different

concentrations of PHH. This indicates that the red cell membrane AchE may be considered as a parameter for the assessment of the magnitude of the oxidative stress. Moreover, the red cell membrane lipid peroxidation at the basal level was studied by assessment of the formation of thioburbituric acid reactive substances. Studies are in progress to demonstrate the thyroid hormone counteraction of the PHH-stimulated oxidative stress in red cell.

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

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

Arun K. Ray and Bela Keshan

In our attempt to elucidate the role of vertebrate sex steroid, estradiol 17B (E_2), on an intervebrate system, namely *Bombyx mori* L., both for academic and commercial interest. We have found that E_2 exerts profound effect on DNA and RNA contents of the posterior silk gland and it also increases the fibroin (the actual silk) content of the silk gland in a dose-dependent manner. E_2 also stimulates the glutamate-pyruvate transaminase and trehalase activity, which are necessary for fibroin synthesis and general metabolic activity.

The wet weight of silk gland is also increased at various doses of E_2. The cocoon shell weight is increased by 7.68% after E_2 treatment. The data demonstrate a prominent anabolic action of E_2 on the *Bombyx mori* silk gland indicating its commercial benefit.

C. Cell signalling.

C.1. *Basic FGF stimulates activation of phospholipase A2, phospholipase C and phospholipase D.*

Gaurisankar Sa, Tanya Das (Immunotechnology Section)

Fibroblast growth factors (FGFs) stimulate the proliferation, differentiation and motility of different cell types. The cellular effects of FGF are transduced by its interaction with any one of four members of a family of high affinity, cell surface FGF receptors (FGFRs). Activation of FGFR causes release of various low molecular weight signalling molecules. With an approach to undertstand the underlying mechanisms by which basic FGF mobilizes all the four important second messangers, we have found that tyrosine kinase inhibitors can inhibit activation of all the three enzymes, indicating that initial kinase activity of FGFR is important to transduce the signal. We have also observed that a perfussis toxin-sensitive heterotrimeric signal transducing G-protein is required for the activation of cytosolic phospholipase A_2. The phospholipase D activation requires a botulinum toxin-sensitive rho, a ras-like small molecular weight G-protein. On the other hand, FGFR1 directly activates phospholipase C1 by phosphorylation at a specific tyrosin moiety. All these results demonstrate that the pleotropic effects of FGF are exerted through its tyrosine kinase receptors and individual effectors are activated via individual and distinguishable signalling mechanisms according to the cell's need.

C.2. *Intracellular signalling mechanisms in fibroblast growth factor and endothelin mediated differentiation specific immediate early gene expression.*

Gaurisankar Sa, Tanya Das (Immunotechnology Section)

Basic fibroblast growth factor (bFGF) and endothelin (ET) have been shown to stimulate proliferation and differentiation of mammalian cells of different origin. The mechanisms of action of cell proliferation are well established but the intracellular signalling mechanisms of cellular differentiation of both the agents are still unknown. Recently, it has been shown from our laboratory that bFGF and ET stimulate phosphorylation of a transcription factor (s) having molecular mass and characteristic of STAT (signal transducer and activator of transcription) protein through different signalling mechanisms. These transcription factors are known to bind SIE (Sis-inducible element) and transcriptionally activates differentiation specific immediate early genes (e.g.c-fos). The intracellular signalling mechanisms of bFGF and ET-induced gene expressions will be identified. The putative roles of the transcription factor (s) will be studied in details.

PUBLICATIONS

1. Ghosh, R. and Chatterjee, S. Toxicity of carbofuran pesticide in fish : Effects on reproduction. *Proc. of 3rd Asian Fish Soc.* 856-859, 1994.

2. Ghosh, R. and Chatterjee, S. Toxicity of carbamate pesticide, carbofuran technical 75DB to the fertilization of eggs of catfish, *Heteropeustes fossilis* (B1). *Bull. Environ. Cont. Toxicol.* **55**, 111-115, 1995.

3. Lahiri, S., Ray, A.K. and Chakraborty, A. Antibody-induced alterations of thyroid hormone receptor during experimental thyroglobulin immunization in rabbits. *J. Clin. Biochem. Nutr.* **18**, 73-77, 1995.

4. Sa, G., Murugesan, G., Jaye, M., Ivashenko, Y. and Fox, P.L. Activation of cytosolic phospholipase A_2 by basic fibroblast growth factor via a P42 mitogen activated protein kinase-dependent phosphorylation in endothelial cells. *J. Biol. Chem.* **270**, 2360-2366, 1995.

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

Dr. A.K. Ray participated in the XIX All India Cell Biology Conference held at Calcutta in February, 1996.

Dr. R. Ghosh, attended Fourth Asian Fisheries Forum, an International meeting held at Beijing, China, in October 16-20, 1995 and presented two papers in Fish Biology Session.

Dr. G. Sa presented a papers at Society of Biological Chemist's, one day symposium on "Signal Transduction" India, 1995, International Symposium on Trends in Microbiology, India, 1995, and XIX All India Cell Biology Conference, India, 1996. Dr. G. Sa received Young Scientist Award from the Department of Science & Technology, Govt. of India in 1996.

Dr. Ehsan Ahmed Khan participated and presented paper in 83rd Indian Science Congress at Patiala, Punjab. He was also awarded a Gold Model by the 'Society of Biosciences' for best article in Society's Journal, 'Advances in Biosciences' for the year 1994-1995, in November, 1995 at Rohtak, Haryana.

Mr. Basant Tiwary participated in 83rd Indian Science Congress at Patiala in January, 1996 and in the XIX All India Cell Bioloogy Conference held in Calcutta in February, 1996.

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POOL OFFICERS/ POSTDOCTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JUNIOR RESEARCH FELLOWS

Dr. Anuradha Chaudhury, Dr. Swades De, Dr. E.A. Khan, Dr. D. Ghosh, Dr. Soumen Maitra (From 01.4.95 to 30.6.95), Ms. Sudipta Chatterjee (upto 18.6.95), Mr. Basant K. Tiwary, Ms. Bela Keshan, Mr. Nilkanta Chakrabarty, Mr. Manik Ch. Ghosh.

OTHER SUPPORTING STAFF MEMBERS

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

Plant Molecular & Cellular Genetics

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

INSTITUTIONAL PROJECT I

A.1. *Generation of insect resistant transgenic crop plants.*

S.K. Sen, S. Das, D. Basu, P. Nayak, A. Basu, Dipankar Ghosh, Ashis Nandi, Dipankar Das, Krishna Roy, Sushma Mishra, A. Mandal, Ramkrishnan NA, Maloy Ghosh, and Pushpita Mukherjee

The insecticidal protein genes viz., cryIAb, cryIAc and cryIIIA of *Bacillus thuringiensis* have been transferred to IR64, an elite indica rice cultivar. Stable high expression of the toxin in plant prevented damages caused by the yellow stem borer larvae to rice plants in the field. Additionally, a number of independent primary transformants have been identified which are to be analysed further. All the transgenics, thus generated contain synthetic form of the *cry* genes developed in the laboratory. Attempts to generate insect resistant cotton transgenic plants have already made considerable progress. Adoption of a novel stategy for development of cotton transgenics has yielded rich dividends. As the outcome of this progress, gene transfer in cotton has practically become a straight forward technical step. A number of transformants with *cry* gene have already been identified. Critical molecular biological analysis are being carried out. We have reasons to believe that like in rice, cotton transgenics resistant against boll worm would be available, shortly. In the similar line of approach, insect resistant mustard, ground nut, chickpea, tea and certain vegetable crop plants are in active state of development. Transgenic mustard plant with cowpea trypsin inhibitor (CPTI) gene has also been develope l. The plants showed heterologus expression of the CPTI gene in mustard.

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

S.K. Sen, S. Das, P. Nayak, D. Basu, T. Saha, and N.S. Banerjee

Homozygus transgenic *indica* rice lines have been evolved in their R3 generation with *rol* C gene driven by a CaMV 35S promoter. The plant lines in field trials showed higher tillering capacity than the untransformed ones, resulting improved harvest-index.

Attempts are being made to develop transgenic jute cultivars with the plant developmental genes to improve fibre bearing capacity of the crop species and in tea for higher flushing capacity.

A.3. *Plant protoplast manipulation studies to evolve genetically engineered crop species.*

S.K.Sen, S.R. Sikdar, T. Saha, Soma Paul, and Malay Ghosh

Back cross progenies of somatic hybrids between *Brassica* and *Trachystoma* are being studied for development of agronomically useful type of mustard plants.

Attempts for generation of interspecific jute somatic hybrids between *Corchorus olitorius* and *C. capsularis* are being pursued. Protoplast fusion technique is also being employed to transfer selectively the cytoplasmic contents of cytoplasmic male sterile (CMS) lines to mustard cultivars in order to evolve new CMS lines. Significant progress has been achieved in case of cytoplasmic transfer of *Ogu to Brassica juncea* which shows male sterility under the influence of CMS cytoplasm of Ogu.

A.4. *Understanding of male sterility and transgenic approach for generation of nuclear male sterile lines.*

S.K.Sen, S. Das, D. Basu, P. Nayak, A. Basu, P. Roy Choudhury, Sanchita Roy Choudhury, A. Mandal and S. Rajlaxmi

Molecular analysis of two CMS lines of rice was carried out to find out possible correlationship with mt-genomic organisation and the CMS attribute. It was observed that mitochondrial ATPase-6 gene alteration is like to be the candidate gene responsible for developmentally controlled male sterility.

In another programme, developmentally controlled plant promoters are being used in transgenic approach to express an anti-metabolic gene product during microscore formation in mustard. This is expected to result male sterility. Critical strategies have been adopted to select the appropriate promoters and the gene products for the purpose.

A.5. *Improvement of the quality of mustard oil and seed meal.*

S.K. Sen, S. Das, S. Ghosh, D. Basu, P. Nayak, Anita Roy, A. Basu, Soma Pal (PMCG) Krishakali Niyogi, Ashish Bhattacharya, Sharmila Chattopadhyaya and **D. Ghosh** (Chemistry Dept.) and **P.K. Saha,** Amitava Roy (Botany Dept.)

A few prospective low glucosinolate containing mustard lines have been identified amongst the back-crossed progenies of low glucosinolate containing genotype of a noncultivar of *Brassica juncea* from Canada and B85, a cultivar of *B. juncea*.

Genetic engineering of fatty acid chain elongation mechanism in mustard seed is targetted for engineering through heterologus expression of a palmitoyl-ACP-thioesterase gene via transgenic approach. Work on such transgenic plant regeneration is underway.

A.6. *Interrelationship of the two cultivated jute species.*

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

Attempts to estimate the genetic variability present in each of the two cultivated jute species is being estimated. Additional informations through RAPD and RFLP analysis have revealed that the two jute species have evolved from a common progenitor.

A.7. *Attempts to isolate high "dye" producing culture lines of Carthamus tinctorius L. (Safflower).*

Amita Pal and Shamik Das

Florets of safflower produce industrially useful pigments. These dye components are being used as food colourant and as pharmaceutical pigment. It is also used as folk-lore medicine. Attempts are being made to produce these pigments in the suspension culture of safflower. Callus was raised from the leaf and petal tissues of Safflower on a modified MS medium. Suspension cultures were established from these cultures and grown under dark. Most of the dye components were released in the medium within 14-20 days. It has been found that altering the concentration of phosphate and magnesium ions in the culture medium, the pigment production can be enhanced. The result suggests that a two step culture method may be adapted to enhance production of the colouring substances.

PUBLICATIONS

1. Begum, F., Pal., S., Bag, N., Sikdar, S.R. and Sen, S.K. Somatic hybrids between *Brassica juncea* (L) *Diplotaxis harra* (forsk) and generation of backcross progenies. *Theor. Appl. Genet.* **91,** 1167-1172, 1996.

2. Chandra, Monalisa and Pal, Amita. Differential response of the two cotyledons of *Vigna radiata*. *Plant Cell Rep.* **15,** 248-253, 1995.

3. Kar, S., Basu D., Ghosh, D., Ramkrishanan, N.A., Mukherjee, P., Nayak, P. and Sen, S.K. Expression of crylA (c) gene of *Bacillus thuringiensis* in transgenic chickpea plants inhibits development of podborer (Heliothis armigera) larvae. *Transgenic Res.* **5,** 1-9, 1996.

4. Mitra, Aparajita and Pal, Amita. Morphogenetic response and biochemical analysis to determine interclonal genetic relationships of *Populus deltoides* Marsh. *J. Natn. Bot. Soc. Special Issue.* **49,** 57-66, 1995.

5. Nayak, P., Banerjee, N.S., Mishra, S. and Se, S.K. Transfer of plant development genes to improve yield potential for rice cultivars. *Proc. III Intl. Rice Genetics Congr., Manila, IRRI.* **1995.**

6. Nayak, P., Basu, D., Das, S., Ghosh, D., Basu, A. and Sen, S.K. Transfer of insect resistance genes against the damage caused by yellow stem borer to *indica* rice cultivars. *Proc. III Intl. Rice Genetics Congr.. Manila, IRRI,* **1995.**

Figure showing a high "dye" producing suspension culture (A) of *Carthamus tinctorius*, while "dye" content is very low in another culture line (B)

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

Dr. S.R. Sikdar returned in January, 1996 from Waksman Institute, Rutgers University after spending 2 years as a post-doctoral fellow in the laboratory of Prof. P. Maliga.

Prof. S.K. Sen, Dr. Debabrata Basu and Dr. Pritilata Nayak attended and delivered invited lectures in National Rice Biotechnology Network meeting held at NCL, Pune.

Prof. S.K. Sen, Dr. Sampa Das, Dr. Debabrata Basu and Dr. Pritilata Nayak attended the 3rd International Rice Genetics Congress held at Manila, The Phillippines. Prof. Sen and Dr. Nayak delivered invited lectures and Dr. Das and Basu presented posters.

Prof. S.K. Sen delivered key-note lecture at the Symposium/Conference on National scenario on Plant Science Research at Banaras Hindu University ; Chandigarh Symposium at the Punjab University, Chandigarh ; at Centre for Biotechnology, Indian Agricultural Research Institute, New Delhi; DNA-finger printing Int. Symposium at the Centre for Cellular & Molecular Biology, Hyderabad ; Special lectures at the CPMB, Osmania University, Hyderabad; Golden Jubilee Celebration of Association of Engineers, Calcutta ; DBT sponsored Plant Biotechnology Symposium at the Assam Agricultural University, Jorhat and special symposium at the Regional Research Laboratory, Jorhat and Institute of Life Sciences, Bhubaneswar.

Ph.D. Awarded

Name	University	Year	Title	Supervisor
Sm Aparajita Bhattacharyya	Calcutta	1995	*In vitro* propagation of industrially important genotypes of *Populus deltoides* Marsh, and a hybrid *Populus* species.	Dr. A. Pal
Mr. Tony M. Johnson	Calcutta	1995	Isolation and cloning of entomocidal crystal gene from *Bacillus thuringiensis* var. tenebrionis and monitoring its expression in plant system.	Prof. S.K. Sen
Mr. Nilam Sanjib Bandyopadhyay	Calcutta	1995	Isolation and cloning of entomocidal crystal protein gene of *Bacillus thuringiensis* var. berliner and its expression in plant	Prof. S.K. Sen
Ms Sachayita Kar	Calcutta	1996	Molecular characterisation of *rol* genes and their utilisation in plant genetic engineering.	Prof. S.K. Sen
Mr. A.S. Rishi	Calcutta	1995	Genetic transformation studies in chickpea (*Cicer arietinum* L.)	Prof. S.K. Sen

RESEARCH SCIENTISTS/RESEARCH ASSOCIATES/POOL OFFICERS/POST DOTORAL FELLOWS/SENIOR RESEARCH FELLOWS/JOUNIOR RESEARCH FELLOWS

Dr.D. Basu, Dr. P. Nayak, Dr. A. Basu, Dr. T. Saha, Dr. J. Tarfdar, Dr. R.P. Mukhopadhyaya, Dr. M. Chatterjee, Dr. K. Das, B.C. Sabat, Dr. N. S. Banerjee, Dipankar Ghosh, S. Roy Choudhury, K. Roy, S. Mishra, A. Mondal, D. Das, P. Roy Choudhury, Soma Pal, A.K. Nandi, Ramkrishnan NA, Maloy Ghosh, Samj Majumdar, S. Rajlaxmi, Shamik Das, Anita Roy.

OTHER SUPPORTING STAFF MEMBERS

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

GRANTS-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 Rocke-feller foundation
Prof. S.K. Sen	Generation of genetically engineered tea plant.	Tata Tea Ltd.

Immunotechnology Section

Faculty : Prof. P.K. Ray

INSTITUTIONAL PROJECT III

A.1. *Synthesis and functional studies on small peptides having immunological properties.*

P. K. Ray and P.K. Dutta

Several peptides were synthesized following the Protein A structural motifs to study their biological properties, both *in vivo* and *in vitro* cell culture. Modeling studies are being done to find out whether or not increasing or decreasing the number of amino acids in the C-terminal end might provide greater binding affinity.

INSTITUTIONAL PROJECT V

A.2. *Signal transduction mechanisms induced by Protein A in spleenic lymphocytes of Swiss albino mouse.*

P. K. Ray and T. Das

Molecular mechanism(s) underlying the multifactorial activities of Protein A (PA) is being studied. This protein has high affinity binding sites(s) on spleenic lumphocytes. After binding, PA stimulates a cascade of intracellular signaling reactions involving tyrosine kinase, PLC-γ 1, IP_3, Ca^{2+}, PKC and MAP kinase. As a result, concentrations of some important early gene products e.g.: c-*fos*, c-*myc*, increase in the nucleus. Blockers of this pathway could block cell proliferation and cytokine production. Studies on the role of PA on gene expression are in progress.

A.3. *Studies on in vitro production of cytokines by Protein A and their effects on tumor-bearing mice model.*

P. K. Ray and M. Srivastava

Protein A (PA) is a potent immunomodulator and this immunopotentiating effect is mediated by the release of cytokines after stimulation of the immune cells with PA. The production of cytokines like IL1, TNF-α– and γ-IFN *in vitro* by spleenic lymphocyte subpopulation was studied. The kinetics of lymphokine secretion revealed that PA can induce a quick and early response of cytokine release. IL-1, TNF-α and r-IFN were detected in the culture supernatant of lumphocytes activated with PA for 30 minutes. Studies on the molecular mechanism(s) involved in the PA induced cytokine gene expression is in progress. The *in vitro* and *in vivo* effects of these cytokines in combination with PA on tumor cell cytotoxicity are also being investigated.

A.4. *Amelioration of AZT induced hematopoietic toxicity by Protein A.*

P. K. Ray and V. Subbulakshmi

Azidothymidine is a thymidine analogue active against the Human Immunodeficiency Virus (HIV) with demonstrated clinical utility in acquired immunodeficiency syndrome (AIDS) and AIDS related complex (ARC) patients. Its most common and dose limiting toxicity is hematologic, characterized by megaloblastic anemia and leukopenia. *In vivo* and *in vitro* studies in mice model have demonstrated that Protein A, a cell wall protein of *S. aureus* can selectively reverse and prevent AZT toxicity against erythroid and granulocyte-macrophage progenitor cells. Studies on the mechanism of prevention of toxicity by PA are under way.

A.5. *Studies on the mechanism of Nitric oxide production and its relevance to superoxide generation in Protein A activated macrophages and neutrophils.*

P. K. Ray and S. Goenka

Nitric oxide (NO) is known to participate in a wide range of physiological processes including tumor-killing and immune regulation. In order to assess the role of NO in various immune cells, the measurement of NO and the mechanism of its production are under investigation. The measurement of NO by its conversion to NO_2/NO_3 has been standardized by the Greiss reaction and subsequent spectrophotometric measurement. Cultures of peritoneal macrophages were set up and nitric oxide synthase, the enzyme responsible for the gen-

eration of NO, was observed in the cytosol by NADPH-diaphorase staining with nitro-blue tetrazolium (NBT) in cells activated by Protein A, LPS, and γ-IFN.

PUBLICATIONS

1. Raisuddin, S., Parmar, D., Zaidi, S.I.A., Singh, K.P., Verma, A.S. and Ray, P.K. Aflatoxin induces depletion of activities of phase I biotransformation enzymes in growing rats. *Eur. J. Drug Metabol. and Pharmacokinetics.* **19** (2), 163-168, 1994.

2. Raisuddin, S., Singh, K.P., Zaidi, S.I.A. and Ray, P.K. Immuno stimulating effects of protein A in immunosuppressed Aflatoxin-intoxicated rats. *Intl. J. Immunopharmacology.* **16** (12), 977-984, 1994.

3. Ray, P.K., Dutta, P.K., Modak, D.P. Mandal, C. and Subba Rao, N. Designing of peptides with immunomodulatory properties using protein A as probe. *Ind. J. Biochem. Biophys.* **32**, 327-77, 1995.

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

Prof. P. K. Ray was invited to deliver a plenary lecture at the 3rd International Congress of Toxicology in developing countries, and also to chair a session and take part in a round table conference, held at Cairo, Egypt.

Dr. T. Das presented papers in the All India Cell Biology Conference, India and in the Society for Biological Chemists' one day Symposium on Signal Transduction, India. She also attended the workshop on "Upgradation — Flow Cytometry", held at AIIMS, New Delhi.

Dr. P.K. Dutta, Dr. T. Das and V. Subbulakshmi participated in the International Symposium on Trends in Microbiology, India and presented abstracts.

Dr. M. Srivastava participated in the workshop on "Recent Advances in Flow Cytometry", held in PGIMER, Chandigarh. She also attended a DBT-sponsored workshop on the Polymerase Chain Reaction in Biological Analysis at the Bose Institite.

V. Subbulakshmi participated at the Annual Conference of the Society of Toxicology of India, Mumbai and attended a workshop on FACS at CCMB, Hyderabad.

S. Goenka participated in a seminar-cum-workshop on the Internet conducted by the D.I.C., Bose Institute in collaboration with VSNL (Videsh Sanchar Nigam Ltd.)

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

Dr. P.K. Dutta, Dr. T. Das, Dr. M. Srivastava, V. Subbulakshmi, S. Goenka

OTHER SUPPORTING STAFF MEMBERS

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

GRANTS-IN-AID-SCHEME

Investigator/ co-investigator	Title	Financed by
Prof. P.K. Ray	"Development of Polyclonal and Monoclonal antibody based immunodiagnostic kit for the detection of Aflatoxin B1"	DBT

Environmental Sciences Section

Faculty : Prof. P. K. Ray

INSTITUTIONAL PROJECT IV

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

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

Since last decade, West Bental 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 scavanger than the individual oxides with kd values for arsenic $5.0x10^4$. The IR, TGA, DTGA and other structural analysis are initiated. A pilot scale study has also been strated.

A2. *Microbial degradation of organiochlorine pesticides from food products.*

P. K. Ray, P.K. Chakraborty, P. Bhattacharyya, D.P. Modak, S.K. Das, Amiya Maity, 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 bactrial 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.

A.3. *Studies on the pollution impact of sediment dredging in Hooghly river and its estuarine region on the aquatic flora and fauna.*

P. K. Ray and D.P. Modak

Since 1992, we have studied the different aspects of the impact of sediment dredging and dumping in Hooghly estuary including water quality, sediment quality, ecological and biological monitoring and ecotoxicological impact. The data obtained indicate a deterioration of both biotic and abiotic environment during dredging and dumping operations.

The biodiversity, i.e. in other words ecological stability drastically decreased from 1.58 to 0.25. The accumulation of toxic metals and pesticides in aquatic fauna, particularly in fish, indicates a total risk to consumers.

PUBLICATIONS

1. Ray, P.K., Datta, P.K., Modak, D.P., Mandal, C. and Subbarao, N. Desiging of peptides with immunomodulatory properties using protein A as a probe : *Ind. J. Biochem. Biophys.* **32**, 372-377, 1995.

2. Shukla Ygeshwar, 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.

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

Dr. D.P. Modak, Dr. S.K. Das, Mr. Amiya Maity, Mr. Sujit Ghosh

OTHER SUPPORTING STAFF MEMBERS

A. Adak, A. Dalal, S. Jana, Mrs. R. Das, S. Roy, J. Das, D. Nayak

GRANTS-IN-AID SCHEME

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 Turst
Prof. P. K. Ray	An approach ot develop microbial pesticide degradation technology to reduce burden of long persistent pesticide residues in various food stuffs.	DBT
Prof. P. K. Ray	Development of data base on Pesticide residue in food materials.	DBT,
Prof. P. K. Ray	Development of an Immunotherapeutic approach to control aflatoxin mediated death in Poultry.	DST (Govt. of West Bengal)

Drinking water filter having the ability to kill bacteria and remove many harmful pesticides and heavy metals

Library

Mrs. R. Bhattacharyya, **(Librarian, Acting)**

The Library is primarily meant for the use of its research staff, and is also frequently used by the researchers of other institutes. The collection consists of both biological and physical sciences. Library participates in the calibrat programme ; and provides current content services on disk in the main campus library.

ACQUISITION

Library contains 31,070 volumes of books, journals and theses upto 31.03.96. Library purchases books under different schemes such as CPMB, PDF, DST etc. During 95-96, library subscribed 78 journal titles. Library also receives pamphlets, reports, newsletters, publishers' catalogue etc.

Photocopying services are provided to institute as well as outside users. 1.20.263 copies in the Centenary Building Library and 58,886 copies in the Main Campus Library were given during the period. Under inter-library loan system photocopies were also supplied to INSDOC.

PUBLICATIONS

1. Chatterjee, C. and Sarkar, Pradip. Multimedia products and its application in Library and information science. *Proc. 20th All India Conference of IASLIC.* **165,** 1995.

2. Dutta, N., Mitra, Rukmini and Dutta, S. Usage of CD-ROM in Calcutta libraries. *Proc. 20th All India Conference of IASLIC,* **169-172,** 1995.

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

Rukmini Mitra and Pradip Kr. Sarkar participated and presented papers in the 20th All India Conference of *IASLIC, Lucknow,* 26-29, Dec., 1995.

Reba Bhattacharyya, Panchugopal Das and Banhisikha Chaudhuri attended "Information Today & Tomorrow : Joint Session of second information industry promoter-user-interaction meet and fourth National online CD-ROM users meet" at *Sisir Mancha, Calcutta,* 21-24 Dec., 1995.

OTHER SUPPORTING STAFF MEMBERS

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

Workshop

Mr. A. Mukherjee **(Superintendent)**

The Bose Institute Workshop has Mechanical, Electrical, Refrigeration, Carpentry, Glass Blowing, Electronic and Drafting units. The workshop received about 2100 requisitions during the year from various departments and sections.

An important job was the design and fabrication of several instruments and gadgets. Some of these were Colony blot apparatus, Troly for radio active carrier, Camera stand, various gel apparatus, filter arrangement in funnels for purification of water, Beam stoper and support for beam stoper, etc. and also carpentry jobs.

Scientific instruments were repaired and maintained by the Workshop personnel.

Major electrical works included drawing several new lines at the Centenary Building and the Main Campus. Adequet steps were taken to reduce the voltage fluctuation at the Main Campus. 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 stocked items frequently needed, purchased according to Institute rules. Internal telephone system are looked after by the workshop.

One Mahindra Jeep and one old Ambassador car were disposed and replacement with two vehicles will be made soon. Pick up service for the staff members has been introduced from South Calcutta which is operating very smoothly and also regular bus service to Madhyamgram Farm Station has been introduced.

OTHER SUPPORTING STAFF MEMBERS

Sk. Abdul Rezzak, Mrinal Chandra Roy, Dipak Dutta, Ashutosh Sarkar, Samar Kr. Dutta, Sisir Kr. Ghosal, Sithil Mukherjee, Sisir Sarkar, Anil Sengupta, Bankim Dutta, Tarapada Das, Dipen Sen, Pitambar Patra, Subhas Chakraborty, Jogendra Nath Das, Tapan Mondal, Sk. Md. Ehia Hossain, Basanta Kr. Shit, Bholanath Saren, Ashit Banerjee, Sourendra Nath Chakraborty, Abdul Rahaman Molla, Panchanan Santra, Panchugopal Karak, W.D. Rozario, Sk. Md. Raffick, Rajkumar Das, Pranab Banerjee, Kalipada Das, Nirdhan Ch. Das, Lochan Shee, Smt. Sairoon Begum, Gopal Ch. Das, Sk. Md. Farruck, Kishori Mohan Saha, Murari Mohan Shee, Brahmdeo Prasad, Kalachand Sen, Swapan Jogosharma, Thakur Gond, Baidyanath Murmu.

Regional Sophisticated Instrumentation Centre

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

The RSIC continued to provide instrumentation services to users from the universities, R & D laboratories and industry in the region. A resume of services rendered by the Centre is tabulated below.

The installation of the new Single Crystal X-Ray Diffractometer has been completed and regular user services have begun. An expert team visited the Centre to make an on the spot assessment prior to the anticipated replacement of the Scanning Electron Microscope. It is expected that the necessary funds will be released for the purchase a new instrument. Funds for the purchase of a second Atomic Absorption Spectrophotometer have been made available and the instrument is in the process of being procured.

Repair of the Mass Spectrometer, installed in 1977, has been serious by affected owing to the non-availability of essential spare parts. A proposal for replacing this instrument with a LC-MS has been put up for the 9th Plan. The GC-MS suffered a breakdown during the year and its repair has been delayed because of the failure of the manufacturers to make available certain spare parts. Attempts are being made to recommission the instrument with substitute spare parts.

The Atomic Absorption Spectrometer, EPR Spectrometer, Transmission Electron Microscope, GC, HPLC and Spectrofluorimeter have continued to render user services without any major breakdown.

A total of 26 registered participants attended a three day Workshop on Analytical Applications of GLC organised in collaboration with the Central Forensic Science Laboratory, Calcutta.

PUBLICATION

Whittingham, J.L., Chaudhuri, S., Dodson, E. J., Moody, P.C.E. and Dodson, G.G. X-ray crystallographic studies on hexameric insulins in the presence of Helix-stabilizing agents, thiocyanate, methyparaben and phenol. *Biochem.* **34**, 15553-15563, 1995.

Participation in Conferences/Symposia/Training Programmes/Award and Honours received

Dr. A. Chatterjee provided consultancy to the Calcutta Port Trust for the successful installation of a Vessel Traffic Management System.

Dr. S. Chaudhuri was a member of the Local Organising Committee for the International Seminar-cum-School on Macromolecular Crystallographic Data held at the Saha Institute of Nuclear Physics, Calcutta, in November, 1995.

Mr. A.K. Sen has designed a solid state power supply to be used with an electrophoresis instrument of the Botany Department, Bose Institute. He has provided training and consultancy services related to GLC to Pollution and Project Consultants, Calcutta.

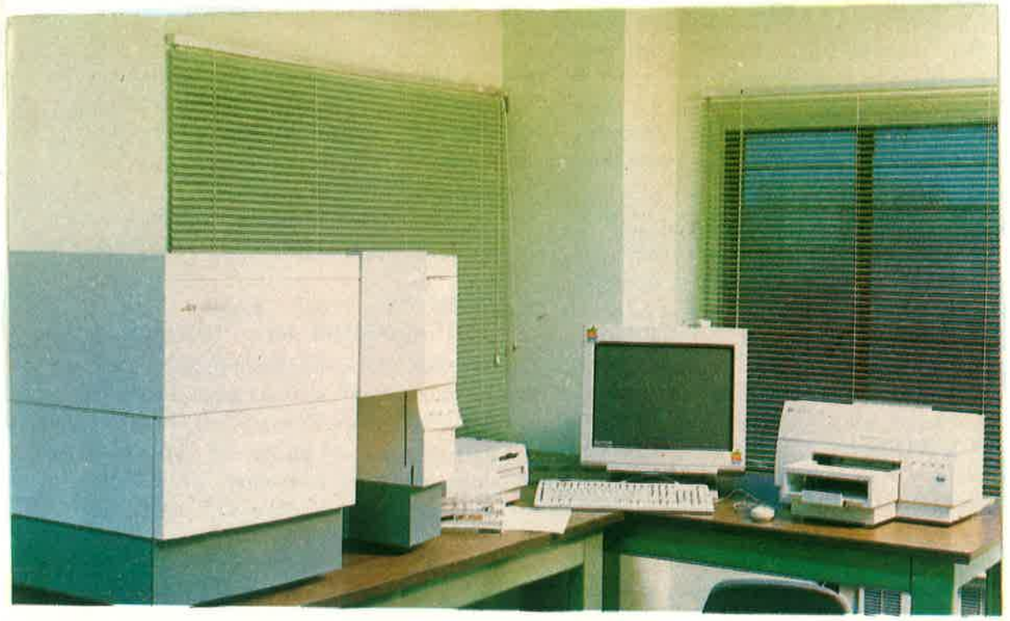
Mr. S. C. Maikap attended a Workshop on LV-SEM at the Central Forensic Science Laboratory, Hyderabad and a Workshop-cum -Symposium on INTERNET organised by the Distributed Information Centre, Bose Institute.

RESUME OF ACTIVITIES—1ST APRIL '95 TO 31ST MARCH '96

Outside Users			Bose Institute Users	
		Revenue Earned (Rs)		Revenue (Unpaid) (Rs)
No. of Samples			No. of Samples	
AAS	400	27,400/-	583	57,425/-
EPR	48	5,050/-	8	400/-
GCMS	13	1,560/-	17	2,040/-
XRD	9	4,290/-	1	Complementary
Hours of use			Hours of use	
SEM	222	10,824/-	124	22,638/-
FLS	45	2,794/-	87	7,240/-
GLC	156	13,250/-	53	8,150/-
TEM	505	44,705/-	315	11,660/-
	Total	1,09,873/-	Total	1,09,553/-
			Grand Total :	Rs.2,19,426/-

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.



Fluorescence assistance cell sorter equipment

J.C. Bose Unit & Museum

Dibakar Sen (**In-charge**)

J.C. BOSE UNIT & MUSEUM took the responsibility of constructing of replica of different instruments of Acharya J.C. Bose with Bose Institute Workshop. At present the third set of compound lever crescograph instrument is under fabrication.

During the year under review a good number of visitors both from abroad and within the country visited the Museum. Besides, the J.C. Bose Unit and Museum furnished information regarding Acharya J.C. Bose and his works to various organisations, and eminent persons on request.

J.C. Bose Unit & Museum Participated in the following :

1. Exhibition Organised by Matrivani Institute of Experimental Research & Education at Moulali Yuva Kendra on 28.04.1995.

2. The 8th World No Tobacco Day Exhibition was organised in the Museum on 31st May 1995 under the auspices of Indian Society on Tobacco and Health, Calcutta Branch, which was co-sponsored by Bose Institute Museum.

3. During celebration of 100th Anniversary of the discovery of Microwaves by Acharya J.C. Bose, an exhibition was organised related to Communication Technology on 22nd December 1995 at the Bose Institute Museum.

4. Similar exhibition on Microwave was organised from 16-20th January 1995 at Science City, Calcutta and at Burdwan Science Centre under the auspices of General Assembly of the National Committee for International Union of Radio Science.

Participation in Conferences/Symposia/Training Programmme Award & Honour received

Shri Sen delivered lecture demonstration with original Microwave Instrument of Acharya J.C. Bose on generation, transmission and reception of millimeter waves in the inaugural session both in the Bose Institute Microwave Symposium on 22.12. 1995 at Bose Institute auditorium and in the National Symposium held on 16.01. 1996 organised by INCURSI'96.

Shri Sen also delivered a lecture and acted as the Chairman of the J.C. Bose Session in the Third West Bengal State Science Congress held on 1st March, 1996.

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 Modeling.

Development of in-house data bases/ Programme:

"IBASE"- A Comprehensive database on introns sequences has been developed in DOS environment. It is accompanied by an utility program 'EXTRACT'. EXTRACT is a menu oriented keyword-based retrieval program which can read any EMBL entry and can search through them using keywords that occurs in any entry in the annotation part. IBASE originates from EMBL nucleic acid sequence database.

GENOLYTE - A PC-based computer program has been developed for simplified visualization of genomic DNA sequences.

1. INTERNET WORKSHOP organised by DIC during MARCH 19-21, 1996 at DIC. Mr. M.F. Ansari, Chief General Manager, VSNL, Calcutta inaugurated and Prof. P.K.Ray, Director, Bose Institute, presided over the workshop. 55 Participants from various Institutions of Eastern Region attended the workshop. Live Internet Connectivity was demonstrated during the workshop by VSNL.

2. One lecture by Prof. D.P. Burma, Benaras Hindu University, on "Di- & Trinucleotide frequency map".

3. Organised a three month course on "C Language" for the Host Institute during Jun-Aug, 1995

Manpower Training

1. Two D.C.A. students of Regional Computer Centre, Jadavpur, were trained to complete their off-campus projects.

2. A student from Chemistry Department, Indian Institute of Technology, Kanpur, had been trained to complete his summer project.

New Systems added to DIC

1. Decalpha 2000 Server DIC procured a Mainframe Decalpha Server with Terminal Servers, 4GB Catridge Drive, CD-ROM Drive with OS as DEC/OSF.

2. PC-486 system has been procured for the development of Database/Programmes.

3. E-mail Facility : The E-mail facility can now be accessed from the Main campus of Bose Institute.

Participation in Conference/Symposia/ Training programme/Award and Honours received

Dr. C. Mukhopadhyay, delivered lectures on "Molecular Modeling and Computer Aids to Drug Design" in the workshop on Molecular Modelling & Computer Aids to Drug Design in April 1995 at Regional Computer Centre, Jadavpur; on "Use of Multidimensional NMR techniques to study Biomolecular Conformation" in the National Symposium on Modern Trends in Structure-Activity Relationship Studies of Drug Related Compounds in June 1995, held at Lady Keane College, Shillong ; on "Sequence Matching by Computer Programmes" in the workshop on DNA Fingerprinting of Plant Denome, organised by Department of Botany, Calcutta University, in October 1995. Dr. C. Mukhopadhyay participated and delivered a lecture on "Conformational Flexibility of complex Carbohydrates" in the National Symposium on Molecular & Cellular Biophysics & 23rd Annual Meeting of Indian Biophysical Society, in February held at AIIMS & JNU, New Delhi. Mr. V.S. Sundararajan, delivered a talk on "Computer usage in Medicine" at N.R.S.Medical College, Calcutta in January 1996.

PUBLICATIONS

1. Gupta, S.K. and Ghosh, T.C. GENOLYTE : A PC-based computer programe for Visualisation of Genomic DNA Sequences. *Biochemistry & Biophysics*, **33**, 152-155, 1996.

Prof. P. K. Ray, Director, Bose Institute distributing certificates of the Internet Workshop, held during Murch 19-21, 1996

GRANTS-IN-AID

Setting up of "National Facility on Interactive Graphics Computer System for Molecular Modelling, Mollecular Dynamics & structures" at Bose Institte. Total grant for 2 years is 27.50 lakhs.

OTHER SUPPORTING STAFF MEMBERS

V.S. Sundararajan, T.K.Bhattacharya, C. Mukhopadhyay, T.C. Ghosh, S. Majumder, S.K. Gupta, J. Mandal.

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 the Symposium and Training Programmes, etc.

On 22nd December, 1995 a valuable book entitled **J.C. Bose and Microwaves - A Collection** edited by Prof. P. Bhattacharyya and Prof. M.H. Engineer has been published to commemorate the 100th Anniversary of discovery of Microwaves by Sir J.C. Bose.

To meet the increasing load and to keep track of the history of the Bose Institute the Publication Section is now under modernisation. One D.T.P. Unit with colour printing facility and a heavy duty copier machine will be installed very soon.

This section is also providing photocopying facility to the faculty and other staff members of our institute.

OTHER SUPPORTING STAFF MEMBER

C.K. Sasmal.

Administration

Prof. P.K. Ray (Director)

Mr. A.J. Dutta **(Registrar)**, Mr. T.K. Ghorui **(Dy. Registrar)**,
Mr. P. Bose **(Astt.. Registrar I)**, Mr. K. Chaudhuri **(Astt. Registrar II)**, Mr. R.K. Kundu **(Astt. Registrar III)**

Mr. B. Chakraborty **(Accounts Officer)**

OTHER SUPPORTING STAFF MEMBERS

Centenary Campus

R.N. Bhattacharyya, Maya Dutta, S.P. Sit, P.K. Barman, S. Pal, A. Bera, S.R. Dechoudhuri, A.K. Sengupta, P. Das, T. Mukherjee, E. Pal, Tapan Chakraborty, N.R. Ghatak, S. Kar, Subir Sen, A. Chakraborty, A.K. Ghosh, R.R. Pandey, S.K. Shosh, Dhrubajyoti Sen, Sujit Kr. Ghosh, B.K. Mandal, M.C. Das, Rita Nath, Ranjit Kr. Ghosh, S. Chakraborty, Ruby Das, Basudeb Marrick, Babli Marrick, Swapan Singh, A. Jana, Sukumar Das, S. Chatterjee, R.C. Sarkar, Dipak Dutta, R. Ghosh, K. Sur, Dulal Turi, S. Devi, C. Rangwa, T.K. Banerjee, K. Turi, R. Das, A Hela, S. Turi, K. Basar, Kamala Turi, N.N. Yadav, K. Ansari, Debasish Mandal, Mahabir Prasad, Sukumar Mandal, Sudhanshu Guchait, P.K. Mullick, Rita Ganguly, Kanak Baran Hazra.

Main Campus

Samar Chakraborty, Ankur Dutta, Madhusudan Mitra, Sankar Nath Sinha, Rina Roy, Sanat Kr. Dey, Mahendra Nath Shee, Santosh Patra, Ramani Kanta Jana, Tarun Chakraborty, Kashinath Paul.

Acharya Jagadis Chandra Bose Memorial Lecture

The 57th Acharya Jagadis chandra Bose Memorial Lecture was delivered by **Dr. P.K Iyengar,** member, Atomic Energy Commission, on **"Technology - an Extension of Basic Science".**

Lectures

Dr. Gautam Basu, Kyoto University, Japan, (presently at Dept. of Biophysics, Bose Institute). "Coupling of Protein fluctuations to electron transfer function".

Dr. I. B. Maity, Tobacco Health Research Centre, University of Kentucky, USA. "Genetically engineered protection of plants against poty virus".

Dr. Rama S. Dwivedi, Senior Scientist, Department of Radiation Medicine, The Evanston Hospital, Illinois, USA. "Molecular mechanism of the glutathione S-transferase gene expression in chemo prevention".

Dr. J.S. Khillan, Director, transgenic facility thomas jefferson Medical University. Functional analysis of Genes via, gene Targetting in ES cells.

Dr. Rajagopal Chattopadhyay, Department of Biochemistry, Bose Institute, Calcutta. "Crystallographic studies on a DNA hairpin".

Prof. Amalendu Bandopadhyay, Ex member of staff, Positional Astronomy Centre, Calcutta. "Forthcoming solar eclipse".

Dr. V. Nagaraja, Centre for Genetic Engineering, Indian Institute of Science, Bangalore. "Assymetric interaction and altered conformation upon binding of bacteriophase Mu O protein".

Dr. Pradip Das, Department of Chemistry, Bose Institute. "Partially disordered states in nature".

Dr. Soumitra Das, UCLA, Los Angeles, USA. "Antiviral effect of small yeast RNA".

Dr. Sovana Sharma, Molecular Biology Unit, TIFR, Bombay. "Novel putative protective proteins of *Plasmodium falciparum* identified by differential immunoscreening".

Dr. Jaydip Das Gupta, University of Kentucky, Lexington, USA. " A novel poly - A polymerase from pea (*Pisum sativum)".*

Dr. Utpal Dutta, UCLA, Los Angeles, USA. "Role of glycosylation in polio virus RNA replication".

Prof. Asim Dasgupta, Dept. of Microbiology & Immunology, UCLA School of Medicine. "An Antiviral RNA from yeast".

Dr. Gokul C. Das, University of Texas Health Centre at Tyler, USA. "Trans-acting function of Tumor suppressor protein p53".

Dr. Anis Sen Majumder, Applied Immune Sciences, U.S.A. "Superantigen & T-cell Development".

Dr. Joyoti Basu and Dr. Sibaji Raha, Science Forum, Bose Institute.

Dr. B.C. Paria, Kansas State university. "Effect of growth factor on pre-implanation embryo development and implantation in mice".

Dr. James Robertson, Applied Biosystems, USA. " Automated DNA sequencing".

Dr. Dharani Dharan Dubey, Kutir Mahavidyalaya Chakkey, Jaunpur. " Eukaryotic replication orgins : A study in schizosaccharomyces prombe".

Prof. John C. Samuelson, Harvard School of Public Health, Boston, USA. "Recent discoveries in the biochemistry & molecular biology of Entamoeba".

Dr. Arun Chattopadhyay, IIT, Guwahati. "Hydrogen atoms and gas phase dynamics".

Dr. Seyed E. Hasnain, National Institute of Immunology, New Delhi. "Host factors and transcription from the baculovirus polyhedrin gene promoter".

Prof. J.M. Ghuysen, Center for Protein Engineering, University of Liege, Liege, Belgium. "Penicillin and Beyond".

Dr. Ishwar S. Singh, Albert Einstein College of Medicine. "Characterization of the minimal promoter of the regulatory subunit of cAMP dependent protein kinase gene".

Dr. Dipa Bhaumick, Stanford University, USA. "Role of DNA polymerase alpha in cell cycle regulation".

Dr. Barsanjit Majumder, Dept. of Cell Biology, Cleveland Clinic Foundation Cleveland, OHIO, USA. "Regulation of gene expression of human respiratory syneytial virus, role of cellular kinase".

Dr. Asok Mal , CCF, Cleveland, USA. "Deregulation of cell cycle by adenovirus ELA protein".

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. D. Banerjea - upto 20.11.95
6. Prof. B.B. Baliga - upto 20.11.95
7. Prof. (Mrs) Debi Chakraborty - from 21.11.95
8. Mr. Somnath Sanyal - from 21.11.95
9. Prof. S.N. Chatterjee

} Nominees of the Governing Body

10. Secretary, Department of Science & Technology, Government of India, or his nominee
11. Director General, C.S.I.R. or his nominee
12. Joint Secretary and Financial Adviser, Department of Science and Technology, Govt. of India or his nominee
13. Representative of the Lok Sabha
14. Principal Accountant General (A & E), West Bengal
15. Secretary, Higher Education (Nominee of the Govt. of West Bengal)
16. Municipal Commissioner, Representative of the Calcutta Municipal Corporation
17. Director, Bose Institute - Ex-officio
18. Deputy Director, Bose Institute - Ex-officio
19. Dr. K.K. Kannan
20. Prof. D. Balasubramanian

} Two scientists from outside West Bengal

Registrar, Bose Institute - Secretary

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

Members of the Governing Body

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

Members of the Finance Committee

1. Prof. B.B. Baliga - (Representative of the Council) - Chairman (upto 20.11.95)
2. Shri Sanjoy Sen - (Representative of the Council) - Chairman (from 21.11.95)
3. Shri Debabrata Bose (Representative of the Governing Body)
4. Director, Bose Institute - Ex-officio
5. Joint Secretary and Financial Adviser to the Department of Science and Technology, Govt. of India, or his nominee
6. Principal Accountant General (A & E), West Bengal

Registrar, Bose Institute - Secretary

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

1. Prof. P.K. Ray, Director, Bose Institute, Calcutta
2. Dr. R.P. Singh, Jt. Adviser, D.S.T., New Delhi
3. Dr. M.S. Rao, Director, Central Forensic Sc. Lab., Calcutta
4. Prof. D. Khathing, Head, RSIC, NEHU, Shillong
5. Dr. S.P. Chaudhuri, Scientist E II, CG & CRI, Calcutta
6. Dr. Ashit Mazumdar, Quality Control In-Charge, Wardex Pharmaceauticals Ltd., Calcutta
7. Prof. M.H. Engineer, Dept. of Physics, Bose Institute
8. Dr. Siddhartha Ray, Dept. of Bio-physics, Bose Institute
9. Dr. A. Chatterjee, Scientist In-Charge, RSIC - Member Secretary

The Lady with the Lamp at the Nivedita Memorial
at Bose Institute