

INDIAN STATISTICAL INSTITUTE



FIFTY-THIRD ANNUAL REPORT

April 1984—March 1985

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INDIAN STATISTICAL INSTITUTE

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Part I. Teaching, Training, Research, Projects and Publications

1. TEACHING AND TRAINING

Degree and Training Courses

During the period under review, 7780 candidates applied for admission and were called for written selection tests for the courses offered by the Institute viz. B.Stat. (Hons.), M.Stat., M. Tech., one year post-graduate Diploma in SQC and OR, 2-year part-time post-graduate Diploma in SQC and OR (Bombay and Madras), Research Fellowships in Statistics, Mathematics and Economics, one year Evening Course in Statistical Methods and Applications and the course on Operation of Data Processing Equipment. Admission tests were conducted at 12 centres all over the country and successful candidates were called for interview for final selection for admission to various courses during the academic year 1984-85.

There were three foreign applicants who had either been sponsored by the Government or applied directly for admission to our courses. The candidates were given special admission tests conducted through the Indian High Commissions or Embassies at Bangladesh, France, Kenya.

The annual examinations of the B.Stat. and M.Stat. courses were held in May/June 1984. The 1984-85 academic year commenced on 18 July, 1984.

One hundred seven candidates received their degrees and diplomas at the Nineteenth Convocation of the Institute held in 1985. One hundred and forty-four candidates, who passed various regular courses of duration one year or less received certificates during the year.

Two UNDP fellows from Sierra Leone have undergone special training courses for 10 months during the period. Another group of 5 UNDP fellows from that country are currently undergoing similar special courses being conducted for them. One UNDP fellow from Nigeria is undergoing advanced studies.

The number of candidates admitted to the different degrees, diplomas and training courses during 1983-84 and 1984-85 and the results of examinations held during the period are given in the following page.

International Statistical Education Centre (ISEC), Calcutta.

The Centre was opened in 1950, and is operated jointly by the International Statistical Institute and the Indian Statistical Institute, under the auspices of the UNESCO and the Government of India. The Centre provides training in theoretical and applied statistics at various levels to selected participants from countries in the Middle-East, South and South-Asia, the Far East and from the Commonwealth countries in Africa.

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NUMBER OF STUDENTS ADMITTED AND PASSED IN DIFFERENT COURSES

Course	number of students in academic sessions		number appeared at the final examination in	number passed in annual examination in
	1983-84	1984-85	1984	the year 1984
1	2	3	4	5
1. Courses leading to a Degree in Statistics :				
1.1 Bachelor of Statistics with Honours (B.Stat.(Hons.))				
1st year	25	29	14	11
2nd year	14	14	14	14
3rd year	13	14	12	13
1.2 Master of Statistics (M.Stat.) (Calcutta and Delhi)				
1st year	80	22	25	25
2nd year	41	25	41	39
1.3 Junior and Senior Research Fellows, Visiting Fellows				
	73	80	..	+
2. Specialised courses in Applied Statistics leading to Diploma :				
2.1 Statistical Quality Control and Operations Research (one-year)				
	16	26	16	17***
3. Courses in Statistics for persons in employ- ment (jointly with C.S.O.) :				
3.1 Junior Certificate Course in Statistics (8.10.84 to 23.2.85)				
	16	16	16	16
3.2 Indian Statistical Service Probationers' Training Course (9.10.84 to 17.11.84)				
	34	34	34	34
4. Evening Courses :				
4.1 Statistical Methods and Applications				
Calcutta	66	50	20	16
Delhi	16	—	5	4
4.2 Two-year Post-Graduate Diploma in Statistical Quality Control and Operations Research (Bombay and Madras)				
Bombay : 1st year	7	6	7	6
2nd year	—	—	—	—
Madras : 1st year	23	9	17	13
2nd year	6	13	7	7*
4.3 Six-month Evening Course in Statistical Quality Control (Bangalore and Hyderabad)				
Bangalore : July-December 1983	17	25	10	14
January-June 1984	18	**	6	**
July-December 1984	**	25	9	7
Hyderabad : July-December 1983	24	28	9	4
January-June 1984	12	**	11	8
July-December 1984	*	28	—	10
5. Electronic Computer Courses :				
5.1 M.Tech. in Computer Science				
1st year	17	16	17	16
2nd year	24	18	24	24
5.2 Intensive Course on Programming and Applications				
	20	35	36	38
5.3 Course on Operations of Automatic Data Processing Equipment				
	13	10	12	12
6. Associationship in Documentation and Information Science				
	8	**	8	**
Total	643	623	450	345

* Including one candidate of previous session.

** Not available.

*** Including 6 candidates from Delhi Centre, awarded diploma by dissertation.

+ Not applicable.

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The Centre offers a Regular Course of training every year over a period of ten months (June to March). The course is divided into two parts. The first eight months are devoted to training on general statistical methods including six-weeks training in official statistical systems conducted by the Central Statistical Organization, Government of India, New Delhi. During the remaining two months, each trainee specialises in one selected branch of applied statistics, like Sample Surveys, Mechanized Data Processing, Econometrics and Economic Planning, Statistical Quality Control and Operations Research, and Vital Statistics and Demography. The course is offered through lectures, practical work and assignments, field visits, and guided reading.

In addition to the Regular Course, a few persons are admitted from time to time, on an individual basis, for Special Courses of varying duration and in different subject fields. Facilities are also available for research work and advanced study by senior visiting statisticians from abroad.

The Centre functions under a joint Board of Directors. During 1984-85 the Board of Directors consisted of Chairman : C. H. Rao ; Members : J. Durbin, J. M. Gani and E. Lunenberg (Ex-officio members representing the International Statistical Institute) ; Secretary, Department of Statistics, Govt. of India (representing the Govt. of India) and A. Maitra, Director, Indian Statistical Institute ; Member-Secretary : N. Bhattacharya (till middle of July, 1984) and S. Bandyopadhyay (after mid-July, 1984) (representing the Indian Statistical Institute).

During the year under review, that is, the thirty-eighth term, there were 27 trainees in the Regular Course from 12 countries in South and South-East Asia, the Far East, and Commonwealth Africa. The Government of India awarded 14 fellowships for the foreign trainees — 4 under the Technical Cooperation Scheme of the Colombo Plan, 9 under the Special Commonwealth Africa Assistance Plan (SCAAP) and 2 under the Indian Technical and Economic Cooperation. Three foreign trainees were awarded CFTC fellowships. Nine trainees including 5 Indians were financially supported by their National Governments.

In addition to the above, two trainees attended Special Courses in different fields of applied statistics. One of them was from Gambia and had completed the ten-month Regular Course during the previous term, that is, during June 1983-March 1984, followed by a three month Special Course in Tourism and Transport Statistics during April-June 1984 with the support of a SCAAP fellowship. The other, from Uganda, studied ANOVA, Experimental Design, Sample Surveys and Data Processing during July-Dec., 1984, and was enjoying a SCAAP fellowship.

The Regular Course of the thirty-eighth term started on 1st June, 1984. The training included lectures, laboratory work, project work and assignments. The first four months at Calcutta were devoted to general statistical training including training in mathematics, mechanized data processing, probability theory, descriptive statistics, sample survey techniques, statistical methods and economic statistics. Most of these courses were compulsory for all students. This was followed by six-week training in official statistics conducted by the Central Statistical Organization, Government of India, New Delhi, during 8 October — 18 November 1984. Further training in general statistical methods was imparted at Calcutta during November 1984-January 1985. Most of the courses offered during this period were optional courses. Finally during February-March 1985, the trainees specialised in particular fields of applied statistics like sample surveys and data processing or economic planning. Tutorial classes in the

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evening were arranged for the trainees, formed into small batches, during the general training in statistical theory and applications. Indian Council for Cultural Relations organised an Orientation Course for the foreign trainees of the ISEC Regular Course.

Examinations were held at the end of each of the four phases of the training programme. The examinations on the last phase devoted to specialization in particular fields were held towards the end of March 1985. While most of the examinations were written tests, the evaluation of the specialization training was partly carried out through project work and assignments.

Students participating in the Term were taken out on educational tours to a number of places of interest : (1) Raniganj, (2) Agra and Jaipur, and (3) Digha. These trips were organized by the Calcutta and Delhi offices of the ISI.

Dr. Masaki Teguri of the Department of Mathematics, Chiba University, Japan, taught at the Centre as Visiting Professor from December 1984 to March 1985.

Professor C. R. Rao visited Calcutta during 7-9 January 1985 and held discussions with the trainees. He also reviewed the process of acquiring a micro-computer for the ISEC.

Certificate of Merit has been renamed as Statistical Training Diploma with effect from 1983-84 Regular Course.

Professional Examinations in Statistics

The holding of Professional Examinations in Statistics for external candidates on all-India basis has been an important activity of the Institute since 1938. These examinations are based on well-organised syllabi achieving high professional standards and lead to Certificates and Diplomas.

During the year under review, the Statistical Assistantship Certificate, Junior Diploma in Statistics and Senior Diploma in Statistics examinations were held at Bangalore, Bombay, Calcutta, Delhi, Hyderabad, Lucknow and Madras during April and October 1984 terms.

The number of candidates and their results for April and October 1984 terms of the examinations are shown below :

examination	number of candidates					
	registered		appeared		passed*	
	April	October	April	October	April	October
Statistical Assistantship Certificate	40	38	23	13	8	7
Junior Diploma in Statistics	42	42	33	17	5	11
Senior Diploma in Statistics	11	7	8	5	5	4

*in one or more papers only -- not necessarily completed the examination.

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The total number of candidates who have qualified for the award of Certificates and Diplomas in these professional examinations in statistics including the results of October 1984 term are 473 and 235 respectively.

2. RESEARCH WORK

A brief account of the progress of research in different divisions and units of the Institute is given below :

Theoretical Statistics and Mathematics

Calcutta : During the period, members of the Division have been engaged in research in the following areas : Stochastic Processes, Probability Theory, Probabilistic Number Theory, Ergodic Theory, Asymptotic Theory, Multivariate Analysis, Decision Theory, Inferences about Stochastic Processes, Sampling Theory, Constructional and Combinatorial Aspects of Designs, Optimality Theory of Designs, Combinatorial Mathematics and Graph Theory, Descriptive Set Theory and Mathematical Logic, Measure Theory, Harmonic Analysis, Functional Analysis, Algebraic Topology, General Topology, Complex Analysis and Moduli Problems, Topological Automata, Sediment Transport, Discrete Multivariate Analysis, Characterizations of Distributions in Statistics, Sequential Analysis and Inference.

Among its other activities, the Division held two Summer Schools in (i) Statistics and Probability and (ii) Combinatorics and Graph Theory with Applications, both in Bangalore, under the auspices of the Bangalore Centre of the Indian Statistical Institute and the Mehta Research Institute, Allahabad from May 21 to June 16, 1984. The participants were lecturers, research scholars and postgraduate students from various universities. The subjects covered in the School for Statistics and Probability were Multivariate Non-parametric Inference and Variance Components Estimation, Stochastic Modelling, Statistical Methods for Directional Data, Probability Theory, Linear Models, Optimality Theory of Designs, Calculus of Discrete and Continuous Factorial Experiments, Categorical Data Analysis, Designs for Biological and Serological Experiments, Finite Population Inference, Asymptotic Theory of Inference. In the School for Combinatorics and Graph Theory with Applications, topics covered in Graph Theory with applications include : Graphs and Diagraphs, Trees, Eulerian Graphs, Hamiltonian Graphs, Connectivity and Matchings, Flows in Networks, Colorability and Planarity, Polya's Enumeration theorem, Ramsey Theory, and several applications of these which include applications to : Computer Science (algorithms), Operations Research (minimal connector problems, shortest path problems, travelling salesman problem, transportation problem), Social Sciences (balance in small groups, reciprocity), Statistics (methods of paired comparisons, tournaments). The topics covered in Combinatorics include Orthogonal Latin Squares and Orthogonal Arrays ; Projective and affine planes, BIBDs, Construction of Designs, Disproof of Euler's Conjecture, Strongly Regular Graphs, Introduction to T Designs.

Delli : Studies were carried out in the following fields : Algebraic and Differential Topology Operator Theory, Mathematical theory of Scattering, Stochastic Integration and its applications in Quantum Mechanics, Linear Algebra, Linear Models, Inference in Stochastic Process, Optimal Designs, Characterisation Problems, Game Theory, Harmonic Analysis, Multivariate Statistical Methods.

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Bangalore : Some new large deviation theorems for finite Markov chains were proved and their relationship to other known theorems was exhibited.

The theory of vector measures, geometry of Banach spaces, semistable and infinitely divisible stochastic processes and information theory are the main topics under study.

Applied Statistics Surveys and Computing

Research activities in the Division include both theoretical investigations into methodology on the one hand and applications of known methods in the study of socially relevant real life problems on the other. During the year under review research was conducted in the following broad areas.

(a) *Applied statistics* : The main areas of research were Design of Experiments, Sample Surveys, Multivariate Analysis, Linear Models and Graph Theory. New results were obtained in optimality and efficiency in various sampling strategies, randomised response techniques, covering designs, repeated measurement designs etc. Maximum likelihood estimators, least squares estimators, rank estimators and other biased and unbiased estimators were proposed for regression coefficients and comparisons were made. Autoregressive structures, covariance structures, models with misclassifications, errors in variables models were also analysed and positive results were found. Among other topics of research were estimation of treatment effect, Hadamard matrices and their uses in statistics, double sampling with varying probabilities, sampling over two occasions, consumption of public services etc.

(b) *Projects* : A subsidiary study on Market potentials in West Asian Region based on the data collected for 'Foreign Tourist Survey, 1982-83' was made and a report was submitted in August 1984.

An inter-institutional research project on 'Constraints to Technological Progress in Rice Cultivation : An Experiment-Survey Research in West Bengal' was sponsored by the Ford Foundation and executed by a collaborative team from University of Kalyani, Bidhan Chandra Krishi Viswavidyalaya and ISI. Preliminary report was submitted in September 1984.

Analysis of CSIR JRF Test Data is on progress. Seasonal survey on agricultural data was completed.

The project on developing a Block plan continued during the year under review. Three rounds of seasonal survey on 403 households, 118 schedules for Enterprise survey, and Health survey for 348 households were completed.

Field work on the survey on socio-economic evaluation of education in English medium and vernacular schools. Calcutta, 1985 is almost complete.

Time-series data were collected for Tropical diseases and processing of data will start soon. Studies on the impact of the common oral antidiabetic drugs at the Immunoglobulin and Heptaglobin levels are being made.

Field survey of the PIREP follow-up study, 1985 was conducted during March, 1985.

(c) *Bio-statistics* : Researches were carried out on problems of detecting genetic linkage, electrophoretic mutation rates from rare alleles, statistical detection of linkage

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for an autosomal recessive diseases, distribution of ABO blood groups, vitiligo, blood-glucose homeostasis, growth in the first year of life etc.

(d) *Computer science* : Work on diagnostic logic graph and diagnosis of multi-processor systems, logical modelling of physical failures in MOS circuits, detection of stuck-at and bridging fault, hazard-free and syndrome testable design of combinational circuits, classification of parallel processing system, measurement of execution time of FORTRAN statements etc. were done by the computer scientists of the Division.

Physical and Earth Sciences

CHEMISTRY

Chemically resistant fractions of soil organic matter : Resistance offered by humin to solubilising attempts, has often been ascribed to its strong binding to the mineral components of soil. It is assumed that humins contain more nitrogen than either humic or fulvic acid and has higher electron density in its structure. These assumptions remain as yet unconfirmed.

Mobile humic acids and humins isolated from different soils have been examined for nitrogen and amino acid contents as well as their relative mineral-binding abilities. Results suggests no reasonable difference between the two humus fractions in these respects.

Aggregate formation in soils : Informations on the formations of clay-organic mixed aggregates and their structures have been elicited from a study of the interaction of soil clays and micelle forming organic substances.

Absorption of biologically active molecules on inorganic and organic biocolloids : Influence of pH, ionic strength and metal ions on the sorption of basic antibiotics by humic acids have been studied.

ELECTRONICS

(a) *Digital Systems Research*

(1) *Development of microcomputer network* : This is an on-going project with an ultimate aim of interconnecting different microcomputer systems via a local-area network. The emphasis is on extensive sharing of software and to a limited extent, hardware resources. The various systems planned to be connected in this network are the following :

(i) a Motorola M6800 based system ; (ii) a single user Z80 based system ; (iii) a multiuser Z80 based system ; (iv) an Intel 8085 based system ; (v) a Motorola M6809 based system ; (vi) a 16-bit single board system based on Intel 8086 microprocessor.

A simple multiuser operating system using prioritized round robin processor scheduling and first-fit dynamic partitioned memory allocation scheme is operational on the Motorola 6800 system. Run-time memory violation has been taken care of by additional hardware which has been built into the system.

A compiler for a more or less complete subset of PASCAL has been developed for the Z80 based systems. It has been developed using ELAN. It is being debugged

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and fine-tuned. The development of a PASCAL to P-code translator is almost complete. It has been written in PASCAL as proposed above. The P-code to machine code interpreters/translators for the various 8-bit and 16-bit systems are under progress.

A rudimentary link for connecting the various single board system to the larger systems with secondary storage has been implemented. Low level driver routines necessary for communication through this link have also been developed. The first version of a single user operating system for the 8085 system is operational. The software modules which will operate just above these driver routines and are necessary to maintain network protocol are being developed.

(2) *Development of an interactive line graphics system* : The software and hardware necessary for an interactive line graphics system for the M6800 system is under development. The system will have a resolution of 512×300 pixels. Interaction is through a light pen. The hardware graphics controller and light pen interface has been developed. It is being tested and debugged. Software necessary for implementing primitives such as lines, circles, polygons and other geometrical figures are also being developed concurrently. Recommendations as in the CORE graphics system are being adhered to. The routines which will ultimately allow the editing of line drawing with a light pen are also being developed. Software package for obtaining hard-copy graphics on a high speed dot addressable matrix pointer is also being developed.

(3) *Theoretical research on computer science* : Theoretical research works are currently under progress in the following areas :

(a) *Fault tolerant computing* : New methods for generating test sets for fault detection in combinational and sequential logic circuits have been developed. Special emphasis has been given to take care of sophisticated fault modelling like short circuit or bridging faults. Development of diagnosis schemes for modular digital system and microprocessors is currently under study.

(b) *Design for testability in LSI/VLSI* : Testability considerations in LSI/VLSI circuits have been examined from a completely new angle. Research papers reflecting new design rules for inducing testability in LSI/VLSI circuits for detecting of stuck-at and bridging faults have been published. Methods like random testing, syndrome testing have been developed so that these can be used more efficiently for testing large digital logic circuits. The study of inadmissible class of faulty functions in logic circuits has been undertaken, the knowledge of which aids the design for testability. Testable design of CMOS/VLSI for detection of hard fault like "stuck-open faults" has also been proposed.

(c) *Microprogramming* : Several results have been obtained in the area of control memory width minimisation and the development of efficient address selection schemes in microprogrammed digital computers. An algorithm has been developed for verification of microprograms using the induction method of program verification.

(d) *Logic design* : (i) An algorithm has been developed for failsafe realization of sequential machines using MOSFET networks. The states and inputs are coded using a restricted class of codes in such a way that each of the next state and output functions is realised by a two level MOS network and the realization is failsafe. (ii) 2-assumability is a very important property in threshold logic and it has useful applications in the synthesis of threshold logic network. An iterative algorithm has been developed for testing of 2-assumability of Boolean functions. The algorithm is well

suited for machine computing. A FORTHAN program has been written based on this algorithm. Logic design with DSTL (Digital Summation Threshold Logic) arrays has been investigated.

(e) *System diagnosis* : Some studies have been made in the area of systems diagnosability e.g., techniques for designing optimal self-diagnosable systems, etc.

(f) *Graph theory and combinatorics* : Several theoretical works on different problems of graph theory and combinatorics have been undertaken. In particular, the graph isomorphism problem, the forbidden clique problem, Pascal graph, combinatorial problems involving Stirlings number of the 2nd kind, Fibonacci numbers and their engineering applications, have been worked out.

(g) *Heuristic search* : The recent techniques of heuristic search algorithms have been successfully implemented for solving some difficult problems of message routing in a distributed computing network environment. Many interesting properties of Mobius graphs, De-Bruijn graphs, have been explored regarding their suitability as computer networks. Admissible heuristic estimates can then be assigned to each processor node, which settle the optimal message routing problem in polynomial time complexity. Fault tolerance of these networks is currently under investigation.

(h) *Parallel architecture and parallel algorithms* : Parallel realization of numeric, non-numeric and graph theoretic algorithms are currently under study. In particular, the numeric power evaluation problem, the sorting problem, and the diameter evaluation problem in a symmetric graph have already been implemented. Parallel architecture for improving the speed for a FFT processor has also been proposed.

(b) *Theoretical physics*

1. *Particle physics* : (a) In recent years multiparticle production phenomena in hadron-induced reactions are being studied from the viewpoint of the limited validity of the scale invariance hypothesis. A program has been undertaken to investigate various forms of scaling and their validity. Along with these, some very interesting features of the very high energy PP colliders are being studied in depth. (b) Alternative to the standard grand unified theories is progressively being built up incorporating supersymmetry. Utilising the properties of conformal reflection supersymmetry and the generation of internal symmetry algebra are being probed. Also the role of random fields and stochastic quantization in supersymmetry is being investigated. Attention is also being paid to the controversial magnetic monopole physics.

2. *Cosmic ray physics* : The invariant distributions derived dynamically for the secondary particles like pions and kaons in high energy proton-proton scattering are utilised in deriving the muon-electron ratio observed in Cosmic Ray experiments and the shower size of the cosmic rays.

3. *Nuclear physics* : From the viewpoint of a strong interaction dynamics nucleon-nucleon potential has been derived earlier. Making use of this result, the problem of high density nucleons studied to apply this result to the neutron stars. Pions condensation for highly dense nuclear matter is also being investigated. Besides, baryon-baryon potential problems and the problems connected with the phase-shifts in nuclear physics are also being resolved.

4. *Heavy ion reactions* : Relativistic heavy ion reactions are being studied utilising the results of proton-proton scattering in the high energy region. Plans have

been chalked out to study the hadron-nuclei collision problems at both low and large values of transverse momenta and the Feynman variable.

5. *Supersymmetry* : The role of supersymmetry in the generation of internal symmetry of hadrons is being investigated. Also the role of random fields in Bose-Fermi transition has been investigated. Besides, the relevance of supercharge and Witten Index in geometrical properties of hadrons is being studied. Also the role of De Sitter space in supergravity has been investigated.

6. *Stochastic quantization* : A relativistic formulation of stochastic mechanics has been developed and the equivalence of stochastic mechanics with supersymmetric quantum mechanics has been studied. The position operator in stochastic mechanics has also been investigated. Besides, the problem of interaction is being studied.

7. *Quantum field theory in $1+1$ dimension* : The problem of mass generation from massless oscillators in $1+1$ dimension has been studied. From this view point the equivalence of massive Thirring model and Sine-Gordon solitons has been investigated. Also the problem of quantum solitons in a linear chain has been studied. Again the problem of equivalence of massive Thirring model with solitons with respect to discrete symmetry has been investigated.

8. *High energy physics* : Results obtained from theoretical studies in hadron-hadron collisions are now being applied to the hadron-nucleus and nucleus-nucleus collisions processes, especially at large values of X and P_T . Applications are also being made in analysing some cosmic ray experiments with encouraging success. Studies in the so-called Z^0 anomalies in pp colliders are also being conducted side by side. This apart, connectedness between string models and the approach so long followed by us is also being proved.

9. (a) *Stochastic geometry and foundations of quantum mechanics* : A generalised Langevin equation starting from probabilistic metric in the micro region of space-time has been constructed. Then an attempt has been made to formulate the operator formalism in quantum mechanics following Namiki's procedure. A beginning has been made in the investigation of the De Broglie pilot wave hypothesis within the framework of stochastic geometry and its relation to background field hypothesis.

(b) *Space problem* : The famous Helmholtz-Lie space problem has been reformulated within the framework of Lie admissible algebraic structure as proposed and developed by Santilli. A new measurement theory has been proposed with the framework of stochastic geometry.

(c) *Stochastic geometry and its application to astrophysics* : Studied the primary cosmic ray spectrum at $E_p 10^{18}$ ev using the hypothesis of stochastic metric at extremely high energy.

(d) Using rigorous saddle point method the Hadronic components of EAS at high energy has been studied.

10. *Plasma physics* : In plasma physics it is shown that the property of a linear system viz. the result that the square of the amplitude propagates with the group velocity continues to be valid in the case of magnetic acoustic waves in the presence of weak

non-linearity. Also the effect of inhomogeneity on ion-acoustic solitary waves has been studied. In case of inhomogeneous plasma with negative ion a modified Kdv equation for ion acoustic wave soliton has been derived. The equation has been solved with the perturbation technique of Zakharov-Shabat inverse scattering method. Studies are being made on the soliton solutions of ion acoustic waves in case of warm plasma with two electron temperatures.

11. *Quantum mechanics and dynamical symmetry* : An algebraic perturbation theory based on the Lie algebra of $SO(2,1)$ group and the scaling variational method has been successfully applied to the exponential Cosine Screened Coulomb potential and Stark effect problem. This group theoretic approach is now being extended to relativistic cases. Also $1/N$ expansion is being studied in the context of some important perturbation problems in atomic and particle physics.

12. *Super symmetry and field theory* : The study of super symmetric vacuum under the influence of various external field configurations has been completed. Presently the density effect on super symmetric (with particular emphasis on density induced phase transition) is being studied. It has also been possible to determine the critical temperature for some models. Some aspects of super symmetric quantum mechanics (viz., super symmetry breaking, construction of super symmetric Hamiltonians) are also being investigated. Applications of QCD model prediction for deep inelastic scattering in calculating the photo nuclear energy loss term for Muon-Nucleus interactions has been made.

(c) *Fluid Mechanics*

(1) Theoretical analysis of the boundary layer in a two-phase flow problem with reference to separation of solid-phase suspended in liquid phase in a hydrocyclone. (2) Flow analysis in an opposed jet in connection with the problem of flame stabilization by an opposed jet. (3) Study of atmospheric turbulence in the case when the interaction of mean and turbulent fields of temperature and wind velocity is weak. (4) Study of non-linear stability of (a) Ekman layer on a porous plate and of (b) buoyancy boundary layer in the presence of transverse magnetic field. (5) Investigation of storm surge on a continental shelf due to cyclonic storm generated over sea. (6) Study of abnormal flow conditions of blood in a locally constricted blood vessel. (7) Study of sediment transport mechanism.

FLUME PROJECT

Theoretical study of the behaviour of laminar sub-layer due to pressure fluctuations and its effects on sediment transport phenomenon was continued. A few joint discussions with the scientists of River Research Institute were carried out with a view to carry out experiments.

ELECTRONICS AND COMMUNICATION SCIENCES

Research activities in the unit include both theoretical investigation of methodology development and applications of the existing methods to the solution of practical real life problems. The scientists participated in the M.Tech. (Comp. Sc.) and M.Stat. (ASDA) teaching programmes of the Institute. More than 40 research papers have been published this year in Indian and International Journals, Conferences Proceedings

by the research workers of the Unit. During the period under review research was conducted in the following broad areas.

1. *Implementation of advance computer architectures for high level image processing/pattern recognition* : Work has been started this year on specialised computer architectures to apply the real-world tasks of image processing specially in field mineral identification, military application etc. Attempt will be made to develop a massively parallel processor (micro) for high level image processing problems. Image processing and pattern recognition require relatively simple but very high speed processing of large amounts of data. For example, edges in an image can be detected by examining groups of picture elements (pixels) and looking for a sudden change in light intensity. Because a series of such operations may have to be performed to recognise features of an image, the typical image-understanding architecture consists of a series of pipeline stages, each performing a single operation on a small region of pixels. Some special parallel architectures are also under consideration for artificial intelligence applications in computer vision, where many rules must be examined for wide range of deducting in the search for a desired conclusion.

2. *Pattern recognition and image processing, shape analysis and graphics* :

(a) Application of quadtree technique to pattern classification and shape analysis ;
 (b) Approximate coding of two-tone pictures ; (c) Use of spline technique to curve and surface design ; (d) 2-D shape classification through syntactic procedure ; (e) Application of fuzzy set theory in robot learning ; (f) Development of acoustic phonetic data Base for Bengali speech sounds ; (g) Development of lexical expert systems ;
 (h) Development of an acoustic expert systems ; (i) New perception-linked hierarchical model for acoustic phonetic recognition of phonemes ; (j) Modelling of neural phenomena in auditing path way ; (k) Investigation on the 'Shrutis' in Hindusthani vocal music.

3. *Robots, expert system, adaptive controls and fault-tolerance in process control* :

The work has been started to develop advance robots equipped with latest visual and acoustical sensing, image processing, adaptive control algorithms and artificial intelligence. Such an intelligent robot will inspect the art work—say, a layout for a printed-circuit board design at low resolution from a distance to identify the main features. It then focuses on a specific detail at a higher resolution, seeking to identify violation of basic criteria in workmanship—for example, a break in a conductor line, conductors spaced too close to each other, or a missing component pad at the end of a conductor line. A special application of such an intelligent machine/robot is in process control, e.g. power plant control etc. The intelligent controller will continuously adjust gains and time constants of the plant control circuits in response to changing process conditions, such as disturbances, variations in raw materials, component aging and other factors.

In the field of process control, controlling and co-ordinating the simultaneous operation of numerous subsystems has traditionally posed unique fault-tolerance problems, that is, maximizing the reliability of a process control system is of prime importance to control systems designers. This is especially the case when systems must promise nonstop operation and on-line maintenance, as well as offer possibilities for expansion. An attempt has been made, for such fault tolerant problem, to use autonomous decentralized computer control systems which grasped the entire process control system as a biological organism with the following attributes :

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(a) The system always has faulty parts ; (b) It changes constantly, alternating between operation, maintenance and growth, and (c) It keeps accomplishing its objective almost completely.

4. *External collaborative projects* : (1) The unit continued to work on a project entitled 'Development of continuous nonfading patient monitoring system' sponsored by Electronic Commission, Govt. of India. The project has been completed and the final report has been submitted.

(2) The collaborative research project between ISI and Sangeet Research Academy (SRA) on Hinusthani Rega Sangeet and on Indian Stringed Instruments was continued during the year under review.

(3) The joint project entitled 'Statistical studies on the tropospheric propagation for VHF/UHF and microwave link' has been sanctioned by The Department of Science and Technology (DST) for 3 years and the work for this project has been started.

(4) Project of Electronics Commission entitled 'Application for pattern recognition and image processing techniques to geological mapping and mineral detection' has been sanctioned.

(5) Research project under Defence Grant in Aid Scheme, entitled 'System and algorithm development for Pattern Recognition and shape analysis of objects of Defence interest' has been started.

(6) Fifth Generation Computer System Research—Electronics and Communication Sciences Unit is a nodal agency (National Centre) with Prof. D. Dutta Majumder as Co-ordinator in the fields of pattern recognition, artificial intelligence, image processing and computer vision.

GEOLOGY

Programme of geological research progressed in the following areas :

1. *Structural geology* : Structural and stratigraphic study of the deformed Proterozoic rocks of Rajasthan.

2. *Trace-fossils* : (a) Studies of trace-fossils in the Maleri Formation, (b) Trace fossils and stromatolites in the Kota formation of the Gondwana sequence in the Pranhita-Godavari valley ; (c) Morphological analysis and stratigraphic position of trace-fossils from the Proterozoic sediments around Ramgundam, Andhra Pradesh.

3. *Sedimentology* : (a) Geological controls of arkose formation in marine and continental environments ; (b) Studies on the lime-pellet rock and associated sediments of the Maleri formation.

4. *Stratigraphy and sedimentology* : (a) Stratigraphy and sedimentation of the undeformed as well as deformed sequence of the Pakhal and the Sullavai groups ; (b) Stratigraphy and sedimentology of the Albaka sequence and its comparison with the Pakhal sequence ; (c) Gondwana stratigraphy of the Manthani doab and adjoining areas in the Godavari valley.

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(5) *Stratigraphy and palaeontology* : (a) Geology and palaeontology of the N. W. Pranhita-Godavari valley ; (b) Study of the Triassic Yerrapalli vertebrate fauna ; (c) Fish remains from the Lower Jurassic Kota formation and the Cretaceous sediments ; (d) Lower vertebrates from the Upper Cretaceous Pisdura sediments ; (e) Dinosaur and turtle remains from inter-Trapean Pisdura sediments ; (f) Fossil amphibians from the Dewa beds of the Salpura Gondwana basin and their bearing on the stratigraphic relationship of the Dewa beds ; (g) Study on a triassic reptile from the Tiki beds of the Son-Mahanadi valley, India.

6. *Spectral project* : (a) Analysis of siesmological data (as part of ISI team) ; (b) Study of the Glacigene Gondwana rocks (in collaboration with the University of Maine).

PHYSICS

The following is a brief account of research activities during the period under review :

1. A project entitled 'Studies on the thermal and electrical properties of human skin' was taken up during the period under reference.

2. An electronic device named 'Thermosense' has been developed to measure quantitatively the cutaneous thermal sensory threshold. The thermal sensory thresholds of 100 normal subjects comprising both sexes in the age range 10-65 years have been determined in three different locations and their variations with age, sex locations, ambient temperature, relative humidity etc. studied by multivariate analysis and their correlations also determined.

3. Studies of the sensory loss in case of Hanseniasis (leprosy) of various types-indeterminate TT, BT, BL Polynuritic etc. have just been taken up and 50 cases so far covered. The study is also being extended to measure thermal sensory loss in other skin conditions involving nerve. The method appears potential not only in detection and quantification of sensory loss but also in assessing the restoration of loss on medication by subsequent follow-ups. The preliminary findings of the project have been presented in a national conference and two papers have been submitted for publication.

4. The Unit was also engaged in (i) studying the hardness of human nails, (ii) determining the tensile parameters of vaginal mucous membrane and uterian wall and (iii) studying the interaction physics and medicine.

Biological Sciences

ANTHROPOMETRY AND HUMAN GENETICS

Research activities were carried out in the following projects :

1. *Health status and labour productivity* : Data collection and analysis are in progress.

2. *Variation in health status in relation to spatial, economic, social, rural/urban, ethnic, etc. factors in some populations of Eastern India. 1. Effects of micro-environmental factors on health in rural populations* : Data collection and analysis are in progress.

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3. *Variations in health status in relation to spatial, economic, social, rural/urban, ethnic, etc. factors in some populations of Eastern India. II. Psychological stress and health of mother and child* : Data collection is in progress.

4. *Sociocultural characteristics and community health status of the Lepchas of Darjeeling district, West Bengal* : Data collection and analysis are in progress.

5. *Impact of altitude on human population, Phase II Determinants and consequences of human health and activity pattern in the mountain ecosystem* : Data collection and analysis are in progress.

6. *Bioanthropological study of migrant African group, the Siddis of India* : All the contemplated data — demography and population structure, anthropometry, somatoscopy, body build, dermatoglyphics, socio-economic and genetic traits — have been collected. Analysis of the data is in progress.

7. *Relationship between carrying capacity, level of technology, size and social composition and dispersion of human settlements in Western India* : Additional data were collected from Kolhapur district. A draft report has been prepared.

8. *Indo-Soviet collaborative anthropogenetic survey in South India* : This survey was conducted in 1982. Laboratory analysis of biological materials have been completed. Statistical analysis of the data are in progress.

9. *Indo-German collaborative study* : This study is in collaboration with Bremen University. The survey was conducted in Assam, Manipur and Karnataka. Laboratory analysis of about 1500 biological specimens is in progress. Laboratory analysis include the following : Blood groups ABO Rh, MNSs, Kell, Duffy and Diego serum protein Gm and Km systems, Gc, Hp, L₁ antitrypsin, Cp, Tf, Alb ; red cell enzymes Ac Ph, PGM₁, PGM₂, Est-D, AK, ADA, GLO, LDH and Hb pattern.

10. *Biostatistical study on vitiligo : A skin disease* : Prevalence data were gathered from individuals drawn from the general population, pedigree data were collected through vitiligo patients. Analysis of data and preparation of report continued.

11. *Study of physical growth of the Bengali boys and girls* : Collection of anthropometric and socio-demographic data from 1000 urban school boys aged 7-16 years has been completed. Analysis of data by ISI computer is in progress.

Collection of anthropometric data on height, weight, skinfolds, and sociodemographic data from 600 urban school girls aged 7-16 years has been completed. Verification and scrutinising of the collected data are continuing.

Anthropometric survey on the rural school children in Kulpi Block of Diamond Harbour Subdivision, 24 Parganas has been started in collaboration with the officials of the Primary Health Centre, Kulpi. Field work for the collection of the data on the genetical study of human growth has been started in Kulpi, 24-Parganas District.

12. *Pattern of fertility and reproductive wastages by parity and social class* : Collection of birth records from Diamond Harbour Subdivisional Hospital is being continued. So far data on 3000 births were collected recording sex of the infant,

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birth weight, birth order, nature of birth, mode of delivery, multiple births, etc. Processing and screening of the data are in progress.

BIOCHEMISTRY

Research works were carried out in the following fields :

1. *Role of pyruvate phosphate dikinase and phosphoenolpyruvate carboxylase in relation to inorganic pyrophosphatase in photosynthesis* : The distribution of phosphoenolpyruvate (PEP) carboxylase and pyruvate phosphate dikinase enzymes, known to be the key enzymes in the C_4 path way of photosynthesis have been investigated. They were compared with the levels of inorganic pyrophosphatase. The distribution pattern of PEP carboxylase closely parallels that of inorganic pyrophosphatase. The plant leaves possessing very high level of inorganic pyrophosphatase have several folds higher PEP carboxylase activity than that of other species possessing very low level of inorganic pyrophosphatase. Pyruvate phosphate dikinase enzyme level is practically nil in the leaves of low inorganic pyrophosphatase content whereas a measurable level of dikinase enzyme was found in other plant leaves of very high inorganic pyrophosphatase content. Our observation regarding the distribution of PEP carboxylase and pyruvate phosphate dikinase in the leaves of plants and their relation with inorganic pyrophosphatase tempts us to suggest that C_4 plant leaves possess very high level of inorganic pyrophosphatase in comparison to C_3 plants.

2. *Correlation of cyanomethaemoglobin and oxyhaemoglobin levels in adult human beings* : The objective of the project is to examine whether any relationship exists between the technically complicated measurement of cyanomethaemoglobin and simple oxyhaemoglobin (and other haematological parameters).

With small sample size, as the correlation coefficient was found to be high it was expected that a prediction equation might be established between the two haemoglobins. Statistical analyses shown the correlation as :

$$\begin{aligned} \text{plains, male} &= 0.8002 & \text{hill, male} &= 0.9624 \\ \text{plains, female} &= 0.8382 & \text{hill, female} &= 0.9226 \end{aligned}$$

It is also observed that there is a significant decrease in the values of the haematological parameters with advancing age among the males.

The prediction equation has also been established between the two haemoglobins. This finding implies that simpler parameter of oxyhaemoglobin may be used interchangeably with cyanomethaemoglobin and this later can be established from the former. This under field situation is of considerable advantage.

3. *Distribution of intestinal parasites in West Bengal* : Some data on the distribution of intestinal parasites in different regions of West Bengal exists, but there are large gaps in terms of spatial and ethnic coverages. So, collection of further data in different regions, ecological zones, ethnic groups, socio-economic condition, altitude towards disease, diet etc. is needed in order to evaluate the physical, biological and cultural ecological causes and consequences of this major health problem and the change in their prevalences over time, if any.

As a part of this survey data have been collected in pilot studies earlier from hill regions, Doars area and deltaic plains in West Bengal. But for this broader study,

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cartographically the area of West Bengal has been divided into 5/6 ecological zones, considering temperature, humidity, rainfall, soil type, vegetation etc. following the map of National Atlas, and out of which statistical sampling has been done in the coastal zone. Five villages have been selected for this work in the coastal zone. The number of subjects will be proportional to the area of the zone.

BOTANY

1. *Crop improvement* : During the agricultural year 1984-85 the aman rice variety *Subarna*, developed and improved by Botany Research Unit from indigenous germ plasm, was put to performance trial at 10 density levels at ISI experimental farm in Giridih with an aim to determine the optimum density for best expression of yield potential. By combining the densities into three groups, low (average of 20, 40 and 60 thousand plants/hectare), medium (average of 80, 100 and 120 thousand plants/hectare) and high (average of 140, 160, 180 and 200 thousand plants/hectare) it was observed that at medium density level *Subarna* gave highest grain yield (54.12 qntl./ha.) and at high density level it gave highest straw yield (124.59 qntl. ha.) with slight decline in grain yield (53.40 qntl./ha.). It was further seen that biological yield increases (96.76, 118.35 and 124.59 qntl./ha.), as density level increased while harvest index decreased (0.48, 0.46 and 0.43) as density level increased.

For comparative assessment of yield performance, *Subarna*, *Autkooli* and *Mulasail*, all of which are selections from indigenous germ plasm, were put to field trial along with 8 dwarf/semidwarf 'high yielding' rice varieties, IR-8, IR-50, Jaya, Pankaj, IET-1449, IET-2815, IET-3257 and IET-4049 at two levels of fertilizers, M_1 and M_2 .

It was seen that *Subarna* outyielded all but *Pankaj*. The first five ranks of varietal performance in respect of grain and biological yields at two fertilizer levels are shown below :

M_1

Grain yield : Pankaj > IET-2815 > IET-3257 > Autkooli > Subarna > Jaya
 Biological yield : Mulasail > Pankaj > Autkooli > Subarna > IET-3257

M_2

Grain yield : Pankaj > IET-3257 > IR-3 > Autkooli > Mulasail
 Subarna IET-2315

Biological yield : IET-3257 > Subarna > Autkooli > Mulasail > Pankaj

The rest of the 'high-yielding' varieties of rice were extremely poor in both grain as well as biological yields.

It was further observed that all the 11 varieties tested are positively responsive to higher dose of fertilizers, inter-varietal response difference was expressed in yield. However, a clear variation in the response behaviour to higher fertilizer dose was found in respect of straw yield which was reflected in biological yields of the varieties studied. It was observed that straw yield of *Subarna* remained unaltered at M_2 ; *Autkooli* showed very small but positive response to M_2 while *Mulasail* showed negative response to M_2 . Like in the previous year, the straw yield IET-3257 showed highest positive response to M_2 .

Harvest index ranking of these 11 varieties showed that the poorest yielding varieties both in grain and biological yields had highest ranks of harvest index and those

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having high yields of grain and straw, had very low harvest index. It appears that harvest index is negatively correlated with both grain and biological yields. These findings raise a serious doubt as to the validity of use of harvest index as a tool for selection of rice in a breeding programme.

In addition to these field experiments, multilocal performance trials of *Subarna* on the farmers' fields were also conducted under different agroclimatic situations with an aim to find out its adaptive behaviour. The available yield data and the farmers' opinion suggest respectively a high adaptive potential of *Subarna* and possibility of its higher acceptance by farmers over the modern dwarf 'high yielding' rice varieties.

The maintenance of 56 indigenous rice germ plasm lines and 8 modern dwarf "high yielding" rice continued.

2. *Intraspecific and inter-specific interactions in crop plants*: (a) *Inter-varietal mixture effects in rice, wheat and gram*: During 1984-85 agricultural year 8 mixed planting experiments on rice and one on wheat and another on gram were conducted at ISI experimental farm in Giridih. Land Equivalent Ratios (LERs) of grain yields of the varietal mixtures in rice were computed which showed an overall advantage in four combinations, neutrality in two and disadvantage in two. It was further observed that the short duration exotic varieties such as IET-4094, IET-2815 face serious competition in combination with *Subarna* and *Jaya* is wiped out by *Subarna* in mixture. The LERs of grain and seed yields of varietal mixtures respectively for wheat and gram are disadvantageous as compared to their yields in pure stands. (b) *Inter-specific mixture effects in crop plants*: During the reference year 11 inter-cropping systems were studied at ISI experimental farm in Giridih. It was found that in all oat/lentil inter-cropping systems lentil was exposed to competition and so is oat in certain mixture types mixed with two lentil varieties (L-9-12) and (B77). Nine cereal/pulse inter-cropping systems out of 11 tested during 1984-85 showed distinct but variable degree of advantage over the monoculture of the components. Some cereal/pulse inter-cropping systems, wheat (NP 710)/gram (BR77), wheat (UP 262)/gram (BR77), oat (Kent)/lentil (C31) and maize (Vijay)/cow pea showed mutual reproductive stimulation of the components of mixtures leading to an advantage of grain/seed yields as compared to their monoculture.

These results clearly suggest a scope for utilization of properly tested cereal/pulse inter-cropping systems for increase in agricultural production per unit of cropped area.

CROP SCIENCE

1. *Exploratory work on the family Palmae (Areaceae)*: Anatomical study on normal and breathing roots of *Phoenix paludosa*, and embryo of coconut and *Phoenix silvestris* was in progress. Data on stomatal frequency of leaves of young and adult plants of different palms have been collected, and the results were under statistical analysis.

A few tender coconut shells were crushed by a pulper machine and the extracted juice was being estimated for its mineral contents, which might be utilized as fertilizer, and fibres for making of coir, ropes, mattresses etc.

2. *General problems of levo and dextro-rotatory situations in plants and animals*: Data collected on the production of coconut and arecanut from left and right-spiralled palms were under analysis. Interesting results have been obtained from the computer

analysis of data on stomata, epidermal cells and trichomes of left and right-spiralled seedlings of arecanut.

3. *Introduction of oil palm (Elaeis guineensis) and improvement of coconut (Cocos nucifera) production through introduction and selection of high yielding cultivars in the Sunderbans of West Bengal* : Final plan and experimental layout have been placed to the Government of West Bengal for their approval. A land of about 1.25 hectares has been earmarked at the State Seed Multiplication Farm, Manmathanagar, 24-Parganas, by the Department of Agriculture, Government of West Bengal for this project.

4. *Histopathological study on the mango (Mangifera indica) malformation and their correlation with insects and mites* : Some stem galls of mango were collected and sectioned with a microtome. The sections were under study.

EMBRYOLOGY

Research activities during the period are the following :

1. Biochemical evidence was marshalled, indicating that the "glue" for the embryonic cells is, at least partly, due to glycoproteins. Synthesis of glycoproteins is inhibited by tunicamycin and glycerol.

The interesting and unexpected effects of glycerol, a cryoprotectant justify the use of newer systems in order to further study these effects. A new system, the egg of *Loligo*, was explored. The preliminary results obtained support the earlier findings.

For the lack of regular supply of material this fascinating system has not attracted the attention of biochemists or molecular biologists. In the course of this study based largely on material obtained from trawling nets, light was thrown on the biochemical embryology of the Squid. With a combination of biochemical techniques and micro-manipulator, light was shed on the 110 year old problem of cephalopod yolk as a source of nutrition for the embryo. As a result of these investigations, the next phase of work could also be chalked out. The work was done in South France but possibilities are being explored in West Bengal and at the National Institute of Oceanography, Goa.

Over and above this, glycerol, already found to reversibly inhibit mitosis in *Limnaea* was used in this new system i.e. (*Loligo* eggs). Reversible inhibition of mitosis was inferred from the formation of smaller embryos with a glass-clear remnant of yolk cleaved out at the stage when mitosis started once again.

2. *Biomathematical and stochastic modelling of development, differentiation and morphogenesis of normal embryonic cells and cancer cells* : The problem of cellular differentiation and consequent pattern generation during morphogenesis is perhaps the most interesting and important field of study in Biology. The growth and development of normal embryonic cells have striking similarities with those of cancer cells. The main difference between the two is that in the former the cells proceed towards final differentiation after which further cell division is stopped while in the latter, the abnormal cells never attain the stage of final differentiation and the cell division is uncontrolled. From mathematical stand points, normal cells exhibit a stable pattern of growth whereas the growth of cancer cells is dynamically unstable in nature. A dynamic mathematical model involving parameters like DNA, RNA, protein,

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mitochondria, repressor enzymes and known biochemical mechanisms such as feedback inhibition, diffusion, induction etc. can successfully simulate the growth pattern of normal and cancer cells. These types of model based studies help in finding out theoretically the principles underlying the mechanism of normal and cancer cells. Simultaneous experimental studies along with these theoretical studies can reveal much more informations and new lights than can be obtained by undesigned experimental studies alone.

Mathematical models of RNA and protein synthesis during embryonic development have already been constructed and studied in detail. Time delay analysis have also been performed. Stochastic models of transcription have been further developed and new methods have been explored for the analysis of nonlinear stochastic models. Numerical analysis and computer simulation have been simultaneously performed. Reaction - diffusion models of pattern generation and morphogenesis have been constructed and developed.

Solutions of the wave equations have been obtained. The earliest occurring primary layers of differentiation during morphogenesis have been mathematically exhibited with the help of these diffusive models. Bifurcation analysis of the time-periodic spatial solutions have been performed. It has been found that the bifurcation is supercritical which shows that the system generates a stable pattern.

ENTOMOLOGY

1. *Investigation on the breeding of Anopheles spp. in two suburban localities (Baranagar and Dum Dum)*: Collections of *Anopheles* larvae (all stages) were made from 100 sites of Dum Dum Municipality. Newly hatched larvae of *Anopheles subpictus* were found throughout the year, thus showing that breeding is continuous throughout the year and peak of their breeding is reached during monsoon. Larvae of malaria-carrying species such as *Anopheles barbirostris* were rare in the collections. Larval sites were rain puddles, drains and pits made by Metro Railway Construction authorities. Alive larvae of *A. subpictus* were also collected from waterbodies with traces of oil (petroleum or diesel) on the surface. This fact possibly signifies urbanisation of this species. Association of *Anopheles* larvae with those of other mosquitoes (*Culex* or *Aedes*) was very weak.

2. *Ecological investigations on Culex pipiens fatigans*: Collections of eggs of *Culex pipiens fatigans* round the year tends to show that their breeding is least during the monsoon and the peak of breeding is reached during late winter.

LEAF PROTEIN

1. Eighteen aquatic/semi aquatic weeds have been studied in our laboratory regarding their protein extractabilities, protein content of the leaf protein concentrates (LPC), their digestibility etc. the protein nitrogen extractability of *Limnanthemum cristatum*, *Ipomea reptans* and *Pistia stratiotes* were the best ranging from 39.43 to 27.8%. When leaf proteins were prepared from the plants, Azolla had the highest nitrogen (N) content of 9.36%. The LPC prepared from *Ipomea reptans* had the best digestibility (in vitro) followed by *Pistia stratiotes* and *Limnanthemum cristatum*.

Sugarbeet tops, taken at various stages of growth, with known seed rate and fertilizers dose, have been also analysed. Crude protein content varied from 18 to 22% and N extractability varied from 55 to 70% which was considered very encouraging.

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The proximate chemical composition of the plant and various L.P.C.'s is under progress. Special stress is being given on L.P.C.'s from selected water weeds (which have *N* extractability more than 25%). Also estimations of total and available Lysine and Methionine, total and free polyphenols and toxins and B. carotene are under study. Similar work is being carried out on the L.P.C.'s from sugarbeet tops.

2. Field trials were done on cauliflower in Baruipur Experimental Farm of Calcutta University during the winter month of 1984-85. Treatments included spacing and nitrogen doses as variables. Data on periodic growth together with yield and nitrogen uptake as also leaf protein extractability and LP yield, affected by different treatments have been recorded. Chemical analysis and subsequent statistical analysis are being done.

3. (i) In the last year 15 cultivars of winged bean were put on trial in the fields of I.S.I. Different growth characteristics and yield records were taken and protein contents are being analysed. (ii) Ten cultivars have been studied in a separate trial in the Research Farm of Baruipur of Calcutta University. Data on growth and yield as affected by two methods of cultivation have been noted. Chemical analysis to find out the compositional differences are proposed to be taken up.

4. (i) The three yeasts, *Saccharomyces cerevisiae*, *Candida lipolytica* and *Torula utilis* propagate in five whey samples from cowpea, winged bean, turnip, mustard, radish, cauliflower. Cowpea and turnip whey exhibited most promising results (viable cell-count was 25×10^6 and 80×10^6 respectively). Among the three yeasts, *T. utilis* exhibited most promising results in cowpea whey. 0.70 g dried yeast was harvested after 48 hours of incubation. Still better yield was obtained when the incubation time was prolonged to 96 hours. The final yield was 1.5 g/100 ml of cowpea whey/96 hour. Harvested yeast cells were analysed for chemical and mineral make up. All the harvested yeasts have good amount of protein (45.6-54.3%) and vitamin (Riboflavin 60-70 mg/ml; Niacin 320-350 mg/ml; Thiamine, 2-3 mg./ml; Pantothenic acid 110-135 mg./ml; Pyridoxine 30-35 mg./ml; Folic acid 10-15 mg./ml.).

(ii) *Aspergillus flavus*, *A. Niger* and *A. Terreus*, the three filamentous fungi were tried to grow in four cruciferous whey samples. During the microbial load study of whey, the fungi were screened and all the fungi showed a tendency to form colonies on the four whey samples.

Out of the four cruciferous whey samples, turnip's performance was the best. Better results were obtained when all the samples were treated with sugar sources (at 1% level). Sucrose treated whey was found to be the best medium for the growth of *Aspergillus flavus* (100% rise in mycelial weight). Mycelium and protein production reached to their peak when turnip whey was enriched with 2.5% sucrose and 0.15% NaNO_2 . Maximum protein was obtained in between 6th and 9th days of incubation.

(iii) Different filamentous fungi were harvested to reduce COD and BOD values of LPC by-products.

The BOD and COD values were seen to be progressively decreased due to fermentation for a period of seven days or more. The percentage of reduction was minimum (40%) when cowpea whey was treated with *cladosporium herbarum*. COD reduction was maximum (67%) when Croton whey was treated with *Trichoderma viride*. The BOD reduction was minimum (78%) when winged bean whey was treated with *Curvularia*

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lunata and maximum efficiency of reduction (93%) was observed when *limanthemum* whey was treated with *Aspergillus japonicus*.

To study effect of inoculation of *Rhizobium* strain on growth and nodulation of *Psophocarpus tetragonolobus* (cv : Lucknow).

Psophocarpus tetragonolobus is an extremely promising legume capable of forming effective symbiotic association with different strains of *Rhizobia*. The different responses of inoculant *Rhizobium* to competition from indigenous soil microorganisms will profoundly affect performance of this plant under field condition. The aim of our present study is to find out whether any significant increase in shoot dry weight, nitrogen percentage, percentage of starch in roots and efficiency of nodules will occur as a result of inoculation with a strain of *Rhizobium* isolated from nodules of *Psophocarpus tetragonolobus* (cv : Lucknow).

To select an effective strain of *Rhizobium* for *Psophocarpus tetragonolobus* (cv : Lucknow).

14 *Rhizobial* strains have been isolated from 14 winged bean cultivars. Infection tests will be performed to study virulence of strains in excised root culture. The effect of inoculation of the selected strains of *Rhizobium* on the efficiency of N_2 fixation of the nodules and nodule iron contents will be studied. The most efficient strain will be characterised following Bergey's Manual of Determinative Bacteriology.

Social Sciences

DEMOGRAPHY

1. *Population welfare planning in rural areas away from Calcutta* : Funds were available during 1979-80 to 1983-84 for the project on Evaluation of Family Planning Acceptance. Results from the project were released in August, 1984 in a mimeographed report.

The study showed that dependency ratio among the Muslims and scheduled caste Hindus of Murshidabad, Nadia and Birbhum was comparable with figures for countries with high fertility and high mortality whereas the figures of upper caste Hindus were comparable to that of countries with medium level of fertility and mortality. It shows the possibility of higher rate of population growth among Muslims and scheduled caste Hindus if improved health services are provided without popularising the practice of conventional contraceptives. Improved health services available through government institutions are least utilised by the above mentioned two social groups in rural areas of Murshidabad, Nadia and Birbhum. This could be linked with availability of inadequate number of primary health centres. The report showed that net production rate of one could be achieved in India by protecting from pregnancies all of young women of age below 20 years and low parity females of higher ages by practice of conventional contraceptives and by sterilising high parity women of age above 29 years.

Enrolment rates of males and females of age group 10-14 years in rural areas of Murshidabad, Nadia and Birbhum were 53.2% and 42.8% respectively around 1980 compared to the corresponding percentages of 70.4% and 49.0% in rural areas around Calcutta. The survey showed higher educational backwardness of Muslims in rural areas away from Calcutta than that of scheduled caste Hindus whereas scheduled caste Hindus in rural areas around Calcutta lagged behind the Muslims. Education mobility of scheduled caste Hindu males has improved in later years due to the drive by the government whereas it has deteriorated for other social groups in rural areas away from

Calcutta. Educational wastage in the form of drop out before acquiring literacy status was mostly found among scheduled caste Hindu males. The study showed that economic development alone may not be sufficient for promotion of female education above the primary stage which is needed for reduction of birth/fertility rates.

It has been recommended that health services may be made available to all sections of the rural population irrespective of caste or religion by doubling the number of primary health centres in such a manner that scheduled caste Hindus and other Hindus are more benefitted from these New PHCs.

2. *Educational development survey in rural Bihar* : This survey was taken up in 1981-82 under the plan programme to study the educational development and other socio-demographic aspects of the rural population around Patna. Three types of schedules namely household, couple and migration were canvassed to 1880 households of 72 sample villages. Data collection was completed by May, 1984. A part of the data from the household and couple schedules has been analysed and a report is being prepared. Following findings emerge from the survey.

Both the important sectors of economic activities—cultivation and non-manual work (superior service)—are dominated by upper caste Hindus followed by other Hindus, scheduled caste Hindus who are least beneficiaries of planned development are mostly labourers in rural Bihar. About one tenth of upper caste Hindu children of ages 10-14 years are enrolled at ages of 8-9 years. Relative ranks of social groups by education level in rural Bengal around Calcutta hold for rural Bihar also in which education level of other Hindus is lower than upper caste Hindus and higher than Muslims as well as scheduled caste Hindus. Lower enrolment force has been found for scheduled caste Hindus compared to other (Hindu) social groups of both the sexes in rural Bihar. The force was higher for age group 15-19 than that of age group 20-24 except for scheduled caste Hindu males indicating deteriorated enrolment force among teen aged scheduled caste Hindu males in rural Bihar. Scheduled caste Hindu and Muslim wives in rural Bihar are protected by sterilisation after attaining 30 and 35 years respectively. Considering the lower marriage age of females in rural Bihar, they might have completed their family size by those ages. Negligible percentages of scheduled caste Hindu and Muslim live births are averted by sterilising spouses. Although level of vasectomy acceptance by Muslim husbands in rural Bihar is poor, conventional contraceptives are not opposed by Muslim spouses and are being practised in young ages also. Better results of fertility reduction may be expected by putting greater emphasis on the practice of spacing methods.

It is found from the survey data that about 12% of eligible couples have been protected by sterilization and about 40% of couples are practising conventional contraceptives. The practice rate is higher for upper caste Hindu couples showing 20% sterilised and 40% practising conventional contraceptives. Compared to 30% of planners among upper caste Hindus, the figures were around 20% for other social groups. Practice rate of conventional contraceptives was about 21% for couples with wives educated in classes 5-8 compared to 8% for couples with illiterate wives for all social groups.

3. *Evaluation of Y-sample age tables and reconstruction of 1931-41 population age structure and life tables for India* : The purpose of this plan project is to reassess and rebuild the Y-sample age tables in the light of the recent analytical advance. Further as a pre-requisite of the life table construction, attempt is being made to rebuild the age structures of 1931 to 1941 Indian population.

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4. *Effect of child mortality on fertility* : This is a plan budget survey project which has been taken up for rural areas of Hooghly district in West Bengal. It will be taken up for urban areas of the district also. About 1500 married females of rural areas and 1500 married females of urban areas will be interviewed. Selection of villages has been made. Field work of household listing and interview of females will be done in the next financial year.

5. *A study of educational wastage at primary level* : This study has been taken up in rural areas of 24 Parganas district in West Bengal in which about 100 sample villages have been chosen for the study. All the primary schools of each of the sample village will be surveyed if the number of schools does not exceed two. Otherwise two schools will be chosen out of all the schools of the sampled village. Preliminary work regarding selection of primary schools is under progress.

6. *Socio-economic and demographic trends since 1951 with specific reference to disparities across social groups* : This plan project has been taken up jointly with the Economic Research Unit of the Institute. The objective is to study demographic imbalance which has resulted in social tension, economic hardship and ecological mismanagement in selected regions of Eastern India (e.g. Manipur, Tripura and Greater Calcutta). Further, the study aims at evolving a general framework for analysing the underlying factors responsible for discontent and social tension in several regions of India. Inter-relationship between demographic parameters and socio-economic variables will be studied by using multivariate analysis and recursive path analytic model. Such a study by social groups is likely to highlight the possible dimensions of tension.

7. *Development prospects in rural West Bengal* : Development prospect of rural West Bengal is not bright. Fruits of development do not reach the rural poor due to inter social group disparities of education growth. Only one third of the scheduled caste Hindu males of age 15-24 years completed the primary stage of education around the Eighties compared to 80% of upper caste Hindu males. Low occupational mobility, meagre educational development and insufficient health facilities for rural poor have been the cause of hindrances of development in rural Bengal.

8. *Primary education in rural India* : Primary education force among males was found to be the highest in Himachal Pradesh followed by Haryana during 1961-71 in which the level of Himachal Pradesh was significantly higher than that of Haryana. The force was negligible in Andhra Pradesh, Assam, Karnataka, Orissa and West Bengal. Primary education force among females was highest in Punjab followed by Himachal Pradesh in which level difference between these two states were insignificant. Education force was at a very low level in Rajasthan, Bihar, Madhya Pradesh and Uttar Pradesh. All the 4 states mentioned here are included in the group of states backward in female literacy. Significant education force was found among scheduled caste Hindu females in rural areas of Bengal and Bihar, as expected, due to Government Policy, but it was weak in Bengal after attainment of literacy status and as such, the force is less effective in Bengal not only for fertility control but also for utilising maternal and child health services.

9. *Some aspects of rural population around Calcutta* : The study shows age sex structure of the population belonging to different socioeconomic groups of rural areas around Calcutta. The high caste Hindus mostly with non manual occupation show the best structure in terms of lower and higher proportions in young and aged persons respectively. They have higher median ages as well as higher expectancy of life. More-

over, they have lower dependency load due to higher percentage of working age population. On the other hand, Muslims with mainly agricultural and labour occupations show the worst age structure with higher and lower proportions of young and aged persons respectively. They possess lower expectancy of life and higher dependency ratio.

10. *Studies on maintenance of couple registers* : This study was taken up on the request of the Ministry of Health and Family Welfare. On the basis of investigations made in two primary health centres (PHCs) of Hooghly district, it was found that 15% of couples are to be updated every year. Existing arrangement in primary health centres is inadequate. It is recommended that the social welfare officer of the PHC should be made responsible for updating couple registers by utilising services of community health guides (CHGs). It recommends that any CHG found incapable of supplying accurate information of birth, death, marriage and migration of eligible couples for updating couple registers should be penalised.

11. *Some aspects of population control planning* : The study recommends that some sort of compulsion is necessary for motivating couples to educate their children, restrain adolescent marriage of girls and prevent pregnancies to couples in which husbands are older than 34 years or wives are younger than 20 years. Maintenance of couple registers should be decentralised and services of CHGs should be utilised so that it serves as basic document to the field-workers (ANMs) for selection of target couples for family planning education.

12. *On collection of live birth statistics* : The paper makes a review of methodologies adopted in India for collection of live birth data from households since 1936. Distribution of live births by interval (in months) from the date of occurrence to the date of survey from National Sample Surveys and also from the survey conducted by the Institute were examined. The study showed that live birth reports of 2 to 8 months prior to the date of survey are least affected by reporting error. Under reporting for interval months 10 or 11 are due to recall bias in favour of 12 months and it is not due to recall lapse. The bias is controlled by replacing the live births of 10 or 11 months before survey date by the mean of five months 10 to 14 prior to the date of survey. It points out that under estimations of live birth rates in the Twenty Eighth Round was due to organisational slackness. The study recommends use of pregnancy follow-up method for live birth data collection.

13. *Studies on work force participation rate* : The study makes a review of concepts and definitions of work force participation in censuses since 1911 and also in National Sample Surveys. Male work force participation rates by states and rural urban sectors for 1961, 1971 and 1981 censuses have been compared with estimated potential labour force for each of the corresponding census years. The investigations seem to indicate that illiteracy and deployment of children in work are largely responsible for high participation rates for some of the states in India.

14. *Inter state migration in India* : The study based on 1971 census endeavours to provide idea about the direction and volume of migration by states. It concentrates on econo-demographic aspects and tries to identify the factors responsible for inter-state variation in migration. Among migrating states, Maharashtra secures top position followed by West Bengal. Bihar and Uttar Pradesh play crucial role in sending out population. Distance has an important role to play in the migration process.

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The determinants of migratory process lie in "push pull" hypothesis which explains that migration is due to socio-economic and demographic imbalances between regions. Relative advantages of some socio-economic factors work as pull factors. Immigration depends on density of population, number of towns, production, capital used, urbanisation index etc.

15. *Changes of occupation and literacy levels of scheduled communities* : This study in respect of scheduled castes and scheduled tribes of West Bengal was taken up to see the progress of narrowing the educational and economic level gaps between scheduled castes and others. The study shows that overall proportion of agricultural labour in West Bengal has decreased but it has increased for scheduled caste Hindus indicating that the gap of standard of living and education has increased instead of decreasing.

16. *Age at marriage differentials of females* : Factors which influence age at first marriage have been studied in this paper in respect of India and Bangladesh. It has been concluded in the paper that female education is the most important variable to increase marriage age of females except for Muslims in India. Age pattern of marriage may remain unchanged if education is not improved even when level of living of the population is improved. Continuation of lower marriage age in rural West Bengal is due to high percentage of Muslim population in the state. Adolescent marriage problem exists in the states of Bihar, Madhya Pradesh, Uttar Pradesh and Rajasthan but it is not reflected in the data of age at effective marriage. Passive Government attitude to enforce the legislation prohibiting child marriage and poor state of female education in a number of states seem to be responsible for continuation of early marriage in some of the states in India.

17. *Laparoscopic performance in West Bengal* : This research project was taken up at the request of the Ministry of Health and Family Welfare. Field data from 201 acceptors of laparoscopy in 11 PHCs of Burdwan district, West Bengal were collected in November and were analysed. The study showed that post operation complications such as abdominal pain, waist/back pain, pain at the operation point were genuine. The laparoscopic sterilization programme in West Bengal has the bright prospect of becoming acceptable to all women irrespective of religion or caste.

ECONOMICS

The main areas of research during the period under review included economic theory, econometric methods, national and regional economic planning, level of living and poverty in India and sectorwise review of the performance of the Indian economy in recent years.

1. *Economic theory* : Researches were continued on classical and post-classical theories of value and distribution, nature and evolution of technology, analytical representation of productive process in various sectors and the associated process of investment, theory of rent, marketed surplus and agricultural pricing, inventory theory etc. These researches have been generalized and related to the history of economic thought. The two main themes pursued are social accounting and price formation. Efforts were also made to work out the analytical foundations of Keynes' General Theory and to compare modern representations of the General Theory with that of Keynes himself. It turns out that current attempts to represent the Keynesian involuntary unemployment problem in a generalized Walrasian framework are ill-conceived.

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Finally, investigations in social choice theory and game theory were continued leading to several publications.

2. *Econometric methods* : Work in this area has been concerned partly with the analysis of statistical problems arising in the estimation of single-equation econometric models in the context of (i) applications of Box-Cox transformations, (ii) omission of observations in autocorrelated regression models, and (iii) trended regressors in autocorrelated regression models. Substantial work was also done on the analysis of consumer behaviour in India through the fitting of various theoretical systems of demand equations including two new systems of demand with some convenient properties.

3. *National and regional economic planning* : Projects have been taken up at the instance of the Planning Commission for conducting studies on multi-sectoral planning models in the context of the Seventh Five Year Plan and for developing methodological approaches (i) for long term studies on regional models for agriculture and manufacturing sectors and (ii) for studies of technology in the context of perspective planning, among other things. Some of the results already obtained have been discussed in Official Meetings in the Planning Commission and also presented to national scientific conferences. In the area of regional planning work was done (mainly in connection with Ph.D. dissertations) on (i) a statistical study of interdistrict variation in industrial production in India (ii) the degree of monetization, marketable surplus/deficit of foods and agricultural growth for Indian districts and (iii) the interaction between education and trained labour requirements on a regional basis in India.

4. *Studies on level of living and poverty* : The ILO-sponsored project, "Relative price of food and the rural poor—the case of India" took more time than originally envisaged owing to a substantial revision of the basic data emanating from the Indian National Sample Survey. The report, completed towards the end of the year, includes a comprehensive analysis of trends in prices, level of living and disparities in level of living and in the incidence of absolute poverty in rural India since the early fifties. Other studies based on NSS data include one on time trends in housing conditions of the Indian population and another on the areal distribution of "the poor" and "the rich" in rural India during 1973-74.

A project was taken up in collaboration with demographers of the Demography Research Unit to study the socio-economic and demographic trends since 1951 with special reference to disparities across various segments of the population based on religion, caste, ethnic group, mother tongue etc. Three regions would be covered for this study—Manipur, Tripura and Greater Calcutta. The aim of the study would be to examine the objective (demographic and socio-economic) factors underlying social tension that has surfaced or is likely to surface in these three regions. Collection of data for Tripura and Greater Calcutta was started during the year. Professor J. B. Ganguly of the Calcutta University, Postgraduate Studies Centre, Agartala, has been collaborating for the study on the Tripura region.

5. *Annual review of the Indian economy and other studies* : The scientific workers of the Unit revived a project for critically reviewing the performance of the Indian economy in its different sectors with a view to bringing out a special publication around March every year. The ultimate aim would be to evolve a multi-equation macro-econometric model for the Indian economy which would be utilized for short-term

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forecasting and for making policy prescriptions for improving the management of the economy.

6. Many members of the faculty carried on studies on particular sectors of the Indian economy including agriculture, manufacturing industry, energy, labour etc. Special mention may be made of a study of productivity and earnings in Indian manufacturing industries and a sample survey of wage earnings of industrial labourers. The report on the survey project assigned by the Planning Commission/Joint Plant Committee of the Govt. of India on the consumption of iron and steel in small-scale manufacturing enterprises has been completed.

PLANNING (DELHI)

During the period researches were carried out in the following : Study of environment, human settlements and spatial organisation to evaluate the regional structure and processes of development contributing to regional disparities ; Processes and patterns of urbanisation in Karnataka" (with the National Institute of Urban Affairs, Delhi) ; Study of evaluation of demographic structure and occupational attributes on the growth of cities in India (with Shastri Indo-Canadian Institute, New Delhi) ; Price and distribution controls in the Indian economy ; Credit planning in Indian economy ; Economic implications of price and distribution control for vanaspati ; Distributional cost of L.P.G. ; Credit institutions and small Farmers' decision ; Trade in services ; Study on provision of basic social services in India ; Effect of rise in the price of cereals on the disparities in the distribution of cereal consumption in value and physical terms ; Regional disparities in educational facilities with particular reference to geographical factors ; Macro-econometric models for India ; Study on provision of basic social services in rural India ; Alwar District — A case study ; Women and Rice Cultivation.

ECONOMIC ANALYSIS (BANGALORE)

1. *Studies on regional demand patterns in India* : Studies are going on various aspects of the problem. Preliminary results have been reported in some working papers of the Unit.

2. *An Indian agricultural policy and planning model* : This research project was formulated and submitted to the Divisional Council of Scientific Workers of the Institute.

NATIONAL INCOME

The Unit (NIRU) continued to be engaged in researches on different aspects of national income and related aggregates with special reference to the Indian economy at national and regional levels.

(i) Work was continued on the preparation of a time series of capital formation and national income in India from 1857 to 1900. The work is based on historical data compiled from the National Library and other Libraries in Calcutta, and from the National Archives and the Nehru Memorial Library in New Delhi. Attempts are being made to build estimates at current prices as well as at constant prices.

(ii) The data collected through a sample survey of wage earnings of workers engaged in small-scale manufacturing enterprises in the Calcutta Corporation area

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were tabulated and analysed. The aim is to study the size distribution of wage earnings and the disparities in wage earnings across industry-occupation categories and categories by tenure, level of skill etc.

(iii) The study on size distributions of emoluments for employees in the public sector was continued. The object is to examine inter-temporal and inter-regional variation in these size distributions on the basis of secondary data from official censuses of employees of the Central Govt., the States Govts. and the Local Bodies.

(iv) A sample survey on unaccounted components of human capital formation was carried out in Howrah and Hooghly districts of West Bengal during March-May, 1984. The tabulation of the material was taken up during the period under review. The major aim of the study is to assess in a broad way the extent of human capital formation through the imparting of general or technical education wholly or partly free of charge by persons in the sample households to members of their own households and to outsiders.

(v) The scientific workers of the Unit also collaborated in the project for annual review of the Indian economy during 1984-85.

(vi) Among other studies taken up during the year mention may be made of one on state-wise trends in Indian agriculture since 1951 and another on a comparative study of different official series of CPI numbers in India for different classes of the population.

LINGUISTICS

Research in fundamental and applied linguistics was continued under three main headings, namely :

1. Studies on the phonetic structures of major Indian languages and application of the results in the areas of (a) Speech pathology ; (b) Second language acquisition and (c) Cultivation of mother tongue.
2. Studies on acquisition of language and bi-lingualism.
3. Application of statistics in linguistic problems.

A survey of the articulatory and acoustic structure of the Oriya language was initiated in 1979-80. Data has been collected on Oriya speech sounds and spectrographic recordings and analysis carried out. Further data was collected in 1984-85. Fundamental research on the suprasegmentals of Bengali, Hindi and Telugu is in progress. Word stress, sentence melody and intonation patterns are being studied with the help of modern equipment.

Studies are in progress on (a) acquisition of language and mother-tongue and (b) acquisition of Bi-lingualism and factors involved in retention of mother-tongue in areas where other languages are dominant.

Based on data provided by Visiting Professor Djordje Kostic, Belgrade, Yugoslavia, a number of studies are in progress on the vocabularies of leading Yugoslav poets of the 19th and 20th centuries. Vocabularies of three prominent Serbian poets are being processed with the collaboration of the Computer Science Unit. Spectro-graphic data on an American Indian Language, Zuni, was provided by Visiting Professor

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Djordje Kostic for statistical studies utilising Mahalanobis D^2 . A paper on Zuni vowel structure has been written and is in preparation for publication.

A number of comparative studies are planned, based on spectrographic data on the Bengali, Hindi, Telugu, Oriya and Punjabi languages, as well as Serbo-Croat and English. Linguistic data on the Bengali language has been collected and is being collected for purposes of statistical processing for studies on authors' vocabulary and linguistic usage.

PRE-CENSUS POPULATION

(i) Editing of manuscripts of statistical survey of Bengal, 1807-14 by Francis Buchanan — the districts of Gorakhpur and Rungpore.

(ii) Economic changes in rural India : (a) A study of 200 villages in Bengal, Bihar and Orissa, 1850-1981, (b) Trends of socio-economic changes in 4 districts (Burdwan, Broach, Gorakhpur, Bellary) in India, 1801-1981.

(iii) Pre-census atlas.

Work on Gorakhpur has been done on a collaborative basis with Dr. Shahid Amin. It has been identified the tract and prepared the statistical tables, compiled and analysed trends of population and some other key variables at the district level up to 1971. Some papers were earlier published. Recently a paper on Gorakhpur was presented at the Silver Jubilee Seminar of the Socio-Economic Research Institute relating to Economics, Economic History and Indian Society held in November, 1984. Rungpore manuscripts have been copied out except some illegible parts. Tables of the Rungpore survey are being presented in the report on the Population Estimates of India, Vol. II, 1801-1810.

Data were collected from Central Record Room of Directorate of Land Records and Survey of more than 3,000 villages of the districts of 24-Parganas, Nadia, Murshidabad, Malda and Birbhum for 1846-1850 on a ten percent sample basis. There is a map for each village and statistical data are inserted on the map. Data are available on area, houses — kuchha and pucca, population by religion and by division into agricultural and non-agricultural sector, plough and other implements. Among these villages, 1080 villages have been identified on a current list contained in the respective District Census Handbook. Supplementary data at mauza level have already been collected from settlement Halka Office, Collectorate Record Room, Tazui Assessment Office and Settlement Circle Office of the respective district.

There was progress of work in all the 4 districts. (i) *Broach* — Data have been collected on area, area under cultivation by crops, soil type, population with age, sex, caste and religious breakdown, revenue, stock, wages and prices, typical family budget, urban population for several years between 1820 and 1875. A comparative wage table was presented for 1774, 1844, 1864 and 1875 for labourer, carpenter and bricklayer. A time series of prices of grain and cotton was available for 1810-20 and 1833-74. (ii) *Gorakhpur* — Similar data were collected for this tract also, work on both the districts is continuing. Papers are being prepared separately consolidating the data already collected. (iii) *Burdwan, Bellary* — Data on various aspects have been collected and are being processed for analytical studies.

There has been good progress of pre-census atlas for Vol. III, Part-B, India, 1811-1820. The maps are being drawn under the general supervision of the Deputy Registrar General of the Map Division of the Registrar General, India.

PSYCHOOMETRY

Research work in the following projects is going on during this period :

1. *Development of an intelligence test for the hearing impaired children* : The test is revised on the basis of item analysis. Reliability and concurrent validity have been estimated and found to be satisfactory. A report on this has been sent for publication. The data are being collected throughout India for the development of the age norm.
2. *Development of a forced-choice scale of managerial skill* : The data collection for the final form is over. The inventory is being developed on the basis of iterative item analysis and is validated against different standardised inventory and job success index. The final report writing is going on.
3. *Consequences of social and economical deprivation on academic achievement* : The preliminary work for the study is in progress. A questionnaire is being sent to different Bengali medium schools of West Bengal enquiring about the percentage of pass in Madhyamik examination for the last two years, teacher-student ratio and other relevant information. This would help in categorising the schools. About 60% of the cases the schedule has been received back and in other cases the reminder is being sent. Data from four different schools — two of them being in the urban area and two in the rural area have been collected. A preliminary report is being written on the basis of the pilot study made.
4. *Rorschach psychogram through computer programming* : The work has been completed. A paper in this connection entitled Computer model of scoring of Rorschach responses has already been published. Another paper named Computer model of interpretation of Rorschach responses, has also been ready for publication.
5. *Popular concepts of mental health* : A part of data relating to the project was computerised.
6. *Statistical analysis of multiple choice test scores* : After completing the usual item and other analyses related to mental test for the B.Stat. selection test data of the years 1979, 81 and 82 on the basis of classical test theories, further investigation in the light of modern test theories was felt necessary. A computer program was developed to estimate the parameters under latest trait model, assuming that the two parameter logistic item characteristics curve would be suitable for the data. Both item parameters as well as ability parameters were estimated successfully. Further analysis under this model is being done.
7. A project work on Selection tests for Senior and Junior Operative Trainees of the Steel Authority of India Ltd., R & D Centre, Ranchi, July-September, 1984 was carried out.

SOCIOLOGY

The main topics of research were as follows :

1. *Social ecology of Sundarban* : The objective of the study is to explore the possibilities and potentialities of the symbiotic relationship between the societal groups and their natural resources. The sampling design for the study was

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prepared in collaboration with a statistician colleague of Stat-Math Division of ISI. Relevant available materials from the existing sources have been collated and the first phase of the field work has been completed. A preliminary report is available.

2. *Potentialities and constraints of development : A social-ecological approach :* The primary objective of this study is to explore the scope and barriers to development of symbiotic relationship between societal groups and their natural resources in a specific ecological zone. The area under study is the Simlipal forest range in the district of Keonjhor, Orissa. The study is in the preparatory stage.

3. *Problems of deforestation :* The objective of the study is to identify and quantify to the extent feasible the factors influencing the process of deforestation and its consequences on the geographic character of land and species of plants and socio-economic characteristics of the population depending on forest economy. This study will be conducted in different regions of India. An internal seminar on the basis of data already analysed was organised. A report of findings is being prepared.

4. *Problems of social and economic adjustment of persons retiring from active workforce :* The study will examine the aging of the individual as a social unit. The main issue that would be covered are problems arising out of exclusion of individuals from active workforce. Data on social and economic adjustments of the retired persons are being analysed. Preparation of papers has been undertaken.

5. *Village re-survey :* Re-survey will indicate changes in rural life in terms of quantifiable variables, and will also help to analyse processes of societal change. It will also provide comparative data over time.

6. *Value system and social change :* The study seeks to identify socio-cultural and political value patterns among various societal groups in two sample villages in Purulia and to find out how and to what extent these affect the programmes of rural development. The phase of intensive field work being over, data processing is under way.

7. *New pattern of leadership and social action : an exploratory enquiry :* The objective of the enquiry is to study the process and background of the new generation of leaders emerging in the villages along with the recent socio-political changes in the state. The framework of analysis will be graph-theoretic. Scientists of Stat-Math Division of ISI are collaborating in this project. The project will be completed within the next year along with the writing of a report based on the project.

8. *The study of registry marriage and the impact of legislation in West Bengal :* The objective is to study the changing character of marriage as a social institution in West Bengal, the impact of various marriage legislations in this regard, identify the groups by their responses to such legislations and examine the nature and extent of their postmarital adjustments in society. Field work is continuing.

9. *The Hindu-Muslim relationship in Bengal during the 18th century with special reference to the Fakir and Sannyasi rebellion :* The Hindu-Muslim relations, which have played an important role in Indian society, underwent significant changes after the introduction of British rule. Objective of this project is to study these variations in the context of peasant rising which challenged the colonial rule from the middle of the 18th century onwards. In addition to the on-going activities regarding collection

and analysis of relevant archival data, a scientific paper has been published. An intensive small group discussion was organised regarding the various aspects of methodology of appraising peasant movements in colonial India. A note has been prepared on the discussion. Data collection was done in the State Archives, in the manuscript service of Visva-Bharati and in the record rooms of different District Collectorate of West Bengal. Analysis of the materials is over and the report is being finalised. This study has produced a dissertation for doctoral degree.

10. *A study on educational wastage (stagnation and drop-out) at primary and middle school level. (in collaboration with Demography Research Unit) :* The object of the study is to (a) attempt an estimation of expected "life" of a student—a problem of methodological interest; (b) find out educational wastage differences by various demographic, socio-economic and other related factors, (c) try to identify and evaluate various factors as determinants of educational wastage. The study will be confined in the 24-Parganas district of West Bengal. The sampling of schools has been completed and field work is going on.

The Unit is also continuing collaborative work with the scientists of Stat-Math Division to work out new methods of sampling and analysis regarding new substantive areas of research in sociology. A technical report is available in the Unit.

Statistical Quality Control and Operation Research

The Division continued with its objectives of promoting applications of Statistical Quality Control (SQC) and Operation Research (OR) methods, training and education of executives, inspectors, trainees, operators, consultative services to industrial establishments and research in SQC and OR and allied methods. The activities of the Division are organised through comprehensive programme under the broad classification of (a) promotion, (b) training, (c) plant services and (d) research.

(a) *Promotional activities :* Promotional activities were continued in public and private sectors. Inplant training of technologists, trainers, inspectors and operatives including the training programme in local languages and services continued to have support from a number of public and private sector organisations. The units of Bharat Heavy Electricals Ltd., Hyderabad, Haridwar, Bhopal and Jhansi etc., and units of Hindustan Cables Ltd.—Hyderabad and Calcutta continued as servicing plants of the Division besides a number of other plants both in public and private sectors. Several organisations were added to the list of servicing plants during the period.

The Division undertook new project assignments during the period apart from rendering consultative services to factories already on its rolls. The Division has so far produced about 850 specialists and over 700 research papers, technical literatures, manuals etc. The Division continued liaison with various academic and technical institutions, productivity councils, societies and several other national and international bodies by way of its academic, technical and promotional activities. The specialists from the Division delivered 276 lectures, talks, etc., to various institutions and organisations. The Division also arranged 20 seminars and the specialists from various units attended 37 seminars. Introductory visits were paid to 44 factories. 16 surveys and pilot projects were carried out and 23 reports sent.

(b) *Education and training :* Inplant training programme at various factories continued. A series of training programmes for senior executives of Bharat Heavy

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Electricals Ltd., continued on regular basis, besides regular inplant programme for executives at various level. One-year special programme for executives at fairly advanced level blended with practical applications continued for fifth and sixth batches of trainees at Madras. Several short term specially designed training programmes were also conducted at different units of the Division for select group of executives from organisations in India and abroad.

During the period under review 3890 managers and technologists were trained in various inplants, general and other courses, 171 trainees underwent professional training in SQC and OR at a post graduate level and in part-time courses in Calcutta, Bombay, Delhi, Madras, Bangalore and Hyderabad. A general course and later, a specialisation course in SQC-OR was offered to the trainees of International Statistical Education Centre (ISEC) by the Division.

The Division organised a Summer Institute on 'Algorithmic aspects of mathematical programming' at IIM, Bangalore. Twenty-seven participants including university teachers and SQC-OR specialists of the division attended the programme. Besides SQC-OR specialists from the division some external experts in the area served as faculty for the programme.

(c) *Services* : During the period under review 17 plants joined the SQC service scheme. 130 technical reports were sent to factories and 14 factories discontinued. A total of 63 factories are taking consultative services as in March 1985.

Special studies involving applications of SQC and OR methods were taken up in the areas : Blending operation in refinery ; optimal despatch model ; optimisation of cutting material for connecting plate ; control of heating elements ; optimum design of air heater economiser ; design optimisation of tubular air heaters ; study on valve stem grinding ; critical components for burner assembly ; surface defects of tubes, expansion in tube to tube joints, defective parts in old joints ; computer programmes for cluster analysis graphic of terminals etc., replacement of spinning and allied frames, welding of centrifugal compressor impeller ; tool wear in machining of rotor slots ; SFC of diesel engines ; outgoing quality of diesel engine ; leakage problem in DMA of FHP compressors ; rejection in die casting ; discharge gas temperature of compressors ; amount of ash in paper ; optimum design of ceiling fan for minimum wattage consumption and maximum air delivery.

(d) *Research* : During the period under review 8 papers were published, 26 submitted for publication and presented, at conferences, seminars etc., 25 manuals and technical reports, etc., prepared by the specialists of the Division. Some of the areas in which applied research work is carried out include algorithm for testing a Z-matrix, simple games and reliability coherent structure ; operation of contraction for simple games based on analogy of matroids and some combinatorial results for matroidal games ; optimum design of control charts ; inspection error and its effect on outgoing quality ; three-decision Bayesian sampling plan ; continuous sampling plan ; optimum ordering policy for exponentially decaying inventory etc.

Library, Documentation and Information Sciences

Central library : With the addition of 2,728 books and 4,260 bound volumes of journals to the stock the total collection of the Library rose to 1,79,843 volumes.

Acquisition unit : The unit accessioned 2,728 titles during the period under report, out of which 2,233 were purchased and 452 were received as gift. 5 titles were

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also acquired on exchange basis. It also acquired 701 titles for the Circulating Library.

Periodicals unit : The Unit received 2,438 periodicals out of which 719 were received against subscription, 1,100 on complimentary basis and 619 on exchange arrangement with national and international organisations. The Library also acquired 70 back volumes of journals. It accessioned 1,260 bound volumes of journals and completed the technical processing of 800 journal titles.

Circulation and stock maintenance unit : The Unit issued 71,838 books and journals to the users on loan and on reference. The total membership of the Library rose to 4,532 which includes NSSO staff, ISI staff, Research Scholars and Project Assistants, B.Stat. & M.Stat. students, ISEC trainees etc., as well as outside students and institute members. 422 readers were given special permission to use the library for a short period. 84 books and journals were borrowed from other libraries and 8 books and journals were loaned to other libraries under the Inter-Library loan arrangement.

Reports and records unit : The Unit accessioned 584 titles and processed 854 titles. 1,560 titles were issued to borrowers during the period.

Translation unit : The Unit translated the following : last portion of 'A quality control text : off-line quality control relating to technical and design departments' by G. Taguchi (1981), German document — Data Bank Architecture, A French research paper placed at the International Conference on Operational Research, A communication in German from a German technical publication and has taken up a project to translate a Japanese document on 'Multivariate Analysis' ed. by Prof. T. Kitagawa.

Shri Sunit Bose, Translator is giving a regular course in Russian to the B.Stat. students.

Special materials unit : The Unit accessioned 96 micro-documents and 115 Russian books.

Circulating library : The Workers' circulating library acquired 700 new titles bringing the total collection to 32,807 books. It issued 32,185 books to the members.

Technical processing unit : The Unit classified 1,550 and catalogued 2,195 new books.

Reprography and photography unit : The Unit provided 2,23,758 xerox prints for the users during the period under report. 516 frames of photographs of different occasions, 7,198 prints of bromide enlargements, 1,356 frames of microfilming from drawing books, charts, journals, etc., 1,421 copies of photoprints from big maps and documents and 389 slides for lecture were made during the period under report.

Delhi Centre Library Books : The Delhi centre library accessioned 670 new books and 589 bound periodicals during the period under report. 88 publications were received as gift. The total collection of the library rose to 24,069 documents. In addition to the above more than 100 reprints in printed form and 250 technical reports in microform were also added to the stock.

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Periodicals : The library received 277 titles of periodicals both Indian and foreign, out of which 13 were received either on exchange or on complimentary basis.

Circulation : The library issued 12,493 publications during the period under report. The total membership of the library were 284 out of which 188 were given special permission to avail of the reading room facilities and 96 continued to utilize the facilities as permanent members. 162 publications were borrowed from other libraries on inter-library loan and 110 were lent out to other institutions.

Reprographic services : 5,426 pages of xerox copies were obtained to serve 104 readers.

Documentation service : 5000 cards were prepared to compile a bibliography entitled Women Studies in Asia, on the occasion of the Regional Conference on 'Women and the Household' at Delhi Centre from January 27-31, 1985. The List of Additions continued to be circulated during the period under report.

Library trainees : As usual 4 Library trainees were appointed on monthly remuneration for a period of 4 months. They were awarded an experience certificate after the expiry of the period.

A book exhibition was also arranged from January 27-31, 1985.

Bangalore Centre Library : During April 1984-March 1985, with the addition of 807 books, total collection of Library rose to 8462. During this period, 40 books were received on grants. The number of bound volumes of periodicals added during this period was 202. Also 2 new periodicals were subscribed during the period. About 280 books were classified during the year. 320 books were catalogued. About 2,500 catalogue cards were filed. A total of about 4,480 books were circulated by the library during the period; Number of periodicals (including bound volumes) circulated was around 3,570. Also the inhouse use of books and periodicals was around 11,200. About 412 inter-library loan transactions were handled.

Documentation Research and Training Centre (DRTC), Bangalore

(i) *Objectives and programmes of DRTC* : The objectives of DRTC are as follows : (a) To contribute to the development of different branches of information sciences including documentation and library science by doing, guiding, and supporting research and development in the concerned fields. The aim is to develop expertise and excellence in different areas of information science. (b) To help development of information centres including libraries, documentation centres, data centres and information analysis and consolidation centres by offering advisory services in designing specific development plans, tools and techniques required for this purpose. (c) To disseminate results of research, information analysis and consolidation and of advisory services in different areas of information sciences including documentation and library science. (d) To develop man-power with appropriate professional skills and understanding that is capable of participating efficiently and effectively in the management (that is, design, development, organization, implementation, operation, control and evaluation) of information service systems, centres and programmes and in the advanced teaching and research programmes in information sciences; and to help this man-power in finding appropriate job opportunities. (e) To ensure the development of the man-power

engaged in professional activities. (j) To ensure the development of the members of the DRTC Faculty.

(ii) *Training* : The 1984-85 session of the DRTC Course leading to the award "Associateship in Documentation and Information Science" commenced on 1 August 1984. On the basis of an admission test and interview, 8 candidates were selected for admission to the course. There were 3 deputed candidates.

(iii) *Research* : The main topics of research in which the different members of the DRTC Faculty have been engaged during the period of report are furnished below :

(1) Application of the Postulate-based Permuted Subject Indexing (= POPSI) to text-indexing for information retrieval. (2) Designing a classaurus based on the general theory of subject indexing language for indexing documents in the field of agricultural sciences and technology. (3) Revision of the schedules of basic subjects and common isolates in the Colon Classification of Dr. S. R. Ranganathan. (4) Analysis of the trends pertaining to the different varieties of sources of information and communication media. (5) Impact of information technology on document delivery services in libraries. (6) Planning and management of information systems and services. (7) Information analysis and consolidation. (8) Bibliometrics—development of measures for evaluating use of library and information services. (9) Library automation—guidelines for developing software for serial and circulation control. (10) Library education—development of curriculum for Master's degree programme in library and information science. (11) Development of a system for on-line generation and maintenance of alphabetic classaurus. (12) Computer generation of Chain Index Entries and PRECIS-Formal Entries from a single input prepared according to the general theory of subject indexing language.

Progress of the project : The DRTC project for designing a classaurus for agricultural sciences and technology was taken up by G. Bhattacharyya. The Project has been planned to be completed in minimum three years—that is, in November 1987. The totality of work involves several broad stages as follows : (1) The study of the subject "Agricultural Sciences and Technology" to determine precisely the scope of the subject for indexing purpose ; (2) To develop a reference framework of classification scheme on the basis of primarily an *a-priori* approach. (3) To collect a comparatively large assorted sample of document references with abstracts falling within the area of "Agricultural Sciences and Technology." (4) Indexing of the collected references according to the general theory of subject indexing language (= GETSIL). (5) Preparation of "Term Cards" for each substantive term indexing its definition wherever necessary, equivalents, superordinates, subordinates, illustrative references, etc. (6) Organizing the collected terms within the reference framework of the classification scheme to augment it to produce the first draft of the Classaurus. (7) Using the first draft to index another large sample of document references separately collected for this purpose to determine the extent of the application-value of the draft Classaurus, and to incorporate necessary changes on the basis of the indexing experience ; and (8) Finalizing the Classaurus according to standardised methodology and format. The work of the study of the subject was completed during the period of the report. The development of the reference framework of classification scheme is in progress. It will take some time to finish it as many classification schemes and thesauri are to be analysed for this purpose.

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3. SYMPOSIA, SEMINARS, LECTURES AND CONFERENCES

Among different conferences, symposia, seminars, workshops and lectures organised by the Indian Statistical Institute mention may be made of the following :

A one day workshop on Eucalyptus Plantation was held on June 29, 1984 at Bangalore. About 40 delegates from all over India participated.

The 38th annual conference of the Indian Society of Agricultural Statistics (ISAS) was held at Indian Statistical Institute during November 24-26, 1984. The conference was organised by ISI. Shri J C Sengupta, IAS(Reid., Vice-Chancellor, Bidhan Chandra Krishi Viswa Vidyalaya delivered the inaugural address. Two symposia on (i) Application of robust non-parametric reference techniques in agriculture and (ii) Increase in agricultural productivity from non-monetary inputs. About 110 delegates from different states of India participated in the Conference.

The Indian Association for the Study of Population in collaboration with the Indian Statistical Institute organised a two-week Orientation Course in Demography during 29 November to 12 December 1984. The idea was to give a brief exposure to techniques in quantitative analysis to young lecturers, social scientists and Government officials in East and North Eastern India.

An international conference on Quantum Statistics and Foundational Problems of Quantum Mechanics, was held in the Indian Statistical Institute during the period January 28-February 1, 1985. Many foreign mathematicians and physicists participated in its deliberations. Professor P. Bandhyopadhyay gave a talk on Stochastic Quantization, Supersymmetry and the Anisotropy of Microlocal space-time. Dr. Sisir Roy also delivered a talk.

A two-day workshop on the Strategies for the Seventh Plan was held during 15-16 April, 1985 at I.S.I. Delhi Centre. It was organised by Dr. V. K. Chetty.

Besides the above, the following seminars/lectures were arranged during the period.

Dr. R. N. Mohan, D. A. R. College, Nuzvid, Andhra Pradesh (4.4.84-6.5.84) delivered a lecture entitled 'On dualization in combinatorial designs.'

Dr. Dipak Dey, Texas Tech. University, U.S.A. (4.7.84) delivered a lecture entitled 'Estimation of covariance matrix under Stein's loss.'

Dr. Bimal K. Sinha, Department of Statistics and Mathematics, University of Pittsburgh, Pennsylvania, U.S.A. (2.7.84-27.7.84) delivered a series of lectures entitled 'Robustness of multivariate tests.'

Dr. P. K. Sen, University of North Carolina, Chapel Hill, U.S.A. (16.7.84) delivered a lecture entitled 'Two sample Kolmogorov-Smirnov tests with unknown location.'

Dr. P. K. Bhattacharya, University of California, Davis, U.S.A. (23.7.84) delivered a lecture entitled 'Estimation of density functions and regression functions.'

Dr. P. Jeganathan, University of Michigan, U.S.A. (29.7.84-4.8.84) delivered two lectures entitled (i) 'An elementary proof of the converse of the Lindeberg-Levy theorem' and (ii) 'On local asymptotic admissibility for the mixed normal families.'

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Dr. Subinoy Chakravarty of Michigan State University, U.S.A. (18.10.84) delivered a lecture entitled 'Bloch functions.'

Professor S. Panchapakesan of Southern Illinois University, Carbondale, U.S.A. (29.10.84-19.10.84) delivered two lectures entitled 'Some selections and ranking procedures—I and II.'

Professor A. P. Basu, University of Missouri, U.S.A. (5.11.84-21.11.84) delivered a lecture entitled 'Testing whether survival function is harmonic new better than used in expectation (HNBUE).'

Professor Geri H. Muller, University of Heidelberg, W. Germany (10.11.84) delivered a lecture entitled 'The axiom of determinateness and the projective hierarchy.'

Professor J. S. Rustagi, The Ohio State University (17.4.84) delivered a lecture entitled 'Jackknife and probability density estimates.'

Dr. Samar Singh, BHEL (25.4.84) delivered a lecture entitled 'Improved methods of storing and updating information in the out of the Kilter algorithm.'

Dr. S. Lalitha, IIT, Kanpur (30.5.84) delivered a lecture entitled 'Murphy's test for two or more outliers in a linear model.'

Dr. W. J. Anderson, McGill University (31.5.84) delivered a lecture entitled 'Application of queueing theory of photographic science.'

Professor A. M. Mathai, McGill University (12.7.84) delivered lectures entitled (i) Extensions of Wilks' integral equations and distributions of test statistics, (ii) Linear combinations of random variables with applications to queueing and other models.

Professor John G. Thompson, University of Cambridge (30.7.84) delivered a lecture entitled 'The history and classification of finite simple groups.'

Dr. M. T. Nair, IIT, Bombay (9.8.84) delivered a lecture entitled 'Rayleigh-Schrodinger approximation foreign elements.'

Professor T. V. Narayana, University of Alberta (7.8.84) delivered a lecture entitled 'The catalan sequence again.'

Professor M. S. Raghunathan, TIFR (30.8.84) delivered a lecture entitled 'Arithmetically defined hyperbolic space forms.'

Dr. K. C. Tripathi, University of Delhi (19.9.84) delivered a lecture entitled 'Lie superalgebras.'

Dr. T. Krishna Kumar, Indian Institute of Management, Bangalore (23.5.84) delivered a lecture entitled 'Gerhard Tintner, the econometrician.'

Dr. P. R. Brahmananda, University of Bombay (24.5.84, 20.6.84, 26.10.84, 9.11.84) delivered lectures entitled (i) An economist view of the rational expectations revolution, (ii) The Seventh Plan priorities and perspectives, (iii) Contributions of Professor J. R. N. Stone, (iv) India's economic development under Indira Gandhi era.

Mrs. Indira Rajaraman, Indian Institute of Management, Bangalore (27.7.84 and 2.8.84) delivered lectures entitled (i) Wages and labour supply in rural labour markets, (ii) Labour supply in rural labour markets.

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Dr. P. A. V. B. Swamy, Federal Reserve Board, Washington (11.7.84-18.7.84) delivered lectures entitled (i) The foundations of econometrics—are there any? (ii) Estimating distributed by relationships using near-minimax procedures.

Dr. N. H. Stern, University of Warwick, U.K. (25.10.84) delivered a lecture entitled 'Alcohol-demand and taxation.'

The following seminars/lectures were organised by the Economic Research Unit during the year.

Dr. L. K. Raut, Yale University and World Bank (12.4.84) : Capital accumulation, income inequality and endogeneous fertility in an overlapping general equilibrium model.

Professor L. Meldelosi of Naples, Italy (23.4.84) : Critical economics and long-term economic history.

Professor Amitaba Kriahna Dutt, Florida International University (21.6.84) : Uneven development.

Professor Mihir K. Rakshit, Presidency College, Calcutta (1.8.84) : Some features of the General Theory model.

Smt. Amita Majumdar, ISI (22.8.84) : A system of demand equation based on price independent generalized linearly.

Dr. Tapao Sinha, University of Wisconsin, U.S.A. (23.8.84) : Wealth distribution in the absence of annuity market.

Dr. Ajit Chowdhury and Kalyan Sanyal, University of Calcutta (5.9.84) : On mis-reading Kalecki.

Professor Yashkin, Institute of Oriental Studies, U.S.S.R. (15.9.84) : New economic order and Indo-Soviet economic co-operation.

Dr. Abhirup Sarkar, ISI (26.9.84) : Patterns of specialization in a neo-Austrian model of international trade.

Dr. Anantadeb Bhattacharya, Tata Energy Research Institute, New Delhi, (29.9.84) : Economics of fuel choice in thermal power generation in India.

Dr. Debprasad Chatterjee and Arup Mallick, University of Calcutta (16.10.84 & 12.11.84) : Marx's value theory in relation to Marx's theoretical method : an issue in the history of economic thought.

Dr. Anjan Mukherjee, Jawaharlal Nehru University, Delhi (25.10.84) : Stability and general equilibrium.

Sri P. Gajapathi, ISI (16.11.84) : On causality.

Sri T. K. Dasgupta, Deputy Director of Industries, West Bengal (26.11.84) : A steady declining trend in engineering industry in West Bengal—A statistical analysis.

Dr. A. K. Sengupta, ISI (28.11.84) : On effective rate of protection and shadow price of foreign exchange.

Dr. D. Dasgupta, ISI (12.12.84) : Some remarks on the general : The market for land—An analysis of interim transaction.

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Dr. Kaushik Basu, Delhi School of Economics (20.12.84) : Some remarks on the general : Stagnation, tenurial insecurity and the law.

Dr. Sanjit Bose, ISI (2.1.85) : Physocracy and theoretical : the boundary and measurement of production.

Dr. Sugata Marjit, Centre for Economics Studies, Presidency College (23.1.85) : Temporary shocks and the current account in large countries.

Professor Angus Deaton, Woodrow Wilson School of Public and International Affairs, Princeton University, USA (29.1.85) : Modelling demographic effects on household expenditure patterns.

Dr. Manas Ranjan Gupta, Burdwan University (13.2.85) : Shadow wages, migration and investment of rural surplus.

Dr. Srikanta Chatterjee, Massey University, New Zealand (20.2.85) : Balance of payments constraints and economic growth : Some empirical evidences.

Dr. Tamal Datta Chowdhury, Department of Economics, University of Calcutta (6.3.85) : Informal sector vis-a-vis the formal sector : A theoretical analysis of linkages.

Dr. Monojit Chatterjee, Economic Analysis Unit, ISI, Bangalore, (18.3.85) : Union dutch disease and unemployment.

Dr. B. K. Pradhan, ISI, Delhi (26.3.85) : Periodic behaviour of a competitive monetary economy.

The Seminars Organised by the Demography Research Unit during the year are as follows :

Dr. P. K. Majumdar, National Family Planning Board, Government of Malaysia (1. 8. 1984) : Female labour force in Malaysia.

Dr. P. K. Sircar, Hony. Director, Family Welfare Development Research Project, South Bihar (10. 12. 1984) : Survey strategy of primitive tribes of South Bihar.

Dr. A. S. Chauhan, Research Officer, Population Project, Uttar Pradesh (11. 12. 1984) : The area project in our country.

Dr. K. G. Jolly, Institute of Economic Growth, Delhi (12. 12. 84) Differential performance of family planning at the district level.

Sri Babulal Pathak, Population Research Centre, Patna (12. 12. 84) : On impact of sex preference and voluntary sterilization on sex ratio.

Dr. P. K. Majumdar, Visiting Scientist, (4. 12. 84) : A frame work for generational growth in human population and its application to rural Uttar Pradesh.

Shri B. N. Sarkar, Demography, (8. 5. 84, 27, 9. 84, 5. 12. 84.) : (i) Development prospects in rural Bengal. (ii) People and states in India around the nineteen eighty. (iii) On collection of live birth statistics.

Sri A. K. Ghosal, Demography, (7. 12. 84) : Studies on work force participation in India.

The seminars/lectures organised by the Applied Statistics, Surveys and Computing Division during the period of report are :-

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Dr. N. K. Mandal, Calcutta University (17.4.84) : *D*-optimal designs in exploratory studies (Uniresponse and Multiresponse).

Dr. S. Iyenger, Indian Institute of Science, Bangalore (6.8.84) : Translation invariant data structure for strong images.

Dr. S. Pramanik, Michigan State University, USA (24.8.84) : Data base machines.

Dr. T. Roy Chaudhuri, Calcutta Medical Research Institute (19.9.84) : Use of statistics in heart surgery.

Dr. A. Dewanji, University of Waterloo, Canada (17.10.84) : Non-parametric estimation of disease-onset distributions.

Dr. J. Seberry, University of Sydney, Australia (23.11.84) : Public key secret codes.

Dr. S. Dasgupta, University of South-Western Louisiana, U.S.A. (4.1.85) : Some recent advances in Firmware Engineering.

Prof. M. Taguri, Chiba University, Japan (17.1.85 and 27.2.85) : (i) Graphical methods for representing multi-dimensional data. (ii) Some sensitivity analysis and its application in stratified random sampling.

Dr. P. K. Bose, Artificial Intelligence Research, CSE, U.S.A. (30.1.85) : Is artificial intelligence a reality?

Prof. M. Sen, Kalyani University (14.2.85) : Optimal repeated measurements designs under interaction.

Prof. T. Inoue, Chiba University, Japan (1.3.85) : Statistical analysis of nitrogen oxide concentration data.

Dr. A. S. Bhatia, Applied Statistics, Surveys and Computing (4.4.84) : Prediction of survival in burn patients.

Dr. B. N. Mukherjee, Applied Statistics, Surveys and Computing (11.4.84) : Explicit solution of maximum likelihood estimates in analysis of covariance structure.

Dr. T. Krishnan, Applied Statistics, Surveys and Computing (18.4.84) : Transformations on multivariate binary data.

Dr. P. Bhimasankaram, Applied Statistics, Surveys and Computing (9.5.84) : Solution of linear equations : A unified approach.

Dr. P. S. S. N. V. P. Rao, Applied Statistics, Surveys and Computing (16.5.84) : Biased estimation of regression coefficients : A simulation study.

Dr. M. Pal, Applied Statistics, Surveys and Computing (123.5.84) Grouping and rank estimators in "Errors-in-Variables" models.

Dr. A. Sengupta, Applied Statistics, Surveys and Computing (30.5.84, 20.6.84 and 27.6.84) : Additional and incomplete information : optimal tests and numerical computations.

Dr. P. P. Majumder, Applied Statistics, Surveys and Computing (8.6.84) : Likelihood analysis in detecting genetic linkage : Theory and applications.

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Dr. A. Chaudhuri, Applied Statistics, Surveys and Computing (18.7.84) :
(i) Optional randomization in responses. (ii) Certain optional strategies in sampling.

Dr. B. Gupta, Applied Statistics, Surveys and Computing (1.8.84) :
Universal test sets for detecting stuckat and bridging faults in Reed-Muller canonic networks.

Dr. H. Mukherjee, Applied Statistics, Surveys and Computing (5.9.84) :
Construction of factorial designs controlling inter-action efficiencies.

Dr. S. Bagchi, Applied Statistics, Surveys and Computing (12.9.84) : On the optimality of MBGDDs under mixed effects model.

Dr. A. C. Mukhopadhyay, Applied Statistics, Surveys and Computing (25.10.84) :
Generalised hadamard matrices and their uses in statistics.

Dr. B. K. Roy, Applied Statistics, Surveys and Computing (7.1.84, 20.2.85) :
(i) Applications of eigen values in graph theory. (ii) On optimality of some covering designs for block size 3.

Dr. R. Roychowdhuri, Applied Statistics, Surveys and Computing (14.11.84) :
Growth in the first year of life.

Dr. A. Chaudhuri, Applied Statistics, Surveys and Computing (21.11.84) :
Asymptotic optimality of generalized regression estimators in double sampling.

Dr. R. Saharay, Applied Statistics, Surveys and Computing (28.11.84 and 1.12.84) :
Non-additive models in block designs.

Dr. P. Mukhopadhyay, Applied Statistics, Surveys and Computing (23.1.85) :
Estimation under linear regression models.

Dr. T. Krishnan, Applied Statistics, Surveys and Computing (6.2.85 and 13.2.85) :
Efficiency of an imperfect teacher.

Dr. M. Pal, Applied Statistics, Surveys and Computing (13.3.85) : Estimation of parameters of a three-parameter lognormal distribution when the sample size is 20.

Dr. A. Basu and P. P. Majumdar, Applied Statistics, Surveys and Computing (20.3.85) :
Anthropometry in the Eastern Himalayas : Effects of altitude, ethnicity, religion and occupation.

The seminars organised by DRFC, Bangalore are : On "New policy of the British Council libraries in India" held on 12 April 1984. The leading presentation was made by Mr. David Spiller, Head, Information Resources Unit, British Council Division, British High Commission, New Delhi.

On "Industrial information systems and services" held during 23-28 April 1984. The lectures were delivered by Sri B. S. Ramananda, Superintendent, Central Technical Information Centre, HMT Ltd., Bangalore.

On "Translation services" held during 25-29 April 1984. The lectures were delivered by Shri M. V. Ranganathan, Manager, Central Technical Information Centre, HMT Ltd., Bangalore.

On "Information society : Its features" held during 12-14 June 1984. The leading presentations were made by Professor A. Noellameghan, Division of General Information Programme (PGI), Unesco, Paris.

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On "Integrated information resource management systems" (IRMS) held on 18 June 1984 in collaboration with Institution of Engineers. The leading presentation was made by Prof. A. Neelameghan, Division of General Information Programme (PGI), Unesco, Paris.

On "Current trends in the curriculum for post-graduate courses in Information science" held on 25 July 1984. The leading presentation was made by Dr. I. K. Ravichandra Rao, DRTC, Bangalore.

On "Ranganathan's ideas" held on 9 August 1984. The leading presentations were made by Dr. G. Bhattacharyya, Dr. M. A. Gopinath, Dr. S. Seetharama, Dr. I. K. Ravichandra Rao and Dr. F. J. Devalason.

On "Information flow in planning and coordination." held on 13 August 1984. The leading presentations were made by Shri G. K. Arora, Scientist-in-Charge, Planning, Monitoring and Evaluation Group, National Physical Laboratory, New Delhi.

On "Industrial information flow to small and medium scale industries in and among developing countries." held on 5 September 1984. The leading presentation was made by Dr. C. V. S. Ratnam, UNIDO Consultant, Bangalore.

On "Development of terminology in library classification : Ranganathan's contributions" held on 27 September 1984. The leading presentation was made by Dr. K. N. Prasad, Documentation Officer, HMT Ltd., Bangalore.

On "Microcomputer and information work" held on 9 November 1984. The leading presentation was made by Professor A. Neelameghan, Division of General Information Programme (PGI), Unesco, Paris.

On "Impact of technology on libraries" held on 22 Nov., 1984. The leading presentation was made by Professor S. Parthasarathy, Retired Scientist-in-Charge, INSDOC, New Delhi.

The DRTC Refresher Seminar (15) on "Current trends in information sources and communication media (ISCOM)" was held in DRTC, 12-14 Dec., 1984. Dr. M. A. Gopinath prepared the working document and presented it during the seminar. About 100 professionals from the different parts of India participated in the Seminar.

DRTC (in collaboration with the Sarada Ranganathan Endowment for Library Science) organised the 16th Series of the Sarada Ranganathan Lectures, 12-14 December, 1984. Professor G. Bhattacharyya delivered the lectures. The theme of the lectures was "Indexing Language." It was delivered in three successive parts. The titles of the lectures were : (1) General theory of subject indexing ; (2) New indexing systems based on the general theory ; and (3) New vocabulary control device based on the general theory. About 100 professionals from different parts of India attended the lectures.

Professor T. N. Rajan, Head, Training Division, INSDOC, New Delhi presented a seminar on "Document delivery system", on 9 January, 1985.

Professor Anthony Thompson, College of Librarianship, U. K., presented seminar on "Trends in library and information science education with special reference to U.K." on 14 January 1985.

Mr. Clive D. Wing, Regional Programme Officer (Information Sciences), International Development Research Centre, New Delhi presented a seminar on "IDRC's information programmes in South Asia" on 31 January 1985.

Professor C. A. Taylor, Topic Leader, Information Transfer and Technology, ICSU, Paris, presented a seminar on "Information transfer and technology" on 31 January 1985.

Professor A. Neelameghan, Division of the General Information Programme, Unesco, Paris, presented a seminar on "The use of computer for bibliographic information service : Problems of developing countries", on 23 March 1985.

4. PUBLICATIONS

The following publications were brought out during April 1984 — March 1985 :

(i) *Sankhyā* : The Indian Journal of Statistics, the official organ of the Indian Statistical Institute.

Series A : Vol. 46, Parts 2, 3

Series A : Vol. 47, Part 1

Series B : Vol. 46, Parts 1, 2, 3.

(ii) The following proceedings have been published during the period :

(1) Proceedings of the Golden Jubilee International Conference on Statistics : Applications and New Directions.

(2) Proceedings of the Golden Jubilee International Conference on Advances in Information Sciences and Technology.

Vol. 1 : Pattern Recognition and Digital Technique.

(3) Proceedings of the Golden Jubilee International Conference on Human Genetics and Adaptation.

Vol. 2 : Human Adaptation.

(4) Proceedings of the Golden Jubilee International Conference on Frontiers of Research in Agriculture.

(5) Proceedings of the Conference on Combinatorics and Applications in Honour of Professor S. S. Shrikhande, December, 1982.

(iii) Thirty-one technical reports from the Statistics-Mathematics group have been issued during the period.

5. SCIENTIFIC PAPERS AND PUBLICATIONS

List of Papers Published

Theoretical Statistics and Mathematics

1. Bagchi, S. (with Sitaram, A.) (1984) : Some remarks on Homomorphisms of compact Lie groups. *Proc. Amer. Math. Soc.*, 93, 159-163.

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2. Dhatia, R. (1984) : Variation of symmetric tensor powers and permanents. *Linear Algebra and Application*, 62, 269-276.
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2. ---- (with Gopalakrishna, Mallika) : On appropriate criteria for measurement of levels of living, Indian Economic Review.
3. Swamy, P. A. V. B. (with Mehta, J. S., Thruman, S. S. and Iyengar, N. S.) : A generalised multicollinearity index for regression analysis. Sankhyā, B.
4. Suryanarayana, M. H. (with Iyengar, N. S.) : On the reliability of NSS data, Economic and Political Weekly.

National Income

1. Mazumdar, Krishna (with Pal, Manabendra) : Inter-state variation in the human resources and economic development, Indian Journal of Regional Science.

Pre-Census Population

1. Deb Roy, Rama : The great trigonometrical survey of India in a historical perspective, Indian Journal of History of Science.

Psychometry

1. Banerjee, S. N. : A solution on the Epileptic personality—A Psychodiagnostic approach, Journal of Indian Academy of Applied Psychology.
2. Chatterjee, S. (with Mukherjee, M.) : Isolation of profile pattern of successful individuals using cluster analysis and Q-technique, Japanese Psychological Research, Japan.
3. ---- (with Mukherjee, M., and Ghosh, Anjali) : Managerial motivation and self assessment of certain managerial qualities, Personnel Psychology, U.S.A.
4. ---- (with Mukherjee, M., and Gupta, Rumki) : Assessment of intelligence level of hearing impaired children, Indian Journal of Applied Psychology, Madras.
5. ---- (with Mukherjee, M.) : Comparison of the personality pattern of over, under and equal achievers, Journal of Education — Psychology, Mysore.
6. Mukherjee, M. (with Chatterjee, S.) : Effectiveness of merit as promotion criterion, Productivity, New Delhi.

Sociology

1. Biswas, S. K. : Dependence and family care of the aged in village India : A case study, The Journal of International Studies, No. 11, Japan.

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2. Chakraborti, Prafulla : Some aspects of complex families in Calcutta, Journal of Comparative Family Studies, Canada.

Statistical Quality Control

1. Ghosh, D. T. : An investigation on the effect of inspection on AOQ of a single sampling plan acceptance-rectification system, Sankhyā.
2. Majumdar, A. : System of double sampling plans for fixed sample sizes, C.S.A. Bulletin.
3. Narayana, V. : Quality assurance. Special technical number for the 47th Annual meeting of Institution of Engineers.
4. Narayana, Iyer, V. : Popularising defect prevention approaches in industries through operative training programme, QR Journal of Indian Association for Quality - Reliability.
5. Pandey, R. J. : A note on asymptotic solution to Bayesian three-decision plan, Sankhyā.
6. Ramanurthy, K. G. (with Mohan, S. R.) : Non-negativity of principal minors of P -matrices, Linear Algebras and its Applications.
7. ---- (with Parthasarathy, T.) : Matroidal games, International Journal of Game Theory.
8. ---- : A polynomial algorithm for testing the non-negativity of principal minors of Z -matrices, Linear Algebras and its Applications.
9. Rajendra Prasad, V. : Scheduling on a single processor subject to interruption in processing, OPSEARCH.
10. Ramanurthy, K. G. (with Parthasarathy, T.) : A generalization of the three modules theorem, OPSEARCH.

Teaching and Training Division

1. Das, P. K. : Multipliers into a class of analytic functions, Demonstratio Mathematica, No. 3, 18.

Library, Documentation and Information Sciences

1. Chatterjee, Bhomra : Charging system in a large library, Granthagar (in Bengali).
2. ---- : Sadharan granthagar upoyogi charging byabastha. Granthagar.
3. ---- (Jl. comp.) : Granthakar nama, rev. ed.
4. Devadason, F. J. : Micro-computer applications in library automation and in-house information retrieval, Librarian, 17.
5. Gopinath, M. A. : Citations in biochemistry : an analysis of periodical literature, Library Science with a slant to Documentation, 22.
6. ---- : Collection development and usage : an analytical approach, Library Science with a slant to Documentation, 22.

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7. --- : Compound subjects in biology and agriculture : a quantitative analysis, Library Science with a Slant to Documentation, 22.
8. --- : Compound subjects in the field of physics : Quantitative analysis of facets, Library Science with a slant to Documentation, 22.
9. Ravichandra Rao, I. K. (with Gopinath, M. A.) : Collection development and usage. Library Science with a slant to Documentation.
10. Seetharama, S. : Compatibility among medical classification systems : A case study in the classification of cardiovascular diseases. International Classification.
11. --- : Model of presentation of information in information consolidation products, Library Science with a slant to Documentation, 21.

Papers read at Conferences and/or to be published in Conference Proceedings

Theoretical Statistics and Mathematics

1. Karandikar, R. L. (with Kallianpur, G.) : White noise calculus, IFIP working conference on stochastic modelling and filtering, Rome, December, 1984.
2. Prakasa Rao, B. L. S. : Interface between probability and statistics, Symposium on Frontiers in Mathematical Sciences, I.I.T., Kanpur, March 1985.
3. Rama Murthy, K. (with Rajput, B. S.) : Properties of semistable probability measures on \mathbb{R}^m , Proceedings of a Conference held in Lublin, Poland, 1983. Probability Theory on Vector Spaces III (Lecture Notes in Mathematics ; 1080) Springer-Verlag, 1984, 214-232.

Applied Statistics, Surveys & Computing

1. Adhikari, A. K. (with Bandyopadhyay, S.) : Growth curves using longitudinal data. Presented in the second conference of the Indian Society for Medical Statistics held at Lucknow in 1984.
2. Basu, A. : Classification of parallel processing system. Presented at the International Conference on Computer Design held at New York in October, 1984.
3. Basu, T. K. : Computer simulation of blood glucose homeostasis under different physiological condition. Presented at the 29th Congress of the Indian Society of Theoretical and Applied Mechanics held at Karnataka in 1984.
4. Chaudhuri, A. : Foundation of survey sampling theory : A review—An invited talk given at the Silver Jubilee Celebration of IASRI held at New Delhi in 1985.
5. --- (with Mukherjee, R.) : Optimally randomized response techniques. Presented at the Indian Science Congress held at Lucknow in 1985.
6. --- (with Adhikari, A.) : On varying probability sampling strategies with randomized response about quantitative items. Presented at the Indian Science Congress held at Lucknow in 1985.
7. Gupta, B. : Logical modelling of physical failures and their inherent syndrome testability in MOSLSI/VLSI networks. Presented in the IEEE International Test Conference held at Philadelphia in October 1984.

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8. Gupta, S. K. : Cholesterol content on major arteries of rat. Presented in I.S.C.A. conference in the Physiology section on January, 1985.
9. --- : Diets on Ischaemia. Presented in a conference of the Physiological Society of India.
10. Krishnan, T. : Efficiency of normal discrimination with misclassified initial sample. Presented at the UGC Advanced Seminar on Probability and Statistics held at Chandigarh in 1985.
11. Majumder, P. P. : Statistical detection of linkage for an autosomal recessive disease : Sampling considerations. Presented in the XI Annual Conference of the Indian Society of Human Genetics at Sagar in 1985.
12. --- : Assessment of risk in genetic epidemiology : Some problems and methods. Keynote address in Workshop on Genetic Epidemiological Approaches to Health Care held at New Delhi in 1985.
13. Mukherjee, B. N. : Cross-validated discriminant models of Dinary data for predicting survival in burned patients. Presented in the XII International Biometric Conference held at Tokyo in 1984.
14. --- : Selected applications of multivariate analysis in India. Special lecture delivered at the Institute of Statistical Mathematics at Tokyo in 1984.
15. Mikhopadhyay, A. C. (with Sinha, B. K. and Saha Roy, R.) : Characterization of optimal designs for efficient estimation of non-additive parameters in Tukey's non-additive model. Presented by R. Saha Roy in Indian Science Congress held at Lucknow in 1985.
16. Pal Chauthury, P. (1984) : On systems diagnosis algorithm with adaptive testing. Presented in the IEEE FTCS-14 held in Florida in 1984.
17. --- : Diagnostic logic graph. Special lecture delivered at the University of Lethbridge, Canada.

Physical and Earth Sciences

Electronics and Communication Sciences

1. Biswas, S. N. (with Dutta Majumder, D.) : A new method for 2-D shape dilation, Proc. 7th ICIP, Montreal, July 30-2nd August, 1984.
2. --- (with Chaudhuri, B. B. and Dutta Majumder, D.) : Computer graphics generation of discrete circular objects and some associated properties, Proc. ICCSP, Bangalore, Dec. 10-12, 1984.
3. Chanda, B. (with Chaudhuri, B. B. and Dutta Majumder, D.) : A modified technique for image segmentation and edge detection, Proc. Int. Conf. on Cybernetics and Society, New Delhi, India, 777-781, 1984.
4. Dutta Majumder, D. : On the relevancy of fuzzy mathematical systems in science and society, Proc. of the Seminar on Fuzzy Systems and Non-standard Logic, May 14-16, 1984, Dept. of Math., C U.
5. Pal, S. K. (with Pramanik, P. K.) : A dynamic optimal clustering technique for speech sounds, Proc. IEEE Int. Conf. Comput., Syst., and Sig. Process Bangalore, India, Dec. 1984, 905-909.

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6. Pal, S. K. (with Chakraborty, B.) : Feature evaluation index using fuzzy sets. Proc. IEEE Int. Conf. Comput., Syst. and Sig. Process., Bangalore Dec. 1984, 63-67.
7. Pathak, A. (with Pal, S. K.) : Learning of a speech recognition system using stochastic approximation, Proc. IEEE Int. Conf. Comput. Syst. and Sig. Process., Bangalore, Dec. 1984, 910-913.
8. ——— : Fuzzy approach to the syntactic recognition of skeletal maturity, Proc. IEEE Int. Conf. Comput., Syst. Sig. Process., Bangalore Dec. 1984, 58-62.
9. Parui, S. K. (with Dutta Majumder, D.) : How to quantify shape distance for 2-dimensional regions. Proc. 7th ICPR, Montreal, 1984.
10. ——— (with Sarma, S. E. and Dutta Majumder, D.) : Shape discrimination using shape vector. International Conference on Informatics 1985.
11. Roy, A. (with Datta, A. K.) : A perceptual model for ASR, Proc. Intern. Conf. Computer, Systems and Signal Processing, Bangalore, India, Dec. 1984.
12. ——— : A hierarchical model for machine recognition of vowel and semivowel, IEEE SMC Conference, Arizona, 1985.
13. Roy, Kumar S. (with Dutta Majumder, D.) : Application of fuzzy logic in multivariable control. Proceedings of the Seminar on Fuzzy Systems and Non-standard Logic, May 14-16, 1984, Dept. of Math. Univ. of Calcutta.

Digital Electronics

1. Bhattacharyya, B. B. (with Ghose, S., Sinha, B. P. and Srimani, P. K.) : Heuristic search approach to optimal routing in a distributed architecture, Fourth Conference on Foundations of Software Technology and Theoretical Computer Science, Bangalore, India, December 13-15, 1984.
2. ——— : A heuristic search approach to optimal routing and some related properties in trivalent processor network graphs, IEEE International Conference on Computers, Systems and Signal Processing, Bangalore, India, 10-12, 1984.
3. Ghose, S. (with Sinha, B. P., Bhattacharya, B. B. and Srimani, P. K.) : Pascal graphs and their application in self diagnosable system design, IEEE International Conference on Computers, Systems and Signal Processing, Bangalore, India, December, 10-12, 1984.
4. Sinha, B. P. (with Bhattacharya, B. B., Ghose, S. and Srimani, P. K.) : A parallel algorithm to compute the diameter of a symmetric graph. IEEE International Conference on Computers, Systems and Signal Processing, Bangalore, India, December, 10-12, 1984.

Theoretical Physics

1. Bhattacharya, Subrata : ENC effect — another outlook. International particles and Nuclei (PANIC) Conference held in Heidelberg (West Germany) in August, 1984.
2. Roychoudhury, R. K. : Photo nuclear energy loss term for muon-nucleus interaction based on a scaling model of QCD, Proc. of XIX ICRC, La Jolla, U.S.A.

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Fluid Mechanics

1. Dandapat, B. S. : Steady thermocapillary flow in two-dimensional slots : formation of surface wave. U.G.C. Conference held at North-Bengal University, Sept. 1984.

Physics

1. Gupta, A. B. (with Ghosh, S. N.) : Cutaneous thermal sensory thresholds in normal population. XIII National Conference of the Indian Association of Dermatologists, Venereologists and Leprologists, Cochin, January, 3-6, 1985.
2. ——— (with Halder, B.) : Cutaneous response to thermal stimuli in leprosy and morphea. XIII National Conference of the Indian Association of Dermatologists, Venereologists and Leprologists, Cochin, January, 3-6, 1985.

Geology

1. Rudra, D. K. (with Maulik, P. K.) : Trace fossils from the freshwater Kota limestone of the Pranhita-Godavari Valley, South Central India. Proc. XI Indian Coll. Micropal. and Strat. Calcutta, Oct., 1984.

Biological Sciences

Anthropometry and Human Genetics

1. Basu, A. (with Roy, S. K., Mukhopadhyay, B., Bharati, P., Gupta, R. and Majumder, P. P.) : Each according to his need ? Intra-household food distribution in some contrasting populations/subpopulations of West Bengal, India. Paper presented at the Symposium on the Sharing of Food from-Phylogeny to History, Bad Hamburg, West Germany, 3-5 Dec., 1984.
2. Malhotra, K. C. (with Karmakar, B. and Narain, P.) : Palmar dermatoglyphic differentiation among Dhangers of Maharashtra. XIth Annual Conf. of Indian Society of Human Genetics, 27-29, December, 1984, Sagar.
3. ——— : Applications of anthropology in eco-development. UGC Seminar of Applications of Anthropology, Sagar Univ., Sagar, 27-29 December, 1984.
4. Mukherjee, B. N. : Social and geographical distribution of sickle cell gene in India with special reference to growth status (Sambalpur).
5. Pakrasi, K. (with Sii, Dasgupta, P. and Dasgupta, I) : Effects of maternal age, gestation time and parity on the birth weight of poor and well-off infants of contemporary Calcutta. Seminar on Anthropological Studies in India, held at the Asiatic Society, Calcutta on 22nd September, 1984 as a part of the Society's Bicentenary Celebration.

Crop Science

1. Ghose, M. : The relationships between quantitative characteristics of stomata and epidermal cells in leaves of young and adult palms. Seventh All India Botanical Conference, University of Rajasthan, Jaipur, December 28-30, 1984. Journal of Indian Botanical Society, Abstracts Supplement, 63 : Abs. No. VI 39, 56.

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Social Sciences

Demography

1. Sarkar, B. N. : People and states in India around the Nineteen Eighty. Paper read at the Ninth Social Science Congress by the Indian Academy of Social Sciences, 16-19 April, 1984, Aligarh Muslim University (Proceedings of the Social Science Congress).
2. ——— : Some aspects of population control planning in India, A paper read at the Statistics Section of the Seventy Second Session of the Indian Science Congress Association, 3-8 January, 1985, Lucknow University. Proceedings of the Science Congress Association.
3. ——— : Development prospects of rural West Bengal, a paper read at the Symposium of the Anthropology and Archaeology Section of the Seventy Second Session of the Indian Science Congress Association, 3-8 January, 1985. Lucknow University. Proceedings of the Science Congress Association.
4. ——— : Primary education in rural India, a paper read at the Education Section of the Tenth Social Science Congress, 21-30 January, 1985, Allahabad University. Proceedings of the Tenth Social Science Congress.

National Income

1. Roy, Biswanath : Sundarbaner Arthanaitik Paryalochana (in Bengali), Presented at the Seminar on Economics, Economic History and Indian Society at Calcutta, 24-25 November, 1984, organised by the Socio-Economic Research Institute, Calcutta.

Pre-Census Population

1. Bhattacharya, Chitra : Socio-economic trends in the district of Gorakhpur, 1813-1961 — An outline. Presented at the Silver Jubilee Seminar on Economics, Economic History and Indian Society, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall, November 23-25, 1984.
2. Bhattacharya, Durgaprasad : Scientific writings in some major Indian languages in the 19th century — A preliminary survey. Presented at the Silver Jubilee Seminar on Science and Technology, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall, on November 9, 1984.
3. ——— (with Deb Roy, Rama) : Land reforms in West Bengal — Results of some village level studies, 1979-1984. Presented at the Silver Jubilee Seminar on Land Reforms, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya, at Darbhanga Hall, on November 10-11, 1984.
4. ——— (with Bhattacharya, Aparna) : A bibliographical survey of sociological writings in Bengali, 1800-1950 (Part-I). Presented at the Silver Jubilee Seminar

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- on Economics, Economic History and Indian Society, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall, on November 23-25, 1984.
5. ——— (with Deb Roy, Rama) : A note on the approach to the Seventh Five Year Plan in a historical perspective. Presented at the Silver Jubilee Seminar on the Seventh Five Year Plan, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall on November 19, 1984.
 6. ——— : A preliminary note on a survey of books on science and technology in major Indian languages in the last quarter of the 19th century. Presented at the Seminar on Science and Empire, organised by the National Institute of Science, Technology and Development Studies, CSIR, Delhi, January 21-23, 1985.
 7. Chattopadhyay, Kunal . Quantitative village studies in the early 19th century. Presented at the Silver Jubilee Seminar on Economics, Economic History and Indian Society, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall, November 23-25, 1984.
 8. Deb Roy, Rama : Writings on science and technology in Bengali journals, 1818-1947. Presented at the Silver Jubilee Seminar on Science and Technology, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall on November 9, 1984.
 9. ——— : Economic drain and India, 1750-1900. Presented at the Silver Jubilee Seminar on Economics, Economic History and Indian Society, organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall on November 23-25, 1984.
 10. ——— : Science education in Bengal in the Nineteenth century. Presented at the Seminar on Science and Empire, organised by the National Institute of Science, Technology and Development Studies, CSIR, Delhi, January 21-23, 1985.
 11. Ghosh, Guruprasad : Socio-economic trends in Braach district, 1812-1961. Presented at the Silver Jubilee Seminar on Economics, Economic History and Indian Society, organised by Socio-Economic Research Institute, Calcutta in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall, November 23-25, 1984.

Planning (Delhi)

1. Bhat, L. S. : Two invited lectures on Applied Geography at the UGC sponsored seminar on Regional Surveys organised by the Dept. of Geography, University of Udaipur, during July 1-3, 1984.
2. ——— : Spatial integration in planning to the trainees under Management Development Programme (Integrated Approach to Budgeting at the Indian Institute of Public Administration, New Delhi, September 27, 1984.

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3. --- : Delivered six lectures on Geography of health and diseases with reference to spatial aspects of providing health facilities to the trainees attending the certificate course in Planning and Evaluation of Health Programme conducted by Institute for Research in Medical Statistics (ICMR), New Delhi, during 24-27 April, 1984.
4. --- : Delivered three lectures on Regional Planning, Data sources and Analytical techniques to Junior Statisticians in the training programme organised by the C. S. O.
5. Chetty, V. K. : Attended 23rd Indian Econometric Conference held in Hyderabad from January 3-5, 1985 and delivered the Mahalanobis's Memorial Award Lecture.
6. Gangopadhyay, S. : Has given two seminar lectures in the Delhi School of Economics, one in the Presidency College, Calcutta and one seminar lecture in Agro-Economic Research Centre, Shantiniketan.
7. Kansal, S. M. : Attended the seminar on Structure, Presentation and Validity of National Income Estimates, held in Poona during 3-5, December, 1984 which was organised by the Indian Association for Research in National Income and Wealth. Presented a paper entitled A note on the presentation of the brief analysis of national income and savings results.
8. Mukherji, P. N. : Social conflict and changes towards a theoretic orientation. Paper read at the seminar on Domestic Conflict in South Asian states, 18th October 1984, J. N. U., New Delhi.
9. Saradamoni, K. : Progressive land legislation and subordination of women. Read in the second National Conference on Women's studies, Kerala University, Trivandrum, April, 9-12, 1984.
10. --- : Employment and unemployment for the landless agricultural labourers : Some field data examined. Read in the Silver Jubilee Seminar of the Institute of Economic Growth, Delhi, April 27-30, 1984.
11. --- : Organised sub-theme on household as the unit of data collection and analysis in research and surveys in the Asian Regional Conference on Women and the Household, 27-31 January, 1985, New Delhi.
12. Sahuje, M. R. : The data base of the unorganised manufacturing industry problems assessment and suggestions. Presented at the Conference on Small Industry Development sponsored by the Institute of Economic Growth, Delhi and the World Bank, held at New Delhi, March, 22-24, 1985.

Sociology

1. Bandyopadhyay, Suraj (with Duttagupta, Bela) : Understanding trends in society from a sample of writings in Bengali : Some findings from a content of published materials in Bengali language. Presented in the Workshop on Economics, Economic History and Indian Society, Silver Jubilee Session of Socio-Economic Research Institute, Calcutta, November 1984 (Abstract published).
2. --- : Exploring boundaries of social interaction : Kinship, caste and class. Presented in the 17th All India Sociological Conference at Surat of Indian Sociological Society in December 1984 (Abstract published).

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3. --- (with Chattopadhyay, K. and Chakrabarti, P.) : Do the brahmins always stay at the top? An empirical relationship between caste, class and power. Presented in the 10th Indian Social Science Congress at Allahabad, organised by the Indian Academy of Social Sciences in January, 1985.
4. Biswas, S. K. (with Mukherjee, Shyamal) : Economic activity and residential arrangements of the rural aged in India. Presented in the International Seminar on Population Aging in India, Trivandrum, 4-7 February, 1985.
5. --- : Family support system for the elderly persons in rural areas. Prepared for a national seminar on aging, held at S. V. University, Tirupati, 22-24 November 1984 (Abstract published).
6. Chattopadhyay, K. : Lessons from Eastern India : An anthropological view. Presented in the bi-centenary celebration of Asiatic Society in its seminar on Anthropological Studies in India, Calcutta, September 1984.
7. Chakrabarti, Anirudha : Some findings on the use of traditional medicine in the rural areas of Palawan. Presented in the seminar concept of treatment of disease among the tribals of India, in Calcutta, 27-28 February, 1985.
8. Ghosh, Bhola Nath : Difficulties of research work in our country. Presented in the national symposium on National Integration, organised by Seva Bharati, Kalyani, Midnapore, in August, 1984.
9. --- : Adivasi Samaje Daini Bidyar Pravah (in Bengali). Presented in the yearly festival of Kanu Sidhu Cultural Centre, organised by the District Information Office, Department of Information and Cultural Affairs, Suri, Birbhum, during 30th June and 1st July, 1984.

Psychometry

1. Chatterji, S. : Interview as selection tool. Presented at the International seminar on Selection and Appraisal Systems, organised by the Bureau of Public Enterprises, Govt. of India and Indian Institute of Psychometry, during 28-30 January, 1985, New Delhi.
2. Ghosh, Anjali : Managerial skill and its relation with leadership styles. Presented at the 22nd Annual conference of the Indian Academy of Applied Psychology, held at the Deptt. of Applied Psychology, Calcutta University, from 1st to 3rd March, 1985.
3. Mukherjee, Manjula : Employees, attitude and productivity. Presented at the international seminar on Selection and Appraisal Systems, organised by the Bureau of Public Enterprises, Govt. of India and Indian Institute of Psychometry, Calcutta, during 28-30 January, 1985, New Delhi.

Economic Research

1. Bandyopadhyay, Debdas (with Majumdar, K. C.) : Taxation, income distribution and growth : An analysis in input-output planning frame. Presented at the eighth input-output conference held in Bombay University.

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2. ---- (with Majumdar, K. C.) : Poverty focussed planning : An analysis in input-output framework. Presented at the seminar on Seventh Plan organized by Socio-Economic Research Institute, Calcutta on the occasion of its Silver Jubilee on November, 1984.
3. Majumdar, K. C. (with Bandyopadhyay, Debdas) : A two-region multisectoral model for regional development with special reference to Assam. Presented at the symposium on the Development on North Eastern region of India held in Shillong in May, 1984.
4. ---- : Estimation of total five year plan investment - Alternative to Sixth plan model of India. Presented at the 23rd Indian Econometric Conference, Hyderabad, January 1985.
5. Sengupta, A. K. : Economic interaction between Maharashtra and the rest of India. Submitted to Indian Econometric Conference, Hyderabad, January 1985.
6. Sarkar, Abhirup : A dynamic assignment problem. Submitted to Indian Econometric Conference, Hyderabad, January 1985.

Economic Analysis (Bangalore)

1. Gopalakrishna, Mallika : Household needs and measurement of welfare. Presented at the 23rd Indian Econometric Conference, Hyderabad, 3-5 January 1985.

Library, Documentation and Information Sciences

Library

1. Basak, Nanda Dulal (with Das, Binod Bihari) : Grantha Kroy-O-Samgraha Anchal bhittik sahajogita (in Bengali). Granthagar, V. 34, No. 1, 1391 BS (1984), pt. 14-16. Read at 39th Bengal Library Conference, Purulia (West Bengal).
2. Verghese, J. : Silver Halide Microfilm. Read at the National Convention on Micrographics at Delhi on September 19-21, 1984 and was published in the Conference Proceedings.

Documentation Research and Training

1. Bhattacharyya, G. : Classurus and POPSI. Paper presented at the Seminar on Information Processing and Management held on 7-18 January 1985 at the National Aeronautical Laboratory, Bangalore.
2. ---- : Concept of integrated rural library development (Director's speech on the occasion of the Seminar on Integrated Rural Library Development held on 23-24 November 1984 at Hyderabad under the auspices of the Andhra Pradesh Library Association, Hyderabad).
3. ---- : Factors contributing to the development of the discipline Information Science. Key note address delivered on the occasion of the inauguration of the Seminar on Information Processing and Management held on 7 January 1985 at the National Aeronautical Laboratory, Bangalore.
4. ---- : Towards a strategy for modernization of library work and services in India. Presidential address on the occasion of the IASLIC 11th National Seminar held on 20-29 November 1984 at the Osmania University, Hyderabad.

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5. Devadason, F. J. : Computer generation of different types of subject indexes based on deep structure of subject indexing languages (to be published in American Society for Information Science, 48th Annual Meeting Proceedings 48, 1985).
6. --- : Micro computer applications in library automation and in-house information retrieval. Paper presented at the Seminar on the Changing Environment and Development Work Force held on 21-24 January 1985 at the Osmania University, Hyderabad. and also at the Seminar on Computer based bibliographic information processing held on 18 April 1985 at the Deptt. of Science and Technology, New Delhi.
7. Gopinath, M. A. : Changing technology and its implications to courses information science : a model. Paper presented at the UGC Seminar on implications of changing technology to Library and Information Science courses in India held in January 1985 at the Osmania University, Hyderabad.
8. --- : Document delivery systems and information technology. Presented at the Eleventh IASLIC Seminar held on 26 to 29 November 1984 at the Osmania University, Hyderabad and published in the seminar volume entitled XI IASLIC Seminar 1984.
9. --- : Guidelines for national information policy for India. Paper presented at the Indian Library Conference held at Jaipur in December 1984 under the auspices of the Indian Library Association.
10. --- : Information resources : its varieties. Paper presented at the Seminar on Information Processing and Management, held in January 1985 at the National Aeronautical Laboratory, Bangalore.
11. --- : National information policy and development of Information Professionals. Paper presented at the Seminar on National Information Policy held in December 1984 in Madras under the auspices of the Society for Information Science.
12. --- : On-line information system and its implications to information dissemination. Paper presented at the Seminar on On-line Information Systems held on 29 March 1985 at the Regional Research Laboratory, Hyderabad.
13. --- : Outline for MIS for financial management. Paper presented at the Seminar on Management of Small Industries held in April 1984 in Bangalore under the auspices of the Small Industries Service Institute, KASSIA, and K. M. Nanjappa Foundation.
14. --- : Thesaurus in information retrieval. Paper presented at the Seminar on Information Processing and Management, held in January 1985 at the National Aeronautical Laboratory, Bangalore.
15. Ravichandra Rao, I. K. : Curriculum development for Master's degree in information studies with emphasis on information technology. Paper presented at the Seminar on Changing Technological Environment and Development Workforce : Directions for Library and Information Science Education held on 21-24 January 1985 at the Osmania University, Hyderabad.

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16. ---- : Elements of statistics for librarians. Paper presented at the Workshop on Application of Mathematical and Financial Techniques to Information Management held on 13-14 September 1984 at National Aeronautical Laboratory, Bangalore.
17. ---- : Information technology: Its application to library and information field for effective library and information management. Paper presented at the Seminar on New Trends in Management of Libraries held during 19-22 December 1984 at Poona University.
18. ---- : A linear model for cost-of-research index. Paper presented in the Workshop on Science and Technology Indicators for Development, jointly organised by Commonwealth Science Council, London and NISTADS, New Delhi, during 21-26 February 1985 at NISTADS, New Delhi.
19. ---- : Quantitative methods for library and information science. Paper presented in the workshop on Curriculum Development, organised by UNESCO, held during 18-29 June 1984 in Caracas, Venezuela.
20. Seetharama, S. : Design of depth classification schedules : A synopsis. Paper presented at the Workshop on Design of Depth Classification held on 11-15 December 1984 at the Nagpur University.
21. ---- : In search of a code of professional ethics. Paper presented at the Eleventh IASLIC Seminar held on 26-29 November 1984 at the Osmania University, Hyderabad and published in the Seminar volume entitled XI IASLIC Seminar, 1984.
22. ---- : Man-power planning in libraries and information centre. Paper presented on Information Processing and Management held on 7-18 January 1985 at the National Aeronautical Laboratory, Bangalore.
23. ---- : Towards a health information centred society. Paper presented at the Seminar on Health Information for All, held on 16-18 February 1985 at Jaipur under the auspices of the Medical Library Association of India.

Statistical Quality Control

1. Acharya, U. H. : Study of mixings-applications of statistical methodology. Presented in IAQR 5th National Convention at Delhi, December 1984.
2. Chowdhury, A. B. (with Prodhan, P. L., Goswami, S. B., Chowdhury, A. K. and Sarkar, N. R.) : An experimental approach for improvement in quality of high voltage stator coils using orthogonal array technique. Presented in the Seminar on Electrical Insulation (INSULEC-84).
3. Chowdhuri, A. K. (with 3 others of Jyoti Ltd.) : Group motivation and management : an Indian experience . Presented by Shri A. K. Chowdhuri at the World Quality Congress 1984 held in Brighton, England during 19-21 June 1984.
4. Chowdhury, K. K. : A case study on adaptation of foreign technical know how for indigenous manufacturing. Presented in the IAQR 5th National Convention at Delhi, December 1984.

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5. Pal, B. K. (with Ghosh, M. K. and Narasimhachar, R. V.) : Achieving consistency around the target value of carbon in cast iron. Presented in All India Foundry Convention.
6. --- (with two other from EPD, BHEL, Bangalore) : Optimisation of foundry process. Presented in the IAQR 5th National Convention at Delhi, December 1984.
7. Rau, Y. R. : Monitoring of inwarranty returns. Presented at V Convention on Quality & Reliability of IAQR held at New Delhi, during 6-7 Dec. 1984.
8. --- : Improvement in design quality of compressor using concurrent design techniques. Read at V Convention of IAQR held at New Delhi, during 6-7 Dec. 1984.
9. Ray, Somnath : Process development of resin coated sand at vendors end. Presented in 34th National Convention of the Institute of Indian Foundrymen held in Bombay, during February 1985.
10. Seth, A. (with Rajendra Prasad, V.) : A new heuristic approach to one dimensional cutting stock problem. Presented in a symposium in system improvement through OR/SA organised by ISSA in New Delhi, during 21-22 February 1985.
11. Sundara Raju, S. M. : Implementation research. Presented at the Summer School on Theory & Applications of Dynamic Programming Scheduling Problem held in June 1984.
12. --- : Reliable power system. Presented at group 77 Electrical Industry Seminar held in New Delhi in September 1984.
13. --- : Quality & reliability (Q & R) in Airborne systems and equipments. Presented at Top Management Seminar, HAL, staff college, Bangalore, held in October, 1984.

Books Published

Theoretical Statistics and Mathematics

1. Prakasa Rao, B. L. S. : Translated from Russian and edited "Parametric Estimation for Stochastic Processes" by Yu A. Kutoyants, Heldermann-Verlag, Berlin, 1984.
2. Srivastava, S. M. : Lectures in Descriptive Set Theory, University of Bombay, 1985.
3. Mukerjee, R. (with Chaudhuri, A.) : Randomized Response : Theory and Techniques, M/S, Marcel Dekker Inc., New York (in press).

Physical and Earth Sciences

Electronics & Communication Sciences

1. Pal, S. K. (with Dutta Majumder, D.) : Fuzzy Mathematical Approach Pattern Recognition, Wiley Eastern Ltd., 1984.

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Physics

1. Gupta, A. B. : *Modern Physics, Vol. 2, Nuclear Physics*, Book Home, 32 College Row, Calcutta, pp. 300 1985.

Biological Sciences

Anthropometry and Human Genetics

1. Basu, A. (with Mukhopadhyay, B. (eds.)) : *Human adaptation to environment*. Calcutta : Indian Anthropological Society, pp. 97 + VI, 1985.
2. Basu, A. (with Malhotra, K. C.) (eds.) : *Proceedings of the Indian Statistical Institute Golden Jubilee Int. Conf. on Human Genetics and Adaptation. Volume 2, Human Adaptation*. Indian Statistical Institute, Calcutta, 1984 (pp. 1-325 + XXIV).
3. Malhotra, K. C. (with Basu, A.) (eds.) : *Proceedings of the Indian Statistical Institute Golden Jubilee Int. Conference on Human Genetics and Adaptation. Volume 1. Human Genetics*. Indian Statistical Institute, Calcutta, 1984, (pp. 1-614).

Botany

1. Roy, S. K. (Ed.) (with Sarkar, A. K., Samejpati, N. and Chattopadhyay, N. C.) : *Proceedings of the National Workshop on Betelvine : 1982*. Agricultural Society of India, Calcutta, pp. IV + 218, 1984.

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Demography

1. *Report on Population Welfare Planning (pages 1 to 350)*.

Economic Research

1. Chattopadhyay, Manabendu : *Condition of Labour in Indian Agriculture : Apparent and Real*. pp. 146, K. P. Bagchi and Co., Calcutta, 1985.

Sociology

1. Chakrabarti, Prafulla : *Social profile of Tarakeswar*. Calcutta, Firma K. L. M. (P) Ltd.

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1. Gopinath, M. A. : *Current trends in information sources and communication media (working document for the DRTC Refresher Seminar held on 12-14 December, 1984 at DRTC, Bangalore)*.

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1. Prakasa Rao, B. L. S. (with Van Ryzin, J.) : *Asymptotic theory for two estimators of the generalized failure rate*. In *Statistical Theory and Data Analysis* (Editor K. Matusita), North-Holland, Amsterdam, 547-563, 1985.

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2. ----- (with Sreehari, M.) : Remarks on the rate of convergence in the invariance principle for random sums. In colloquium Mathematical Society Janos Bolyai 36 (Editors P. Revesz *et al*), Veszprem, Hungary, 907-914, 1984.
3. ----- : Sudakov's Lemma. In Encyclopaedia of Statistical Sciences (Editors N. L. Johnson and S. Kotz), John Wiley, New York (in press).

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2. Roy, Kumar, S. (with Dutta Majumder, D.) : Structure of an intelligent controller and its behaviour. In approximate reasoning in expert systems (eds. M. M. Gupta, A. Kandel, W. Bandler and J. B. Kiszka), North Holland, Amsterdam, 1985 (in press).

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1. Bhattacharya, B. B. (with Ghose, S., Sinha, B. P. and Srimani, P. K.) : Heuristic search approach to optimal routing in a distributed architecture. Lecture notes in Computer Science, 181, Springer Verlag : Berlin, pp. 152-164, 1984.

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Anthropometry and Human Genetics

1. Basu, A. (with Gupta, R., Bharati, P., Mukhopadhyay, B. and Roy, S. K.) : Physical environmental, socio-cultural and ethnic correlates of human biology in some populations of West Bengal, India and neighbouring regions : Mortality differentials. In : R. Chakraborty, and E. J. E. Szathmary (Eds.), Diseases of complex etiology in small populations : Ethnic differences and research approaches. New York : Alan R. Liss, 1985.
2. --- (with Gupta, R. and Mukhopadhyay, B.) : Anthropological demography of populations of the Eastern Himalayas. In Lukacs, J. R. (Ed.). The People of South Asia : The biological anthropology of India, Pakistan, and Nepal. New York : Plenum Press, 1984.
3. Forsius, H. (with Mukhopadhyay, B., Basu, A., Gupta, R., Bhattacharya, S. K. and Majumder, V.) : Ophthalmological traits in three populations of Kalimpong Subdivision, Darjeeling district, West Bengal, India : Effects of ethnic, sexual and physical environmental factors. In A Basu and B. Mukhopadhyay (Eds.), Human adaptation to environment. Calcutta : Indian Anthropological Society.
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5. ——— (with Gadgil, M.) : Subsistence strategies among the pastoralists of Maharashtra, India. In *The People of South Asia*. J. R. Lukacs (ed.), Plenum Press, New York, pp. 441-458, 1984.
6. ——— : Population structure among the Dhangar caste-cluster of Maharashtra, India. In *The People of South Asia*. J. R. Lukacs (ed.), Plenum Press, New York, pp. 295-324, 1984.
7. ——— (with Karmakar, B. and Vijayakumar, M.) : Frequency distribution of total manus pattern ridge count (TMPRC) and the relationship between TMPRC, TFR and TPRC. In *Proc. of Golden Jubilee Int. Conf. of Indian Statistical Institute*, Volume, I, K. C. Malhotra and A. Basu (eds.), Indian Statistical Institute, Calcutta, pp. 571-586, 1984.
8. ——— (with Vijayakumar, M. and Karmakar, B.) : Genetics of sole pattern ridge counts. I. Methodology for counting ridges of true pattern in planar configurational areas. In *Proc. of the Indian Statistical Institute Golden Jubilee Int. Conf. on Human Genetics and Adaptation*. Volume I. K. C. Malhotra and A. Basu (eds.). Indian Statistical Institute, Calcutta, pp. 587-604, 1984.
9. ——— (with Karmakar, B., Vijayakumar, M. and Banerjee, D.) : Genetics of sole pattern ridge counts. II. Frequency distribution of sole pattern ridge counts and correlation between ridge counts on different configurational areas. In *Proc. of the Indian Statistical Institute Golden Jubilee Int. Conf. on Human Genetics and Adaptation*. Volume I. Human Genetics, K. C. Malhotra and A. Basu (eds.). Indian Statistical Institute, Calcutta, pp. 605-614, 1984.
10. ——— (with Mukherjee, B. N., Das, R., Bandyopadhyay, S. and Kate, S. L.) : Spatial and social variation in sickle-cell trait, G6PD deficiency and malaria in North Maharashtra : A preliminary report. In *Proceeding of the Indian Statistical Institute Golden Jubilee Int. Conf. on Human Genetics and Adaptation*, Volume I, Human Genetics. K. C. Malhotra and A. Basu, (Eds.). Indian Statistical Institute, Calcutta pp., 325-333, 1984.
11. Roy, B. (with Bharati, P., Ganguli, P., Pal, N., Biswas, P., Roy, P. C. Roy, R. N., Roychoudhuri, S. K., Biswas, P., Ganguli, S. K., Mitra, P., Gupta, R., Bhattacharya, S. K., Das, S. K., Manna, D. K. and Basu, A.) : Physical environmental, socio-cultural and ethnic correlates of human biology in some populations of West Bengal, India : Morbidity patterns. In : Basu, A. and Mukhopadhyay, B. (eds.). *Human Adaptation to environment*. Calcutta, Indian Anthropological Society, 1985.

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Planning (Delhi)

1. Parkash, Chander : The design of efficient resource allocation mechanisms in Microeconomic Theory (ed.), L. Samuelson, Kluwer-Nijhoff Publishing, pp. 236-261, 1985.

Sociology

1. Bandyopadhyay, Suraj : Towards a multi-dimensional approach on field-work', Chowdhury, Anwarullah (ed.) : Pains and Pleasures of Fieldwork. National Institute of Local Government, Dhaka, Bangladesh.

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1. Bhattacharyya, G. : Relevance of Ranganathan's ideas in the context of modern developments. In *New Trends in International Librarianship* edited by P. A. Mohan Rajan in 1984.

Technical Reports

Theoretical Statistics and Mathematics

1. Mitra, S. K. (with Odell, P. L.) : On parallel summability of matrices, ISI Technical Report No. 8419.
2. --- : The minus partial order and shorted matrices, ISI Technical Report No. 8427.
3. Rama Murthy, K. (with Rajput, B. S.) : On the spectral representations of complex semistable and other infinitely divisible processes, 26 pages (cyclostyled).
4. --- : On sample path properties of semistable processes, 17 pages (cyclostyled).

Applied Statistics, Surveys and Computing

1. Bose, T. K. : Use of integrated rate equations to explain homeostasis in human. For presentation at the 29th Congress of the Indian Society of Theoretical and Applied Mechanics.
2. Bhattacharjee, P. K. (with Roy, J.) : Application of analysis of variance methods to a long-term cultivation experiment on Tea. Tech. Rep. No. ASC/85/4.
3. Chaudhuri, A. : Optimal double sampling with varying probabilities. Tech. Rep. No. ASC/84/9.
4. --- : Variance estimation in double sampling. Tech. Rep. No. ASC/84/10.
5. --- (with Adhikary, A.) : Optimal sampling strategies with quantitative randomized responses. Tech. Rep. No. ASC/84/8.
6. --- (with Mukherjee, R.) : Optionally randomized response techniques. Tech. Rep. No. ASC/84/7.
7. Krishnan, T. : Efficiency of normal discrimination with misclassified initial samples. Tech. Rep. No. ASC/85/3.
8. --- : Role of supervisor in learning : A survey. Tech. Rep. No. ASC/85/5.
9. Majumder, P. P. : Statistical detection of linkage for an autosomal recessive disease : sample size determination for nuclear families. Tech. Rep. No. ASC/84/4.
10. Mukherjee, R. N. (with Maiti, S.) : Explicit maximum likelihood estimation in the analysis of covariance structures. Tech. Rep. No. ABC/84/6.
11. Mukherjee, R. (with Chaudhuri, A.) : Asymptotic optimality of generalised regression estimators in double sampling. Tech. Rep. No. ASC/85/1.

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12. Mukhopadhyay, A. C. : Generalised Hadamard matrices and orthogonal main effects plan. Tech. Rep. No. ASC/85/2.
13. Roy, J. : Use of autoregressive structures in the estimation of treatment effects over time. Tech. Rep. No. ASC/84/13.
14. --- (with Bhattacharjee, P. K.) : Traditional methods for analysis of long-term experiments. Tech. Rep. No. ASC/85/11.
15. --- : Correlated error structure in perennial crop experiments. Tech. Rep. No. ASC/84/12.
16. Sengupta, A. : Optimal test for the parameter of the exponential distribution in the type I censoring case. Tech. Rep. No. ASC/84/5.
17. --- : On tests for equicorrelation coefficient of a standard symmetric multivariate normal distribution—II. Tech. Rep. ASC/84/14.

Physical and Earth Sciences

Digital Electronics

1. Sinha, B. P. (with Chose, S., Bhattacharya, B. B. and Srimani, P. K.) : A note on the upper bound on the number of edges in Pascal graphs, Tech. Report No. P & E/E-01, Indian Statistical Institute, Calcutta.
2. --- : A parallel algorithm to compute the shortest paths and diameter of a graph and its VLSI implementation, Tech. Report No. 84-01, Department of Computer Science, Southern Illinois University at Carbondale, Illinois, USA.
3. --- : Heuristic search approach to optimal routing in a distributed architecture. Tech. Report No. 84/02, Southern Illinois University at Carbondale, Illinois, USA.

Fluid Mechanics

1. Ghosh, A. (with Debnath, K. D.) : On potential flow analysis in an opposed jet, 25 pages—Cyclostyled.

Electronics and Communication Sciences

1. Electronics and Communication Sciences Unit : Development of continuous noninvasive patient monitoring system (Sponsored by the Electronics Commission, Govt. of India).

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Anthropometry and Human Genetics

1. Basu, A. (with Mukhopadhyay, S., Roy, S. K., Bharati, P. and Gupta, R.) : Sherpa body dimensions : Further studies on altitudinal and sociocultural effects. ISI Tech. Report No. Anthropol/85.
2. Majumder, P. P. (with Gupta, R., Mukhopadhyay, B., Bharati, P., Roy, S. K., Masali, M., Sloan, A. W. and Basu, A.) : Altitude effects on anthropometric characters : Multivariate analysis of Eastern Himalayan data (Cyclostyled), pp. 46, 1985.

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3. Malhotra, K. C. (with Reddy, B. M.) : Genetics of finger ridge counts. ISI Tech. Report No. Anthropol./3/84, pp. 1-93, (Cyclostyled).
4. Pakrasi, K. (with Sil, S., Dasgupta, P., and Dasgupta, I.) : Pattern of low birth weight in the Bengali newborns. pp. 26 (Cyclostyled).

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1. Chanda, S. (with Matai, S. and Chakraborty, S.) : Production of bio-fertilizer in deproteinized juice, a liquid waste of leaf protein production plant. ISI Technical Report No. Leaf Pro./1/84.

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1. Bhattacharya, A. K. : On a general theorem on the intrinsic rate of a mixture of population and some examples of stability. Tech. Report No. DRU/58.
2. Datta, Pranati : Inter-state migration. Tech. Report No. DRU/63.
3. Das, C. R. : Decadal changes in occupation and literacy levels of scheduled castes and scheduled tribes of rural West Bengal. Tech. Report No. DRU/66.
4. Ghosal, A. K. : Life tables for India, 1978. Tech. Report No. DRU/61.
5. --- (with Sarkar, B. N.) : Studies on work participation rate. Tech. Report No. DRU/67.
6. Guha Roy, S. : On quality of age data in 1981 Census of India. Tech. Report No. DRU/68.
7. Mukhopadhyay, B. K. : Some aspects of rural population around Calcutta. Tech. Report No. DRU/57.
8. --- : Studies on age adjustment of children population. Tech. Report No. DRU/65.
9. Raman, M. V. : The influence of health on population. Tech. Report No. DRU/59.
10. Saha, A. K. : On acceptance of rural health services. Tech. Report No. DRU/55.
11. Sarkar, B. N. : Couple registers in primary health centres. Tech. Report No. DRU/54.
12. --- : People and states in India around the Nineteen Eighty. Tech. Report No. DRU/56.
13. --- : Development prospects in West Bengal. Tech. Report No. DRU/60.
14. --- : On collection of live birth statistics. Tech. Report No. DRU/64.
15. --- : Primary education in rural India. Tech. Report No. DRU/62.
16. --- : Differentials of age at first marriage in India. Tech. Report No. DRU/69.

Economic Research

1. Bhattacharya, N. (with Chatterjee, G. S. and Pal, Padmasja) : On variation in level of living across regions and social groups in rural India during 1963-84 and 1973-74. Tech. Report No. ERU/3/84.

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2. Bose, D. K. (with Chowdhury, Rama) : Forecasting of demand for power in West Bengal, 2000 A.D. Tech. Report No. ERU/3/85.
3. Chowdhury, Prabir : Monopoly capitalism : A suggested approach. Tech. Report No. ERU/2/84.
4. Dutta, Bhaskar : Ethical indices of distance between income distribution. Tech. Report No. ERU/1/84.
5. ——— : Fuzzy preferences and social choice. Tech. Report No. ERU/4/84.
6. Dasgupta, Dipankar : The analysis of effective demand : The general theory and its modern exposition. Tech. Report No. ERU/2/85.
7. Majumdar, K. C. (with Bandyopadhyay, Debidas) : Estimation of total five-year plan investment—An alternative to sixth plan model of India. Tech. Report No. ERU/1/85.

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1. Ghosh, Buddhadev (with Bhattacharya, Goutam) : Survival of economic farms : myths and realities. Tech. Report No. ERU/D/1/84.

Sociology

1. Bandyopadhyay, Suraj : Measures of reciprocity in a social network : A study of some villages in West Bengal. (with Rao, A. R. Statistics-Mathematics Division, ISI) (Mimeo.).
2. Chakrabarti, Prafulla : Impact of rural development on some aspects of village life : Report of a pilot study on a multi-ethnic village of Purulia. (Mimeo.).
3. Chattopadhyay, Kumarananda : A preliminary report of a pilot-enquiry on the social ecology of Sundarban. (Mimeo.).
4. ——— : Palamau survey : A provisional report. (Mimeo.).
5. Dasgupta, Atis : A report on the Fakir and Sannyasi uprisings, (Mimeo.).

Statistical Quality Control

1. Dutta, T. K. : Manual for course on SQC techniques at HEI, SQC Unit, Hyderabad.
2. ——— (with Goel, R.) : Manual for course on linear programming at HEI, SQC Unit, Hyderabad.
3. Iyer, V. N. : Course manual for the operative training programme on quality control for FACT, Cochin Division in Malayalam language. SQC Unit, Trivandrum.
4. ——— : Course manual for the operative training programme on quality circles for M/S. Hindustan Machine Tools Ltd., Kalamassery in Malayalam Language. SQC Unit, Trivandrum.
5. ——— : Course manual on simple tools of quality control for the HMT Training Programme at Kalamassery Unit, SQC Unit, Trivandrum.
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7. Mukherjee, S. P. : Optimum ordering interval for exponentially decaying inventory with varying decay rate and with known demand, SQC, T & P Unit, Calcutta.
8. Narayana, V. : Course manual for reliability course at BHEL (R & D), SQC Unit, Hyderabad.
9. Pandey, R. J. : Certain generalisations of acceptance sampling plan by attributes. SQC T & P Unit, Calcutta.
10. Ranga Rao, N. T. V. : Manual for course on industrial experimentation at ECIL. SQC Unit, Hyderabad.
11. Seth, A. : Simulation of accumulating analysis. SQC Unit, Delhi.
12. --- : Reducing wave soldering defects in an electronic industry. SQC Unit, Delhi.
13. Venkatappaiah, J. : Determination of optimum process conditions for Jelly filled cables. SQC Unit, Hyderabad.
14. --- (with Goel, R.) : Manual for course on process control at SRPM, SQC Unit, Hyderabad.
15. --- : Manual for course on sampling techniques at SRPM. SQC Unit, Hyderabad.
16. SQC Unit, Hyderabad, Manual for course on management of quality at ECIL.
17. --- Manual for course on management of quality at SRPM.
18. --- Manual for course on management of quality at HCL.
19. SQC Unit, Pune. Course manual on 'quality motivation programme' for Bajaj Auto Ltd., Pune in Marathi (produced in twenty two volumes).
20. --- Course manual for programme on orthogonal array experiments for Sudarshan Chemical Industries Ltd., Pune & Roha.
21. SQC T & P Unit (with SQC Unit, Calcutta). Course manual on design of experiment for in-plant training course at Hindustan Cables Ltd.,
22. SQC Unit, Madras. Course manual for the training programme on concurrent Designs organised by the SQC & OR Division at Bangalore during July-August, 1984.
23. --- Volume of case studies for presentation in the training programme on concurrent designs held at Bangalore during July-August, 1984.
24. --- Course notes on several topics for the two-year part-time Diploma Course in SQC & OR, Madras.
25. --- Course notes on several topics for the one year special training course in Quality, Reliability and OR for BHEL Engineers.

Part II. Convocation, Visiting Scientists, Honours and Awards,
Scientific Tours and Assignments

6. NINETEENTH CONVOCATION

The Nineteenth Convocation of the Indian Statistical Institute held on 25 January 1985 was presided over by Professor Bhabatosh Datta the noted economist. Professor Edward Nelson, Princeton University, New Jersey, U.S.A., delivered the convocation Address. Dr. A. Maitra, Director of the Institute, presented the annual review of research, teaching and training.

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The number of candidates awarded Ph.D., M.tech., M.Stat., B.Stat. (Hons.) Degrees, Statistician's Diploma and Post-Graduate Diploma in Applied Statistics and Diploma in Professional Examinations in Statistics is given below.

Number of candidates awarded degrees and diplomas

degrees/diplomas	number of candidates
Doctor of Philosophy (Ph.D)	3
Master of Technology in Computer Science (M.Tech.)	24
Master of Statistics (M.Stat.)	39
Bachelor of Statistics (Honours) (B.Stat.(Hons.)	12
Post Graduate Diploma in Applied Statistics :	
(i) Statistical Quality Control and Operations Research, Calcutta	12
(ii) Statistical Quality Control and Operations Research, Delhi	5
(iii) Statistical Quality Control and Operations Research, Madras	7
Professional Examinations in Statistics :	
(i) Senior Diploma in Statistics	2
(ii) Junior Diploma in Statistics	3
Total	107

Annual Review by Dr. A. Mitra, Director

Professor Datta, Professor Nelson, Distinguished Guests, Ladies and Gentlemen :

I have great pleasure in presenting to you a brief report on the activities of the Indian Statistical Institute during the past year.

As in previous years scientists of the Institute have continued their teaching, research and project activities. It is gratifying that the expertise of the Institute has been in increasing demand by various Government agencies. Our economists and statisticians have either completed or are in the process of completing various projects commissioned by different agencies of Government, like the Planning Commission, the Bureau of Industrial Costs and Prices, the Steel Authority of India and others. At the instance of the Oil and Natural Gas Commission, the Institute is going to undertake an economic evaluation of the 20-year Perspective Plan for oil exploration now being drawn up by the Commission. The Perspective Plan aims at stimulating and accelerating efforts for the exploration of oil resources in the country. The economic analysis will help decision makers in determining the scale and pattern of investment on oil exploration in different regions. The economists of the Institute have revived a project for critically reviewing the performance of the Indian economy in its different sectors with a view to bringing out a special publication around March every year. The ultimate aim would be to evolve a multi-equation macroeconomic model for the Indian economy which would be utilized for short-term forecasting and for making policy prescriptions for improving the management of the economy. In the field of electronics and communication sciences the Department of Science and Technology (DST) have entrusted our scientists with a project entitled "Statistical studies on the tropospheric propagation for VHF/UHF and microwave link". The Electronics Commission has asked the Institute to undertake a project entitled "Application of

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pattern recognition and image processing techniques in geological mapping and mineral detection". The statisticians of this Institute are engaged in the analysis of data on earthquakes in North East India. Negotiations are being carried on with the Department of Environment to undertake an interdisciplinary study on the social attitude towards air pollution. The Statistical Quality Control and Operational Research Division are engaged in working out for the refinery in Madras an optimum plan for the blending of different kinds of crude oil.

The International Statistical Education Centre (ISEC), which is run by the Institute in collaboration with the International Statistical Institute, is conducting its 38th term during the year. The Centre admitted 27 trainees from 12 countries in South and South-East Asia, the Middle and Far East, and the Commonwealth countries of Africa during the year. Following his review of the ISEC course last year, Professor J. Gani, Chairman, Education Committee, International Statistical Institute, recommended that the certificate now awarded to ISEC trainees on successful completion of the course be upgraded to a diploma in recognition of the high standards of the course. The Board of Directors of ISEC have accepted the recommendation and it has been decided to award a diploma to successful trainees from the 37th term onwards. Short term special courses in statistics were organized for UNDP fellows from abroad.

Several conferences and workshops were held in the Institute during the year under review. The 60th Annual Conference of the Indian Economic Association was organized in Bangalore under the joint sponsorship of the Indian Statistical Institute, the Indian Institute of Science and the Indian Institute of Management, Bangalore. About 500 delegates from India and abroad attended, and over 60 technical papers were read in the broad areas of Marxian economics, productivity and growth in the Indian economy, and income, savings and capital formation in rural India. The 38th Annual Conference of the Indian Society of Agricultural Statistics was hosted by the Indian Statistical Institute at Calcutta. The highlights of the conference were symposia on the themes of application of robust nonparametric inference techniques in agriculture, and increase in agricultural productivity from non-monetary inputs; the Rajendra Prasad Memorial Lecture entitled "some reflections on the agricultural productivity of Eastern India" was read by the noted agricultural scientist, Professor S. K. Mukherjee, at the Conference. The Institute conducted three summer schools for college teachers and for research scholars working in the Universities. The subject covered were Probability and Statistics, Combinatorics and Graph Theory with Applications, and Algorithmic Aspects of Mathematical Programming. The Institute also organized an Orientation Course in Demography jointly with the Indian Association for the Study of Population.

The Institute will commemorate the 60th anniversary of Bose Statistics by holding a five-day international conference on Quantum Statistics and Foundational Problems of Quantum Mechanics. The Conference, which starts on 28 January 1985, has attracted a number of eminent physicists from all over the world. I should mention here that Professor S. N. Bose was very closely associated with the Institute for a number of years and had served it in various capacities, having been Secretary during 1946-47 and President from 1967 to his death in 1974.

During the Golden Jubilee celebrations in 1981-82 a number of International conferences in different subjects of interest to the scientists of the Institute were organised. I am happy to announce that the proceedings of most of these conferences came out

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during 1984. The following volumes of proceedings were published : Human Adaptation, Frontiers of Research in Agriculture, Statistics : Applications and New Directions, and Pattern Recognition and Digital Techniques. The remaining volumes are in press and are expected to be published soon. The proceedings of the Seminar on Combinatorics and Applications in honour of Prof. S. S. Shrikhande, the well known combinatorial mathematician, were also published during the year.

I mentioned last year that the Institute had received the report of the Second ISI Review Committee. The Council of the Institute set up a Committee to advise it in matters relating to the report of the Review Committee. The Advisory Committee has submitted its report to the Council and it is expected that the Council will be able to formulate its views on the recommendations of the Review Committee in the near future. In my last review I had also indicated that the Review Committee had commented favourably on the quality of research done at the Institute. Nonetheless, a review of the activities of the Institute is a time for introspection, for self-examination and self-criticism. We must seriously address the question of how the institute shall develop in the coming years. What new directions of research are worth pursuing and which ones should be abandoned as less promising? How should the scientific activities of the Institute be organised so as to achieve sharper definition in the overall aims of the Institute? But whatever organisation of the scientific activities might finally be decided upon by the Council of the Institute, the Institute must continue the tradition, set by its founder, Professor P. C. Mahalanobis, of bringing to bear the methods of statistics on the solution of various problems of national development and welfare. The revolution in computer technology has made it possible to process and analyse vast amounts of data. This has resulted in considerably increasing the power and scope of statistical methods. The Institute possesses the expertise for using these powerful methods in the service of the nation. It should therefore be our endeavour to tackle problems of national significance, while continuing to maintain our standards in academic research.

Now turning to matters administrative I am happy to report that construction activities have proceeded rapidly at the Headquarters as well as at the Branches of the Institute. I had mentioned in my last report that work was in progress on the construction of staff quarters in Calcutta. During the year under review this work was completed and considerable progress made on the construction of a three-storied administrative building. Besides, work has started on the construction of a building for the Medical Welfare Unit. During the coming year construction of a Hostel building for the Medical Welfare Unit. During the coming year construction of a Hostel building to accommodate our foreign students and research scholars will be started. The Academic Block at Bangalore is ready for occupation and the formal opening of our Centre there on our own premises will take place soon. The Institute has finalised plans for construction of an administrative building and staff quarters in Hyderabad; the foundation stone for the administrative building was laid by Professor C. R. Rao in December 1984.

In conclusion may I take this opportunity of recording my gratitude to Mr. Subimal Dutt, President of the Institute, and Mr. P. N. Haksar, Chairman of the Institute, for their counsel and guidance. I should like to thank Professor S. B. Rao, our Dean of Studies, for attending to the many details associated with organising this function. I take this opportunity of expressing my appreciation for the exemplary manner in which Dr. Sibdas Bandyopadhyay has conducted the affairs of the International Statistical

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Education Centre. I also wish to record here my gratitude for the cooperation I have received from all sections of workers in the Institute.

Convocation Address

The Convocation Address was delivered by Professor Edward Nelson of the Department of Mathematics, Princeton University, Princeton, New Jersey, U.S.A. The title of the address was "Physical Reality and Mathematical Form". The address has been published in Sankhyā, Series A, Vol. 47, 1985, pp. 1-5.

7. VISITING SCIENTISTS

A number of distinguished scientists from India and abroad participated in the research, training and other scientific activities of the Institute during the year. Some of them came to the Institute on invitation and spent fairly long periods at the Institute to assist in the regular research and teaching programmes and some came for short periods in different assignments for giving lectures and participated in conferences and seminars.

1. Dr. R. N. Mohan, D. A. R. College, Nuzvid, Andhra Pradesh (4.4.84 to 6.5.84).
2. Dr. Dipak Dey, Texas Tech. University, U.S.A. (4.7.84).
3. Dr. Bimal K. Sinha, Dept. of Statistics and Mathematics, University of Pittsburgh, Pittsburgh, Pennsylvania, U.S.A. (2.7.84 to 27.7.84).
4. Dr. P. K. Sen, University of North Carolina, Chapel Hill, U.S.A. (16.7.84).
5. Dr. P. K. Bhattacharyya, University of California, Davis, U.S.A. (23.7.84).
6. Dr. P. Jeganathan, University of Michigan, U.S.A. (29.7.84 to 4.8.84).
7. Dr. Subinoy Chakrabarty of Michigan State, U.S.A. (18.10.84).
8. Professor S. Panchapakesan of Southern Illinois University, Carbondale, U.S.A. (29.10.84 to 19.11.84).
9. Professor A. P. Basu, University of Missouri, U.S.A. (5.11.84 to 21.11.84).
10. Professor Gert H. Muller, University of Heidelberg, W. Germany (10.11.84).
11. Professor J. S. Rustagi, The Ohio State University, Montreal, Canada, (17.4.84).
12. Dr. Samar Singh, BHEL (15.4.84).
13. Dr. S. Lalitha, IIT, Kanpur (30.5.84).
14. Dr. W. J. Anderson, McGill University, Montreal, Canada (31.5.84).
15. Professor A. M. Mathai, McGill University, Montreal, Canada (12.7.84).
16. Professor John G. Thompson, University of Cambridge, England (30.7.84).
17. Dr. M. T. Nair, IIT, Bombay (9.8.84).
18. Professor T. V. Narayana, University of Alberta, Canada (7.8.84).
19. Professor M. S. Raghunathan, TIFR (30.8.84).
20. Dr. K. C. Tripathi, University of Delhi (19.9.84).
21. Dr. T. Krishna Kumar, Indian Institute of Management, Bangalore (23.5.84).
22. Dr. P. R. Brahmananda, University of Bombay (24.5.84 to 20.6.84, 26.10.84, 9.11.84).

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23. Mrs. Indira Rajaraman, Indian Institute of Management, Bangalore (27.7.84 & 2.8.84).
24. Dr. P. A. V. B. Swamy, Federal Reserve Board, Washington (11.7.84 to 18.7.84)
25. Dr. N. H. Storn, University of Warwick, U. K. (25.10.84).
26. Dr. David Spiller, British High Commission, New Delhi (12.4.84).
27. Dr. B. S. Romananda, IIMT Ltd., Bangalore (23.4.84 & 28.4.84).
28. Dr. M. V. Ranganathan, HMT Ltd., Bangalore (25.4.84 to 29.4.84).
29. Professor A. Neelameghian, Division of General Information Programme, UNESCO, Paris (12.6.84 & 14.6.84).
30. Dr. G. K. Arora, National Physical Laboratory, New Delhi (13.8.84).
31. Dr. C. V. S. Ratnam, UNIDO Consultant, Bangalore (5.9.84).
32. Dr. K. N. Prasad, HMT Ltd., Bangalore (27.9.84).
33. Professor S. Parthasarathy, INSDOC, New Delhi, (22.11.84).
34. Professor C. Yast, Centre National De La Recherche Scientifique, U.S.A. (26.4.84 to 27.4.84).
35. Professor J. P. Vigié, Henri Poincaré Institute, Paris, (18.12.84 to 23.12.84).
36. Professor D. Kostic, Institute for Experimental Phonetics and Speech Pathology, Yugoslavia (17.12.84 to 31.3.85).
37. Professor H. Morimoto, Osaka City University, Japan, (15.12.84 to 19.4.85).
38. Professor Kamal C. Chauda, Texas Tech. University, U.S.A. (4.1.85 to 29.1.85).
39. Professor Edward Nelson, Princeton University, Princeton, U.S.A. (23.1.85 to 2.2.85).
40. Professor A. Lesnovsky, Institute of Mathematics, Czechoslovak Academy of Sciences, Czechoslovakia.
41. Professor P. Garbaczski, University of Wrocław, Poland, (15.1.85 to 28.2.85).
42. Dr. T. Taguchi, Institute of Statistical Mathematics, Tokyo, Japan, (15.2.85 to 16.2.85).
43. Professor Yashkin, Institute of Oriental Studies of the USSR (15.9.84).
44. Dr. P. K. Banerjee, University of Brunswick, Canada.
45. Professor F. H. Ruymgaart, Katholieke University, Netherlands, (7.1.85 to 2.2.85).
46. Professor, J. C. Templeton, University of Toronto, Canada, (15.2.85 to 20.2.85).
47. Dr. Jens Ladet Janson, Aarhus University, Denmark, (11.3.85).
48. Dr. A. R. Gustafson, Texas A and M University, U.S.A., (16.3.85 to 23.3.85).
49. Professor K. Viswanath, Hyderabad University, Hyderabad, (16.12.84 to 29.12.84).
50. Dr. Dibyen Majumdar, University of Illinois, Chicago, U.S.A. (20.12.84).
51. Dr. S. Huda, Institute of Statistical Research and Training, Dhaka, Bangladesh (3.3.85 to 12.3.85).
52. Professor W. R. Wade, Dept. of Mathematics, University of Tennessee, Knoxville, Tennessee, U.S.A. (8.4.84 to 29.5.84).
53. Professor B. S. Rajput, Dept. of Mathematics, University of Tennessee, Knoxville, Tennessee, U.S.A. (3.4.84 to 23.6.84)

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54. Dr. N. K. Mandal, Calcutta University, Calcutta, (17.8.84).
55. Dr. S. Iyenger, Indian Institute of Science, Bangalore, (6.8.84).
56. Dr. S. Pramanik, Michigan State University, U.S.A. (24.8.84).
57. Dr. T. Roy Chaudhuri, Calcutta Medical Research Institute, (19.9.84).
58. Dr. A. Dewanji, University of Waterloo, Canada (17.10.84).
59. Dr. J. Seberry, University of Sydney, Australia (23.11.84).
60. Dr. S. Dasgupta, University of South-Western, Louisiana, U.S.A. (4.1.85).
61. Dr. P. K. Bose, Artificial Intelligence Research, CSL, U.S.A. (30.1.85).
62. Prof. M. Sen, Kalyani University (14.2.85).
63. Prof. M. Taguri, Chiba University, Japan (17.2.85).
64. Prof. T. Inoue, Chiba University, Japan (1.3.85).
65. Professor Ashok Sahni, Centre of Advanced Study in Geology, Punjab University, Chandigarh (18.10.1984).
66. Professor S. B. Bhatia, F.N.I., Chairman, Centre of Advanced Study in Geology, Punjab University, Chandigarh, (19.10.84).
67. Professor Pradeep Dubey, Yale University, U.S.A.
68. Professor, W. Drechsler, Max Planck Institute for Physik and Astrophysik, Munich, West Germany (28.1.85 to 1.2.85).
69. Professor M. Namiki, University of Waseda, Tokyo, Japan.
70. Professor A. Jannusis, University of Patras, Patras, Greece (28.1.85 to 1.2.85).
71. Professor E. Prugovecki, University of Toronto, Canada (23.1.1985 to 1.2.85).
72. Professor A. O. Bernt, University of Colorado, Colorado, U.S.A., (28.1.85 to 1.2.1985).
73. Professor R. Graham, University of Essen, West Germany, (28.1.1985 to 1.2.85).
74. Professor S. Kametuchi, University of Tsukuba Ibaraki, Japan, (28.1.85 to 1.2.85).
75. Professor Sudhakar M. Reddy, Department of Electrical and Computer Engineering, University of Iowa, Iowa City, U.S.A. (18.12.84 to 20.12.84).
76. Professor L. N. Persen, Institute of Applied Mechanics, University of Trondheim, Norway, (5.11.84 to 14.11.84).
77. Dr. Charles A. Weitz, Department of Anthropology, Temple University, Philadelphia, U.S.A. (19.7.84 to 15.8.84).
78. Dr. Paul T. Baker, Evan Pugh Professor and Head of the Department of Anthropology, Pennsylvania State University and Chairman, Anthropology Section, National Academy of Sciences, U.S.A. (18.3.85 to 23.2.85).
79. Dr. Thelma S. Baker, Department of Anthropology, Pennsylvania State University, U.S.A. (18.3.85 to 23.3.85).
80. Professor H. Walter, Department of Human Biology/Genetics, Bremen University, W. Germany (11.11.84 to 17.11.84).
81. Dr. B. M. Das, Department of Anthropology, Gauhati University (11.11.84 to 15.11.84).

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82. Dr. Prasanta Kumar Majumder, Ex-adviser, National Family Planning Board, Government of Malaysia, (February & August, 1984).
83. Dr. K. G. Jolly, Institute of Economic Growth, Delhi.
84. Dr. Alex Comfort, Neuropsychiatric Institute, University of California, Los Angeles, U.S.A.
85. Dr. A. Ostrovsky, Academy of Sciences, USSR, Institute of Far Eastern Studies, Moscow, USSR.
86. Dr. Malcolm Blincow, Department of Anthropology, York University, Toronto, Canada.
87. Dr. Bruno Jobert, Institutet' Etudes Politiques, CERAT, France.
88. Professor Trevor Ling, Professor of Comparative Religion, Manchester University, England.
89. Professor Y. B. Damle, Emeritus Professor of Sociology and President, Indian Sociological Society, Poona (25.3.85 to 30.3.85).
90. Professor Ashok Rudra, Visva-Bharati University (December, 1984).
91. Dr. Srikanta Chatterjee, Department of Economics, Massey University, Palmerston, North New Zealand, (February, 1985).
92. Dr. Kaushik Basu, Delhi School of Economics, Delhi University, Delhi, (December, 1984).
93. Dr. Anjan Mukherjee, JNU, Delhi, (October, 1984).
94. Professor Ira N. Gang, Pitzer College
95. Professor Kim Carney, Department of Economics, University of Texas at Arlington, Texas, U.S.A. (21.4.84).
96. Dr. Bovas Abraham, Department of Statistics & Actuarial Science, University of Waterloo, Ontario, Canada (26.6.84).
97. Professor P. C. Hare, University of Stirling, U.K.
98. Professor Louis L. Wilde, California Institute of Technology, U.S.A.
99. Dr. C. Misra, Director and Special Secretary, Planning & Coordination Department, Government of Orissa, Bhubaneswar (13.9.84).
100. Dr. K. G. Murty, Department of Industrial Engineering, Michigan University, U.S.A. (21.5.84 to 9.6.84).
101. Professor N. C. Kakwani, Head of the Department of Econometrics, University of New South Wales, Kensington, NSW, Australia 19.1.85.
102. Professor Angus S. Deaton, Department of Economics, Princeton University, Princeton, U.S.A. (23.1.85 to 24.1.85).
103. Dr. Manojit Chatterjee, University of Essex, England, (30.1.85).
104. Professor Aman Ullah, University of Western Ontario
105. Professor T. N. Rajan, In-Charge, Training Division, INSDOC, New Delhi (9.1.85).
106. Professor Anthony H. Thompson, College of Librarianship, Wales, U.K. (14.1.85).

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107. Mr. Clive D. Wing, Regional Programme Officer (Information Science), IDRC, New Delhi, (31.1.1985)
108. Professor C. A. Tayler, Topic Leader (Information Transfer), International Conference on Science and Technology Education, ICSU, Paris (31.1.1985).

8. HONOURS, AWARDS AND SPECIAL ASSIGNMENTS

Professor J. K. Ghosh (Stat-Math) visited the Universities of Ahmedabad, Indore and Chandigarh as national lecturer in Statistics. There were invitations from many other places. He was a member of the National Board for Higher Mathematics also.

Dr. Rahul Mukerjee (Stat-Math) received the Indian Science Congress Association Young Scientists' Award, 1985 during the 72nd Session of the Science Congress held at Lucknow.

Professor S. K. Mitra (Stat-Math) served on the Advisory Committee for the Bhatnagar Award at the CSIR, on the Technical Advisory Committee for the Indian Statistical Services and on the Indian National Committee for the International Mathematical Union appointed by the Indian National Science Academy. Professor Mitra was elected to the Council of the International Statistical Institute.

Dr. B. N. Mukherjee (Applied Statistics, Surveys and Computing) was nominated as a member of the Educational Research Innovation (ERIC) Sub-committee of National Council of Educational Research and Training, New Delhi. He continued to serve as a member of the Scientific Advisory Committee of the Institute for Research in Medical Statistics, ICMR, New Delhi.

Dr. A Basu (Applied Statistics, Surveys and Computing) was appointed a member of the Board of Examiners for B.Tech. Pt. III (Computer Science) Examination of Calcutta University.

Mr. T. Maitra (Applied Statistics, Surveys and Computing) continued to serve as a Consultant to the National Planning Commission, Nepal, on behalf of ILO and made a number of visits to Kathmandu in this connection.

Mr. A. K. Adhikari (Applied Statistics, Surveys and Computing) has been nominated by the ISI to the Governing Council of NSSO in place of Dr. J. Roy from November, 1984.

Dr. J. Roy (Applied Statistics, Surveys and Computing) has gone to Tokyo, Japan on a United Nations assignment.

Dr. A. B. Gupta (Physics) has been elected member of the International Society of Bioengineering and the Skin, Cardiff, U.K.

Professor P. Bandyopadhyay (Electronics) has been appointed a member of the Expert Committee of the Union Public Service Commission, New Delhi. He attended a meeting of the Advisory Committee of the University Grants Commission for the establishment of the National Centre for Theoretical Studies. He also attended various selection committee meetings of the C.S.I.R. at New Delhi.

Professor D. Dutta Majumder (Electronics and Communication Sciences) has been appointed a member and Co-ordinator of the Fifth Generation Computer Systems Research Committee of DDE, Government of India. Professor Dutta Majumder has been appointed a member of the Programme Advisory Committee of DST, Govt. of India. He has been elected member of the Governing Board of International

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Association of Pattern Recognition (IAPR) and World Organisation General Systems and Cybernetics (WOGSC). He has also been appointed as a member of the Research Advisory Committee of Sangeet Research Academy, Calcutta. Professor Dutta Majumdar has been appointed a member of the Governing Council of the Institute of Modern Management, Calcutta.

Dr. S. L. Jain (Geology) was elected Fellow, Palaeontological Society of India and has been invited to deliver the 3rd Abaninath Choudhuri Memorial Lecture by the Geological, Mining and Metallurgical Society of India, Calcutta. He served as referee for Palaeontological Society of India, Current Science and Science and Culture.

Professor S. K. Roy (Botany) served the Adaptive Research Council on Agriculture, Government of West Bengal as a member. He was elected as a member of the Executive Council of the Indian Society of Agricultural Statistics, New Delhi. Professor Roy served as a member of the Advisory Committee of the Society of Research on Haemology and Blood Transfusion. He served the Executive Council of the Botanical Society of Bengal as an elected member. He has been serving as a member of the ISI Study Group for the PIREP follow up study at Nayagram Block of Midnapore District, West Bengal. He also served the Undergraduates Board of Studies in Botany, University of Calcutta as a Member.

Professor K. C. Malhotra (Anthropometry and Human Genetics) acted as Selection Committee Member : Delhi University, Andhra University.

Dr. Parkash Chander (Planning, Delhi) was appointed member of the Program Committee for the Fifth World Congress of the Econometric Society to be held at Massachusetts Institute of Technology from August 13-17, 1985. Dr. Chander presided over the Sociology-Anthropology section of the Xth Congress of the Indian Academy of Social Sciences in Allahabad, January 1985.

Dr. V. K. Chetty (Planning, Delhi) appointed Chairman of the Indian Econometric Society held at Hyderabad from January 3-5, 1985. The Mahalanobis Memorial Medal for outstanding contribution to the Quantitative Economics by economist of Indian origin, who are below 45 years has been awarded to Dr. V. K. Chetty for the year 1982.

Dr. K. C. Majumdar (Economic Research) served as a member of each of the following bodies : (i) the advisory group on the seventh plan modelling set up by the Planning Commission, (ii) the National Board on Higher Mathematics set up by the Dept. of Atomic Energy, and (iii) the working group on Seventh and Perspective plans set up by the Govt. of Assam.

Professor D. K. Bose (Economic Research) continued to be a member of the West Bengal State Electricity Board. He also served as member of the Perspective Power Planning Committee, Govt. of West Bengal, which submitted its report in August 1984.

Professor D. K. Bose and Dr. Suhas Chattopadhyay (Economic Research) served as members of the Commission for Planning of Higher Education in West Bengal, constituted by the Govt. of West Bengal. The report of the Commission was submitted on April 1984.

Dr. N. Bhattacharya (Economic Research) continued to serve as ISI representative on the Governing Council of NSS Organisation. He became ISI representative on the Standing Committee of the Conference of Central and State Statisticians.

Professor S. Chattarji (Psychometry) continued to serve as a member of the Banking Service Recruitment Board (Eastern Group). He also served as a member

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of the Central Advisory Committee of the National Test Library of the NCERT, New Delhi. He was also invited to serve as a member of the Selection Board for the Rajasthan Public Service Commission, Ajmere. He continued as the Supervisor for tests of the Educational Testing Service, Princeton, U.S.A. He also presided over one of the technical sessions of the Annual Conference of the Indian Academy of Applied Psychology, held on 1-3 March 1985 at Dept. of Applied Psychology, Calcutta University.

Dr. M. Mukherjee (Psychometry) was co-opted for conducting interview for the Banking Service Recruitment Board (Eastern Group) on many occasions during the year. She was also requested to function as test reviewer as well as for editing review for the National Test Library of the NCERT, New Delhi. She was also invited to serve as a member of the Selection Board for the Rajasthan Public Service Commission, Ajmere.

Shri Tapan Kusumillick (Psychometry) acted as a Resource Person in the "Workshop on Mental Health of School-going Adolescents" organised by the Mental Observation Ward, Govt. of West Bengal and Center for Psychological Testing & Research, Calcutta, 16-17 March 1985. He continued to be a member of the Board of Studies in Psychology, Calcutta. He also continued to be a member of the panel of experts of the West Bengal State Hook Board, Govt. of West Bengal.

Shri B. N. Sarkar (Demography) has been elected Vice-President of the Indian Academy of Social Sciences, Allahabad for the 1984-85 session.

Shri Samir Kumar Dutta (Demography) has been elected executive member of the Indian Academy of Social Sciences, Allahabad for 1984-85 session.

Dr. N. S. Iyengar (Economic Analysis, Bangalore) served as a Visiting Fellow at the Department of Econometrics, Sri Venkateswara University, Tirupati, during 11-25 March 1985, and UPSC as an adviser for ISS examinations. He was appointed a member of the Training Advisory Committee for Indian Statistical Service under the Department of Statistics, Ministry of Planning, Government of India.

Dr. Suraj Bandyopadhyay (Sociology) was appointed Hony. Director of Survey Research Centre, Indian Academy of Social Sciences, Allahabad. He was elected as a member, Silver Jubilee Celebration Committee, Socio-Economic Research Institute, Calcutta.

Shri S. K. Biswas (Sociology) Member, Silver Jubilee Celebration Committee, Socio-Economic Research Institute, Calcutta.

Shri Atis Dasgupta (Sociology) continued to act as a member of the following committees of Government of West Bengal : (a) The State Advisory Committee on Archaeology ; (b) The State Gazetteers Advisory Committee ; (c) The State Advisory Committee on Preparation of a Book on Freedom Movement of India.

Shri Durgaprasad Bhattacharya (PCPSU) continued to serve as (i) Member, Indian Historical Records Commission, (ii) Honorary Director, Research Project : Sociological Writings in Bengali, 1818-1947 sponsored by the Indian Council of Social Science Research (iii) Honorary Director, Research Project : Bengali Writings on Science and Technology, 1800-1950 sponsored by the Indian National Science Academy, (iv) Secretary, Socio-Economic Research Institute.

Smt. Rama Deb Roy (PCPSU) continued to serve as the Joint Secretary, Socio-Economic Research Institute and as a Secretary, Silver Jubilee Celebration Committee, Socio-Economic Research Institute.

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Dr. S. Seetharama (DRTC) rendered advisory service to the Tala Energy Documentation and Information Centre, Bombay in relation to (a) finalisation of handbooks on bio-gas technology, and cook-stove technology; (b) finalisation of a project proposal on information centre for bio-mass energy, and (c) guidelines to abstracting. He also rendered advisory service to Orissa Research Development Agency, Bhubaneswar for the establishment of an information centre. Dr. Seetharama rendered advisory service to the National Tuberculosis Institute (NTI), Bangalore in regard to the planning of their library building.

Dr. F. J. Devadason (DRTC), rendered advisory service to the Systems Research Institute, Poona, in relation to the development of Thesaurus on development—policy modelling.

Dr. Jogesh Misra (Central Library) was nominated as member of the Advisory Council of Indian National Scientific Documentation Centre, New Delhi by the Director-General, CSIR, New Delhi. He was nominated as member of the committee on norms for staff in libraries of universities, colleges by the University Grants Commission, New Delhi. He was appointed as Examiner of B.Lib. Sc. Course of the Burdwan University, Burdwan. He was appointed as Guest Lecturer in the Department of Library Science by the Vice-Chancellor of Calcutta University. He has been nominated at the Board of Studies in Library Science in the Department of Library Science, University of Calcutta.

9. SCIENTIFIC TOURS AND ASSIGNMENTS ABROAD

Shri Rana Barua (Stat-Math) attended the Autumn School in Logic and Set Theory conducted by the International Centre for Pure and Applied Mathematics from 28 August to 28 September 1984. He also visited the University of Paris VI from 29 September to 5 October 1984 and gave a talk on the "Generalised Game Formula of Keclbris".

Professor J. K. Ghosh went to Iowa State University for two months as a Visiting Professor. He gave a series of seminars on recent advances in asymptotic theory. He also spent some time at Oklahoma State University as a distinguished foreign scholar of MASUA (Mid America State Universities Association). During his total stay, he lectured at the University of Pittsburgh, Michigan State University, University of Florida, University of California (Berkeley), University of Illinois (Urbana Champaign), University of Missouri (Rolla), University of Missouri (Columbia). He also visited the Indiana University (to work with Habi Bhattacharya and presented a paper at the International Symposium on Stochastic Hydraulics (at Urbana) and also visited Purdue University. For lack of time, he could not accept invitations from a few other universities.

Professor Somesh Das Gupta (Stat-Math) visited the School of Statistics, University of Minnesota, U.S.A. from December 28, 1984 to March 28, 1985 and delivered a course of lectures.

Dr. B. S. Mazumder (Stat-Math) went to Canada and United States taking a scientific assignment for three months starting from 30 August to 30 November 1984. During this period he worked in the Department of Applied Mathematics, University of Western Ontario, Canada for six weeks and worked at St. Anthony Falls Hydraulic Laboratory, Department of Civil and Mineral Engineering, University of Minnesota, Minneapolis, U.S.A. for four weeks. He also visited the Plume Laboratory at Canada

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Centre for Inland Water (CGIW), University of Waterloo, University of Pittsburgh, State University of New York, Binghamton, New York and delivered few lectures on sediment transport and dispersion. The titles of the talk are as follows : (1) Experimental and theoretical studies of grain size distribution of suspension and deposition (2) Dispersion of solute in some laminar flows.

Dr. S. Nag (Stat-Math) visited Australia and Singapore during the period 30.4.1984 to 20.9.1984. During his visit abroad he gave lectures and colloquium/seminar talks at (1) Australian National University, (2) Centre for Math. Analysis (ANU Campus), (3) Flinders University of South Australia (joint seminar also with Murdoch University) and (6) National University of Singapore.

Dr. S. M. Srivastava (Stat-Math) attended a school in "Mathematical Logic and Set Theory" at the International Centre for Pure and Applied Mathematics, Nice, France from August 27, 1985 to September 28, 1985. He also visited Equipe d'analyse, Universite Paris, Paris VI from September 29, 1985 to October 5, 1985.

Dr. R. L. Karandiker (State-Math) attended IJFP working conference on Stochastic Modelling, Rome, December 10-14, 1984, sponsored by IASI, Italy. Read a paper and took part in discussions. Left Delhi on December 9 and returned on December 17, 1984.

Dr. T. Parthasarathy (Stat-Math) was at the Department of Mathematics, Catholic University, Nijmegen, the Netherlands from November 15 to December 26, 1984, where he collaborated with Dr. S. Tijs and Dr. O. J. Varize on research in stochastic games.

Dr. B. Gupta (Applied Statistics, Surveys and Computing) went to USA to attend conference and delivered lectures in some universities.

Dr. P. Pal Choudhury (Applied Statistics, Surveys and Computing) visited Canada and Columbia in 1984 and delivered lectures in different universities.

Dr. P. Mukhopadhyay (Applied Statistics, Surveys and Computing) was on an assignment with University of IFE, Nigeria during 1982-84 from which he returned in October, 1984.

Dr. R. Arnab (Applied Statistics, Surveys and Computing) served as a Lecturer in the University of Ibadan upto 16 February, 1984.

Professor B. N. Mukherjee (Applied Statistics, Surveys and Computing) attended XII International Biometric Conference held in Tokyo, 2-9 September 1984 and delivered lectures in National Centre for University Examinations, Tokyo and Chiba University, Tokyo, Japan.

Dr. A. Basu (Applied Statistics, Surveys and Computing) visited U.S.A. and Canada for attending the International Conference on Computer Design, 1984.

Shri T. S. Kutty (Geology) visited the Palaeontological Institute, Moscow, Institute of Physics of the Earth, Moscow and the Zoological Institute, Leningrad, from 27 November, 1984 to 28 December 1984. During his visit Shri Kutty had discussions with Soviet Scientists on earthquake prediction problems and on various aspects of the Indian Gondwana formation and the vertebrates from them, the continental Permian-Triassic deposits of the USSR and their vertebrate fossils, stratigraphic problems, the nature of fossil occurrences, problems in mapping and correlation of the Indian Gondwanas etc. Shri Kutty also gave a talk at the Palaeontological Institute, Moscow

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about the Indian Gondwana formation and their vertebrate fossils and about the work of the Geological Studies Unit of the Institute.

Professor D. Dutta Majumder (Electronics and Communication Sciences) participated in 8th International Conference on Pattern Recognition at Montreal from 29 August to 6 September 1984. He chaired a session and presented two papers in the conference. He was elected member of the Governing Board of IAPR, and participated in the Board meetings at Montreal from 2 to 5 September 1984. Professor Dutta Majumder delivered invited talks at the University of Maryland, Purdue, Michigan State, Pittsburgh, Carnegie-Mellon, Louisiana State, Columbia-South Carolina in USA and London and Wales in U.K. He also participated in the 6th International Congress on Cybernetics and Systems during 10 to 14 September 1984 under the auspices of WOGSC at Paris where he gave an invited talk on 'Post-Wiener Cybernetics', and chaired a session.

Shri A. K. Dutta (Electronics and Communication Sciences) visited universities of Milan, Dublin, Purdue and Stockholm on invitation. He also participated in 8th Intl. Conf. on Pattern Recognition at Montreal from 29 August to 6 September 1984 and chaired a session.

Mr. Sovanlal Kundu (Electronics and Communication Sciences) has been awarded Full-bright Scholarship (Pre-Doctoral), U.S.A.

Professor P. Bandyopadhyay (Electronics) visited Italy and gave an invited talk at the Second Workshop on Hadronic Mechanics held at Como (Italy) during the period 1-3 August, 1984. The title of the talk was: "Extended conformal group and grand verification of elementary particle interactions".

Shri Sisir Roy (Electronics) delivered an invited talk at the 2nd Workshop on Hadronic Mechanics at Como, Italy from August 1 to August 3, 1984. He also visited International Centre for Theoretical Physics, Trieste, Italy, for two weeks in August 1984. Some collaborative works have been done with Professor J. P. Vigi er, Institute Henri Poincar e, France.

Professor R. L. Brahmachary (Embryology) visited Laboratoire Arago, France during the period from 15 February to April 15, 1985. He studied cephalopod embryology, specifically, that of squids.

Professor Amitabha Basu (Anthropometry and Human Genetics) participated and presented a paper, in the "Symposium on the sharing of food—from phylogeny to history" sponsored by Werner-Reimers-Stiftung and Maison des Sciences de l'Homme, Bad Homburg, West Germany, 3-5 December 1984.

Shri Subrata K. Roy, SRF (Anthropometry and Human Genetics) participated and presented a paper jointly with Professor Amitabha Basu in the "Symposium on the sharing of food—from phylogeny to History" sponsored by Werner-Reimers-Stiftung and Maison des Sciences de l'Homme, Bad Homburg, West Germany, 3-5 December, 1984.

Shri B.N. Mukherjee (Anthropometry and Human Genetics) visited West Germany as a Fellow during the period 1 July—30 September 1984 on invitation from Deutscher Akademischer Austauschdienst (DAAD). (1) Department of Human Biology Human Genetics, Bremen University, Bremen, (2) Department of Human Genetics and Department of Anthropology, Hamburg University, Hamburg (3) Department of Human Genetics, Medizinische Hochschule, Hannover. On invitation he also visited

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the following institutions during 1 October–30 October 1984 : (1) Swiss Federal Institute of Forestry Research, Zurich, Switzerland, (2) Department of Human Genetics, University of Newcastle upon Tyne, Newcastle, U.K. (3) Department of Preventive Medicine, Division of Biostatistics, Washington School of Medicines, St. Louis, USA, (4) Center for Demographic and Population Genetics, Graduate School of Biomedical Sciences, The University of Texas, Houston, USA, and gave seminars.

Dr. C. R. Malakar (Demography) visited Kabul, Afghanistan on 15 February, 1985 on an United Nations assignment as consultant in the Project, AFG. 82. P01 and returned on 17 March, 1985. He delivered a series of lectures on "Measures of Mortality" at the Department of Demographic Research and Training, C.S.O., Kabul.

Dr. N. S. Iyengar (Economic Analysis, Bangalore) participated in the 1984 Australian meetings of the Econometric Society at the University of Sydney, Australia, from 22-24 August 1984 and presented a paper (with M.H. Suryanarayana) entitled "On growth and equity in India". He also visited Australia and Singapore during August-September 1984 and delivered lectures and seminars at the University of Sydney, the University of New South Wales (6-7 September), the University of New England (3 September) and the National University of Singapore (10 September).

Dr. N. S. S. Narayana (Economic Analysis, Bangalore) attended the 1984 Congress of the International Federation of Operations Research Societies in Washington, D. C., U.S.A. from 6-10 August 1984 and presented a paper (with K. S. Parikh and T. N. Srinivasan) entitled "An Indian agricultural policy model : Preliminary results of an analysis of some redistributive policies". Dr. Narayana also visited the Agricultural Research Unit of the World Bank, Washington, D. C., U.S.A. on 13-17 August 1984 and the International Institute of Applied Systems Analysis (IIASA), Laxenburg, Austria from 20 August to 18 October 1984.

Dr. K. C. Majumdar (Economic Research) on an invitation by the Centre D' Etudes Des Programmes Economiques, Paris, delivered a series of twelve lectures on the Indian planning process and planning techniques including the plan models considered in Indian First through Sixth Five-Year Plans and also the current thinking on the subject with special reference to his on-going project. Later, this Institute organised personal discussions on Econometric Plan Models between him and experts and high officials of the University of Paris, the French Ministry of Finance, French Planning Commission and their Statistical Institute (INSEE).

Dr. Bhaskar Dutta (Economic Research) visited C.O.R.E., Belgium and the Universidad del Pais Vasco, Bilbao, Spain, during May–June 1984.

Dr. Pradip Maiti (Economic Research) returned in July 1984 after completing a teaching assignment at the University of Nigeria, Nsuka.

Shri A. K. Chowdhury (SQC unit, Bangalore) attended the World Quality Congress held during 18-22 June 1984 at Brighton, U.K. He also studied the QA system and application work of statistical methods in the plants namely, sew Ltd. Heidelberg, W. Germany and Centure Bailey, Paris, France.

Shri S. S. Handa and Shri P. R. Lakshminathan (SQC Unit, Delhi) attended the 'International Training Programme on QC in Industry' organised by Swedish Commission for Technical Cooperation at Stockholm, Sweden during 13 August to 18 October 1984.

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Dr. S. R. Mohan (SQC Unit, Delhi) continued to be at Chicago University on extension of his visiting fellowship by one year with effect from September 1984.

Dr. I. K. Ravichandra Rao (DRTC, Bangalore) attended the "Regional Workshop on Curriculum Development for Post-graduate Course in Information Studies for Latin American Region" in Caracas, Venezuela during the period 18 to 29 June 1984 as an invited resource person. He was invited by the Unesco, Paris. He left India on 16 June 1984. During the period 1 to 4 July 1984, Dr. Ravichandra Rao also visited Paris for observational study of Computerised Information Activities in that region. For this purpose, he visited the following Institutions: (1) Institut National des Techniques de La Documentation (INTD); (2) Institut Français du Pétrole; (3) Centre de Documentation Scientifique et Technique (of the centre de la Recherche Scientifique et Technique (CNRS)). Dr. Ravichandra Rao arrived at Paris on 30 June 1984. After completion of the journey, Dr. Rao returned to Bangalore on 9 July 1984.

Dr. G. Bhattacharyya (DRTC, Bangalore) attended the "International Symposium on Harmonization of Education and Training Programmes in Information Science, Librarianship and Archival Studies" during the period 8 to 12 October 1984. Dr. Bhattacharyya was invited by the Division of General Information Programme, UNESCO Paris. He left India for this purpose on 4 October 1984. During the period 15 to 19 October 1984 Dr. Bhattacharyya also visited London, Sheffield, and Boston, Spa for the purpose of making observational studies of the use of modern technology for information work and services. Dr. Bhattacharyya was invited by the British Council, London. He left Paris on 15 October 1984, and reached London on the same day. After completing his observational studies, Dr. Bhattacharyya returned to Bangalore on 21 October 1984.

40. SCIENTIFIC ASSIGNMENTS IN INDIA

Shri B. Dutta (Stat-Math) attended the 72nd Session of the Indian Science Congress held at Lucknow from 3 January to 8 January 1985 and presented a paper.

Dr. Joseph Mathew (Stat-Math) visited the Department of Mathematics, University of Bombay from November 13, 1984 to January 10 1985 and worked with Professor M. G. Nadkarni during this period.

Dr. Rahul Mukerjee (Stat-Math) presented an invited review paper on recent developments in factorial experiments at the Indian Agricultural Statistics Research Institute Silver Jubilee Symposium held in New Delhi in October 1984. He also attended the 72nd Session of the Indian Science Congress held at Lucknow from 3 January to 8 January 1985 and presented a paper.

Dr. S. Nag (Stat-Math) participated in the conferences and presented invited papers: (i) University Grants Commission Conference at IIT, Kanpur—16 to 20 April 1984; (ii) Symposium in Mathematical Analysis under the auspices of the IIT Madras and the National Board for Higher Mathematics—20 to 21 December 1984; (iii) IIT Kanpur Silver Jubilee Conference on "Frontiers of Mathematical Sciences"—25 to 29 March 1985.

Dr. B. V. Rao (Stat-Math) participated in the Vth Annual Conference of the Indian Society for the Theory of Probability and its Applications held at Trivandrum during 27-29 December 1984 and delivered lecture on a characterization of the Dirichlet distribution. He also participated in the Instructional Colloquium on applicable

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stochastic studies conducted at Jadavpur University during March 9-11, 1985 and gave two lectures on Wright-Fisher and Moran models in genetics.

Professor T. J. Rao (Stat-Math) visited Andhra University, Waltair from 29 March to 11 April 1985 and gave a course of lectures on 'Recent Advances in Survey Sampling'.

Professor A. K. Roy (Stat-Math) attended the symposium on "Frontiers of Mathematical Sciences" held during the period 25 to 29 March 1985 as part of the silver jubilee celebration of the IIT, Kanpur and presented a paper.

Dr. G. M. Saha (Stat-Math) was invited as a Visiting Fellow (U.G.C. Programme) by the Department of Statistics, Sambalpur University, during December 2-22, 1984 and delivered a series of lectures in design and analysis of experiments and gave some seminars.

Sm. Rita Saha Roy (Stat-Math) attended the 72nd session of Science Congress held at Lucknow during the period January 3 to January 8, 1985 and presented a paper.

Dr. Bikas Kumar Sinha (Stat-Math) attended the 72nd session of Science Congress held at Lucknow during the period January 3-8, 1985 and delivered an invited lecture.

Dr. R. L. Karandikar (Stat-Math) delivered lecture on "White Noise Approach to Filtering".

Dr. Shova Madan, Post-doctoral Visiting Fellow (Stat-Math) delivered a series of lectures on Maximal function characterisation of L^1 and martingale transforms.

Dr. K. R. Parthasarathy (Stat-Math) presented a survey of "Quantum Stochastic Calculus" at the International Symposium to commemorate the 60th anniversary of Bose Statistics, held at Calcutta, January 28 to February 1, 1985.

Dr. B. Ramachandran (Stat-Math) delivered a lecture on "Integrated Cauchy functional equations on a half-line and the line", at the University of Delhi on March 12, 1985.

Dr. G. Ravindran (Stat-Math) attended the Symposium on Mathematical Analysis, IIT, Madras, from December 19 to 21, 1984 and gave a talk on "Completely mixed games and univalence".

Dr. V. S. Sunder (Stat-Math) gave a course of lectures on "Von Neumann algebras (from Von Neumann to Connes)" from June 6 to July 15, 1985.

Dr. B. P. Sinha and B. B. Bhattacharya (Electronics) attended two conferences (i) IEEE International Conference on Computers, Systems and Signal Processing, Bangalore, Dec. 10-12, 1984. (ii) Fourth Conference in Foundations of Software Technology and Theoretical Computer Science, Bangalore, December 13-15, 1984.

Malabika Sinha (SRF) (Electronics) has delivered a talk in the High Energy Symposium at Jammu, 1984.

Professor A. Ghosh (Electronics) attended and gave a talk on "Computational Fluid Mechanics" at the All-India Seminar-cum-Workshops on 'Mathematical Concepts and Techniques in Applicable Discrete and Computational Mechanics' held at Jadavpur University from 25 to 29 September, 1984.

Dr. B. S. Dandapat (Electronics) attended the seminar on "Linear and non-linear waves in continuous media" held at the North Bengal University in September, 1984; attended the All-India seminar-cum-workshop on 'Mathematical concepts and tech-

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niques in Applicable Discrete and Computational Mechanics' held at Jadavpur University in September, 1984. Dr. Dandapat attended the International short term course on "Techniques in Applied Mathematics" held at Bangalore University from November 26 to December 21, 1984.

Dr. S. L. Jain (Geology) attended 72nd Session of the Indian Science Congress at Lucknow, 2-7 January 1985 and chaired a session of the XI Indian Colloquium on Micropalaëontology and Stratigraphy at Calcutta University 16-18 October 1984.

Dr. D. K. Rudra and Shri P. K. Maulik (Geology) attended the XI Colloquium on Micropalaëontology and Stratigraphy, Calcutta and presented a joint paper.

Dr. D. Saha (Geology) attended the leadership training course on Environment Awareness sponsored by Department of Environment, Government of West Bengal and Indian Association for the Cultivation of Science held at IACS, Jadavpur, during 29-30 January 1985. He obtained a certificate for excellent performance.

Dr. S. L. Jain (Geology) delivered invited lectures : (1) 'Age and environment of dinosaurs' at Indian Museum, Calcutta on 4 June, 1984 on World Environment Day, (2) a special lecture on 'Triassic-Jurassic fish fauna of Pranhita-Godavari Valley' at Punjab University on 11 Sept. 1984, (3) Special lecture on "Palaeobiology of dinosaurs : recent studies" at the 72nd session of the Indian Science Congress, Lucknow, 5 January 1985, (4) 'A new look at the dinosaurs' at the Gondwana Geological Society, Nagpur University, Nagpur on 14 January, 1985 and (5) a popular lecture on 'Facts and fallacies about dinosaurs' at Ananda Niketan College, Warora, Dt. Chandrapur, Maharashtra on 14 February, 1985.

Dr. A. B. Gupta (Physics) attended XIII National Conference of the Indian Association of Dermatologists, Venereologists and Leprologists, Cochin during January 3-6, 1985 (sponsored by the Indian Association of Dermatologists, Venereologists and Leprologists in collaboration with Lisic Hospital, Cochin, Kerala) and presented two papers on investigative dermatology. He also actively participated in the special seminar and workshop conducted as a part of the Conference.

Professor S. K. Roy (Botany) gave two seminars at the Life Science Centre of the North Bengal University on January 17 and 18, 1985 on the following topics : (i) Breeding strategy for the rice improvement : a critical analysis. (ii) The behaviour of the field rodent and assessment of pre-harvest grain losses caused by it.

Professor Amitabha Biju (Anthropometry and Human Genetics) participated in the following seminars/workshops : (a) Seminar on Tribal Medicine, sponsored jointly by the Anthropological Survey of India, Calcutta and North Bengal University, in March 1985 (Chaired a session) (b) Workshop on Small Populations, sponsored by the Anthropological Survey of India, Calcutta in March 1985 (Chaired a session) (c) Workshop on Area Studies sponsored by the Anthropological Survey of India, Calcutta in March 1985.

Professor K. C. Malhotra (Anthropometry and Human Genetics) participated in the following conferences in India : (a) Workshop on Eco-development of Western Ghats, May 11-14, 1984, Trivandrum (presented an invited paper). (b) UGC Task Force Meeting to develop courses in Environmental Sciences at Rajkot, May 8, 1984. (c) Symposium on Environment, Education and Action, Ahmadnagar College, Ahmadnagar, 4-6 June, 1984 (presented an invited paper). (d) Workshop on Courses in Environmental Sciences, Roorkee University, Roorkee, 18-20 August, 1984. (e) Visiting Scientist to CTS, Indian Institute of Sciences, Bangalore, from

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7-20 September, 1984. (f) Invited to give a lecture on Applications of Anthropology to Eco-development in UGC seminar Applications of Anthropology, Sagar University, Sagar, 27-29 December, 1984. (g) Development of Environment meeting on Cultural Ecology of Hushanded Plants, 4-5 February, 1984 at New Delhi. (h) Workshop on Genetic Epidemiological Approaches to Health Care, National Institute of Health and Family Welfare, 13-16 February, 1985 New Delhi (Discussant). (i) Meeting of the National Museum of Man at New Delhi, 12 February 1985. (j) Meeting of the National Museum of Man at Calcutta, 5 March, 1985. (k) Xth Annual Conference of the Indian Society of Human Genetics, Sagar University, 27-29 December, 1984 (presented a paper and Chaired a session). (l) DST meeting on thrust area programme in Biology, IISC, Bangalore, 14-16 March, 1985. (m) UGC visiting Fellow to Dept. of Anthropology, Tirupati University, Tirupati, from 17-30 March, 1985 (delivered a series of 16 lectures). (n) Advisory Committee meetings DST project on Cooking Energy, Society for Development Alternatives (October 9-10, 1984, December 16, 1984, February 6 and 17, 1985 (all at Delhi). (o) Acted as Selection Committee Member, Delhi University, Andhra University, Waltair.

Shri B. N. Mukherjee (Anthropometry and Human Genetics) attended the Xth Annual Conference of Indian Society of Human Genetics, Sagar, January 1985 and chaired a session on population variation. He also presented a paper. He attended the national seminar on sickle cell trait in India sponsored by UGC at Sambalpur University, 14-15 February 1985, chaired a session on Population Genetics and delivered an invited lecture on "Social geographical distribution of sickle cell in India.

Dr. M. Ghose (Crop Science) participated in the Seventh All India Botanical Conference held during 28-30 December 1984 at the University of Rajasthan, Jaipur and presented a paper

Dr. Suraj Bandyopadhyay (Sociology) presided over a session of seminar on "Tribal Health - Concept and Treatment of Diseases," during February 1985, in Calcutta, (post-Congress to 2nd International Congress on Traditional Asian Medicine in Indonesia), organised in collaboration with Anthropological Survey of India. Dr. Bandyopadhyay was invited to attend as discussant for the session: "Social action for change" of the 17th All-India Sociological Conference at Surat of Indian Sociological Society. A paper presented in the conference entitled, "Exploring boundaries of social interaction: Kinship, caste and class." The conference was held in December 1984 at Surat. Dr. Bandyopadhyay was also invited to attend and read a paper in the 10th Indian Social Science Congress at Allahabad of Indian Academy of Social Sciences, Allahabad, during January 1985. Paper read at the Congress entitled "Do the Brahmins always stay at the top? An empirical relationship between caste, class and power" (with K. Chattopadhyay and P. Chakrabarti), in the Plenary Session II on "Historicity of different perspectives of the contemporary social structure." Dr. Bandyopadhyay presided over a session of the seminar on "Anthropology of small population," organised by Anthropological Survey of India, in 12-14 March 1985. Dr. Bandyopadhyay at the request of Dr. A. K. Danda, Director, Anthropological Survey of India, delivered the "Concluding Observations"—summing up the major features and trends in research, coming out of the seminar on "Anthropology of Small Population". Dr. Bandyopadhyay was invited to attend as discussant for the Workshop on "Social and Management Issues", Conference on Metropolitan

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Development, organised by the Centre for Urban Economic Studies, Department of Economics, Calcutta University, April 1984.

Shri S. K. Biswas (Sociology) attended seminar on Anthropological Studies in India, organised by Asiatic Society, Calcutta, on 22.9.1984. Shri Biswas attended seminar on Science and Technology in Indian Language, organised by Socio-Economic Research Institute, Calcutta, on 9.11.84 to 11.11.84. Shri Biswas attended seminar on economic history, sociology, and Indian Society, organised by Socio-Economic Research Institute, Calcutta, on 23.11.84 to 25.11.84. Shri Biswas attended International seminar on population aging in India, Department of Sociology, Kerala University, Trivandrum on 4-7 February, 1985. Shri Biswas attended a seminar on anthropology of small population, organised by the Anthropological Survey of India, Calcutta on 12-14 February, 1985.

Shri K. Chattopadhyay and Dr. P. Chakrabarti (Sociology) attended bi-centenary celebrations of Asiatic Society, in its seminar on "Anthropological Studies in India," in September 1984, at Calcutta. Shri Chattopadhyay, Dr. P. Chakraborty and Shri T. N. Ghosh (Sociology) attended workshop on economic, economic history and Indian Society, Silver Jubilee Session of Socio-Economic Research Institute, Calcutta, in November 1984.

Shri B. N. Sarkar (Demography) attended six seminars and conferences during the year : (a) Ninth Social Science Congress held at Aligarh (16 to 19 April, 1984) and presented a paper. He also chaired one of the sessions of the Congress. (b) Annual function of the Statistics Department of Utkal University (3rd May, 1984) and delivered a lecture. (c) Pre-conference National Seminar on Population held at Vidyut Bhawan, New Delhi (31 May to 2 June, 1984) and presented a paper. (d) Conferences of the Directors of Population Research Centres held at Nirman Bhawan (6 and 7 July, 1984), New Delhi. (e) Seventy-second Session of the Indian Science Congress Association held at Lucknow (3 to 8 January, 1985) and presented a paper in the Statistics Section of the Association. He also participated in the symposium organised by the Anthropology and Archaeology Section by presenting another paper. (f) Tenth Social Science Congress held at Allahabad (27 to 30 January, 1985) and presented a paper.

Professor M. N. Pal (Economic Research), at the invitation of the Department of Regional Planning and Architecture, IIT, Kharagpur, addressed two seminars in April 1984 on (i) Methods of Identification of the spatially varying factors of agricultural productivity in a rugged terrain and (ii) VLS regression technique in discriminatory analysis for the best dependent variable and the relevant explanatory variables.

Dr. K. C. Majumdar (Economic Research) attended the symposium sponsored by the Planning Commission and the North East Hill University, Shillong, on the development of North-Eastern Region of India and presented a paper on a "Two-region Plan model with special reference to Assam." He also attended the Seminar on the Seventh Plan sponsored by the Planning Commission and organised by the committee of silver jubilee celebration of the Socio-Economic Research Institute, Calcutta, and presented a paper based on the models and exercises of the Planning Commission Project mentioned earlier.

Dr. D. Dasgupta (Economic Research) gave a seminar on the Analytics of effective demand - General theory and its modern exponents - at the Indian Institute of Management, Calcutta, in March 1985.

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Dr. Abhirup Sorkar (Economic Research) addressed a seminar on diffusion of technology through Multinationals, Presidency College, Calcutta in August 1984. He also addressed seminars on a model of trade in intermediate goods, and on a neo-Austrian model of international trade in ISI, Delhi and in JNU, Delhi, respectively, in December 1984. He later spoke on recent developments in the pure theory of international trade and again on technology diffusion, technological progress and the multinationals at the University of Hyderabad during February 1985.

Dr. P. Maity (Economic Research) gave a seminar on "The rural poor and relative prices in India" at the Presidency College, Calcutta on 7 December 1984.

Dr. N. S. Iyengar (Economic Analysis, Bangalore) attended the Silver Jubilee Seminar on Structural Changes in the Indian Economy at the Institute of Economic Growth, New Delhi (27-30 April 1984) and presented a paper with Suryanarayana entitled, "Growth and equity in India: An empirical analysis." He also presented a paper with Harish on "Asymptotic bias of adjusted LIML estimators" at the 23rd Indian Econometric Conference, Hyderabad (3-5 January 1984). He chaired the inaugural session of the national seminar on control of non-sampling errors, National Sample Survey, Jaipur (12-14 March 1985) and participated in the Forty-first Round Training Conference of NSSO (15-16 March 1985). He delivered the valedictory address at the seminar on development statistics, National Institute of Rural Development, Hyderabad (26 November 1984). Dr. Iyengar also lectured at the following universities and research organisations: (i) Centre for Aeronautical Studies and Analysis (CASA), Bangalore (Technological forecasting and future design, 2 November 1984). (ii) Madurai Kamaraj University, Madurai (Statistical distributions in economics, 16 November 1984). (iii) Sri Venkateswara University, Tirupati (Uses of econometrics in decision making, 27 February 1985). (iv) Reserve Bank of India, Bombay (Inequality measure in asset distribution and its decomposition, 15 March 1985). (v) Osmania University, Hyderabad (Measurement of economic indicators, 8 March 1984).

Dr. M. H. Suryanarayana (Economic Analysis, Bangalore) participated in the IEG National Seminar on Structural Changes in the Indian Economy and Society, Delhi (27-30 April 1984) and presented a paper with N. S. Iyengar on growth and equity in India.

Dr. Mallika Gopalkrishna (Economic Analysis, Bangalore) presented a paper entitled, "Household needs and measurement of welfare" at the 23rd Indian Econometric Conference, Hyderabad (3-5 January 1985).

Dr. L. S. Bhat (Planning, Delhi) delivered two invited lectures on applied geography at the UGC sponsored seminar on regional surveys organised by the Department of Geography, University of Udaipur, during July 1-3, 1984. Dr. Bhat delivered lecture entitled "Spatial Integration in Planning" to the trainees under Management Development Programme (integrated Approach to Budgeting) at the Indian Institute of Public Administration, New Delhi, September 27, 1984. Dr. Bhat delivered six lectures on "Geography of Health and Diseases with reference to Spatial aspects of providing Health Facilities" to the trainees attending the Certificate course in Planning and Evaluation of Health Programmes conducted by Institute for Research in Medical Statistics (ICMR), New Delhi, during 24-27 April 1984. He also delivered three lectures on Regional Planning, Data Sources and Analytical Techniques to Junior Statisticians in the training programme organised by the C. S. O.

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Dr. V. K. Chetty (Planning, Delhi) attended 23rd Indian Econometric Conference held in Hyderabad from January 3-5, 1985. During the conference he delivered the Mahalanobis's Memorial Award lecture.

Dr. Partha N. Mukherjee (Planning, Delhi) read a paper "Social conflict and changes towards a theoretic orientation" at the seminar on domestic conflict in South Asian States, 18th October 1984, J. N. U., New Delhi.

Dr. K. Saradmoni (Planning, Delhi) attended along with a paper entitled "Progressive land legislation and subordination of women" in the second National Conference on women's studies, Kerala University, Trivandrum, April 9-12, 1984. She attended along with a paper entitled "Employment and unemployment for the landless agricultural labourers : some field data examined" in the Silver Jubilee Seminar of the Institute of Economic Growth, Delhi, April 27-30, 1984. She also organised sub-theme on "Household as the Unit of Data collection and Analysis in Research and Surveys" in the Asian Regional Conference on Women and the Household, 27-31, January 1985, New Delhi.

Dr. S. Gangopadhyay (Planning, Delhi) has given two seminars in the Delhi School of Economics, one in the Presidency College, Calcutta and one in Agro-Economic Research Centre, Shantiniketan.

Shri S. M. Kansal (Planning, Delhi), attended the seminar on Structure, Presentation and Validity of National Income Estimates, held in Poona during 3-5, December 1985 which was organised by the Indian Association for Research in National Income and Wealth. Presented a paper entitled "A note on the presentation of the brief analysis of national income and savings results".

Shri M. R. Saluja (Planning, Delhi) attended the conference on small scale industry development sponsored by the Institute of Economic Growth, Delhi and the World Bank, held at New Delhi March 22-24, 1985 and presented a paper entitled "The data base of the unorganised manufacturing industry problems assessment and suggestions."

Shri Durgaprasad Bhattacharya (Pre-Census Population Studies) attended the seminars : (i) Silver Jubilee Seminar on Science, Technology and Land Reforms organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalyaya on November 9-11, 1984. (ii) Silver Jubilee Seminar on Economics, Economic History and Indian Society organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalyaya on November 23-25, 1984. (iii) Silver Jubilee Seminar on Seventh Five Year Plan organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalyaya at Darbhanga Hall on November 29, 1984. (iv) Seminar on Science and Empire organised by the National Institute of Science, Technology and Development Studies, CSIR, New Delhi, January 21-23, 1985. (v) Seminar on Anthropology of Small Population, March 12-14, 1985, held at Anthropological Survey of India, Calcutta. Acted as Chairman in the Session on Demo-Centric Issues. (vi) U.G.C. sponsored Summer Institute on Development Economics as a subject for teaching and research held at Rajendra Bharati University on 31 March, 1985.

Sm. Rama Deb Roy (Pre-Census Population Studies) attended the seminars :
(i) Silver Jubilee Seminar on Science, Technology and Land Reforms organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya on November 9-11, 1984. (ii) Silver Jubilee seminar on Economics, Economic History and Indian society organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya on November 23-25, 1984. (iii) Silver Jubilee seminar on Seventh Five Year Plan organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall on November 29, 1984. (iv) Seminar on Science and Empire organised by the National Institute of Science, Technology and Development Studies, CSIR, New Delhi, January 21-23, 1985.

Shri Kunal Chattopadhyay (Pre-Census Population Studies) attended the seminar :
(i) Seminar on promotion of tourism in Eastern India — opportunities and constraints, held on 15 September, 1984 at Calcutta by Indian Chamber of Commerce and Industries. (ii) Silver Jubilee Seminar on Science, Technology and Land Reforms organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya on November 9-11, 1984. (iii) Silver Jubilee Seminar on Economics, Economic History and Indian Society organised by Socio-Economic Research Institute, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya on November 23-25, 1984. (iv) Silver Jubilee Seminar on Seventh Five Year Plan organised by Socio-Economic Research Institute, Calcutta, in collaboration with Indian Statistical Institute, Calcutta University and Bidhan Chandra Krishi Viswa Vidyalaya at Darbhanga Hall on November 29, 1984. (v) Seminar on the Problem of Environmental Pollution organised by Institute of Commerce, Calcutta, at Sodpur on 3 February, 1985. (vi) Fifth Annual Conference of Bangiya Arthaniti Parishad held at Calcutta on February 23-24, 1985.

Shri Amitav Choudhury (Linguistics) presented a paper entitled "Socio-cultural and psychological factors responsible for the evolution of Indianisms in English" at a Seminar on "Indianisms in English" organised by Delhi University, New Delhi (15-16 March, 1985).

Dr. S. Chatterjee (Psychometry) delivered a lecture on "Objective tests and methods — how these can be used for recruitment" at BHEL, Ajmere, on 9 October 1984. He also attended the 12th annual conference of the Indian Academy of Applied Psychology during 1st to 3rd March 1985 at Department of Applied Psychology, Calcutta University.

Dr. Manjula Mukherjee (Psychometry) delivered a lecture on "How to make interview objective" at BHEL, Ajmere, on 9 October 1984. She also attended the 12th annual conference of the Indian Academy of Applied Psychology, during 1st to 3rd March 1985 at Department of Applied Psychology, Calcutta University.

Shri S. N. Banerjee (Psychometry) attended the seminar organised by the Socio-Economic Research Institute in connection with their Silver Jubilee Celebration at Darbhanga Building, Calcutta University, on 7th July 1985, 19-21st September 1984, 9-11 November, 1984, 22-24 and 29th November, 1984. He also attended the XXII

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Annual Conference of Indian Academy of Applied Psychology, on 1st to 3rd March, 1985, at the Department of Applied Psychology, Calcutta University.

Shri Biswanath Ray (National Income) participated in the seminar on "Economics, Economic History and Indian Society" organised at Calcutta on 23-25 November 1984 on the occasion of the Silver Jubilee of the Socio-Economic Research Institute, Calcutta. He presented a paper (in Bengali) entitled, "An economic review of the Sunderbans" at this seminar.

Professor G. Bhattacharya (DRTC) attended the State level seminar on "Integrated rural library development" sponsored by Andhra Pradesh Library Association, Hyderabad, held during 23-24 November 1984. Professor Bhattacharya was the Director of the Seminar. His paper for the seminar was entitled "Integrated rural library development in the context of integrated rural development." Professor Bhattacharya, Dr. M. L. Gopinath and Dr. S. Seetharama (DRTC) attended the IASLIC National Seminar - 41 (1984) held during 26-29 November 1984 at the Osmania University, Hyderabad. Professor Bhattacharya was the President of the seminar. His presidential address was entitled "Towards a strategy for modernization of library work and services in India." Dr. Gopinath's paper was entitled "Development of information technology and document delivery service by libraries". Dr. S. Seetharama's paper was entitled "In search of a code of professional ethics."

Dr. M. A. Gopinath (DRTC) attended the seminar on Management of Small Industries, held in April 1984 at Small Industries Service Institute, Bangalore and presented a paper entitled "An outline for MIS for financial management."

Dr. I. K. Ravichandra Rao (DRTC) attended the workshop on Application of mathematical and financial techniques to Information management, held during 13-14 September 1984 at National Aeronautical Laboratory, Bangalore and presented a paper entitled "Elements of Statistics for Librarians". Dr. Rao attended the seminar on new trends in management of libraries held during 1922 December 1984 at Poona University and presented a paper entitled "Information technology: Its application to library and information field for effective library and information management."

Shri J. Verghese (Central Library) attended the National Convention on Micrographics at Delhi from September 19-21, 1984. He presented a paper 'Silver Halide Microfilm.' He also attended IASLIC National Seminar on 'Document Delivery' at Hyderabad from 26-29 November 1984.

Shri N. D. Basak (Central Library) attended the 30th All India Library Conference at Jaipur, 28-31, January 1985. He along with Shri B. B. Das presented a paper 'Problems with the less used books and their storage: a cases study.'

Sm. Ratna Bandyopadhyay (Das) (Central Library) attended the XIth National Seminar of IASLIC held at Osmania University, Hyderabad, 26-29 November 1984. She submitted a paper 'Ethics for an institutional library' which was published in the proceedings of the seminar.

41. THE NINETY-FIRST BIRTH ANNIVERSARY OF THE LATE PROFESSOR P. C. MAHALANOBIS

A meeting of the workers and students of the Institute was held in the auditorium of the Institute at Baranagar on 29 June 1984 to celebrate the Ninety-first Birth

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Anniversary of the Late Professor P. C. Mahalanobis, the Founder of the Institute. The meeting was jointly organised by the ISI Administration, ISIWO and ISI Club. Dr. A. Maitra, Director of the Institute welcomed the distinguished guests and all those who attended the meeting. Professor Prannatha Nath Bisi and Professor Asok Mitra, the well-known demographer reminisced about Professor Mahalanobis and his times. Renowned litterateur Sri. Maitreyee Devi presided over the meeting.

Part III. Administration and Office-Bearers

12. GENERAL ADMINISTRATION

Membership : During the year seventy-two persons were elected as ordinary members, sixteen ordinary members became life members and five ordinary members resigned from membership.

The membership position as on 31 March 1985 : 786 (ordinary members : 596 ; life members : 174 and institutional members : 16). During the year 191 student members were enrolled.

Annual General Meetings : Four annual general meetings of the Institute were held during the year on 24 July 1984, 7 September 1984, 18 September 1984 and 31 December 1984.

Council Meetings : Seven meetings of the Council of the Institute were held during the year on 28 April 1984, 28 June 1984, 24 July 1984, 7 September 1984, 18 September 1984, 31 December 1984 and 4 February 1985.

Finance Committee Meetings : Two meetings of the Finance Committee were held during the year on 18 September 1984 and 20 December 1984.

A list of the names of the President of the Institute and Chairman and Members of the Council of the Institute together with names of members of the different committees is given in Chapter 13.

Institute staff : The following senior members of the staff have been functioning in the posts mentioned during the year.

- (1) Dr. A. Maitra, M.Sc. (Stat., Bombay), Ph.D. (Stat., Berkeley), Director.
- (2) Dr. S. B. Rao, Dean of Studies.
- (3) Dr. B. Ramachandran, Head of Delhi Centre.
- (4) Shri N. Srinivasan, Officer-on-Special Duty (Administration & Finance).

New Appointments : The following faculty staff joined the Institute during the year :

- (1) Dr. Monoranjan Pal, Lecturer, CSU.
- (2) Dr. V. V. Srivatsa, Lecturer, Stat-Math Division.
- (3) Dr. Thomas Mathew, Lecturer, Stat-Math Division, Delhi Centre.
- (4) Shri J. N. Ghosh, Administrative Officer, Delhi Centre.
- (5) Dr. Satya R. Chakraborty, Lecturer, ERU.
- (6) Dr. Abhirup Sarkar, Lecturer, ERU.
- (7) Dr. Bimal Kr. Roy, Lecturer, CSU.

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- (8) Dr. P. K. Das, Lecturer, ISEC.
- (9) Dr. R. L. Karandikar, Associate Professor, Stat-Math Division, Delhi Centre.
- (10) Dr. Dilip Kr. Saha, Lecturer, GSU.
- (11) Dr. Pulakesh Maiti, Publication Officer, Stat-Math Division.
- (12) Dr. Amitav Sarkar, Lecturer, ERU.
- (13) Dr. Rajendra Bhatia, Associate Professor, Stat-Math Division, Delhi Centre.
- (14) Dr. Ashis Sen Gupta, Lecturer, CSU.
- (15) Shri Somnath Roy, Technical Officer Gr. III, SQC Unit, Bangalore.
- (16) Shri Pathik Kr. Mondal, Technical Officer Gr. III, SQC Unit, Bangalore.
- (17) Shri Rajiv Goel, Technical Officer Gr. III, SQC Unit, Delhi.
- (18) Shri G. Nagaraj, Technical Officer Gr. III, SQC Unit, Madras.
- (19) Shri Amit Kr. Biswas, Technical Officer Gr. III, SQC Unit, Hyderabad.
- (20) Dr. Prasanta Kr. Mazumdar, Lecturer, DRU.

Retirement : The following staff retired from services :

- (1) Shri M. V. Raman, Associate Professor, DRU.
- (2) Shri A. R. Desai, Special Officer, Library.
- (3) Shri Anil Kr. Chatterjee, Associate Professor, ERU.
- (4) Shri N. K. Chatterjee, Sr. Lecturer, ERU.
- (5) Shri H. P. Biswas, Sr. Lecturer, ERU.
- (6) Dr. B. C. Das, Professor, Biometry.

Resignation and termination of service : The following staff left the Institute on resignation/termination of service :

- (1) Shri M. K. Abuja, Administrative Officer, Delhi Centre.
- (2) Shri Sobhan Mukhopadhyay, Computer Engineer, CSU.
- (3) Shri V. V. Buche, Technical Officer Gr. III, SQC Unit, Pune.
- (4) Shri J. N. Ghosh, Administrative Officer, Delhi Centre.

Staff position as on 31 March 1985 :

- (1) Scientific and Technical Group — 505
- (2) Non-Scientific Group — 1067

Land and Construction :

Calcutta

(1) *Staff quarters at Delux Garden :* The construction of 4th block of another 16 units has been completed in all respects. Calcutta Electric Supply Corporation has taken necessary steps to supply power to these new buildings.

(2) *Deep tube well and water supply :* A new deep tube well has been sunk during the year and necessary pipe lines have been laid to supply water to the staff quarters at Delux Garden and also to Composite Library Building.

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(3) *Faculty staff quarters* : Two blocks of eight quarters each have been completed in all respects and have been allotted to the faculty members.

(4) *Administrative Building at 202 B. T. Road* : The contract for combined civil and plumbing work has been awarded to M/s. S.T.P. Development and Construction Ltd. About 15,000 sq.ft. of the building which are on solid land have been completed. The rest which have been constructed after filling a portion of pond is nearing completion.

(5) *Medical Welfare Unit* : The contract for combined civil and plumbing work of Medical Welfare Unit has been awarded to M/s. J. N. Dutt. The construction work is progressing satisfactorily.

(6) *Extension of Composite Library Building* : The contract for extension of Library Building up to 7th, 8th and 9th floor has been awarded to M/s. B. B. G. Construction.

(7) *Installation of Lift* : Construction of stair-case portion along with lift well has been taken up to facilitate erection of two lifts to be installed by M/s. OTIS up to 9th floor.

Delhi

(1) Construction of 9 'B' type quarters has been completed and occupied by the staff, another 6 'B-5' type quarters has also been completed and allotment of the same is in process.

(2) Construction of 32 'C' type quarters for low paid staff has been completed and allotted to staff.

(3) Construction of 6 'A-1' type quarters is nearing completion and work for extension of Guest House has also been initiated.

Bangalore

(1) *Barbed wire fencing and compound wall* : The boundaries of the campus has been protected with barbed wire fencing and masonry wall with gates. The work has been completed.

(2) *Store-cum-office shed* : Construction of a temporary shed for site office and cement godown has been completed.

(3) *Water-supply* : Two tube-wells have been sunk. One has been fitted with hand pump and the larger one with a submersible pump.

(4) *Academic block* : The building with a total floor area of 32,000 sq.ft. has been completed. The building has already been occupied. The same will accommodate Administrative Office, Scientific Staff, Class Room, Library, Conference Hall, Stores, Canteen, Computer, Garages, etc.

(5) *Construction of A, B and C type staff quarters* : Construction of the following units of staff quarters has been taken up : A type — 10 quarters, B type — 4 quarters and C type — 12 quarters; total 26 quarters. The work has been awarded to M/s. Sree Byravn Engineers.

(6) *Construction of Hostel building* : The work has been awarded to M/s. Sree Byravn Engineers. The work is in progress.

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(7) *Construction of road, culverts, etc.* : The construction of road and culverts have been awarded to M/s. Byrava Engineers. The work is in progress.

(8) *Installation of 200 K.V. High Tension Transformer* : The work is in progress.

Hyderabad

For construction of office and residential buildings, sanitary and plumbing works including water-supply and roads for the campus, tenders were invited and contract awarded to M/s. P. Viswanadha Raju. The progress of work during the year is as follows : (a) R. C. C. column structure has been completed for Academic block, (b) Layout for A-type quarters and foundation for B-type quarters have been completed, (c) 6" tube-well has been sunk and is ready for water-supply.

Baroda

Construction of boundary wall has been completed.

Madras

The Government of Tamil Nadu allotted 5 acres of land in Taramani near Adyar and adjacent to CSIR complex. The title deed transferring the above land to ISI was registered and handed over to ISI. Works Advisory Committee has been constituted.

13. LIST OF PRESIDENT, CHAIRMAN AND MEMBERS OF THE COUNCIL, MEMBERS OF THE COMMITTEES OF THE COUNCIL AND ACADEMIC COUNCIL

President : Shri Subimal Dutt, ICS (Retd.)

The Council

1. *Chairman* : Shri P. N. Haksar, M.Sc., Bar-at-Law, IFS (Retd.)

Representatives of Government of India (4)

2. (i) Dr. K. C. Seal, Director General, Central Statistical Organisation
Department of Statistics, Ministry of Planning
3. (ii) Shri M. L. Majumder, Joint Secretary to the Government of India, Ministry of Finance, Department of Expenditure
4. (iii) Dr. (Mrs.) A. R. Rajeshwari, Director, Department of Science and Technology
5. (iv) Shri C. V. Rao, Principal Adviser, Department of Statistical Analysis & Computer Services, Reserve Bank of India.

Scientists not employed in the Institute (7)

Representative of ICSSR (1)

6. Professor A. Vaidyanathan, Madras Institute of Development Studies, Madras.

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Representatives of INSA (4)

7. (i) Professor S. K. Trehan, F.N.A., Professor of Applied Mathematics, Punjab University, Chandigarh.
8. (ii) Professor S. S. Shrikhande, Director, Mehta Research Institute, Allahabad.
9. (iii) Professor Asok Ghosh, Sir Nilratan Sircar Professor of Zoology, Calcutta University.
10. (iv) Professor U. R. Chatak, F.N.A., Professor & Head, Department of Organic Chemistry, Indian Association for the Cultivation of Science, Calcutta.

Scientists Co-opted by the Council (2)

11. (i) Professor C. G. Khatri, Department of Statistics, Gujrat University, Ahmedabad.
12. (ii) Dr. N. Seshagiri, F.A.Sc., F.I.E.T.E., Additional Secretary, Government of India, Department of Electronics.

Elected Representatives of the Institute Members not employed in the Institute (2)

13. (i) Dr. P. K. Bose, M.Sc., Ph.D., F.S.S. (London), Formerly Centenary Professor and Head, Department of Statistics, University of Calcutta.
14. (ii) Shri S. H. Sen, M. Jodhpur Park, Calcutta.

Elected Representatives of the employees of the Institute (2)

15. Shri Ranajit Kanta Lahjri, Representative of Scientific workers of the rank below that of Associate Professor or equivalent.
16. Shri Sital Chatterjee, Representative of Non-Scientific workers.

Officers of the Institute (ex-officio) (9)

17. (i) Dr. A. Maitra, Director

Professor-in-Charge of Scientific Divisions (5)

18. (ii) Dr. T. J. Rao, Theoretical Statistics and Mathematics Division.
19. (iii) Dr. Shirdas Bandyopadhyay, Applied Statistics, Surveys and Computing Division.
20. (iv) Dr. Rabin Mukherjee, Social Sciences Division.
21. (v) Dr. Mihir Kr. Chakraborty, Physical and Earth Sciences Division.
22. (vi) Dr. Amilava Basu, Biological Sciences Division
23. (vii) Shri A. N. Nankana, Head, Statistical Quality Control and Operations Research Division.
24. (viii) Dr. B. Ramachandran, Head, Delhi Centre
25. (ix) Dr. S. B. Rao, Dean of Studies
Shri N. Srinivasan, Officer-on-Special Duty (Administration & Finance),
acted as non-member Secretary.

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List of Members of the Academic Council

1. Dr. A. Mitra Director — *Chairman*
2. Dr. S. B. Rao, Dean of Studies — *Convener*

Theoretical Statistics and Mathematics Division

3. Dr. A. K. Roy, 4. Dr. B. P. Adhikari, 5. Dr. E. M. Paul, 6. Dr. G. Jogesh Babu, 7. Dr. B. V. Rao, 8. Dr. J. K. Ghosh, 9. Dr. T. J. Rao, 10. Dr. Somesh Dasgupta, 11. Dr. B. Ramchandran, 12. Dr. K. R. Parthasarathy, 13. Dr. Sujit Kr. Mitra, 14. Dr. T. Parthasarathy, 15. Dr. B. L. S. Prakasa Rao, 16. Dr. K. B. Sinha, 17. Dr. G. A. Swarup, 18. Dr. T. V. Hanurav, *19. Dr. A. B. Baha, *20. Dr. G. M. Saha.

Applied Statistics Surveys and Computing Division

21. Dr. J. Roy, 22. Dr. B. N. Mukherjee, 23. Dr. B. C. Das, 24. Dr. Arijit Chaudhuri, 25. Dr. Subir Bandyopadhyay, 26. Dr. S. K. Pal, *27. Dr. T. Krishnan, *28. Dr. K. S. Vijayan.

Social Sciences Division

29. Dr. D. K. Bose, 30. Dr. N. Bhattacharya, 31. Dr. Ashok Mitra, 32. Dr. S. Chatterji, 33. Dr. Partha Nath Mukherjee, 34. Dr. Sanjit Bose, 35. Dr. M. N. Pal, 36. Dr. D. Dasgupta, 37. Dr. Rabin Mukherjee, 38. Dr. S. K. Chakraborty, 39. Dr. (Miss) M. Mukherjee, 40. Dr. B. S. Minhas, 41. Dr. V. K. Chetty, 42. Dr. L. S. Bhat, 43. Dr. Atul Sarma, 44. Dr. N. S. Iyenger, *45. Dr. Suhas Chattopadhyay, *46. Dr. Chittaranjan Malakar.

Biological Sciences Division

47. Dr. K. C. Malhotra, 48. Prof. S. K. Roy, 49. Dr. Amitabha Basu, 50. Prof. R. L. Brahmachari, 51. Dr. K. Pakrasi, *52. Shri Dipak Kr. Bagchi, *53. Dr. Manoranjan Ghosh.

Physical and Earth Sciences Division

54. Dr. D. Dutta Majumder, 55. Dr. Ambarish Ghosh, 56. Dr. T. Roy Chaudhury, 57. Prof. P. Bandyopadhyay, 58. Shri Ashis Sen, 59. Dr. S. L. Jain, 60. Dr. M. K. Chakraborty, *61. Dr. Sankar Kumar Pal, *62. Dr. Bhubani Prasad Sinha.

SQC and OR Division

63. Shri C. A. Setty, 64. Shri N. Srinivasan, 65. Dr. K. G. Ramamurthy, 66. Shri S. M. Sundara Raju, 67. Shri V. Narayana, 68. Shri C. R. Prasad, 69. Shri A. N. Nankaa, 70. Shri B. K. Sarkar, *71. Shri J. Venkatappaiah, *72. Shri B. K. Pal.

Library, Documentation and Information Sciences Division

73. Dr. J. Misra, 74. Prof. A. Neelameghan, 75. Prof. G. Bhattacharyya

Member-Secretary, ISEC, Calcutta

76. Dr. Shubdas Bandyopadhyay

* Representatives selected by the Divisional Committee of Scientific workers.

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Head, SQC T & P Unit

77. Shri R. J. Pandey.

Secretary, Examinations Committee

78. Shri Tarush Maitra.

List of Members of Different Committees of the Institute

1. Finance Committee :

1. Director (Ex-Officio Chairman), 2. Dr. P. K. Bose, Formerly Centenary Professor and Head, Department of Statistics, University of Calcutta, 3. Professor Ashok Ghosh, 4. Dr. K. C. Seal, 5. Shri M. L. Majumder, 6. Shri N. Srinivasan, 7. Dr. B. Ramachandran, 8. Dr. D. Dutta Majumder, 9. Shri A. K. Ailhikari, 10. Dr. P. Maity, 11. Dr. J. Mishra.

Shri P. K. Chatterjee, Senior Accounts Officer, Indian Statistical Institute (Non-member Secretary).

2. Journal Committee :

Editors : Sankhya, Series A and B

Dr. C. R. Rao and Dr. G. Kallianpur

Co-editors : Series A

1. Dr. G. Jogesh Babu, 2. Dr. J. K. Ghosh, 3. Dr. S. K. Mitra, 4. Dr. K. R. Parthasarathy, 5. Dr. B. Ramachandran, 6. Dr. Bimal Kumar Sinha.

Co-editors : Series B

1. Dr. N. Bhattacharya, 2. Dr. Arijit Chaudhuri, 3. Dr. Dipankar Das Gupta, 4. Dr. S. K. Mitra, 5. Dr. K. G. Ramamurthy, 6. Dr. J. Roy.

Members of Journal Committee : Sankhya, Series A and B

1. Dr. R. R. Bahadur, 2. Dr. D. Basu, 3. Dr. Sukhmanj Chakraborty, 4. Dr. S. K. Chatterjee, 5. Dr. T. J. Rao, 6. Dr. Malay Ghosh, 7. Dr. C. G. Khatri, 8. Dr. M. N. Murthy, 9. Dr. R. P. Pakshirajan, 10. Dr. B. L. S. Prakasa Rao, 11. Dr. J. Seshuraman, 12. Dr. S. S. Shrikhande, 13. Dr. S. R. S. Varadhan.

The Editors and Co-editors are ex-officio members of the Committee.

The Editorial Secretary will function as Convener of the Committee.

3. Examinations Committee :

1. Professor S. P. Mukherjee (Chairman), Professor of Statistics, Calcutta University, 2. Dr. J. Roy, Indian Statistical Institute, 3. Dr. N. Bhattacharya, Indian Statistical Institute, 4. Dr. C. R. Malakar, Indian Statistical Institute, 5. Dr. D. Dasgupta, Indian Statistical Institute, 6. Dr. T. V. Hanurav, Indian Statistical Institute, 7. Officer-in-Charge, Training Division, Central Statistical Organisation, New Delhi, 8. Professor A. M. Goon, Presidency College, Department of Statistics, Calcutta, 9. Dr. Anis Mukherjee, Indian Statistical Institute, 10. Dr. S. B. Rao, Dean of Studies, 11. Shri Tarush Maitra, Indian Statistical Institute (Secretary-Convener).

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4. Works Advisory Committees for Construction :

(a) Baranagar, Calcutta :

1. Dr. P. K. Bose (Chairman), 2. Shri S. Bandyopadhyay (Outside Expert), 3. Dr. J. Roy, 4. Dr. Shyam Matai, 5. Shri Ashoke Dutta, 6. Shri N. Srinivasan, 7. Shri V. S. Bhat, 8. Shri Supriya Gupta, 9. Shri Sanjay Sinha, 10. Shri Soumen Bose, 11. Shri Aparesb Mukherjee (Convener).

(b) Delhi :

1. Dr. Jagjit Singh (Chairman), 2. Shri R. S. Panesar, 3. Dr. K. R. Parihasarathy, 4. Dr. B. L. S. Prakasa Rao, 5. Shri A. N. Nankana, 6. Sri G. S. Pasricha, 7. Dr. B. Ramschandren, 8. Administrative Officer (Convener), 9. Shri N. Srinivasan.

(c) Bangalore :

1. Shri C. S. Seshadri (Chairman), 2. Prof. Srinagobhushana, 3. Shri Ganesh Bhattacharya, 4. Shri C. A. Setty, 5. Dr. N. S. Jyenger, 6. One nominee of the Government of Karnataka, 7. Shri K. Ganesh, Engineer-in-Charge, 8. Shri R. Narayana Rao (Non-member Convener), 9. Shri N. Srinivasan.

(d) Madras :

1. Shri P. C. Mathew, ICS (Retd.) (Chairman), 2. Shri K. Madhava Sarma, Commissioner and Secretary, PWD, Govt. of Tamil Nadu, 3. Shri S. Sanmuga Sundaram, Chief Engineer, PWD, Govt. of Tamil Nadu, 4. Shri C. R. Prasad, 5. Shri C. Y. Krishna Murti (Convener), 6. Shri N. Srinivasan.

(d) Hyderabad :

1. Justice P. Jaganmohan Reddy (Chairman), 2. Shri T. L. Shankar, 3. Prof. T. Navneeth Rao, 4. Dr. T. V. Hanurav, 5. Shri V. Narayana (Convener), 6. Shri N. Srinivasan.

Technical Advisory Committees of Divisions

I. Theoretical Statistics and Mathematics Division

1. Dr. A. Maitra, Director (Chairman), 2. Dr. S. S. Shrikhande, Director, Mehta Research Institute, Allahabad, 3. Dr. M. G. Nadkarni, Department of Mathematics, University of Bombay, Bombay, 4. Dr. S. K. Chatterjee, Department of Statistics, University of Calcutta, Calcutta, 5. Dr. C. G. Khatri, Professor of Statistics, Gujarat University, Ahmedabad, 6. Professor T. J. Rao, Professor-in-Charge (Convener).

II. Applied Statistics, Surveys and Computing Division.

1. Dr. A. Maitra, Director (Chairman), 2. Dr. K. C. Seal, Central Statistical Organisation, Department of Statistics, 3. Professor C. G. Khatri, Department of Statistics, Gujarat University, Ahmedabad, 4. Dr. S. N. Roy, Executive Director, Computer Centre, Department of Statistics, 5. Dr. E. V. Krishnamurthy, Department of Applied Mathematics, Indian Institute of Science, Bombay, 6. Dr. Prem Narain, Director, Indian Agricultural Statistics Research Institute (ICAR), New Delhi, 7. Dr. S. P. Mukherjee, Head, Department of Statistics, Calcutta University, Calcutta, 8. Professor Mohit Roy, Department of Electronics and

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Tele-Communications, Jadavpur University, Calcutta, 9. Professor P. V. Sukhatme, Hony. Professor of Biometry, Maharashtra Association of Cultivation of Science, 10. Dr. Moni Mukherjee, Calcutta, 11. Dr. S. K. Mukhopadhyay, Professor of Economics and Director, Centre for Human Resource Development, Department of Economics, University of Kalyani, Kalyani, 12. Dr. Shubdas Bandyopadhyay, Professor-in-Charge (Convener).

III. Social Sciences Division

1. Dr. A. Maitra, Director (Chairman), 2. Professor Asok Mitra, ICS (Reid.), Adviser, Land Use and Chairman, State Land Use Board, Government of West Bengal, 3. Professor K. B. Pathak, International Institute of Publication Studies, Bombay, 4. Professor Asish Dose, Institute of Economic Growth, Delhi, 5. Professor Mihir Rakshit, Centre for Advanced Studies, Presidency College, Calcutta, 6. Professor S. D. Tendulkar, Delhi School of Economics, University of Delhi, 7. Professor C. R. Rangarajan, Deputy Governor, Reserve Bank of India, Bombay, 8. Professor A. Vaidyanathan, Centre for Development Studies, Trivandrum, 9. Professor B. H. Krishnamurthi, Professor of Linguistics, Osmania University, Hyderabad, 10. Professor R. N. Srivastava, Department of Linguistics, University of Delhi, Delhi, 11. Professor S. K. Mitra, New Delhi, 12. Professor K. V. Limaye, National Institute of Bank Management, Bombay, 13. Professor S. M. Mohsin, Reid. Professor of Psychology, Patna University, Patna, 14. Professor Surajit C. Sinha, Director, Professor of Social Anthropology, Centre for Studies in Social Sciences, Calcutta, 15. Professor Barun De, Professor of History, Centre for Studies in Social Sciences, Calcutta, 16. Professor P. C. Joshi, Director, Institute of Economic Growth, Delhi, 17. Professor Robinatranath Mukherjee, Professor-in-Charge (Convener).

IV. Physical and Earth Sciences Division

1. Dr. A. Maitra, Director (Chairman), 2. Prof. S. N. Sen, Dept. of Geology, Calcutta University, Calcutta, 3. Prof. A. K. Saha, Head, Department of Geology, Presidency College, Calcutta, 4. Prof. S. B. Bhatia, Chairman, Centre of Advanced Study in Geology and Head, Dept. of Geology, Punjab University, Chandigarh, 5. Prof. Mahadeb Adhikari, Acharya P. C. Roy Professor of Agriculture, University of Calcutta, Calcutta, 6. Prof. A. N. Mitra, Dept. of Physics, Delhi University, Delhi, 7. Prof. B. R. Nag, Institute of Radio Physics and Electronics, Calcutta University, Calcutta, 8. Prof. J. Das, I.I.T., Kanpur, 9. Prof. R. K. Verma, Physical Research Laboratory, Ahmedabad, 10. Prof. A. K. Chowdhury, Dept. of Computer Science, Calcutta University, Calcutta, 11. Prof. G. Krishna, Chairman, School of Automation, Indian Institute of Science, Bangalore, 12. Prof. M. Dutta, Professor-in-Charge, S. N. Bose Institute of Physical Sciences, Calcutta University, Calcutta, 13. Prof. B. L. Deekshatulu, Director, NRSA, Hyderabad, 14. Prof. P. Neyogi, Dept. of Mathematics, I.I.T., Kharagpur, 15. Prof. S. Khamrui, Head, Dept. of Mathematics, Jadavpur University, Calcutta, 16. Dr. M. K. Chakrabarti, Professor-in-Charge, (Convener).

V. Biological Sciences Division

1. Dr. A. Maitra, Director (Chairman), 2. Dr. L. D. Sanghvi, Cancer Research Institute, Tala Memorial Centre, Bombay, 3. Dr. Narendra Singh, Scientist, Protein Technology Discipline, Central Food Technological Research Institute, Mysore, 4. Dr. Sivalosh Mukherjee, Dean, School of Life Science, Jawaharlal

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Nehru University, New Delhi, 5. Prof. P. N. Bhaduri, Emeritus Professor (ICAR), Bidhan Chandra Krishi Viswa Vidyalaya, West Bengal, 6. Prof. B. B. Biswas, Head, Dept. of Biochemistry, Bose Institute, Calcutta, 7. Shri H. K. Rakshit, Visiting Fellow, Anthropological Survey of India, Calcutta, 8. Dr. D. K. Dasgupta, Professor of Crop Physiology, University of Calcutta, Calcutta, 9. Dr. N. D. Dutta Banik, Deputy Director-General, Indian Council of Medical Research, New Delhi, 10. Prof. P. V. Sukhatme, Dept. of Biometry, M.A.C.S. Research Institute, Pune, 11. Prof. J. J. Ghosh, Centenary Professor, Department of Biochemistry, University of Calcutta, Calcutta, 12. Prof. I. P. Singh, Professor & Head, Dept. of Anthropology and Dean, Faculty of Science, Delhi University, Delhi, 13. Dr. A. K. Sharma, Professor, Dept. of Botany, Calcutta University, Calcutta, 14. Dr. A. B. Roy, Dept. of Mathematics, Jadavpur University, Calcutta, 15. Dr. A. Basu, Professor-in-Charge (Convener).

VI. Statistical Quality Control and Operations Research

1. Dr. A. Maitra, Director (Chairman), 2. Shri P. N. Arunugham, Chief, Quality Assurance, Bharat Heavy Electricals Ltd., New Delhi, 3. Shri Y. K. Bhat, Director of Statistics, Indian Standards Institution, New Delhi, 4. Shri M. V. Raman, Regional Director, National Productivity Council, Madras, 5. Shri G. V. S. Desikan, Chairman, Kerala State Textile Corpn. Ltd., Trivandrum, 6. Shri R. S. Gupta, Dy Executive Director, National Productivity Council, New Delhi, 7. Shri A. N. Nankana, Head, SQC & OR (Convener).

VII. Library, Documentation and Information Sciences Division

1. Dr. A. Maitra, Director (Chairman), 2. Dr. V. A. Kamath, Retired Head, Bhabha Atomic Research Centre, Bombay, 3. Prof. P. B. Mangala, Professor & Head, Dept. of Library Science and Dean, Faculty of Arts, Delhi University, Delhi, 4. Prof. A. P. Srivastava, University Librarian, Delhi University Library, Delhi, 5. Dr. P. S. K. Sharma, Librarian, University Grants Commission, New Delhi, 6. Dr. I. N. Sengupta, Scientist, Indian Institute of Chemical Biology, Calcutta, 7. Prof. P. K. Mahapatra, Head, Dept. of Library Science, University of Calcutta, Calcutta, 8. Shri A. R. Chakraborty, Chief Librarian, Jadavpur University Library, Calcutta, 9. Smt. Kalpana Dasgupta, Librarian, National Library, Calcutta, 10. Dr. J. Mishra, Chief Librarian (Convener).

14. REPORT OF ACTIVITIES OF THE BRANCH : KARNATAKA BRANCH

*1. *Golden Jubilee Activities* : The Golden Jubilee activities which started during 1981 continued till 1983.

2. *Workshop on statistics for market intelligence* : Jointly with the Officers' Association of the Bureau of Economics and Statistics, the above workshop was organised. Shri M.A.S. Rajan, IAS, Retd. Commissioner, inaugurated the workshop and stressed on correct collection of information and its distribution. Shri H. V. Dayal, Member, Karnataka Power Corporation suggested consumer education and information distribution for market intelligence. Rear Admiral Vasant spoke about computers. On various topics listed by Shri B.V.S. Rao, there was lively discussions by Dr. G. Thimmappaiah and Dr. N. S. Iyengar and others. The Minister for Marketing and Muzrai Shri Sudeendra Rao Kashe gave the valedictory address.

* Since this was not reported in earlier Annual Report, Institute is furnishing this information now.

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3. *Seminar on use of recent statistical methods* : The joint seminar on "Use of recent statistical methods in (a) Sample Surveys, (b) Agriculture, (c) Quality Control and Operations Research" was organised in May 1983 under the joint auspices of the Branch and the Bangalore University. Shri P. N. Haksar, Chairman ISI delivered the Inaugural Address. He emphasised that growth does not take place in a vacuum and that society is not merely a structure of knowledge, technology and resources but a dynamic statistical reality. Such arithmetic existence of society and the laws of causation and of change being probabilistic, statistical tools have to find a natural place. In India, from a state consisting of religio-ethnic entities came the social consciousness for change and the consequent need for better planning, and it was upto Professor P. C. Mahalanobis and his pioneering work to give the acceptability that is obtained for statistics today.

Presiding on the occasion Dr. M. N. Viswanathaiah, Vice-Chancellor, Bangalore University stressed the importance of collecting vital statistics of every technological operation in the country, which only can permit their economic operation. He also pleaded for a statistical orientation in every inter-disciplinary field recalling his own experience.

Dr. B. R. Bhat of Karnataka University delivered the keynote address on the relevance of probabilistic models in real life data.

20 papers from different Universities and Organisations were discussed at the Seminar. In addition, invited lectures were also organised.

4. *Essay Competition* : To promote the need of statistics in designing plans among PG students, an essay competition on Statistics and Planning was organised for the PG students in Economics and Statistics in the Mysore, Bangalore and Karnataka Universities. Out of 7 essays received from three Universities, the selection committee after assessing the essays, recommended the award to Smt. Jyothi Nagaraja of the Mysore University.

Accordingly, at a special function jointly organised by the Branch with the Bangalore Management Association, in connection with the Golden Jubilee Celebrations the prize for the essay competition was awarded to Mrs. Jyothi Nagaraja.

Shri C. S. Seshadri, Chairman of the Branch presided over the function. The prize winner Mrs. Nagaraja also spoke on the subject of "Statistics and planning."

On this occasion, Dr. N. S. Iyengar, Head, Economic Analysis Unit of Indian Statistical Institute, speaking on the subject, referred to Fisher's notation of Statistics as a 'Key Technology' which was used in optimal utilisation of the resources of the plan. To evaluate the growth statistics was a tool for investment and employment. For income elasticity demand and changes therein, changes in prices, statistics gives more accurate estimates. For analysing N.S.S. data statistics are needed and he suggested good quality of statistics to build up the data usefully for which a cell is to be created. Computer analysis and standard tables are formed, he added, for early result and for reports. He pleaded for honest statisticians for correct interpretation. He also spoke on proper sampling when considering results on large quantities.

5. *Lecture Programmes* :

Shri P. N. Haksar, Chairman, Indian Statistical Institute during his visit to Bangalore in connection with inauguration of Golden Jubilee Seminar, delivered an im-

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ssive lecture at the Rotary Club of Bangalore on "War and Peace in Nuclear Age," concluding the terrible results a nuclear war may lead the world to.

Dr. K. P. Srinath, Statistician, Canada, delivered a lecture on "Problems in designing continuous monthly surveys". Shri B. K. Das, I.A.S., Director of Census Operations, Karnataka, Government of India, presided over the function.

Shri D. Manohar, Director of Facilities (India), Systems Services Pvt. Ltd., Bangalore delivered a lecture and also exhibited films on "Working of Computer with a film showing its functions". Nearly 100 students participated in the programme which included discussions. Shri C. S. Seshadri, Chairman of the Branch presided over the function.

6. *Student members :*

The students of Bangalore University colleges have enrolled as members and are participating in the meetings. At the seminars and lectures they have shown considerable interest seeking answers to various questions. They also utilise the facilities of the library of the Institute.

7. *Courses :*

The Branch is contemplating to organise courses on (a) Operations Research and (b) Computer programming for which details are being worked out.