

# INDIAN STATISTICAL INSTITUTE

FORTYSEVENTH ANNUAL REPORT

April 1978—March 1979



203 Barrackpore Trunk Road  
CALCUTTA 700 035

## INDIAN STATISTICAL INSTITUTE

President: Shri Subimal Dutt, ICS (Retd.)

The Council

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

Representatives of Government of India (4)

1. (i) Dr. K. C. Seal, Director, Central Statistical Organisation, Department of Statistics, Ministry of Planning. 3. (ii) Shri N. K. Panda, Joint Secretary, Ministry of Finance, Department of Expenditure. 4. (iii) Dr. (Mrs.) A. R. Rajeshwari, Principal Scientific Officer, Department of Science and Technology. 5. (iv) Shri V. V. Divatia, Executive Director, Reserve Bank of India.

Scientists not employed in the Institute (7)

Representative of ICSSR (1) 6. Professor Bhabatosh Datta

Representatives of INSA (4)

7. (i) Professor M. S. Narasimhan, School of Mathematics, Tata Institute of Fundamental Research, Bombay. 8. (ii) Professor S. S. Shrikhande. 9. (iii) Professor B. K. Bachhawat, Director, Indian Institute of Experimental Medicine, Calcutta. 10. (iv) Dr. S. C. Bhattacharya, Director, Bose Institute, Calcutta.

Scientists co-opted by the Council (2)

11. (i) Professor R. P. Bambah, Department of Mathematics, Centre for Advanced Studies in Mathematics, Punjab University. 12. (ii) Dr. R. Narasimhan, Head, Computer Group, Tata Institute of Fundamental Research, Bombay.

Elected representatives of the Institute

Members not employed in the Institute (2)

13. (i) Dr. P. K. Bose, M.Sc., Ph.D., FSS (London), Head, Department of Statistics, University of Calcutta. 14. (ii) Dr. P. V. Sukhatme, M.A., Ph.D., F.N.A., Honorary Professor of Biometry, Maharashtra Association for Cultivation of Science.

Elected representatives of the employees of the Institute (2)

15. (i) Dr. (Mrs.) K. Saradamoni, Senior Lecturer. 16. (ii) Shri Kamalendu Bhattacharya, Section Officer.

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

17. (i) Dr. G. Kallianpur, Director.

Professors-in-charge of Scientific Divisions (5)

18. (ii) Dr. Asok Mitra, Professor, Division of Theoretical Statistics & Mathematics. 19. (iii) Shri Dohdas Chaudhuri, Applied Statistics, Surveys & Computing Division. 20. (iv) Dr. Asok Rudra, Professor, Social Sciences Division. 21. (v) Dr. Ambarish Ghosh, Professor, Physical and Earth Sciences Division. 22. (vi) Dr. Kanti Bhusan Pakraai, Biological Sciences Division. 23. (vii) Shri C. R. Prasad, Head of Statistical Quality Control and Operations Research Division. 24. (viii) Dr. S. K. Mitra, Head, Delhi Centre. 25. (ix) Dr. T. Krishnan, Dean of Studies. Shri N. Srinivasan, Officer-on-Special Duty, acted as non-member Secretary.

### LIST OF MEMBERS OF DIFFERENT COMMITTEES

1. Finance Committee of the Council:

1. Director of the Indian Statistical Institute or his nominee (ex-officio Chairman). 2. Dr. P. K. Bose, Head, Department of Statistics, University of Calcutta. 3. Dr. Bhabatosh Datta. 4. Dr. B. P. Adhikari. 5. Dr. J. Roy. 6. Shri S. M. Sundara Raju. 7. Dr. S. K. Mitra. 8. Dr. K. B. Pakraai. 9. Dr. Ambarish Ghosh. 10. & 11. Two representatives nominated by the Government of India (Dr. K. C. Seal, Director, C.S.O. and Sri N. K. Panda, Joint Secretary, Department of Expenditure, Ministry of Finance). 12. Shri P. K. Chatterjee, Senior Accounts Officer, Indian Statistical Institute. (Non-member Secretary).

2. Examination Committee:

1. Dr. P. K. Bose, Head, Department of Statistics, University of Calcutta; 2. Professor H. K. Nandi, Department of Statistics, University of Calcutta; 3. Professor A. M. Goon, Presidency College, Department of Statistics; 4. Professor T. V. Abhadhani, University of Andhra; 5. Dr. T. P. Abraham, Additional Director, C.S.O., Ministry of Planning, Government of India; 6. Dean of Studies, Indian Statistical Institute; 7. Dr. B. Ramachandran; 8. Dr. J. Roy; 9. Dr. K. R. Parthasarathy; 10. Shri Tara Maitra, Secretary, Calcutta

3. Journal Committee of the Institute:

(i) Committee for *Sankhyā, Series A*: 1. Dr. R. R. R. Hazarbasar, 4. Dr. K. R. Parthasarathy; 5. Dr. S. S.

REFERENCE BU

Co-editors: 1. Dr. B. V. Rao and 2. Dr. K. R. F.

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

#### I. TEACHING AND TRAINING

1. *Teaching for Degrees and Diplomas*: Three thousand one hundred sixteen candidates applied for admission to the B.Stat. and M.Stat. degree courses, post-M.A./M.Sc. diploma courses and research scholarships and took special admission tests at 11 centres in different parts of the country for primary selection and appeared for interviews and the final selection at Calcutta. Special admission tests were also held for admission to the (1) Evening Course in Statistics at Calcutta and Delhi, (2) One-year Certificate Course in Data Collection and Processing Methods, (3) Two-year Advanced Diploma Course in Computer Science, (4) Course on Operation of Punched Card Machines, and (5) Two-year part-time Diploma Course in SQC & OR, Bombay and Madras. The annual examinations of the B.Stat. and M.Stat. courses were held in May-June 1978. The 1978-79 academic year commenced on 1 August 1978.

In accordance with the decisions of the Academic Council, changes in the structure, syllabi, and duration of a number of courses were implemented from the academic year 1978-79. The four-year B.Stat. (Hons.) course has been changed into a three-year course, following the change-over of the Higher Secondary Education in the country to a 10+2 year system. Far-reaching changes in the syllabi and course-content were introduced. Some new features are that a student can choose for study one elective subject out of the following groups: Biological Sciences, Mathematical Sciences, Physical Sciences, Economics, Sociology, and Psychology etc. Statistics and Mathematics are compulsory subjects along with a language course—English or French.

The three-year M.Stat. degree course has been changed into a two-year course and admission to the previous year (1st year) of the course is restricted to candidates having both statistics and mathematics at the B.A./B.Sc. level.

Some changes have been made in the syllabus and structure of the one-year Evening Course in Statistical Methods and Applications.

A new full-time course, the two-year Advanced Diploma Course in Computer Science has been introduced in Calcutta from the session 1978-79. The course is designed to produce specialists in computer software, hardware and applications. Persons with a Master's degree in a relevant subject or B.E. or equivalent degree are admitted.

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An evening course in Russian language for scientific use, started from October 1978, is open to students, fellows and employees of the Institute. Forty persons registered for admission.

Under the auspices of the ISI Workers Organisation, evening classes for adult education are being held regularly from July 1978.

The Thirteenth Convocation of the Institute was held on 30 March 1979. Ninetyeight candidates received degrees and diplomas on the occasion.

A list of the number of candidates to the different degree and training courses during 1977-78 and 1978-79 and the results of examinations held during the period is given below.

### 1. Courses leading to a Degree in Statistics :

	Number of students		Number passed in
	1977-78	1978-79	Annual Examination 1978
1.1 Bachelor of Statistics with Honours, B.Stat. (Hons.) 1st year .. ...	15	14	15
2nd year ... ..	17	15	17
3rd year ... ..	15	15	15
4th year ... ..	19	17	18
1.2 Master of Statistics (M.Stat.)*			
1st year ... ..	5	discontinued	—
Previous year/2nd year	15	21	10
3rd year/Final year ...	27	32	27
1.3 Junior and Senior Research Fellows, Visiting Fellows* ... ..	70	98	—
2. <i>Specialised Courses in Applied Statistics leading to Diplomas :</i>			
2.1 Statistical Quality Control and Operations Research ... ..	19	18	22
2.2 Diploma in Econometrics and Planning ...	2	—	1
3. <i>Courses in Statistics for Persons in Employment (jointly with the OSO) :</i>			
3.1 Junior Certificate Course in Statistics ...	14	13	14
3.2 Indian Statistical Service Probationers Training Course ... ..	—	18	—

\* including Delhi Centre

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	Number of students		Number passed in
	1977-78	1978-79	Annual Examinations 1978
<b>4. Evening Courses :</b>			
<b>4.1 Statistical Methods and Applications (One year) :</b>			
(i) Calcutta ... ..	46	44	14
(ii) Delhi ... ..	38	39	6
<b>4.2 Two-year Post-Graduate Diploma in Statistical Quality Control and Operations Research (Bombay and Madras) :</b>			
4.2.1 (i) Bombay—1st year ... ..	14	15	11
(ii) Bombay—2nd year ... ..	11	11	8
4.2.2 (i) Madras—1st year ... ..	23	30	5
(ii) Madras—2nd year ... ..	9	—	5
<b>4.3 Six-month Evening Course in Statistical Quality Control at Bangalore (July to December/January to June) ...</b>			
	63	—	20 (January-June)
<b>5. Electronic Computer Courses :</b>			
<b>5.1 Two-year Advance Diploma in Computer Science ... ..</b>			
	18	12	17
<b>5.2 One-year Certificate Course in Data Collec- tion and Processing Methods... ..</b>			
	9	9	6
<b>5.3 Intensive Course on Programming and Applications ... ..</b>			
	22	27	22
<b>5.4 Course on Operation of Punched Card Machines ... ..</b>			
	11	13	11
<b>6. Diploma in Statistical Quality Control and Operations Research (for three months) (selected on the basis of M.Stat. III results) at ISI, New Delhi ... ..</b>			
	3	—	1
	<u>485</u>	<u>461</u>	<u>270</u>

2. INTERNATIONAL STATISTICAL EDUCATION CENTRE (ISEC), CALCUTTA

The International Statistical Education Centre (ISEC), opened in 1960, is operated jointly by the International Statistical Institute and the Indian Statistical Institute, under the auspices of the UNESCO and the Government of India. During the year, the Centre

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functioned under a Board of Directors consisting of *Chairman*: O. R. Rao, *Members*: J. Gani and E. Lunenborg (ex-officio members representing the International Statistical Institute), N. K. Mukherjee (Cabinet Secretary, representing the Government of India), G. Kallianpur and N. Bhattacharya (*Member-Secretary*) (representing the Indian Statistical Institute).

During the year, when the Thirty-second Term was conducted, there were 19 trainees in the Regular Course from 12 countries in South and South-East Asia, the Far East, the Commonwealth countries of Africa, and West Indies. In addition, 12 trainees attended the Special Courses in different fields: one trainee from Bangladesh attended a three-month course in sample surveys; two trainees from Zambia underwent a three-month course in mathematical statistics; one trainee from Nigeria underwent a five-month course in SQC; and one trainee from Uganda attended a six-month course in sample surveys and data processing with special reference to educational statistics and educational planning.

The Government of India awarded fellowships to 9 foreign trainees attending the Regular Course—6 under the Technical Cooperation Scheme of the Colombo Plan and 3 under the Special Commonwealth African Assistance Plan (SCAAP); it also supported 4 Indians undergoing the same course. Five regular course trainees enjoyed CPTC fellowships, and the remaining trainee from Japan was financially supported by his employer institution. The number of special course trainees enjoying fellowships were as follows: SCAAP fellowship from the Government of India (8); CPTC fellowship (1); and fellowship from the UNESCO (1). The remaining candidate from Nigeria was supported by his government.

The Regular Course of the Thirty-second Term was conducted from June 1978 to March 1979. Dr. T. P. Speed, University of Western Australia, Perth, stayed as Visiting Professor from November 1978 to February 1979.

The special course trainees in sample surveys studied basic statistical theory, sampling theory of surveys, and planning and organization of large-scale surveys. They also visited the NSSO and other important offices of the Government of India at Delhi and Calcutta to study the methodology adopted for different types of enquiries.

The special course trainees in mathematical statistics studied probability theory, statistical models and large and small sample methods of statistical inference.

The special course trainee in statistical quality control studied control charts, sampling inspection plans, work sampling and also visited factories to study practical applications of SQC techniques.

The special course trainee in sample surveys, data processing, educational statistics and educational planning, started his programme with courses in probability theory, statistical methods, theory and organization of sample surveys and mechanized data processing.

### 3. PROFESSIONAL EXAMINATIONS IN STATISTICS

The holding of the Professional Examinations in Statistics for external candidates on all-India basis has been an important activity of the Institute, since 1938. These

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examinations are based on well-organised syllabi to reach high professional standards and lead to certificates and diplomas.

In order to cater to the present needs of professional careers, the earlier examinations (viz. Computer's Certificate, Statistician's Diploma, Statistical Field Survey Certificate & Diploma and Punched Card Machine Operator's Certificate and Punched Card Data Processing Diploma) were organised and the following examinations have been introduced since May 1978.

The Computer's Certificate Examination has been replaced by the Statistical Assistantship Certificate Examination, keeping in view the professional requirements of primary statistical workers like statistical assistants, enumerators, key-punch operators and field investigators.

The Statistician's Diploma Examination has been replaced by two examinations, viz. (i) *Junior Diploma in Statistics* and (ii) *Senior Diploma in Statistics* to meet the requirements of *Intermediate and Professional Personnel* respectively, in the above fields.

During the period, the Statistical Assistantship Certificate and Junior and Senior Diploma in Statistics examinations were held at centres in Bangalore, Bombay, Calcutta, Delhi, Hyderabad, Madras and Shillong in May and November terms.

The details of the number of candidates who registered, appeared and passed in one or more papers of these examination during May and November (1978-79) terms are given below :

Examination	number of candidates						
	registered		appeared		passed*		
	May	Nov.	May	Nov.	May	Nov.	
Statistical Assistantship Certificate	...	14	19	11	12	3	5
Junior Diploma in Statistics	...	55	63	44	42	15	18
Senior Diploma in Statistics	...	11	16	9	15	1	5

\* in one or more papers—not necessarily completed the examination.

The total number of candidates who have qualified for the award of Certificates and Diplomas in these professional examinations in statistics upto the end of March 1979 are 452 and 211 respectively.

## II. THEORETICAL STATISTICS AND MATHEMATICS

### 2.1 Calcutta

2.1.1 Research problems in various disciplines of pure mathematics and mathematical statistics were dealt with. The list of published papers and other technical reports in various stages of processing give a more detailed idea of the work done. Work was carried



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out in algebra, algebraic topology, descriptive set theory, functional analysis with special references to Choquet theory, harmonic analysis of spherical functions on semi-simple Lie groups, graph theory, combinatorial mathematics, number theory and probabilistic number theory, topological automata, measure theory, probability theory, probabilities of deviations, stochastic processes, non-linear prediction, statistical inference with special reference to asymptotic theory, optimal stopping and control, multivariate and decision theoretic inference, sufficiency, concepts of efficiency in estimation and testing, pattern recognition, sample surveys, and sediment transport problems.

2.1.2 Several research scholars are working on problems connected with their thesis problems. Many others are being initiated to the subjects of their interest. Research scholars were also given advanced courses of lectures in various topics. Regular seminar courses were held for the more advanced students and researchers. Some seminar courses were held by Visiting Professors on topics like diffusion theory, multivariate analysis and Harmonic analysis. Several seminars by visiting scientists as well as staff members were held during the year. A weekly colloquium was also organised.

### 2.2 Delhi

2.2.1 R. P. Bhargava conducted research on alternatives to component analysis.

2.2.2 G. L. Fotedar conducted research on algebraic geometry and combinatorics.

2.2.3 S. K. Mitra conducted research on generalized inverse of matrices, least squares solutions under quadratic constraints imposed on the solution vector and inference on non-estimable functions.

2.2.4 K. K. Mukherjee conducted a study of the change in spectrum of a linear map under perturbation and the orbit structure of the algebra of matrices under group actions. He is also writing a book on algebraic topology.

2.2.5 K. R. Parthasarathy worked on perturbation of spectra of linear operators. He evaluated Kato bounds for multiplication operator with respect of differential operators and constructed martingales orthogonal to stochastic integrals.

2.2.6 K. Ramamurthy worked on measures on infinite dimensional space.

2.2.7 R. L. S. Prakash Rao worked on limit theorems and rates of convergence for backward martingales and also obtained some results in sequential non-parametric estimation.

2.4 *Teaching and training activities* : As in previous years, staff members in Calcutta shared a major portion of the teaching work for the regular degree and diploma courses of the Institute.

### III. APPLIED STATISTICS, SURVEYS AND COMPUTING

3.1 The Division of Applied Statistics, Surveys and Computing has a Divisional Committee of Scientific Workers (DCSW) and a Technical Advisory Committee (TAC) which came into existence after the introduction of the new constitution of the Indian

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Statistical Institute in 1976-77. The DCSW met thrice during the year to formulate proposals for research and developmental programmes. The TAC met once to finalise the annual programme and budget for the year 1979-80.

3.2 *Teaching and Training* : The Division organised the undermentioned courses :

3.2.1 *Diploma in Computer Science* : Seventeen students in the 1977-78 session successfully completed their course work and submitted dissertations.

The existing Diploma in Computer Science has been upgraded to a two-year programme called "Advanced Diploma in Computer Science."

3.2.2 *M.Stat (final year) Course in Computer Science* : Five students completed successfully the course in 1977-78, while six students were admitted to the session for 1978-79.

3.2.3 *Course on Operation of Punched Card Machines* : Eleven students completed successfully the 1977-78 session, while 13 students were admitted to the 1978-79 session.

3.2.4 *Intensive Course on Programming and Application of Electronic Computers (14th session : 16 October 1978-23 November 1978)* : The objective of the course is to train persons in using electronic computers in solving problems encountered in official work. All the twentyseven persons who joined the course were awarded Certificates of Merit. Trainees for the current session were sponsored by organisations like the National Traffic Planning and Automation Centre, Trivandrum; Geological Survey of India, Calcutta; Hindusthan Steel, Ranchi; Reserve Bank of India, Bombay and the Ministry of Defence and Central Statistical Organisation, Government of India.

3.2.5 *One-year Certificate Course in Data Collection and Processing Methods* : Seven students completed successfully the 1977-78 session, while six students joined the next session.

3.2.6 *Courses on Survey Methodology for Social Scientists* : Sixteen candidates, mainly sponsored by colleges and universities, participated in the course.

3.2.7 *Special Course on Computer Programming for Afghan Nationals* : 15 January 1978-31 March 1979 : A special training programme for six Afghan nationals was arranged at the request of the United Nations Development Programme, Kabul. The trainees were taken on a study tour to Bangalore, Bombay, Delhi and Hyderabad, to visit Government and other data processing centres.

3.3 *Research* : Research fields are in the nature of both theoretical investigation of methodology and applications of existing methods to the solution of practical problems with social relevance.

The main areas of research are : Sample Surveys, Multivariate Analysis, Design of Factorial Experiments, Computer Software, Systems Simulation and Biometry. In the area of sample surveys, research has been carried out in planning sampling strategies particularly for surveys on successive occasions, the estimation of variance of a finite population under some superpopulation set-up and on the choice of sample size for Horvitz-Thompson estimation. In multivariate analysis and related areas, studies are in progress

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on generalised inverses, clustering problems and testing problems under violations of standard assumptions and mixed model analysis. Studies in factorial experiments and search theory have been encouraging. The development of computer software systems for the Population Data Base (National Population Register) and the analysis of survey and census data are the areas of study in computer software. A study is under way on the behaviour and control of environmental and biological systems, using computer simulation.

3.4 *Seminars* : Eighteen seminars by visiting scientists and staff members were organized during the year.

3.5 *Project Work* : The Division undertook a number of projects on request from Government-sponsored organisations and research institutions. The projects provide the staff members with an opportunity to acquaint themselves with live problems requiring statistical methods for their solution.

The undermentioned projects were continued from the previous year :

3.5.1 *Cost-benefit Analysis of Rural Electrification* : A study of four selected projects in West Bengal.

3.5.2 An enquiry into the nature of urban poverty, Calcutta.

3.5.3 Pavement Dwellers Survey, Calcutta.

3.5.4 Calcutta Health Survey.

3.5.5 Household survey on distribution of public expenditure on social sciences in West Bengal, 1976.

During the year, the following projects were undertaken :

3.5.6 Estimation of various geological parameters and contour mapping in connection with the mining of natural resources, on request from the Central Mines, Planning and Design Institute.

3.5.7 Road user cost study in India, in collaboration with the Central Road Research Institute.

3.5.8 The processing of survey data was undertaken on request from the Calcutta Metropolitan Development Authority (CMDA).

3.5.9 The design and implementation of a language for the analysis of survey and census data.

Some work has been carried out in the areas of design of entire retrieval data base, design of diagnosable and probabilistically diagnosable systems, on some problems of graph theory, design of Maitra cascades and machine realization with time varying and invariants components.

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3.6 EC-1033 Computer System : The EC-1033 Computer System from the USSR, installed during January-February 1979, has a 256 KB memory with multi-programming facility and two card-readers, four tape-drives, four disk-drives, two high-speed printers and four video terminals as the supporting peripherals.

### IV. PHYSICAL AND EARTH SCIENCES

#### 4.1 Chemistry

(i) *Interaction between soil-clays and surface active organic substances* : Investigation on the sorption and desorption of surface active substances on inorganic soil-colloids has been carried out. Enthalpy, entropy and free energy of sorption of organic surface active cations on kaolinite, bentonite and vermiculite were calculated. The results obtained are important in elucidating the mechanism of such reactions.

(ii) *Studies on the distribution and characterization of organic matter present in West Bengal soils* : Organic matters present in five different soils of West Bengal belonging to Vindhya alluvial, red, laterite, gravelly and coastal saline types were isolated and fractionated. Humic and fulvic fractions are examined in respect of their nitrogen contents and C/N ratios. Humic to fulvic ratio as well as their individual spectral properties were also studied.

These humus characteristics are sought to be explained on the basis of climatic factors, vegetation, irrigation and cropping pattern and overall soil structure.

#### 4.2 Electronics

Research is being conducted in the undermentioned areas :

##### 4.2.1 Theoretical Physics

- (i) Elementary particles.
- (ii) Gravitation and relativity.
- (iii) Solid state physics.
- (iv) Measurement problem in quantum mechanics.

##### 4.2.2 Physics of fluids

- (i) Flow analysis in hydroclone separators.
- (ii) Study of mechanics of interaction between water sediment mixture and mobile sand bed.
- (iii) Theoretical study on flow field in an opposed jet.
- (iv) A bio-mathematical problem regarding modal study of chuco-regulatory function in human system.
- (v) Turbulent fluid flow.

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### 4.2.3 Computer systems

- (i) Fault tolerant computing.
- (ii) Microprogramming.
- (iii) Switching and automata theory.
- (iv) Study on microprocessors.
- (v) Signal processing system using FFT.

4.2.4 *Flume Project* : Sediment transportation studies : Experimental and theoretical investigations of the problem of sediment transportation by running water were continued by a team consisting of a geologist, a statistician and a mathematician. The efficiencies of the different existing methods for computation of bed load have been investigated. A new formula for computation of suspended load's grain-size distribution directly from the bed load's distribution has been developed in partial modification of Hunt's method.

### 4.3 Electronics and Communication Science

The research activities of the Electronics and Communication Science Unit can be grouped under the following heads. Both theoretical and experimental investigations are carried out and their results published regularly in scientific journals in India and abroad.

*Neural Modelling* : (i) An experimental electronic model was constructed and results obtained regarding their random behaviour and further work on memory and learning mechanism is in progress.

*Digital Signal Processing* : (i) The processing of bio-medical and picture signals along with associated techniques of transformation filtering compression and enhancement.

- (ii) A new scheme for signal compression and transmission.

*Digital Data Communication* : (i) Theoretical study on the problems of optical fibre communication.

- (ii) The effect of phase jitter and inter-symbol interference in data communication and their minimization, using coding techniques developed in the Institute.

*Pattern Recognition and Image Analysis* : (i) Several learning and decision-making algorithms using Fuzzy set Theoretic Approach, both supervised and non-supervised and a Fuzzy Distance Function statistical decision theoretic approach for classificatory analysis.

- (ii) Computer recognition of consonantal speech sounds using Maximum Likelihood criterion.

- (iii) Some methods for analysing finger print, chromosomes and handwritten cursive script pictures for identification and recognition by computers.

- (iv) A theoretical and experimental investigation on symmetry analysis in computer visual perception and learning process.

- (v) The development of a statistical approach for recognition of unaspirated plosives.

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*Acoustic-Phonetic Investigation of Speech Sound* : (i) An intensive investigation on transition in different environment as a case for ASB.

(ii) Acoustic phonetic analysis of Telugu vowels.

*Cybernetics and Systems Theory* : (i) Theoretical and historic-philosophical investigation on the need for a unified approach to cybernetics and general systems theory.

(ii) Application of fuzzy mathematical approach and computer simulation techniques in planning and policy formulation problems.

*Training programme* : Twelve post-graduate students from B.E. College, IIT, Kharagpur, Banaras Hindu University and the Radio Physics Department, Calcutta University, received practical training in digital system electronics.

#### 4.4 Geology

A. The integrated programme of geological research was continued in the Pranhita-Godavari valley. The main topics of research were : (i) Osteology of *Baroposaurus laporei*, a Lower Jurassic sauropod dinosaur from India; (ii) Studies on Triassic prosauropod dinosaur, (iii) Permian continental reptile fauna from India; (iv) Xenacanthid shark fossils from Upper Triassic Maleri formation; (v) New lepidosauirian reptile from the late Triassic Maleri Formation of India; (vi) Stratigraphy of the Upper Gondwana sequence of a part of the Pranhita-Godavari Valley, with special reference to sedimentology of Jurassic rocks; (vii) Structural analysis of the Proterozoic rocks of the Pakhal and Delhi; (viii) Stratigraphy and sedimentation of the underformed as well as deformed sequences of the Pakhal Albaka and Sullavai groups; (ix) Morphological analysis and stratigraphic position of the trace fossils.

B. *Recent Fluvial Studies* : Studies on fluvial sedimentation in the Uri river near Girdih, Bihar, were continued with a view to obtaining clues to the mechanism of transportation of deposition of sand in ancient fluvial regimes. The direction of sediment transportation in the point bars and the relationship between volume of point bar deposits and river discharges were studied during the year.

#### 4.5 Physics

(i) Biomechanics, particularly the mechanical properties of various human tissues and organs.

(ii) Applications of Control Theory to electrical machines and power systems.

(iii) Intersections of physics and medicine.

#### V. BIOLOGICAL SCIENCES

##### 5.1 Anthropometry and Human Genetics

(i) Biosocial study of Khasi, a backward scheduled caste of West Bengal.

(ii) Pattern of fertility and reproductive wastages by parity and social class.

(iii) Micro-evolutionary dynamics among Mahars of Maharashtra,

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- (iv) Biomedical study of Portuguese descendants of Mirpur village, Midnapur district, West Bengal.
- (v) Impact of altitude on human populations.
- (vi) Relationship between socio-economic condition, nutrition and health.
- (vii) Genetic variation among local population of North Sikkim.
- (viii) Possible relationship between polymorphic biochemical characters and genital cancer.
- (ix) Fertility, sex ratio and biochemical genetic markers.
- (x) Bio-anthropological study of a migrant African group—the Sidhis of India.
- (xi) Bio-anthropological study of Nandiwallas.
- (xii) Study and development of laboratory techniques in biochemical genetics.
- (xiii) *Indo-Soviet Anthropological Project, 1978-79* : The project was initiated by the I.S.I. in collaboration with four Soviet anthropologists from the USSR Academy of Sciences, Moscow, in December 1978, to survey about a dozen endogamous population of Rajasthan, Punjab and Himachal Pradesh. About 1,400 human blood samples were collected from these States.

### 5.2 Biochemistry

- (i) Inorganic pyrophosphatase from green leaves.
- (ii) Anthraquinones from different *Cassia* species.
- (iii) Studies on bacterial carotenoids.

### 5.3 Botany

- (i) Breeding of rice.
- (ii) Intraspecific and interspecific competition and interaction in crop-plants.
- (iii) Effects of electro-magnetic field on the mitotic behaviour of plants.

### 5.4 Crop Science

- (i) Studies on the levo- and dextro-rotatory phenomenon occurring in plants and animals.
- (ii) Exploratory work in the commonly cultivated palms regarding their morphology, anatomy and germination process.  
(Germination process in *Areca Catechu* *linn.*; internal structure of juvenile *Areca Catechu* : the ontogeny and structure of stomata and trichomes in leaves of *Areca Catechu* L., *Borassus flabellifer* L., *Cocos nucifera* L., and *Elaeis guineensis* L.).
- (iii) Application of mathematics to biology.
- (iv) Studies in the field of natural history.

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5.5 *Embryology*

- (i) Lipid synthesis in different stages of embryonic developments in *Limnaea*.
- (ii) Investigations on the pheromone (scent used for intraspecific communication of tigers).
- (iii) Further development of immobilisation process of carbonic anhydrase B in polyacrylamide gel.
- (iv) Immobilisation of the enzyme in ion exchange resin (DEAE-cellulose).
- (v) Bio-mathematical investigation on cellular growth and control of growth.

5.6 *Entomology*

- (i) Head kinetics of a mosquito.
- (ii) Simulating sound produced during swarming of mosquitoes.

5.7 *Leaf Protein*

- (i) Role of lipids and lipolytic enzymes in the storage problems of leaf protein.
- (ii) Analysis and subsequent use of fibre as a feed and fodder.
- (iii) Nutritional assessment in vitro, using proteolytic enzymes.
- (iv) Statistically-designed experiments to establish the effect of fertiliser dose, harvesting time and seed rate on the total and fractionated L.P.C. (Leaf Protein Concentrate) yields in root crops, beet root, turnip and radish.
- (v) Experiments to estimate quantitative uptake the NPK by water hyacinth.
- (vi) Qualitative and quantitative analysis of left over fluid from cauliflower, mustard, turnip, radish and spinach.
- (vii) Various aspects of utilization of water hyacinth.
- (viii) Isolation of organisms for proteolytic and lipase enzymes.

VI. SOCIAL SCIENCES

6.1 *Demography*

- (i) Evaluation of family welfare programme.
- (ii) Vasectomy and tubectomy operations in India.
- (iii) Demographic aspects of sterilization in India.
- (iv) Fertility and family planning survey.
- (v) Examination of mean age at marriage in India.
- (vi) Construction of model working force table.



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- (vii) Relationship between child employment and educational development.
- (viii) A minimum variant parity model for population reproduction.
- (ix) Effects of econo-demographic structure on fertility and mortality.
- (x) Socio-psychological study on family size, family limitation and contraceptive behaviour.
- (xi) Nuptiality studies in ESCAP countries.
- (xii) Ideal age of marriage for boys and girls.

### Teaching

Besides teaching for the degree courses, the staff members imparted the following training :

- (i) Specialised training on vital statistics and demography for six statistical officer trainees.
- (ii) Specialised training in demography for two trainees in the International Statistical Education Centre, Calcutta.
- (iii) Training in demography for six Afghan nationals attending special courses on computer programming under the auspices of the United Nations Development Programme.

Four seminars were organised in Calcutta and New Delhi.

### 6.2 Research in Economics and Econometrics

6.2.1 Research in economics and econometrics was conducted in Calcutta as well as in the Delhi Centre of the Indian Statistical Institute. The Economic Analysis Unit was set up in Bangalore during the year.

6.2.2 The research activities of the Economic Research Unit (ERU), Calcutta, conducted on a continuing and regular basis, covered a wide range of problems which included studies on applied economics, and planning and theoretical/methodological studies in economics and econometrics.

Besides teaching economics, economic statistics, and econometrics in degree and other courses, staff members also conducted the advanced course in economics leading to the Ph.D. degree of the Institute, in which 20 Junior Research Fellows are currently enrolled.

6.2.3 A brief account of the progress of research projects are given below :

(a) *Studies in Economic Theory*: Research in economic theory has progressed along the following lines: (i) the concept and structure of production and associated production problems; (ii) social technology, division of labour and comparative economic systems; (iii) construction analysis, and applications of capitalist price system along classical lines; (iv) macro-economic problems with particular reference to Keynes' General Theory model, theory of interest and price fluctuations; (v) economic growth and Turnpike theorems; and (vi) linear models with particular reference to the Leontief system.

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(b) *Studies in Econometric Methods* : Various statistical problems arising in the estimation of single equation econometric models are being examined. New techniques are being suggested for handling problems created by (i) Heteroscedastic disturbances; (ii) errors in variables; and (iii) omission of regressors.

(c) *Planning* : As in earlier years, a number of problems in planning have been studied during the current year. These include (i) examination of certain aspects of the Indian Sixth Plan Draft; (ii) evolving a policy for rational utilisation of energy resources in developing countries with particular reference to India; (iii) examination of the concept of 'basic needs' and its implication in Indian Development Planning; and (iv) certain aspects of regional and spatial planning in India.

(d) *Applied Economic Problems*

(i) *Studies on Rural Economy* : The E.R.U. has undertaken a project to study the potentialities of rural development and institutional obstacles to such development. The work would consist of collecting data at the village and household level from selected villages in West Bengal covering a number of aspects. Preliminary work on the project has been started and some questionnaire/schedules are being canvassed.

(ii) *Socio-economic Enquiries on Labour* : The material collected in the Haldia Labour Enquiry has been tabulated and a report is being prepared. This would cover various characteristics of the industrial and construction labour working at Haldia. Similar material collected in the earlier enquiry in Greater Calcutta is also being processed.

(iii) *Studies in Consumer Behaviour* : The extent and pattern of inter-State variation in Engel elasticities for various items and inter-occupational differences in the pattern of monetized, and non-monetized consumer expenditure have been examined on the basis of NSS data.

(iv) *Industry and Agriculture* : A number of studies were completed on Indian agriculture. Particular attention has been given in these studies to the problems of growth and class relations in Indian agriculture. A study on the measurement of productivity in selected manufacturing industries was undertaken, using ASI data from 1966 onwards.

(v) *Measurement of Inequality* : A study on the theoretical and empirical aspects of the measurement of inequality is in progress.

(vi) *Foreign Trade* : A study is in progress on the export performance of the Indian economy since 1964.

§2.4 The activities of the economists at the Delhi Centre are noted below :

Shri A. K. Chakraverti is working on economic planning models, functional classification of imports and input-output analysis.

Shri V. K. Chetty is working on models for economic policy, production and distribution problems.

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*Shri B. N. Das* is working on a study on provisions of basic social service in rural India with *M. S. Pandalai*.

*Shri L. R. Jain* is working on demand projections with special reference to system of Addilog Engel Functions.

*Shri S. M. Kansal* conducted a study on changes in the level of living in India, 1960-51 to 1975-76. He is working on another study on variations in the degree of non-monetization of national income, 1960-51 to 1970-71.

*Shri K. S. Parikh* is working on the development of a Agricultural Policy Model for India.

*Shri M. S. Pandalai* is working on a study on provision of basic social services in rural India with *Shri B. N. Das*.

*Sm. C. Jayal* is studying the following: (i) Foreign trade and economic development, (ii) Exports of the handloom sector in Tamil Nadu, (iii) Handicraft items of Tanjore district, and (iv) Economic consequences of floods and cyclones.

*Sm. K. Saradamoni* conducted studies on the following: (i) Changing land relations and women in Palghat, (ii) Impact of land reforms and intensive agricultural development projects on agricultural labour in terms of work, earnings and living conditions.

*Shri M. R. Saluja* is engaged in the following studies: (i) Structure of Indian economy, (ii) Development of a planning frame-work at the block level.

*Shri K. L. Sehgal* is engaged in the study of district level and State level growth of agriculture in Haryana and Punjab, 1900-1950 and 1961-1964.

*Shri H. C. Sharma* is engaged in (i) A study of the relationship between trade strategies and employment pattern, (ii) Country commodity analysis of trade.

### 6.2.5 Regional Planning

*Shri L. S. Bhat* undertook the following studies: (i) A regional study of Goa, (ii) A case study of Kanara District, and (iii) South Colaba—a study in settlement hierarchy and rural-urban interaction in collaboration with Bombay University.

*Visiting Fellows*: Dr. Surender Kumar Gupta joined the Delhi Centre, on 4 October 1978 and Dr. Y. S. Prahalad joined on 10 August 1978 for one year as Visiting Fellows.

Eightytwo seminars/lectures by visiting scientists and staff members were organised in Delhi.

Twelve seminars/lectures by visiting scientists and staff members were organised in Calcutta.

6.3 *Linguistic Research*: The programme of research in the Linguistic Research Unit is broadly grouped under the following three headings:

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6.3.1 The study of the phonetic structure of Indian languages and the application of results in the areas of (i) Speech pathology, (ii) Teaching of second language, and (iii) Cultivation of mother tongue.

Research is being conducted in Bengali, Hindi, Telegu, Punjabi and English languages.

The research programme in speech pathology includes intensive training of hearing-impaired children with selective amplification combined with education in standard schools for children with normal hearing. The problems encountered by hearing-impaired children integrated in schools for normal-hearing children are being studied with a view to minimise these problems as far as possible.

6.3.2 Investigation of problems relating to the structure of meaning.

6.3.3 A statistical approach to linguistic problems. Statistical studies are in progress in Bengali, Hindi, Telegu, Punjabi and Serbo-Croat.

A substantial amount of data was collected from Serbo-Croat/English and Bengali dictionaries with the purpose of writing a series of technical papers which will be comparative studies on vocabulary and grammar.

Professor D. Kostic, Institute for Experimental Phonetics and Speech Pathology, Belgrade, Yugoslavia, and Visiting Professor, conducted workshops/seminars for speech habilitators in Calcutta and at the Speech Research Laboratory, Osmania University, Hyderabad.

#### 6.3.4 Publications

(i) English Pronunciation for Bengali Mother-tongue Speakers by Djordje Kostic and Aloksanda Mitter, (pp. 126, Indian Statistical Institute, 1978).

(ii) Speech and the Hearing-Impaired Child by Djordje Kostic (in preparation for publication). One technical paper was prepared during the year.

6.3.5 Audiometric tests were carried out throughout the year on request from hospitals and schools and clinics for the deaf.

#### 6.4 National Income Research

6.4.1 Investigations were completed on the trends in the distribution of income among earners in different categories of occupations in Central Government services, manufacturing industries, mining and plantations.

6.4.2 Studies were continued on national accounts with some emphasis on the preparation of component tables of regional accounts for West Bengal.

6.4.3 In studies on disparities in level of living in India, tables are seen where persons covered by the survey are classified by household consumer expenditure, but the tables give the number of persons and their average per capita consumer expenditure for each class of household consumer expenditure. It is then possible to construct an analogue of

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the Lorenz curve for the capita consumer expenditure using such data. The divergence of such curves and the frequently used Lorenz curves have been examined for the size distributions of population by per capita consumer expenditure based on tabulation by size classes of per capita consumer expenditure.

6.4.4 Class analysis of Indian agriculture.

6.4.5 Organisation of agriculture for rural development—the Indian case.

6.4.6 Green revolution in the States was examined statistically.

### 6.5 *Pre-Census Population Studies*

The Pre-Census Population Studies Unit (PCPSU) continued the undermentioned research projects during the year.

6.5.1 *Pre-Census Population Studies of India*: The purpose of the project, sponsored by the Registrar-General, India, is to search, compile, edit and publish data relating to population and allied variables prior to the first census of India in 1872. One volume containing data on the eastern region of India, 1811-1820, was sent to the press and final work was continued on other regions.

6.5.2 *Statistical Survey of Bengal by Dr. Francis Buchanan, 1807-1814*: Work was continued on the editing of materials relating to Gorakhpur district.

6.5.3 *A Socio-economic Bibliography of India, 1870-1970*: Work was continued on preparing the press copy of the volume.

6.5.4 *Analytical Studies on Historical Data*: The purpose of the study is to trace changes in society during the last two centuries on a quantitative basis by making use of historical data.

The following topics were studied:

- (i) Economy of Bengal, 1750-1800.
- (ii) Socio-economic changes in 20 villages in Allynurh, district.
- (iii) Socio-economic changes in Ballavpur village, Birbhum, West Bengal, 1925-1975.

### 6.6 *Psychometry*

6.6.1 *Development of an instrument to measure the intelligence of deaf and dumb children for diagnostic purposes*: The aim of the present project for which a pilot study has been conducted on the basis of an experimental battery of tests at Agartala is to develop a suitable tool for deaf and dumb children before they are picked up for training. Data on the pilot study have been analysed and the test battery is being revised for further trials. The project is being conducted in collaboration with Professor D. Kostic, Director, Institute for Experimental Phonetics and Speech Pathology, Yugoslavia and the Linguistic Research Unit.

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6.6.2 *Development of a forced-choice instrument for measuring managerial ability :* Data have been collected in a pilot study from a wide sample of potential managers and scoring scales are being developed on the basis of iterative item analysis. The instrument is being revised for further trials.

6.6.3 *Standardization of objective achievement type questions at the graduate level :* The aim of the study is to determine how far objective type tests can replace the conventional essay-type examinations, specially at the higher levels. Data have already been collected for subjects like English and Mathematics.

6.6.4 *Usefulness of aptitude, achievement and personality variables in industrial selection :* Follow-up studies are being conducted of selection tests in which the PRSU provided technical assistance to several public and private sector organisations.

6.6.5 *Conceptions of mental health :* The object of the project will be to study what people think and feel about mental health phenomena, particularly mental disorders.

6.6.6 *Psychological correlates of serum uric acid level :* The current study, being conducted in collaboration with the Biometry Research Unit, is intended to determine the relationship between uric acid level in blood and achievement motivation and some other personality variables.

6.6.7 *Biographical factors and their relation to success in academic and vocational fields :* A pilot study which has been undertaken will be followed by experimental studies on a wider scale.

6.6.8 *Development of a Rorschach psychogram through computer programming :* The present study aims to draw a Rorschach psychogram of human personality through a standardised programming by computer system in order to draw a standardised (objective) scoring procedure and interpretation manual. A pilot study is in progress.

6.6.9 *Service :* Technical assistance was provided to various public sector enterprises and universities in selection, placement and promotion of personnel. Tests were conducted for the Educational Testing Service, Princeton, U.S.A., and for the Psychological Corporation, New York, USA.

## 6.7 Sociology

6.7.1 *Social science research—projects and problems: an inventory/study:* In the perspective of preparing an inventory of social science research projects/studies in the contemporary situation, information was collected from 50 social science departments in 18 universities and 5 research institutes in the eastern region of India. The tabulation was completed and analysis is in progress for preparing a preliminary report.

The field work was completed on Data Inventory Programme (Social Science Research Projects and Problems: An Inventory/Study) in north Indian universities and research institutes.

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8.7.2 *Content analysis of views on an aspect of societal change in India: the Hindu-Muslim relations in the eighteenth century Bengal*: The method of content analysis already developed is now being applied to study in depth Hindu-Muslim relations in eighteenth century Bengal. The collection of data is in progress.

8.7.3 *Study of pilgrim centre: a comparative study of Hindu pilgrims and their activity in eastern India*: The draft report of the project is being prepared. Two papers based on the study were presented at the Tenth International Conference of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.

8.7.4 *Socio-economic structure and change in some selected villages of Birbhum, West Bengal*: A repeat survey was completed to compare data collected by Professor P. C. Mahalanobis at rural Sriniketan in 1937. Three working papers were prepared on the basis of the study. The draft report of the project is being prepared.

8.7.5 *Socio-cultural and biological adaptation in contrasting eco-systems*: For understanding socio-cultural and biological adaptation in contrasting eco-systems, a brief survey was conducted in some sub-Himalayan regions. Materials are being processed and one working paper was prepared.

8.7.6 *Law, society and change—a case study of the Indian situation, 1947-1964 (the Nehru era of Indian politics)*: The manuscript is being prepared of the book, "Concepts of Total Revolution: Evolution of the Political Thoughts and Ideas of Jayaprakash Narayan."

8.7.7 *Field research in various (e.g., socio-religious economics) aspects of the country through projects and programmes*: (a) Field research on urban growth and rural-urban interaction and exploratory studies on the problems of (i) socio-economic polarization, (ii) social communication, and (iii) social change and development in certain backward regions of the State.

(b) Sample surveys in certain backward areas in Palamau district of Bihar.

The second phase of the sample survey covering Chatterpur and Barwardih blocks of Palamau was completed. On the basis of some preliminary results of the analysis, one research paper was prepared and submitted to the Tenth International Congress of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.

(c) A study of group relations in Giridih and surrounding areas with special reference to the development of the scheduled castes and scheduled tribes. The field work is in progress.

8.7.8 *A study of the Nepalese system of Panchayat democracy*: The proposed study would be complementary to two previous studies of Nepal: (i) A Study of Recent Nepalese Politics; (ii) Nepal's Experiment with Democracy. Both studies were published in book form and recommended for the M.A. Political Science Course in the Tribhuvan University, Kathmandu.

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The project will be partly bibliographical and also based on interviews and field-inquiry.

6.7.9 *Violence as a tool of change in Indian polity : 1887--to date, with special reference to the eastern region* : A brief working outline focussing the problem was prepared during the period. The field-work is in progress.

6.7.10 *Study of election in West Bengal* : A collaborative study between the Sociological Research Unit and the Jawaharlal Nehru University was jointly sponsored by the ICSSR and ISI. The second phase of the field-work was completed. The survey materials are being analysed and a report being prepared.

## VII. STATISTICAL QUALITY CONTROL AND OPERATIONS RESEARCH

The Statistical Quality Control and Operations Research (SQC & OR) Division has a Technical Advisory Committee and a Divisional Committee of Scientific Workers which were formed after the introduction of the Revised Memorandum of Association, Indian Statistical Institute.

The Division undertook 21 new project assignments during the year, apart from rendering consultative services to 63 factories already on its rolls. The Division has so far trained over 24,000 managers, technologists, scientists and operators; produced over 550 specialists and prepared about 460 research and application papers in the field of SQC & OR. Heavy electricals and electronics, light engineering, precision tools, drugs and pharmaceuticals, light engineering, precision tools, drugs and pharmaceuticals, chemicals and textiles are some of the industries covered by the education, training and special project studies.

The activities of the Division are described under the following heads : 1. Consultative Service, 2. Education and Training, 3. Promotional Activities, and 4. Research.

*Consultative Service* : There were 63 factories taking consultative advice as on March 1979. During the period, 31 plants joined the SQC service scheme and 11 factories withdrew their membership. Two hundred twelve technical reports were sent to the member organisations including a few special study reports on projects of specific interest to the management.

The main areas of work on consultative service included the design and development of quality systems, procedures, and their implementation, design of quality information and reporting systems, process and product quality evaluation, special studies aimed at waste and cost reduction, product evaluation and development in collaboration with Research and Development Department of factories, and conducting applied research in effecting product and process improvements.

Special studies carried out included the improvement in quality and productivity of : steam turbine generators, H.P. heaters, transformers, tractor motors, switch gears, valves and conductors, pumps, and electric motors. These studies led to significant improvements.



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Other special projects were related to the estimation of reliability of power plant equipment, wastage reduction in cutting of transformer core sheets, cost evaluation and control in textiles, estimation of reliability of oil engines, standardisation and material utilisation in tools factory, electronics industries and optimal allocation of looms in a weaving shed.

*Education and Training* : During the period, the Division trained 2,781 engineers, managers, technologists and others in a large number of in-plant courses for top and middle level management at different centres. Some general and other courses in the basic techniques of SQC such as Reliability Engineering, Design and Analysis of Industrial Experiments, and Operations Research methodology were organised at different centres. Special lectures and training programmes and one-day seminars were conducted for the executives of the Bharat Heavy Electricals Ltd. (BHEL) at its various plants.

Altogether 134 persons underwent professional training at the post-graduate level in courses at Bombay, Madras and Calcutta and at the under-graduate level in the part-time course at Bangalore. Training was also imparted to 52 students of M.Stat. II and B.Stat. (Hons.) in SQC & OR in Calcutta and Delhi.

Twenty-four engineers drawn from manufacturing plants of BHEL, completed the one-year special training programme in quality, reliability and operations research on 23 December 1978. As part of the course requirement, 24 project studies on some live problems of the manufacturing plants were undertaken by the participants under the guidance of the specialists from the Division. For a second batch of 21 engineers, the special training commenced on 2 January 1979.

*Promotional Activities* : Seminars on "Quality Assurance" and "Operations Research" were organised for the managers of BHEL plants and Corporate Quality Assurance Division at Delhi, Haridwar, Bhopal, Hyderabad, Bangalore and Trichinapalli.

The SQC Division conducted 24 seminars on quality and reliability for other industries in the private sector. The specialists of the Division delivered 176 lectures and talks in institutions and organisations and participated in 22 seminars and conferences.

Promotional visits were paid to 71 plants; 29 pilot studies were completed and 33 reports were sent to factories.

*Research* : Some of the areas in which research work is carried out include complementarity problem, deterministic flow shop-sequencing problems, queueing models, reliability, inventory management and Bayesian single-sampling three-decision plan.

## VIII. LIBRARY, DOCUMENTATION AND INFORMATION SCIENCES

### 1. *Library*

1.1. With the addition of 5,180 new books and 2,401 bound volumes, the total collection of the Central Library at Banarasgar rose to 1,57,569 volumes at the close of the year. The Library has also a collection of 34,023 reprints, 3,76,000 maps and a large collection of microfilms, microfiches and photoprints. The services of the Branch libraries at Bombay, Bangalore, Giridih and Delhi were co-ordinated with those of the Central Library to serve researchers, students and staff of the Institute.

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1.2. *Acquisition* : Five thousand six hundred and forty-six books were accessioned during this period.

1.3. *Technical Processing* : The Library classified 2,306 and catalogued 5,361 books. Three issues of the *Quarterly Bulletin* (classified list of current additions to the Library) were published.

1.4. *Periodicals* : The library received 2,202 periodicals, of which 736 were received on subscription, 588 on exchange and 879 on a complimentary basis.

1.5. *Membership and Circulation* : The total library membership was 3,143 (including staff, research scholars, students and guests), of which student members (outside) numbered 566 and Institute members were 126. Altogether 781 persons used the reading room with special permission. 34,967 books and periodicals were issued to members. The library borrowed 34 publications from local and out-station libraries and lent 96 publications to other libraries under the inter-library lending arrangements.

1.6. *Documentation Service* : The following three bibliographical projects were nearing completion : (a) Periodical articles on wages, wage-structure and wage differentials, (b) books on computer science available in the ISI Library, and (c) List of periodicals on computer science with holdings, available in the ISI Library. Work on "An index of selected articles on Energy" was progress.

A selective bibliography of publications and periodical articles on and by Albert Einstein available in the principal science libraries in Calcutta was compiled on the occasion of Einstein Centenary Celebrations in the Institute.

1.7. *Reprographic and Photographic Services* : The following were prepared : (a) 2,686 copies of microfilm negatives from documents, (b) 1,640 photoprints and 6,473 bromide enlargements, besides a large number of photographs of scientific subjects, specimens and functions held in the Institute, (c) 35,021 copies of prints from documents, books and periodicals by xerographic process and (d) reproduction of 22,338 copies of prints by offset printing process (rotaprint).

1.8. *Translation Service* : The following were translated into English : (a) Ten chapters of the Japanese document "Multivariate Analysis" by T. Kitagawa. (b) Two German documents including one on turbulence; (c) Two documents from French. One document in English was translated into French.

Shri Sunit Bose taught Russian at the Evening Course in Russian Language conducted by the Institute. He also worked as an interpreter from 15 January 1979 to 30 March 1979 to the Russian engineers who had come for the installation of the Russian computer EC-1033. He translated Russian documents relating to the computer.

1.9. *Reports and Records* : Eight hundred and ten reports and data books were accessioned. A catalogue of Government of India and United Nations publications was brought out. The Report and Records Unit was shifted to the second floor of the new library building.

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1.10 *Special Material Collection* : Seven hundred Russian books were accessioned and 480 Russian books were processed. One hundred microfilm copies of rare books, monographs and periodical articles were accessioned, of which 36 films were classified.

1.11 *Circulating Library* : The Workers' Circulating Library had a collection of 28,989 books. Seven hundred and nine books were added to the stock of the Circulating Library which issued 34,229 books. Sixtyone new members were admitted.

1.12 *Delhi Library* : During the year, 4120 books and periodicals were issued to members. In the exchange arrangement with other libraries, 230 titles were loaned from 20 libraries and 80 titles were booked out to 17 libraries. Researchers from outside who consulted the library numbered 170.

Other figures were : (i) Periodicals acquired : 220 foreign and 50 Indian titles; (ii) Books acquired : 1000; (iii) Books/bound volumes accessioned : 1800; (iv) Major; 2300 pages of 1300 images; (v) Bindings : 250 books and 200 journals.

Training was given for four months from June 1978 to four students of the Library and Information Science Course on request from the University of Delhi and the Directorate of Training and Technical Education.

### 2. *Documentation Research and Training Centre (DRTC), Bangalore*

2.1 *Training* : Eighteen candidates were admitted to the 1978-80 course in Documentation and Information Science which commenced on 1 August 1978. There were five deputed candidates, of whom one was sponsored by the International Development Research Centre, Ottawa.

2.2 *Research* : Research in documentation and information science was conducted through studies/surveys, the results of which were published. The main areas of research may be grouped as follows :

- (i) Computer-based Information System.
- (ii) Application of indexing languages.
- (iii) Non-hierarchical relations.
- (iv) Planning of library and information systems.
- (v) Publication pattern in the field of science and technology.
- (vi) Trend report on research in electrical engineering in India.
- (vii) Thesaurus of leather technology terms.

### 2.3. *Seminars*

2.3.1. The DRTC Annual Seminar, Bangalore, 4-8 December 1978, co-sponsored by the Department of Science and Technology, Government of India, and the Publications and Information Directorate (CSIR), was attended by 107 participants who contributed 43 scientific papers. The topic of the seminar was "Primary communications in science and technology in India."

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2.3.2. A Refresher Seminar on "Applications of Computers to bibliographical information processing : some development in India," sponsored by the DRTC and the Department of Science and Technology, Government of India, was organised by the DRTC in Bangalore, 10-13 July 1978. Nineteen papers, of which five were from the DRTC staff, were read at the seminar.

2.3.3. A national seminar on Primary Communications in the field of Science and Technology in India, sponsored by the Department of Science and Technology, Government of India, Publication and Information Directorate (CSIR) and the DRTC was organised in Bangalore, 4-8 December 1978.

2.3.4. The faculty of the DRTC participated in the Seminar and Exhibition on Reproduction of Documents and Documents Handling Systems, Bangalore, 6-7 July 1978, sponsored by the Department of Science and Technology.

2.4. *Publications* : A book entitled "Ordering Systems for Global Information Networks," edited by Professor A. Neelamegham, was published. pp. 555.

### IX. CONFERENCES, SYMPOSIA AND SEMINARS

Among different conferences, symposia, seminars and workshops organised by the Indian Statistical Institute may be mentioned the following.

*Seminar in Economic Writings in Bengali (1818-1947), Calcutta, 22-23 April 1978* : Dr. P. C. Chunder, Union Education Minister, inaugurated the Seminar organised by the Indian Statistical Institute in collaboration with some other organisations. The inaugural session was presided over by Dr. Nihar Ranjan Roy and the key-note address was delivered by Dr. Bhabatosh Dutta. Professor C. Kallianpur, Director of ISI, addressed the seminar on behalf of the Organising Committee. Five papers were presented in the three academic sessions by workers of the I.S.I.

*School-cum-Workshop of Cumulative Algebra and Algebraic Geometry, Calcutta, 3-24 February 1979* : The Workshop was attended by 32 participants from India and abroad including two Field Medalists.

### X. PUBLICATIONS

The undermentioned publications were brought out during the year.

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

*Series A* : Vol. 40, Parts 1, 2, 3 and 4.

*Series B* : Vol. 39, Parts 3 and 4.

*Series C* : (Quantitative Economics) : Vol. 39, Parts 2 & 4.

*Series C* : (Sample Surveys) : Vol. 40, Parts 1 & 2.

*Technical Report* : Fortyone technical reports were issued in the Statistics-Mathematics Division.

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### XI. SOCIETY-TYPE ACTIVITIES : BRANCHES

#### 1. Karnataka Branch

1.1. *Membership* : There were 61 members at the end of the year (Life members : 19; Institutional members : 6; and Ordinary members : 26).

1.2. *Office-bearers* : Six office-bearers and four members of the Executive Committee were elected for the year 1978-79.

1.3. *Seminar Proceedings* : Shri K. H. Srinivas, Minister of State for Information and Youth Services, Government of Karnataka, spoke at a function organised on 13 November 1978, to release the printed volume of the proceedings of the seminar on "Statistics for Administration in Government and Commercial Organisations." Shri C.S. Seehadri, Chairman, Karnataka Branch, presided.

#### 1.4. *Lectures* :

(i) Shri P. J. Nayak, Deputy Secretary, Government of Karnataka. *Lecture* : Analytical sophistication in the planning process.

(ii) Shri V. K. Iyer, Deputy Chairman (Liaison), Kudremukh Iron Ore Co. *Lecture* : Kudremukh Iron Ore project in the economy of Kerala.

(iii) Shri S. P. Bhat, Managing Director, Mysore Power Corporation Ltd., Bangalore, *Lecture* : The power position in Karnataka.

### XII. LIST OF SCIENTIFIC PAPERS AND PUBLICATIONS

#### 12.1 *List of Papers Published*

##### A. THEORETICAL STATISTICS AND MATHEMATICS

1. ADEKARI, B. P. (with Sarma, Y. R.) : Some tests of hypotheses for cluster sampling. *Sankhyā*, 40, B, 29-37.
2. BABU, G. JOGESH (with Singh, K.) (1978) : Probabilities of moderate deviations for stationary strong-mixing processes. *Sankhyā*, A, 40, 38-43.
3. — (with Singh K.) (1978) : On probabilities of moderate deviations for dependent processes. *Sankhyā*, A, 40, 28-37.
4. — (with Ghosh, M. and Singh, K.) (1978) : On rates of convergence to normality for  $\phi$ -mixing processes. *Sankhyā*, A, 40, 278-293.
5. DAS, A. K. (with Tripathi, T. P.) (1978) : Use of ancillary information in estimating the finite population variance. *Sankhyā*, C, 40, 138-148.
6. GHOSH, J. K. (with Basu, A. P.) (1978) : Identifiability of the multinormal distribution under competing risk model. *J. Multivariate Analysis*, 8, 413-419.
7. — (with Chandra, T.) (1978) : Comparison of tests with same Bahadur efficiency. *Sankhyā*, A, 40, 253-277.

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8. MATERN, J. (with Nadkarni, M. G.) (1978) : On systems of imprimitivity on locally compact Abelian groups with dense actions. *Annales de l'Institut Fourier de Grenoble*, 28, 1-23.
9. MITRA, S. K. (with Bose, N. K.) (1978) : Generalised inverse of polynomial matrices. *IEEE Transactions on Automatic Control* Ac-23, 3, 491-494.
10. PAUL, E. M. (1978) : On the distribution of values of additive arithmetical functions. *Sankhyā*, A, 40, 1-9.
11. PRABHA RAO, B. L. S. (1978) : Whittle's inequality in Hilbert space. *Teor. Veroyat., Mat. Statist.* (Russian), 16, 102-107.
12. — (1978) : Berry-Essen type bound for density estimators of stationary Markov processes. *Bull. Mathematics and Statistics*, 17, 15-21.
13. — (1978) : On a characterization of Gaussian measure on locally compact Abelian groups. (Russian). *Matem. Zametki*, 22, 759-762.
14. — (1978) : On the rate of approximation in the multidimensional central limit theorem. *Lietuvos. Matem. Rink*, 17, 187-194.
15. — (1978) : A central limit theorem for backward martingales. *Bull. International Statistical Institute*, 37, 697-700.
16. — (1978) : The rate of convergence of Bernstein-von Mises approximation for Markov processes. *Serdica. Bulgarian Mathematical Publications*, 4, 42-46.

B. ANTHROPOMETRY AND HUMAN GENETICS

1. BASU, A. (1978) : Allocation of priorities in anthropological research : as it should be, as it has been, and the causes of discrepancy between the ideal and the achievement. *Spectra of Anthropological Progress* (Dept. of Anthropology, Delhi University), 1, 9-16.
2. MALHOTRA, K. C. (1978) : Relationship between cleft chin and some quantitative and qualitative cephalofacial characters : a statistical study. *Indian Physical Anthropology and Human Genetics*, 4, 31-40.
3. — (1978) : Red cell glucose-6-phospho dehydrogenase deficiency and haemoglobin variants among ten endogamous groups of Maharashtra and West Bengal. *Human Genetics*, 44, 339-343.
4. — (1978) : Micro-evolutionary dynamics among the Gavdas of Goa. *Evolutionary Models and Studies in Human Diversity*. Eds. Meier R. J. et al., Mouton, The Hague/Paris, 279-314.
5. — (1978) : Founder effect, gene drift, and natural selection among four nonadmix Mendelian isolates. *Evolutionary Models and Studies in Human Diversity*. Eds. Meier R. J. et al., Mouton, The Hague/Paris, 315-324.
6. — (with R. Chakraborty) (1978) : Variations of finger dermal ridges at different states of population differentiation. *Am. J. Hum. Genet.*, 29, 29A.

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7. MALHOTRA, K. C. (1978) : Natural selection and colour blindness : fresh data on Indian castes. *Genet. Res. Camb.*, 31, 230-207.
8. — (1978) : Ex-communication as a process leading to the formation of new groups. *Eastern Anthropologist*, 32, 49-53.
9. — (with others) : Distribution of blood groups among 21 Dhanger castes of Maharashtra. *Ind. J. Phys. Anthropol. and Hum. Genet.*, 3, 141-159.
10. — (with G. M. Kanhere) (1978) : Inheritance of ear lobes. *The Anthropologist*, 22, 17-20.
11. — (1978) : Status of dermatoglyphic studies in India; a comment. *Spectra of Anthropological Progress*, 1-8.
12. — (1978) : Ram Mamma Yatra among Nomadic Nandiwallas of Maharashtra : Its origin and socio-religious significance. *Indian Anthropologist*, 8, 7-17.
13. — (with others) (1977-78) : A note on the palaeolithic industry of Karadkhed (Maharashtra). *Bull. Deccan College Research Institute*, 37, 118-123.
14. MURHARJEE, B. N. (with Malhotra, K. C. and Kate, S. L.) (1977) : Distribution of PTC taste threshold among 13 endogamous castes and tribes of Maharashtra. *J. I. Indian Anthropological Society*, 12 : 157-166.
15. — (with Malhotra, K. C., Das, S. K., Undevia, J. V., Bhanu, B. B., Yee, S. and Mazumdar, P. P.) (1978) : Distribution of blood groups among 21 Dhanger castes of Maharashtra. *Indian Journal of Physical Anthropology and Human Genetics*, 2, 141-169.
16. — (with Das, S. K., Malhotra, K. C., Kate, S. L., Mutalik, G. S., Sainani, G. S. and Bhidya, S.) (1978) : Placental enzymes polymorphism among Maharashtrais : alkaline phosphatase and lactate dehydrogenase. *Indian Annals of Human Biology*, 5, 435-442.
17. — (with Das, S. K., Malhotra, K. C. and Majumdar, P. P.) (1978) : Serological and biochemical investigations among five endogamous groups of Delhi. *Indian Annals of Human Biology*, 5, 25-31.

C. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. ARNAB, R. (1978) : On the relative efficiencies of some sampling strategies under a super population model. *Ind. Soc. Agri. Statist.*, 31, 89-96.
2. BANDYOPADHYAY, SHIBDAS : Classification distributions and admissibility in auto-regressive process. *Aust. Statist.*, 20, 3, 229-239.

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3. CHAUDHURI, ABHIT (1978): On estimating the variance of a finite population. *Metrika*, 25, 65-76.
4. — (1978): On the choice of sample-size for a Horvitz-Thompson estimator. *Indian Society for Agricultural Statistics*, 30, 35-42.
5. — (with Arnab, R.) (1978): On the role of sample-size in determining efficiency of Horvitz-Thompson estimators. *Sankhyā*, C, 104-109.
6. — (with Arnab, R.) (1977): On the relative efficiencies of a few strategies of sampling with varying probabilities on the occasions. *Calcutta Statistical Association Bull.*, 26, 25-38.
7. GHOSH, S. (with Srivastava, J. N.): A series of balanced  $2^m$  factorial designs of resolution  $V$  which allow search and estimation of one extra unknown effect (BABB 5.1 plans). *Sankhyā*, B, 3, 280-289.
8. — (with Srivastava, J. N.): On the existence of search designs with continuous factors. *Ann. Institute of Statistical Mathematics*, 29, A, 301-306.
9. MUKHOPADHYAY, ANIS: Lower bounds on  $m_{1,r,q}$ . *J. Combinatorial Theory*, A, 25, 1.
10. — (1978): Some infinite classes of Hadamard matrices. *J. Combinatorial Theory*, A, 25, 2.
11. — (1978): Incomplete block designs through orthogonal and incomplete orthogonal arrays. *Statistical Planning and Inference*.
12. SASTRY, C. H. (with Satyanarayana, B.) (1978): A data base for national population register. *Proc. Convention, Computer Society of India*.

D. COMPUTER SYSTEMS

1. DATTAOUPA, J. (with Musgrave, G.) (1978): An efficient method of determining functional equivalence classes of network with reconvergent fan-out. *International J. System Science*, 9, 10, 1069-1077.
2. — (with Duttagupta, R.) (1978): A graphical approach to the determination of test sequences for sequential circuits. *Proc. Fifth National Systems Conference, Ludhiana, September, 1.67-1.71*.
3. SINHA, B. P. (with Duttagupta, R. and Choudhury, A. K.) (1978): Partition of faults into equivalence classes and their application to location of faults to a replaceable module. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 78-3*.
4. — (with Guhathakurta and De, N.) (1978): Connection routing algorithm on printed circuit boards. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 5.16-5.26*.
5. SRIMANT, P. K. (with Sinha, B. P. and Choudhury, A. K.) (1978): 1-distinguishability of SEC graphs. *Proc. IEEE*, 66, 12, 1668-1669.



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6. SUDHARTI, P. K. (with Sinha, B. P. and Choudhury, A. K.) (1979): A new method to find out the chromatic partition of a symmetric graph, *International J. Systems Science*, 10, 1.
7. — (with Sinha, B. P. and Choudhury, A. K.) (1978): A new algorithm to determine all the minimum edge sets of a system graph. *J. IEEE*, 24, 12, 534-539.
8. — (with Chakravarty, S. K.) (1978): On adoption logic for delta modulation. *J. IETE*, 24, 8, 337-338.
9. — (with Chakravarty, S. K. and Chakravarty, M. K.) (1978): An efficient method to generate the reduced fault-an arbitrary multiple fault in a combinational network. *Proc. Fifth National Systems Conference, Ludhiana, September, 1.84-1.87.*
10. — (with Sinha, B. P. and Choudhury, A. K.) (1978): A new address calculation technique in microprogrammed digital system. *Proc. Fifth National Systems Conference, Ludhiana, September, 1.117-1.121.*
11. — (with Mitra, A. D.) (1979): Identification of sequential machines utilizing the concepts of checking sequence. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 3.89-3.101.*
12. — (with Sen, A.) (1979): A hardware device for generalized register transfer. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 1.1-1.10.*
13. — (with Mukherjee, M., Sengupta, A. and Bandyopadhyay, S.) : An efficient file organisation for fast retrieval. *Proc. Symposium on Mini-Micro Computers and Automation, March, 1.22-1.36.*
14. — (with De, N., Sengupta, A. and Bandyopadhyay, S.) (1979): Checking *t*-diagnosability and design of *t*-diagnosable systems. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 3.15-3.24.*
15. — (with De, N., Sengupta, A. and Bandyopadhyay, S.) (1979): Some studies on self-diagnosable systems. *Proc. Symposium on Mini-Micro Computers and Automation, Roorkee, March, 3.25-3.35.*

#### E. CROP SCIENCE

1. DAVIS, T. A. and ALTEVOOT, RUDOLF (1978): Is the coconut crab a pest of coconut? *World Crops*, 30, 4: 167-162, 172.
2. GHOSH, S. S. (1978): Tender coconut: source of delicious drink and products of utility. *Indian Coconut Journal*, 2, 5: 1-4.

#### F. DEMOGRAPHY

1. RAMAN, M. V. (with Sengupta, B.) (1978): Reduction in fertility due to birth limitation. *Indian J. Population Studies*, Population Studies Centre, Sri Venkateswara University, Tirupathi, Andhra Pradesh, 1, 1, 33-39.

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2. SARKAR, B. N. (1978): Population welfare programme through family planning. *Indian J. Population Studies*, Population Studies Centre, Sri Venkateswara University, Tirupathi, Andhra Pradesh, 1, 1, 68-76.

#### O. ELECTRONICS AND COMMUNICATION SCIENCES

1. CHAUDHURI, B. B. (1978): A simple method of thinning. *Inst. Electronics and Telecom. Engg.*, 24, 6, 364-366.
2. — (with Paul, D. K.) (1978): Wave propagation through a hollow rectangular anisotropic dielectric guide. *IEEE J. Quantum Electronics*, 8, 567-569.
3. — (with Paul, D. K.) (1979): Propagation through hollow cylindrical anisotropic dielectric guides. *IEEE Trans. Microwave Theory and Tech.*, 27, 2.
4. — (1979): Sensitivity analysis of dielectric optical guides. *IEEE J. Quantum Electronics*.
5. CHOWDHURY, F. B. (1978): Simple and automatic logic monitor. *Electronic Engineering*.
6. DATTA, A. K. (with Ganguli, N. R. and Ray, S.) (1978): Transition, a cue for identification of plosive. *J. Acoust. Soc. India*, VI, 4.
7. MAJUMDER, D. DUTTA (with Datta, A. K. and Ganguli, N. R.) (1978): Some studies on acoustic phonetic features of Telugu vowels. *Acustica (Germany)*, 40.
8. MAJUMDER, D. DUTTA (1979): Cybernetics and general system theory—a unitary science, *Kybernetes*.
9. PAL, S. K. (with Majumder, D. Dutta) (1978): Vowel identification using piecewise separation technique. *Indian Technology*, 16, 4, 148-153.
10. — (with Majumder, D. Dutta) (1978): Effect of Fuzzification on plosive cognition system. *Int. J. Syst. Sciences UK*, 9, 8, 873-886.
11. — (with Datta, A. K. and Majumder, D. Dutta) (1978): Adaptive learning algorithm in classification of fuzzy patterns: an application to vowels in CNC Context. *Int. J. Syst. Sciences, UK*, 9, 8, 887-897.
12. — (with Majumder, D. Dutta) (1978): On Automatic Plosive Identification using fuzziness in property sets. *IEEE Trans. Syst. Man and Cybern.*, SMC-8, 4, 302-308.

#### H. EMBRYOLOGY

1. TAFASWI, P. K. (with Roy, A. B.) (1978): Mathematical simulation of RNA and protein synthesis during embryogenesis based on a simplified mathematical model. *Cybernetics, J. International Association of Cybernetics*, Belgium, 21, 2.

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### I. ENTOMOLOGY

1. DASCHAUDEVAL, P. C. (1978): Statistics in modern scientific research. *Science Today*, 12, 10, 6.
2. — (1978): Mosquito research in India. *Science and Culture*, 44, 209-215.

### J. GEOLOGY

1. CHATTERJEE, S. (1978): *Indochinus* and *Indocurus*, Cretaceous carnosaur from India. *J. Paleontology*, 52, (3), 570-580.
2. — (with Sohn, I. G.) (1979): Freshwater ostracodes from the late triassic coprolites of India. *J. Paleontology*, 53, (3), 578-586.
3. JAIN, S. L. (1978): A new fossil pelomedusid turtle from the Upper Cretaceous Pindara sediments, Central India. *Palaontological Society of India* (Academician J. A. Orlov Memorial volume), 20: 360-365.
4. SENGUPTA, SUPRIYA (1978): Grain-size distribution of suspended load in relation to bed materials and flow velocity. *Sedimentology*, 26(1), 83-82.

### K. LEAF PROTEIN

1. BAGCHI, D. (with Matai, S.) (1978): Root yield and extracted protein yield from different varieties of radish (*Raphanus sativus*) under W. Bengal conditions. *Indian Agricultural Chemistry*, 11, 1.
2. CHAKRABARTI, S. (with Matai, S. and Chandra, A. L.) (1979): Extracellular lipase production by a soil streptomycete. *Current Science*, 48, 6, 268-269.
3. CHANDA, S. (1978): Detection of some sugars in protein free leaf extracts of some common vegetable plants. *Science and Engineering*, 31, 11, 231-33.
4. MATAI, S. (with Bagchi, D. and Chanda, S.) (1978): Yield of extracted leaf protein from EC 4216, a fodder variety of cow pea. *Indian Agronomy*, 23(2), 163-166.

### L. PHYSICS

1. GUPTA, A. B. (with Haldar, B.) (1978): Laser: its physical principle and biomedical applications. *Indian Practitioner*, Bombay, XXXI, 12, 847-878.

### M. PHYSICS OF FLUIDS

1. GHOSH, K. M. (with Haldar, K. and Mazumder, H. P.) (1978): Basic concepts of dynamic meteorology. *Monsun Project Report*, I, 1, 5.

### N. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BOSE, D. K. (1978): Towards a policy for exploitation of oil in India. *Urja* IV, 8, October 28, 171-176.

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2. BOSE, K. D. (1978) : Physical constraints for agricultural growth in India. *Problems of Agricultural Growth in India*. Department of Geography, University of Calcutta, 1-8.
3. — (1978) : Planning and Centre State relations. *West Bengal*, XX, 15, April, 381-382.
4. CHAKRABARTI, S. K. (1978) : Recent price fluctuations in India: an explanatory note. *Economic and Political Weekly*, XIII, 16, April 22, 702-706.
5. — (1978) : Money, output and price: guidelines for macro credit planning. *Recent Development in Monetary Theory and Policy*, Reserve Bank of India, Bombay, 76-87.
6. — (1977) : The general theory model: a graphical exposition. *Arthaniti*, January and July, 55-64.
7. — (1978) : A Review: Concepts of Economic Growth and Other Essays by Dutta, Bhabatosh. *Capital*, September 7.
8. CHATTOPADHYAY, S. (1978) : Authoritarianism and democracy: a comment. *Economic and Political Weekly*: July 22, 1190-92.
9. CHETTY, V. K. (1978) : Temporary competitive equilibrium in a monetary economy with uncertain technology and money planning periods. *J. Mathematical Economics*, 5, 1, 23-42.
10. DASGUPTA, D. (1978) : Centenary turnpikes and rolling plans: synthesis and extensions. *Indian Economic Journal*, April-June, 1-17.
11. PAL, M. N. (with Dr. R. N., and Malakar, B.) (1978) : A statistical revision of 1961 agricultural workers for the comparability with the 1971 Census estimates by Indian districts. *Indian J. Regional Science*, 1, X, 11-18 and 18A-18L.
12. MAITI, P. (with Bhattacharya, N.) : Econometric studies on price behaviour. *Survey of Research in Economics*, Vol. II: *Econometrics*, Indian Council of Social Science Research, Applied Problems, 232-276.
13. — (1979) : Sixth Plan Draft: price implications, Part I and II. *Economic Times*, January 18 and 19.
14. ROY, BINA (1979) : Trends in the distribution of wages and salary income between different categories of occupations in Central Government services in India. *Indian J. Labour Economics*, Conference Number, XXI, January, 4(II), 85-126.
15. RUDRA, ASHOK (1978) : Class relations in Indian agriculture-III, *Economic and Political Weekly*, XIII, 24, 998-1004.

O. PRE-CENSUS POPULATION STUDIES

1. BHATTACHARYA, DURGAPRASAD (1977) : Business houses of Bengal. *Proc. Forty-fifth Session, Indian Historical Records Commission*, XLV, Mysore, 31.

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2. BHATTACHARYA, DURGAPRASAD (with Deb Roy, Rama) (1977): *Khanasumari Records and the statistical system of India. Proc. Forty-fifth Session, Indian Historical Records Commission, XLV, Mysore, 227-237.*

### P. PSYCHOMETRY

1. CHATTERJI, S. (with Mukherjee, Manjula) (1978): Concurrent validity and the non-language test of verbal intelligence. *Educational Psychological Measurement, U.S.A., 38, 433-436.*
2. — (with Bhattacharyya, K. P. and Mukherjee, Manjula) (1978): An investigation into the relationship between suppression of certain personality information and delinquent behaviour among the school children. *Manas, 25, 1, 43-48.*

### Q. SOCIOLOGY

1. BISWAS, S. K. (1978): Limitations in anthropological research in India. *Indian Anthropological Society, 12, 19-28.*
2. CHATTOPADHYAY, K. (1979): Notes on the integrative function of rites-de-passage: rural scene. *Bull. Cultural Research Institute, Government of West Bengal, XIII, 3 & 4, 126-134.*
3. MUKHERJEE, R. (1979): Information and documental needs for social aspects of population growth and policy. *Health and Population Perspective and Issues, 1(2), 166-174.*

### R. STATISTICAL QUALITY CONTROL

1. LAKSHMIKANTHAN, P. R. (1979): Control of rejection in filled and sealed ampoules. *QR J. 6, 1 January, 16-18.*
2. — (1978): Statistical Quality Control Techniques—a friend in need to production technology. *Quality Work Souvenir, BHEL, Hardwar, June 11-12.*
3. MAJUMDAR, A. (with Biswas, A.) (1978): Problem of toxicity test procedure of sodium stibegluconate injection. *Eastern Pharmacist, Scientific Section, 248, August, 167.*
4. NANKANA, A. N. (with Choudhury, S. K.): BHEL's march on quality. *Quality-Work Souvenir, BHEL, Hardwar, June 9.*
5. PANDEY, R. J. (1977): Single sampling three-decision plan by attributes providing average quality protection. *Sankhyā, 39, 329-343.*

### S. THEORETICAL PHYSICS

1. BANDYOPADHYAY, P. (with Roychoudhury, R. K., Bhattacharyya, S. and Bhattacharyya, D. P.) (1978): Lepton-hadron relation and a new KNO type scaling. *Nuovo Cimento A., 1 November.*
1. — (with Das, A. and Patari, K.) (1978): Lepton-hadron relation and the nucleon-nucleon potential. *Nuovo Cimento A., 1 December.*

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3. BANDYOPADHYAY, P. (with Sen, K.) (1978): Disintegration of deuteron by neutrineutron scattering and few photon-neutrino weak coupling theory. *Phys. Rev., D*, 18, 2262.
4. — (with Roy, S. and Das, A.) (1978): Mach's principle and the quantal response of the universe. *Letters al Nuovo Cimento*, 23, 429.
5. — (with Roy, S., Bhattacharyya, B. and Sarkar, H.) (1978): Spontaneous breakdown of Gauge symmetry and the photon-neutrino weak coupling theory. *Nuovo Cimento*, A 45, 511.
6. ROTHOUDHURY, R. K. (with Bhattacharyya, D. P.) (1978): Secondary neutral pion nucleon flux ratio at the top of the atmosphere and spectra. *Ann. Phys.*, 36.

12.3 Papers submitted for publication

(The journal to which the paper is submitted for publication is mentioned within brackets).

A. THEORETICAL STATISTICS AND MATHEMATICS

1. BABU, G. JOGESH (with Singh, K.): On deviations between empirical and quantile process for mixing random variables. (*J. Multivariate Analysis*).
2. —: On distribution of multiplicative functions. (*Acta Arithmetica*).
3. —: On the mean values and distributions of arithmetic functions.
4. —: An inequality for moments of sums of truncated  $\phi$ -mixing random variables.
5. — (with Singh, K.): On  $r$ -quick limit sets for empirical and related processes based on mixing random variables. (*Ann. Probability*).
6. BAGCHI, S. C. (with Sitaram, A.): Spherical mean periodic functions on semi-simple Lie groups.
7. BHARAWA, R. P.: An alternative to principal component analysis. (*Sankhyā*).
8. BHATIA, R. (with Mukherjee, K. K.): Perturbation of spectra of finite dimensional operators. (*J. Algebra*).
9. DAS, A. K. (with Tripathi, T. P.): Use of ancillary information in estimating the coefficient of variation of finite population. (*Aust. J. Statist.*).
10. DAS, M. K.: Dominated extension theorem.
11. GANGOPADHYAY, T.: Potentially bipartite self-complementary pair sequences. (*Discrete Mathematics*).
12. — (with Rao Hebbare, S. P.): Paths in  $r$ -partite self-complementary graphs. (*Discrete Mathematics*).
13. GHOSH, J. K. (with Sinha, B. K. and Wicand, H. S.): The second order efficiency of the maximum likelihood estimates for bounded bowl shaped loss functions. (*Ann. Statist.*).

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14. GHOSH, J. K. (with Chandra, T.): Valid asymptotic expansions for likelihood ratio statistic and other perturbed 2-variable. (*Sankhyā*).
15. —: Comments on a paper of Berkson. (*Ann. Statist.*).
16. — (with Basu, A. P.): Asymptotic properties of the likelihood equation for the independent not identically distributed case with life testing applications.
17. — (with Morimoto, H. and Yamada, S.): Neyman factorization and minimality of pairwise sufficient-fields.
18. JAIN, L. R.: On fitting a three parameter lognormal distribution to consumer expenditure data. (*Sankhyā*).
19. MITRA, S. K. (with Puri, M. L.): Shorted operators and generalized inverse of matrices. (*Linear Algebra and its Applications*).
20. — (with Khatri, C. G. and Puri, M. L.): Matrices satisfying simultaneous equations  $A^*MAG = A^*M$  and  $G^*NGA = G^*N$ , Huzurbarzar volume. (*J. Indian Statistical Association*).
21. MUKHERJEE, A.: Alternative definitions of homology groups.
22. —: Immersions with non-vanishing mean curvature vector.
23. MUKHERJEE, K. K. (with Bhatia, R.): The spectra of operator valued functions. (*Algebra and its Applications*).
24. MUTHURAMALINGAM, P. L.: Kato bounds for spherically symmetric potentials with respect to Dirac operator. (*J. Indian Math. Soc.*).
25. NADKARNI, M. G.: On spectra of non-singular transformations and flows. (*Sankhyā*).
26. — (with Ramachandran, D.): On a question of D. Maharam concerning tail fields. (*Sankhyā*).
27. PARTHASARATHY, K. R.: The exact bound of Coulomb potential with respect to Dirac operator. (*Letters in Mathematica Physics*).
28. —: Square integrable martingales orthogonal to every stochastic integral. (*Stochastic Processes and their Application*).
29. —: Eigen values of matrix valued analytic maps. (*J. Aust. Math. Soc.*), 20, A.
30. RAJPUT, BALRAM (with Louie, D.): Support and semi-norm integrability theorems of  $r$ -semistable laws on LCTVS. (*Proc. Am. Mathematical Society*).
31. — (with Louie, D.): A 0-1 dichotomy theorem for  $r$ -semistable laws on infinite dimensional linear spaces. (*Sankhyā*).
32. — (with Chung, D.): On the characterisation of  $r$ -semistable laws on LCTVS. (*JMA*).

33. RAMACHANDRAN, B.: On the strong memorylessness property of the exponential and geometric probability laws. (*Sankhyā*).
34. —: On the strong Markov property of the exponential laws. (*Proc. Colloquium, Methods of Complex Analysis in Probability Theory and Statistics*).
35. RAMACHANDRAN, D.: A note on regular conditional probabilities in Doob's sense. (*Am. Math. Soc.*).
36. RAMAMURTHY, K. (with Athreya, K. B.): Renewal theory—a Markov process approach. (*Indian Institute of Science*), Bangalore.
37. RAMASUBRAMANYAM, S.: Some infinite dimensional Ergodic group actions in Wiener spaces. (*Stochastic Processes and its Applications*).
38. RAO, S. B.: Characterisation of forcibly total-graphic sequences. (*Discrete Mathematics*).
39. —: Characterization of forcibly planar degree sequences. (*Ars Combinatorica*).
40. —: The number of open chains of length  $n$  and the parity of the number of open chains of length  $k$  in self complementary graphs. (*Discrete Mathematics*).
41. ROY, K. K. (with Murthy, R. V. R.): Sufficiency, Bayes sufficiency and decisions theoretic sufficiency. (*Sankhyā*).
42. SARMA, Y. R. (with Bell, C. B.): On a characterization of exponential distribution. (*Metrika*).
43. SINOH, K.: A note on quantile processes of finite populations. (*Aust. J. Statist.*).
44. —: A note on quantile processes of mixing random variables. (*Sankhyā*).
45. —: Representation of quantiles with non-uniform bounds. (*Sankhyā*).
46. —: Large deviation probabilities for some dependent processes. (*J. Multivariate Analysis*).
47. SIVARAM, A.: Positive definite distributions on  $K/G/K$ -11. (*J. Indian Math. Soc.*).
48. —: A note on  $L^p$  ( $\sim SL(2, R)$ ). (*Michigan Mathematical J.*).
49. —: An analogue of the Wiener-Tauberian theorem for spherical functions on semi-simple Lie groups.
50. SRIVASTAVA, S. M.: Selection theorems for  $G$ -valued multifunctions. (*Trans. Am. Math. Soc.*).
51. —: A representation theorem for  $G$ -valued multifunctions. (*Am. J. Math.*).
52. — (with Sarbadhikari, H.): Parametrizations of  $G$ -valued multifunctions. (*Trans. Am. Math. Soc.*).
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B. ANTHROPOMETRY AND HUMAN GENETICS

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3. —: Altitude and demography among the Sherpas. (*J. Biosoc. Sc.*), London.
4. —: A study on bilateral asymmetry in skinfold thickness measurements. (*Collegium Anthropologicum*).
5. MALHOTRA, K. C.: Gene dispersion in man: the Indian case. (*Current Anthropology*).
6. — (with Khosme, S. B.): Fine walk ceremony at the village Hanuman Takti in Maharashtra. (*The Eastern Anthropologist*).
7. —: Inbreeding among 22 Dhanger castes of Maharashtra. (*J. Biosoc. Sc.*), London.
8. — (with Gadgil, M. G.): Role of deities in symbolizing conflicts of dispersing human groups. (*Indian Anthropologist*).
9. —: Inbreeding and marriage distance among three tribal groups of Maharashtra. (*J. Ind. Anthropol. Society*).
10. —: Matrimonial distances among the four Dhanger castes of Maharashtra, India: differences among districts. (*Social Biology*), USA.
11. —: Inbreeding among the four Dhanger castes of Maharashtra, India: differences among districts. (*Collegium Anthropologicum*).
12. — (with Chakravarti, P. and Pal, Da): Puri pilgrim study: 1. area of origin and some socio-economic characteristics of the pilgrims. (*The Eastern Anthropologist*).
13. —: Qualitative finger dermatoglyphic variation among 21 endogamous Dhanger castes of Maharashtra.—60 years later, USA.
14. МУКЕНЯКЪ, B. N. (with Malhotra, K. C. and Kato, S. L.): Incidence of red-green colour blindness in some populations of Delhi, Maharashtra and West Bengal: examination of selection relaxation hypothesis. (*J. Biosoc. Sc.*), London.
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19. — (with Halder, Ajit): The Calcutta couples: a study of their socio-economic characteristics, family planning and abortion behaviour. (*The Calcutta Couples: A Biosocial Profile*), Eds. Pakrasi, K. B., Banerjee, A. R. and Halder, A., Calcutta.
20. — (with Nag, B. N.): On first pregnancy birth pattern with special reference to teenage mothers. (*The Calcutta Couples: A Biosocial Profile*), Eds. Pakrasi, K. B., Banerjee, A. R. and Halder, A., Calcutta.
21. — (with Ramam, M. V.): Ideal family size, sex preference for children, and contraceptive practice by women wanting no more children. (*The Calcutta Couples: A Biosocial Profile*), Eds. Pakrasi, K. B., Banerjee, A. R. and Halder, A., Calcutta.
22. SARADAMONI, K.: Pulayas in a changing society. (*Research Abstracts Quarterly*).

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2. BOSE, TAPAS KUMAR: High dietary fibre in routine Bengalee diet—a check to diabetes mellitus. (*Indian J. Nutrition Dietics*).
3. CHAKRABARTI, S. R.: On some tests in MANCOVA model with different dispersion matrices. (*J. Multivariate Analysis*).
4. CHAKRAVARTI, S. R. (with Giri, N. P.): Locally minimax test of equality of two dispersion matrices. (*Sankhyā*).
5. — (1978): On some tests in MANOVA model with structured covariance matrices. (*Calcutta Statistical Association Bull.*).
6. — (with Giri, N. P.): On asymptotically minimax test of MANOVA. (*Sankhyā*).
7. — (with Maiti, S. S.): On some tests in two-way classified mixed effects model with unbalanced data. (*Calcutta Statistical Association Bull.*).
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13. DE, N. (with Bandyopadhyay, S., Srimani, P. K. and Sengupta, A.): A new method to test system diagnosability. (*Information Processing Letters*).
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15. —: On robustness of designs against incomplete data. (*Sankhyā*).
16. GHOSH, S.: On main effects plus one plans for  $2^m$  factorials. (*Annals of Statistics*).
17. GHOSH, S.: On some new search designs for  $2^m$  factorial experiments. (*J. Statistical Planning and Inference*).
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19. —: A robustness property of BIBD. (*J. Statistical, Planning and Inference*).
20. GOOL, A. M.: Seasonality in Indian birth registration data.
21. MUKHOPADHYAY, AMB: Construction of some series of orthogonal arrays. (*Sankhyā*).
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1. PAL, P. R.: Antibacterial activity of *Cassia tora* leaf. (*Indian J. Microbiology*).
2. BHATTACHARYA, S. K.: Intestinal parasitic infestation in two populations inhabiting contrasting habitats. (*Indian J. Public Health*).

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2. DAS, T. (with Ghosal, D. N.): Investigation into the nature of soil organic matter present in five different soils of West Bengal. (*J. Indian Agricultural Society*).

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2. GHOSH, M. (1978): Ontogenetic study of stomata and trichomes in some palms. (*Phytomorphology*).
3. GHOSH, S. S. (1978): Coconut : An ideal selection for Orissa coast plantation. (*Indian Coconut Journal*).

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2. SARKAR, B. N.: Recall bias and estimation of birth rates. (*Sankhyā*).

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2. — (with Das, J. and Majumder, D. Dutta): Some studies on minimisation of intersymbol interference by coding technique. (*Indian Pure and Applied Physics, Delhi*).
3. CHAUDHURI, B. B.: Wave propagation through weakly anisotropic rectangular optical guides. (*IEEE Students Journal*).
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5. — (with Chaudhuri, F. B.): Dual mark synchronization for PCM/TDMA system, CSIR, Delhi.
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2. —: Biology of alimentation in the larva of *Chaoborus crystallinus* De Geer (*Diptera: Culicidae*) and its significance. (*Proc. Zoological Society*), Calcutta.

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1. CHATTERJEE, S.: A new lepidosaurian reptile from the Late Triassic Maleri Formation of India. (*Philosophical Transactions of the Royal Society of London*).
2. —: The evolution of rhynchosaurs. (*Ecosystemes continentaux due Mesozoique*), Ed. P. Taquet, CNRS, France.
3. JAIN, S. L.: Freshwater Xenacanthid (= pleuracanth) shark fossils from the Upper Triassic Maleri Formation, India, and comments on palaeo-economy of Maleri fauna. (*Geological Society of India*).

#### L. LEAF PROTEIN

1. CHAKRAVARTY, S. (with Maiti, S. and Chanda, A. L.): Isolation of a lipase producing streptomycete from Indian soil. (*Indian J. Micro.*).

#### M. LINGUISTIC RESEARCH

1. BHATTACHARYA, N. (with Samiljka, Vasic and Vladislava, Knaflic): The effect of hearing loss on scholastic performance: an experimental study. (Professor Djordje Kostic's 70th Birth Day Volume). Institute for Experimental Phonetics and Speech Pathology, Belgrade.

#### N. PHYSICS

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O. PHYSICS OF FLUIDS

1. GHOSH, K. M. : On the pressure fluctuations associated with a general type of turbulence. (*Applied Scientific Research*).
2. — : On the final period decay process of reactant concentration field in turbulent mixing with a first order reaction. (*Acta Mechanica*).

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1. BHAT, L. S. (with Deshpande) : Urbanisation in India. (*Geographia Polonica*), Warsaw.
2. — : Development strategy for drought prone areas. (*Proc. Symposium on Drought Prone Areas, Sri Venkateswara University*), Tirupati.
3. CHAKRABARTI, S. K. : Keynes's theory of interest in the general theory : an exposition and review of some well-known criticism. (*Quarterly J. Economics*).
4. — : Review of 'interest and financing of corporate sector' Kriahnamurty, K. and Sastry, D. U. (*Sankhyā*).
5. CHETTY, V. K. (with Dasgupta, D.) : Equilibria for polyhedral and strictly convex sets. (*International Economic Review*).
6. — : Efficiency of temporary equilibria. (*Mathematical Economics*).
7. COONDOO, D. (with Mukherjee, R. and Rao, D. S. P.) : Inter-occupation differences in the pattern of monetized and non-monetized consumer expenditure in rural India. (*Review of Income and Wealth*).
8. JAIN, L. R. : On method of demand projections. (*Sankhyā*).
9. — : On specification of pattern of income redistribution in a demand projection exercise. (*Economic and Political Weekly*).
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11. PAL, M. N. (with De, R. N.) : On an identification of contributory factors to spatial dynamism in agricultural growth in India. (*Sankhyā*).
12. — : An index of agricultural labour pressure on cropped land and production for classification of Indian districts. (*Indian J. of Regional Science*).
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14. — : Some problems of sampling from a J-shaped distribution. (*Sankhyā*).

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2. —: A review of the age distribution of the Indian population. (*Asian Studies*).

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1. CHATTERJEE, S. (with Mukherjee, Manjula): Effect of certain environmental conditions upon neuroticism among delinquent and non-delinquent boys. (*Psychological Studies*).
2. —: (with Mukherjee, Manjula): Application of multivariate analysis to differentiate several groups and the basis of interest. (*Psychological Research*).

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1. BISWAS, S. K.: Comments on 'Systems Theory in Anthropology' by Rodin, Mirian, Michelson Haran and Gerlad M. Britan. (*Current Anthropology*), USA.
2. —: Resources utilisation and social planning. (*Economic and Political Weekly*), Bombay.
3. CHAKRABORTY, P.: Social structure of a pilgrim town, Tarakeswar (West Bengal): an exploratory study. (*Social Research*), Ranchi.
4. —: Puri pilgrim study: area of origin and some socio-economic characteristic of the studies. (*Bull. Cultural Research Institute*) (Government of West Bengal), Calcutta.
5. —: An ethnographic note on *The Kaluar* (Vincakosh), vol. 6, Calcutta (in Bengali).
6. CHATTOPADHYAY, K.: Policeas and researchers: Need for coordination. (*Eastern Anthropologist*), Lucknow.
7. CHATTOPADHYAY, M.: Agricultural labourers of Birbhim. (*Indian Agricultural Economics*), Bombay.
8. —: Who are the rural poor? (in Bengali). (*Paschim Banga*), Government of West Bengal.
9. —: Agrarian structure of Birbhum. (*Indian Anthropological Society*), Calcutta.
10. GHOSH, T. N.: Law and social institution: some observation on influence of marriage legislation in West Bengal. (*Indian Social Research*), Meerut.
11. —: Impact of Special Marriage Act, 1965—an experience from Calcutta. (*Law Quarterly*), Indian Law Institute, West Bengal, Unit, Calcutta,

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3. — : Optimal flow-shop scheduling with earliness and tardiness penalties. (*Operarch*).
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9. CHAKRAVARTY, S. C. (with Gupta, A.) : Performance raising—a means for improving productivity. (*Lok Udyog*).
10. JAISWAL, N. K. (with Kumar, Ashok) : Behaviour of two dissimilar unit imperfect stand-by system with connect switching and priority repair. (*Zamm-88*).
11. — (with Kumar, Ashok) : Stochastic behaviour of some repairable computer systems. (*Engineering Production*).
12. MOHAN, S. R. : Degenerate complementarity cones induced by a Komatrix. (*Mathematical Programming*).
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14. — : Statistical aids in QC-Normal probability paper. (*Quality*) (BHEL News letter).
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17. — : Statistical aids in QC-OC curve, AQL, LTPD, AOQL, ASN, ATI. (*Quality*) (BHEL News letter).
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U. THEORETICAL PHYSICS

1. BANDYOPADHYAY, P. (with Roychoudhury, R. K., Bhattacharyya, S. and Bhattacharyya, D. P.): Lepton-hadron relation and the inclusive distribution of secondary pions, kaons, protons and antiprotons in  $pp$  scattering at high energies. (*Nuovo Cimento*), A.
2. PRASAD, Y. S.: Diffusion of charged particles. (*J. Physics*).
3. ROY, SIBU: Relativistic Brownian motion and the space-time approach to Quantum Mechanics. (*J. Mathematical Physics*), (U.S.A.).
4. —: Relativistic Brownian motion and the foundation of quantum mechanics, (*Nuovo Cimento*), B.
5. ROYCHOUDBURY, R. K. (with Bhattacharyya, D. P.): Relation between primary proton energy and the produced pion energy in  $pp$  in elastic scattering. (*Canadian J. Phys.*, 1979).
6. —: Generalised fourier series and non linear oscillator. (*Indian J. Pure and Applied Mathematics*).
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8. — (with Amrein, W. O. and Pearson, D. B.): Integral bounds on a body scattering cross section. (*Nuovo Cimento*).

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A. THEORETICAL STATISTICS AND MATHEMATICS

1. DAS, A. K. (with Tripathi, T. P.): Use of ancillary information in estimating the coefficient of variation of finite population. The Punjab Agricultural University, Ludhiana, 21 December 1978.
2. GHOSH, J. K. (with Chandra, T.): Valid asymptotic expansions for the likelihood ratio statistic and other perturbed  $T$  variables, Seminar on Probability and Statistical Inference, University of Pune, 12-14 March 1979.
3. MITRA, S. K. (with Majumdar, Dibyen): Statistical analysis of non-estimable functions. Sixth International Conference on Mathematical Statistics, Wlask, Poland 7-13, December 1978.
4. —: Least squares under quadratic constraints. International Conference on Optimization in Statistics, Bombay, 22-24 December 1978.
5. RAO, B. L. S. PRAKASA: Inference for Di Fusion processes. Seminar on Probability and Statistical Inference, University of Pune, March 12-14, 1979.
6. RAO, S. B. (with Naik, R. K., Shrikhande, S. S. and Singhi, N. M.): Intersection graphs of  $K$ -uniform linear hypergraph sp. Combinatorial Mathematics Conference, Colorado State University, Fort Collins, U.S.A., 5-10 June 1978. (*Proc. Symposium*).

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1. BASU, A. (with Gupta, R.): A demographic study of Mirpur: a village in coastal Midnapore district, West Bengal. 10th Int. Cong. Anthrop. Ethnol. Sc., New Delhi, 10-16 December 1978.
2. — : (with Gupta, R. and Bhattacharyya, S. K.): Impact of altitude on human population: an alternative approach in the context of eastern Himalayan situation. Seminar on Ecology of the Eastern Himalayas, North Bengal University, December, 1978.
3. BHARATI, P. (with Ghosh, A. K., Dey, B., Das, S. K., Roy, M., Banerjee, S. and Gupta, R.): Comparative study of red cell enzymes in Mirpur (a Portuguese-descendant community) and some neighbouring populations. 10th Int. Cong. Anthrop. Ethnol. Sc., New Delhi, 10-16 December 1978.
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11. — : Matrimonial distance among the four Dhargar castes of Maharashtra, India: differences among districts. 10th Int. Cong. Anthrop. Ethnol. Sc., Delhi, 10-16 December 1978.
12. — (with Chakraborty, R. and Bhanu, B. V.): Distribution and inter-population differences of TFR, ATFR and FPI among 9 endogamous groups of Maharashtra, India, 10th Int. Cong. Anthrop. Ethnol. Sc., Delhi, 10-16 December, 1978.

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13. MALHOTRA, K. C. (with Chakraborty, R., Bhanu, B. V. and Kazi, R. B.): The correlation between ridge-counts on different fingers, and the relationship between TFRC, ATFCR and FPLI: Indian data.
14. —: Adaptation among the nomads. Symposium on Man and Environment, Delhi, 10-16 December, 1978.
15. —: Hindu social structure, its biological implication. Int. Sym. on Population Structure and Human Variation, Bombay, December 19-21, 1978.
16. —: Inbreeding among four Dhanger castes of Maharashtra, India: Differences among districts. 5th Annual Conference, Indian Society of Human Genetics, Bombay, 22-24 December 1978.
17. — (with Thambidoria, K. and Mutkar, R. K.): Health care among the Nandivallas of Maharashtra. Symposium on Medical Anthropology, Pune, December 19-21, 1978.
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1. BANDYOPADHYAY, S. (with Sengupta, A. and Mukhopadhyay, M.): Design of a language for creating data bases for surveys and census. Seminar on Impact of Computers on Statistical Systems in India, CSO, Delhi, October, 1978.
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G. PHYSICS

1. GUPTA, A. B. (with Ghosh, K. G. and Haldar, B.): Studies on the tensile properties of human scalp hair.
2. —: Studies on the tensile properties of human gall bladder. P & E/Phys/2/78, 6.

H. PHYSICS OF FLUIDS

1. MOKID, A. (with Mazumder, H. P.): On reactant concentration field in turbulent mixing with a first order reaction. P and E/E/6-79.

I. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BANERJEE, BIDYUT (with Chakrabarti, S. K.): Estimation of quarterly agricultural income in India. ERU/11/78, 16.3.79.
2. BOSE, D. K.: Economics of nuclear power in India. ERU/8/78, 27.12.78.
3. CHAKRAVARTI, A. K.: Social, economic and demographic implications of rural urban migration and labour force participation behaviour. January 1979.
4. —: Functional classification of imports: development planning framework in India reviewed. March 1979.
5. CHAKRAVARTI, S. K.: Keynes' theory of investment in the general theory: an exposition and review of some criticism. ERU/4/78, 8.9.78.
6. —: Some neglected elements in Keynes' theory of investment. ERU/5/78, 11.9.78.
7. CHAKRABARTY, SATYARANJAN (with Pal, Monoranjan): Some results on social welfare functions. ERU/6/78, 18.10.78.
8. COONDOO, D. (with Sarkar, N.): Regression analysis with heteroscedastic disturbances. ERU/9/78, 3.1.79.
9. DASGUPTA, D.: The Hawkins-Simon conditions and input-output analysis. ERU/10/78, 20.2.79.
10. DESAI, ASHOK. V.: Mon, beasets and fossil. ERU/1/78, 24.7.78.
11. —: Coal resources and consumption: implication for medium term development. ERU/2/78, 4.9.78.
12. GUPTA, S. K.: A course on projective modules.
13. JAIN, L. R.: Effect of household size on household expenditure pattern—an application of indirect addilog model. No. 7815, July 1978.
14. —: On specification of the pattern of income redistribution in a demand project, No. 7721, July 1978.



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15. MAITI, P.: Some exercise on monetary and price implications of sixth plan draft. ERU/7/78, 7.12.78.
16. PAL, MONOGRAMJAN (with Chakraborty, Satyranjan): Some results on measurement of inequality. ERU/3/78, 4.8.78.
17. PARIKH, K. S. (with Narayana, N. S. S.): Estimates of farm supply response and acreage allocation, No. 7902, January 1978.
18. — (with Parikh, Jyoti): Simulation of macro-economic scenarios for assessing energy demands for India—SIMA, September 1978.
19. ROY, BINA: Trends in the distributions of wages and salaries income between different categories of occupations in Central Government Services in India, NIRU/1/78, 31 July 1978.
20. — (with Paul, G.): A comparative study in real income generated in the agricultural sector of different states in India: 1954-55 to 1975-76, NIRU/2/78, 15 September 1978.
21. — (with Haider, A. K.): Variations in the degree of monetization among different states in India by levels of living, NIRU/4/78, 12 December 1978.
22. RUDRA, ASHOK (with Paul, Gobinda): Green revolution in the states: a statistical examination, NIRU/3/78, 30 November 1978.
23. SALUJA, M. R.: Component wise capital output ratios in the Indian economy, No. 7817, October, 1978.
24. SARADAMONI, K.: Changing land relations and women: a case study of Palghat district in Kerala.

### J. PRE-CENSUS POPULATION STUDIES

1. BISWAS, KULADA (with Sengupta, Saitesh): Palli-Parikahan, Ballavpur, Second Phase (in Bengali), iv, 61, map, illustrations.

### K. SEDIMENT TRANSPORTATION STUDIES

1. GHOSH, J. K. (with Mazumder, B. S. and Sengupta, S.) (1979): On computation of suspended load from bed material and flow parameters.

### L. SOCIOLOGY

1. BISWAS, S. K.: A note on the traces of early ethnic elements in the tribes of Arunachal Pradesh.

### M. STATISTICAL QUALITY CONTROL

1. AGUTHAN, N. R. (with Ghosh, D. T.): Heuristic rules for the  $(n/3/F/F \max)$  problem.
2. BANERJEE, K. K.: Control of substance in paper.
3. —: Control of wastage at finishing house of a paper mill.

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4. JAISWAL, N. K. (with Krishna, J. V.): Analysis of two dissimilar units standby redundant system with administrative delay in repair.
5. KARMESHU (with Jaiswal, N. K.): A non-linear stochastic model for machine interference problem.
6. MAJUMDER, A. (with Paul, N.): Standardisation of micro-biological assay of tetracycline and oxytetracycline.
7. MAJUMDER, S. K.: Developing quality system at fottling shop.
8. PANDEY, R. J.: Asymptotic properties of Bayesian three decision plan by attributes.
9. RAMAMURTHY (with Prasad, Rajendra): Some classes of flow shop problems.
10. —: Optimization of few lot sizes to cover a range of requirements—theoretical aspects, etc.
11. SESOUPTA, S. (with Banerjee, K. K.): Studies at Kamyr register.
12. S.Q.C. UNIT, PUNE: Scope for application of quantitative techniques in the area of quality and reliability of reconditioned engines at central workshop of M.S.R.T.C., Pune.
13. —: Studies undertaken by SQC & OR Unit, Pune (March-May 1978) at Messrs. R. B. M. Poona Mills Ltd.
14. —: Scope for application of SQC & OR techniques at Messrs. Bajaj Tempo Ltd.
15. —: Scope for introducing quality evaluation and development programme at Messrs. Bharat Forge Company Ltd.
16. —: SQC studies during November 1977–October 1978 at Messrs. Kirloskar Pneumatic.

N. THEORETICAL PHYSICS

1. BANDYOPADHYAY, P. (with Roychoudhury, R. K., Bhattacharyya, S. and Bhattacharyya, D. P.) (1978): Lepton-Hadron relation and a new KNO type scaling, *Nuovo Cimento A*, 1 November.
2. — (with Das, A. and Patari, K.) (1978): Lepton-Hadron relation and the nucleon-nucleon potential, *Nuovo Cimento A*, 1 December.
3. — (with Sen, K.) (1978): Disintegration of deuteron by neutrino-deuteron scattering and few photon-neutrino weak coupling theory, *Phys. Rev. D* 18, 2262.
4. — (with Roy, S. and Das, A.) (1978): Mach's principle and the quantal response of the universe. *Letters of Nuovo Cimento*, 23, 429.
5. — (with Roy, S., Bhattacharyya, B. and Sarkar, H.) (1978): Spontaneous breakdown of and gauge symmetry and the photon-neutrino weak coupling theory, *Nuovo Cimento A* 45, 511.
6. ROYCHOUDBHAY, R. K. (with Bhattacharyya, D. P.) (1978): Secondary neutral pion nucleon flux nation at the top of the atmosphere and spectra, *Annal. Phys.*, 36.

**Part II : Convocations, Visiting Scientists, Honours, Awards, and  
Special Assignments**

**XIII. THIRTEENTH CONVOCAATION : INDIAN STATISTICAL INSTITUTE**

13.1 The Thirteenth Convocation of the Indian Statistical Institute, held on 30 March 1979, was presided over by Shri Subimal Dutt, President of the Institute. Dr. P. V. Sukhatme, Honorary Professor, Department of Biometry, Maharashtra Association for the Cultivation of Science Research Institute, Pune, delivered the Convocation Address on "Nutrition in India in Current Five-year Plans." Dr. A. Maitra, Officiating Director, Indian Statistical Institute, presented the annual review of research and training.

Seven candidates were awarded the Ph.D. degree, 27 the M.Stat. degree by examination and 18 the B.Stat. degree. In the post-graduate diploma in applied statistics, 28 candidates were awarded diplomas in Statistical Quality Control and Operations Research, after successfully completing their training in Bombay, Calcutta, Delhi and Madras. Seventeen candidates were awarded diplomas in computer science and one candidate received the diploma in econometrics and planning.

13.2 *International Statistical Education Centre (ISEC), Calcutta*

Nineteen trainees attending the thirty-second term, International Statistical Education Centre, were awarded certificates at the Thirteenth Convocation. The trainees came from 12 countries in South East Asia, Africa, Japan, Korea, Fiji Islands and the West Indies.

**XIV. VISITING SCIENTISTS**

A number of distinguished foreign scientists 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 work, while others came for short periods and gave lectures and seminars. Most of them were available for consultations by research workers and teachers of the Institute.

I. The following scientists visited the Institute on invitation and worked for fairly long periods during the year.

DR. MALKHAZ G. ABDUSHELISHVILI, Director, Department of Archaeology and Ethnography, Academy of Sciences, Georgian SSR, and Professor, Tbilisi State University, came with a team of three Soviet scientific workers from the USSR Academy of Sciences, on a joint anthropological research project started at the end of 1974 (9 December 1978-6 March 1979). The other members of the team were :

(i) PROFESSOR S. ARUTUNOV D. SRGOBEV, Deputy Director, South-Asia Programme, Institute of Ethnography.

(ii) DR. (Mrs.) IRINA MIKHAILOVNA SEMASHKO, Institute of Ethnography.

(iii) DR. V. A. ALEXEEV, Physical Anthropologist, Institute of Ethnography.

During the year, they carried out anthropometric survey of 11 endogamous populations of north-west India in collaboration with I.S.I. scientists.

MR. IKUO BABA, International Expert on Quality Control, Japan, (April 1978-May 1978), Lectures: Orthogonal array experimentation in industry. He also delivered some special lectures highlighting areas of application of OA designs under the auspices of the Indian Statistical Institute and the Indian Association for Quality and Reliability, Bangalore.

DR. RABI BHATTACHARYYA, University of Arizona, USA (1 November 1978-28 February 1979) taught a course on non-parametric methods and sequential analysis to M.Stat. students in Delhi. Seminars: (i) Recurrence of diffusion in the exterior Dirichlet problem for a second order elliptic operations, (ii) Donaker-Varadhan large deviation theory of Markov processes, (iii) Statistical theory of solute transport in porous media (Calcutta & Delhi).

DR. S. K. CHANDA, Reader, Department of Geological Sciences, Jadavpur University, participated in the field programme, for 1978-79 on invitation from the I.S.I., Dr. Chanda visited the Godavari valley. (23 December 1978-7 January 1979). Some problems relating to the deposition of arkosic sediments in the near-shore environments, development of tidal channel deposits and recognition of sub-environments of the tidal flat complex were jointly investigated during the field work.

DR. HILMAR DRYGAS, University of Kassel, Federal Republic of Germany (March 1978-April 1978) attended the All-India Seminar on Non-parameter Statistics and Inference under Order Alternatives, New Delhi, 10-14 April 1979. He visited Bangalore, Calcutta, Delhi, Hyderabad and Madras. Lectures: (i) Linear models in co-ordinate free form, (ii) Sufficiency and completeness in general linear model, (iii) Some topics in linear models.

PROFESSOR DJORDJE KOSTIC, Director, Institute for Experimental Phonetics and Speech Pathology, Belgrade, Yugoslavia (15 December 1978-10 April 1978) came on his eleventh consecutive visit in connection with the programme of fundamental linguistic research being conducted in collaboration between the Institute for Experimental Phonetics and Speech Pathology and the Indian Statistical Institute. His visits were arranged under the Indo-Yugoslav Cultural Exchange Programme. During the ten years of his association with the Indian Statistical Institute, Professor Kostic has studied the phonetic structure of major Indian languages in collaboration with Indian linguists. On the basis of his research work, the Indian Statistical Institute has published three books on the phonetics of Bengali, Hindi and Telugu, as well as several technical papers and tests for the evaluation of speech sounds.

During the year, Professor Kostic was in Calcutta, Hyderabad and New Delhi in connexion with his research work.

In Hyderabad, he conducted a workshop (19 January 1979-2 February 1979) at the Speech Pathology Research Laboratory, Osmania University, on the following topics: (i) Classification of hearing-impaired children in five groups and basic characteristics of each group, (ii) Selective Auditory Filter Amplification: its utilisation in diagnosis and treatment of certain groups of hearing loss, (iii) Phonetic Audiometry: its relevance to speech habilitation, (iv) Classification of Telugu speech sounds according to function of speech organs.

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He had discussions at the Department of Linguistics, Osmania University, on further expansion of the programme of speech habilitation of hearing-impaired children and on the tripartite programme of collaboration between the Institute for Experimental Phonetics and Speech Pathology, Indian Statistical Institute and the Osmania University.

In Calcutta, he conducted a Workshop for Speech Habilitators (February 1978), on the following topics: (i) Basic principles of speech habilitation of small, hearing-impaired children, (ii) Evaluation of articulation of speech sounds. He also had discussions with the I.S.I. scientists on the processing of linguistic data and the preparation of special I.Q. tests for hearing-impaired children. In New Delhi, he had discussions at the Department of Linguistics, Delhi University, on collaboration in research on Hindi phonetics and at the National Council of Educational Research and Training, on the preparation of a methodology for speech habilitation of hearing-impaired children with Hindi as their mother tongue. *Lectures (Delhi Centre)*: Language and language culture.

DR. PARTHA N. MUKHERJEE, Associate Professor, Centre for Study of Social Systems, Jawaharlal Nehru University, New Delhi, worked in the Sociological Research Unit (April-June 1978). *Lecture*: Nazalbari movement and the present revolt in North Bengal.

PROFESSOR PAVAMAN MURTHY, University of Chicago, USA, joined as Visiting Professor at the Delhi Centre for one year from 8 July 1978. *Lectures*: (i) Setro problem and complete intersections; (ii) A basic course in Algebra.

DR. R. FRYKUS, Institute of Mathematics and Mechanics, Academy of Sciences, German Democratic Republic (13 November 1978-14 April 1979) came to the Delhi Centre under the Indo-G.D.R. Cultural Exchange Programme. He visited Calcutta, Bangalore and Madras and attended the All-India Seminar on Non-parametric Statistics and Inference under Order Alternatives, New Delhi, 10-14 April 1979. He chaired a session. *Lectures*: (i) Isotomic regression, (ii) Estimation and testing of linear hypothesis, (iii) Likelihood ratio tests, (iv) Conditional expectation given a 6-lattice, (v) Analysis of variance under order restrictions, (vi) Goodness of fit tests based on a measure of divergency between scalar products, (vii) Divergency in scalar products and its use in statistical testing, and (viii) Goodness of fit tests based on a measure of divergency between scalar products (Bangalore, Calcutta and Delhi).

DR. BALRAM RAJPUT, University of Tennessee, U.S.A. (22 August 1978-30 July 1979). *Lectures*: (i)  $R$ -seminstable laws on LCTVS, (ii) A short survey on results around fundamental theorem of statistics, (iii) A necessary and sufficient condition for the measurability of stochastic processes, (iv) Infinitely divisible and related laws of LCTVS, (v) Seminorm integrability, 0-1 dichotomy and support theorems for semistable laws on LCTVS, (vi) 0-1 laws, semi-norm integrability and support theorems for semi-stable laws of linear spaces. (Agra, Bangalore, Calcutta, Delhi and Madras).

PROFESSOR L. S. SHAPLEY, The Cowles Commission, Yale University; and Rand Corporation, U.S.A. (December 1978-January 1979) came to the Delhi Centre under the Ford Foundation Grant for senior scientists (economists). *Lectures*: (i) Game theory, (ii) Strategic market games; (iii) Values of games without side payments; (iv) Sequential games; (v) Game theory and economic problems involving game theory (Bangalore, Calcutta and Delhi).

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PROFESSOR MARTIN SHUBIK, Yale University, USA (December 1978-January 1979) came to the Delhi Centre under the Ford Foundation Grant for senior scientists (economists). *Lectures*: (i) Game theory. (ii) Modelling methods for game theory, applied to economics, (iii) Oligopoly theory and theory of games—Part I, (iv) Co-operative game theory as applied to economics, (v) Strategic market games, (vi) Political games, (vii) Allocation of costs using methods of game theory (Bangalore, Calcutta and Delhi).

DR. T. P. SPEED, University of Western Australia, Perth (18 November 1978-7 February 1979) came as Visiting Professor at the International Statistical Education Centre, Calcutta, for its Thirty-second Term. *Lectures*: (i) Interactions, (ii) The GENSTAT approach to the analysis of designed experiments, (iii) Negligible probabilities of nuclear reactor accidents: use and misuse of statistics.

II. The following are some of the scientists who paid short visits, gave lectures and/or seminars, and participated in conferences.

DR. V. AFREMOV, International Export, ESCAP Regional Centre for Technology Transfer, visited DRTC, Bangalore (2 March 1979). *Lecture*: Latest developments in information systems and services in USSR.

PROFESSOR K. B. ATREVEYA, Institute of Science, Bangalore (25 January 1978). *Lecture*: Renewal theory marker process approach.

PROFESSOR ARUNABHA BAOCHI, Department of Applied Mathematics, Twente University of Technology, Netherlands (December 1978-January 1979). *Lectures*: (i) Filtering and control problems in stochastic systems, and (ii) Linear stochastic differential games.

PROFESSOR P. K. BANERJEE, New Brunswick, USA (7 August 1978-22 October 1978). *Lecture*: Some problems in optimal stopping.

DR. I. V. BASAWA, La Trobe University, Australia; Cornell University, U.S.A. (17-23 December 1978). *Lecture*: Inference in stochastic processes.

PROFESSOR A. L. BASHAM, Department of Asian Studies, Australian National University, Canberra (19 January 1979). *Lecture*: The civilization of monsoon Asia.

PROFESSOR D. BASU, Florida State University, U.S.A. (20 July 1978-26 August 1978). *Lectures*: (i) Partial sufficiency, (ii) Some controversial issues in statistics.

PROFESSOR KAUSHIK BASU, University of Reading, England (13 July 1978). *Lecture*: Optimal policy for a dual economy.

PROFESSOR P. K. BHATTACHARYA, University of Arizona (22 September 1978-3 January 1979). *Lectures*: (i) Diffusion approximation of the posterior distribution of a dirichlet process from quantal response data, (ii) Asymptotic inference about the change point in the distribution of independent random variables.

SHRI S. K. BHATTACHARYYA, Indian Institute of Science, Bangalore, visited DRTC, Bangalore (December 1978 and January-March 1979). *Lectures*: Quantification in information science.

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PROFESSOR CHARLES P. BODRNE, Senior Staff Scientist, Lockheed Missiles Corporation, Palo Alto, California, U.S.A. visited the DRTC, Bangalore (2-15 December 1978). *Lectures*: Computer-based information system prevalent in the USA, such as dialogue, chemical abstract services and RECON.

PROFESSOR ANTHONY B. BUBENIK, Research Scientist, Wild Life Section, Fish and Wild Life Research Branch, Ministry of National Resources, Canada; Foundation for Environmental Studies, Oxford; accompanied by Mrs. Bubenik (5-11 November 1978). *Lectures*: (i) Evolution of horns and antlers, (ii) The impact of social structure on physical, physiological and behavioural maturation.

PROFESSOR TERENCE J. BYRES, Department of Economic and Political Studies, School of Oriental and African Studies, University of London, U.K. (29 November 1978-2 January 1979) was invited to examine the work of the Pre-Census Population Studies Unit. *Lecture*: Myth of urbanism.

SRI ARAVINDA CHAKRABORTY, Centre for Demographic and Population Genetics, University of Texas, Houston, USA (6 December 1978). *Lecture*: Pre-natal diagnosis of genetic diseases.

SM BANDANA CHAKRABORTY, Department of Biophysical Sciences, University of Texas, Houston, U.S.A. (7 December 1978). *Lecture*: Development of a method for synchronization of mammalian cells.

DR. RAJAJIT CHAKRABORTI, Centre for Demographic and Population Genetics, Houston, USA (27 November 1978-6 December 1978). *Lectures*: (i) Genetic analysis of age-of-onset distributions of familial diseases; (ii) Evolutionary dynamics of quantitative traits with high genetic determinations; (iii) Statistical analysis of genetic variations in natural populations: problems of hypothesis testing (Part I); (iv) Statistical analysis of genetic variations in natural populations: problems of hypothesis testing (Part II); (v) Geneological aspects of population genetic research: some suggestions to do computerized record linkage; (vi) Medico-legal aspects of population genetic research: non-paternity and child exchange detections; (vii) Identification of alleles by electrophoresis and detection of hidden variability; (viii) Demographic genetics: effective population size and drift effects.

DR. B. P. CROWDHURY, Department of Psychology, University College of Cardiff, U.K. (9 June 1978). *Lecture*: Visual systems as a communication medium.

SRI A. K. DAS GUPTA, Librarian, Administrative Staff College of India, visited DRTC, Bangalore (3 November 1978). *Lecture*: Library services to managers.

DR. P. DASGUPTA, Director, Software Group of Operations Research Group, Baroda (11 September 1978). *Lecture*: Computer activity at ORG.

DR. PRADEEP DUBEY, Yale University, U.S.A. (June-July 1978; 1 December 1978-13 January 1979). *Seminar*: (i) An exchange economy viewed as a non-cooperative game, (ii) Value theory without efficiency for non-atomic games (Delhi and Calcutta).

PROFESSOR X. FERNIQUE, Department of Mathematics, Université de Strasbourg, France (9 August 1978-23 October 1978). *Lectures*: (i) Gaussian laws and stable laws in measurable vector spaces and sample path properties of some stationary and non-stationary

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random functions, (ii) Lower bounds for Gaussian random functions, (iii) Sums of independent random variables in separable Banach spaces: convergence of series and limit theorems (Calcutta and Bangalore).

PROFESSOR D. J. FOSKETT, Director, Central Library Services and Goldsmiths' Librarian, University of London, U.K. (7-18 January 1979). *Lectures*: (i) History of Classification Research Group, London; (ii) Theory of integrative levels, (iii) Classification in education, and (iv) New development in classification.

DR. S. P. GHOSH, IBM Laboratory, San Jose, USA (15 September 1978). *Lecture*: Recent advances in data bases.

PROFESSOR N. C. GIRI, Department of Mathematics and Statistics, University of Montreal, Canada (29 June 1978). *Lecture*: Multivariate statistical inference.

PROFESSOR MADHAV GADGIL, Ph.D. (Harvard), Centre for Theoretical Studies, Indian Institute of Science, Bangalore (30 October 1978-3 November 1978) had discussions with ISI anthropologists and worked on data collected in a collaborative study on Dhangars. *Lecture*: Gawhi Dhangars of Sahyadris: a study of human ecology.

DR. A. K. HALDER, Salford University, U.K. (20 January 1979). *Lecture*: A unified method for solving combinatorial logic problems with demonstration of the PET-micro-computer.

PROFESSOR B. M. JHRI, Department of Botany, University of Delhi, Delhi (16-17 August 1978). *Lectures*: (i) Test tube plants, (ii) Botanical gardens and some famous plants.

PROFESSOR L. KAUFMAN, University of Brussels, Belgium (1 May 1978). *Lecture*: (i) An algorithm for the quadratic assignment problem using Benders decomposition (Delhi).

MR. E. E. KAUNGMONO, Director, Tanzania Library Services, who was invited to India by the Indian Council for Cultural Relations, visited DRTC Bangalore (12 March 1978). *Lecture*: Library services in Tanzania.

PROFESSOR RAJ KRISHNA, Member, Planning Commission, New Delhi (1 July 1978). *Lecture*: Priorities and methodology of the new plan.

PROFESSOR J. GIL DE LAMADRID, University of Minnesota, USA (1 March 1979-29 April 1979). *Lectures*: (i) Some topics in abelian harmonic analysis, (ii) The abstract moments problems.

PROFESSOR P. B. MANGLA, Hcnd, Department of Library Science, Delhi University, visited the DRTC, Bangalore (24 October 1978). *Lecture*: Library education in India.

SRI S. K. MUKHERJEE, Personnel Officer, International Crops Research Institute for Semi-arid Tropics (ICRISAT), Hyderabad, visited DRTC, Bangalore (14 September 1978). *Lecture*: Personnel Management.

PROFESSOR MAKIYO NISHI, Kobe University, Japan (11 September 1978-9 November 1978). *Lecture*: Optimal control theory (Bangalore).



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DR. HANS-UWE OTTO, Department of Social Problems and Social Work, University of Education Science, Bielefeld, Federal Republic of Germany, worked in the Sociological Research Unit (18 August 1978-1 September 1978). *Lecture*: Qualification and socialisation of young apprentices—remarks on the current discussion in the context of youth unemployment in West Germany.

DR. (MRS.) RENATE OTTO-WALTER, Faculty of Sociology, University of Bielefeld, Federal Republic of Germany, worked in the Sociological Research Unit (18 August 1978-1 September 1978). *Lecture*: Limits to growth and theories of social change.

PROFESSOR LUIGI PASINETTI, Department of Economics, Catholic University of Milan, Italy; Fellow, Nuffield College, Cambridge University (19 February 1979-14 March 1979). *Lectures*: Value distribution and growth.

SHRI S. S. RANGAOKAR, Senior Editor and Faculty Member, SENDOC, SIET Institute, Hyderabad, visited the DRTC Bangalore (2 November 1978). *Lecture*: SENDOC services.

PROFESSOR P. V. SUKHMATK, Department of Biometry, Maharashtra Association for the Cultivation of Science, Pune (24 May 1978). *Lecture*: Dimensions of hunger and poverty.

DR. D. SURYANARAYANA, Andhra University, Waltair (17 May 1978). *Lecture*: Asymptotic results on some divisor functions.

PROFESSOR I. VINCZE, Mathematical Institute, Hungarian Academy of Sciences (2-4 December 1978) came to the Delhi Centre under the Indo-Hungarian Cultural Exchange Programme. *Lecture*: On a test statistic similar to Pearson's chi-square.

PROFESSOR GROBOE WALD, Nobel Laureate (18 January 1979). *Lecture*: Survival in the nuclear age.

PROFESSOR IMMANUEL WALLERSTEIN, Distinguished Professor of Sociology, State University of New York, USA (19 January 1979). *Lecture*: The capitalist world economy.

PROFESSOR M. T. WASAY, Queen's University, Ontario, Canada (August 1978). *Lecture*: Properties of the first passage times of Brownian motion (Delhi).

DR. D. ZELINSKY, North-Western University, Chicago, USA (5-10 December 1978) came to the Delhi Centre. *Lecture*: Coherence makes long exact sequences.

PROFESSOR A. ZELNER, University of Chicago, USA (14-15 July 1978). *Lecture*: Statistical analysis of econometric models.

DR. F. ZITK, Institute of Mathematics, Czechoslovak Academy of Sciences, Prague (10 January 1979). *Lecture*: Some special queue disciplines in queuing theory.

III. The following are some of the visitors who came to the Institute for short periods on different assignments.

DR. M. R. BHAWAN, Institute of Economic Studies, Stockholm, Sweden, worked for sometime during the year in the Economic Research Unit on problems related to industrialisation in India.

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Dr. R. P. BHARGAVA, Ontario Institute for Studies in Education, Ontario, Canada (29 August 1978-24 March 1979).

PROFESSOR POPOV BLADOJEV, Dean, Faculty of Mathematics, University of Skopje; Secretary, Academy of Sciences and Arts, Socialist Republic of Macedonia, Yugoslavia (11 January 1979).

Mrs. S. L. CHENNAFFA, Librarian, Institute for Research in Reproduction, Bombay (15-31 July 1978) did experimental work on the design of a classification and indexing system for reprints collection of her library at the DRTC, Bangalore.

Hon. Excellency Dr. (Mrs.) HESTHA FIRNBERG, leader of a seven-member Austrian delegation on Science and Technology, visited the Delhi Centre on 12 January 1979, and had discussion on research activities. Shri P. N. Haksar, Chairman, I.S.I., was present.

Miss HERMINIATI, Head, Library and Information Services, Indonesian Institute of Sciences, Jakarta, visited DRTC, Bangalore, on 15 February 1979 and acquainted herself with the teaching and research programmes.

Miss JANTINE LICOIS, Centre Alfred Binet, Paris, (30 October 1978-4 November 1979).

Mr. MAURICE B. LINE, Director-General, British Library Lending Division and Mr. SIDNEY SMITH, Director-in-Charge, Overseas Division, British Library Lending Division, visited the DRTC, Bangalore, (24 October 1978). They had a brief discussion on the British Library Lending Division.

PROFESSOR ROGER LIVIEN, Director, International Institute for Applied System Analysis, Luxemburg, Austria, (15-18 January 1978).

Dr. PO NODDOV, Head, Department of Food Technology, University of Ife, Ile-Ife, Nigeria, and Dr. O. A. KOLBOSO, Director, Federal Institute of Industrial Research, Oshodi, Nigeria, visited the DRTC, Bangalore, (24 August 1978) for information on the training facilities available to foreign students.

Dr. ARNOLD NORDWIG, Max Plank Institute für Biochemie, Munich, Federal Republic of Germany, visited the DRTC (15 February 1979) for discussions on the present activities of the DRTC and its future plans and programmes.

Mr. A. OMADHOMY, Training Supervisor, Nigerian Institute for Steel Development Authority, Nigeria, (24 February 1978) held discussions in the SQC Division on prospective training for executives under the Nigerian Institute of Steel Development Authority, in the area of Statistical Quality Control and Operations Research.

Mr. MIROSLAV PROKOPEC, Institute of Hygiene and Epidemiology, Czechoslovakia (22-28 December 1978).

Dr. D. S. PRASADA RAO, University of New England, Australia, spent four months in the Economic Research Unit, as a Visiting Fellow.

Mr. M. A. SHERMAKOV, Senior Engineer, Department of Scientific and Technical Information, USSR State Committee on Science and Technology and a delegation of four other Russian scientists visited the DRTC, Bangalore, on 23 February 1979.

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DR. I. C. VARMA, Department of Pediatrics, Jawaharlal Institute of P. G. Medical Education and Research, Pondicherry (7-9 May 1978).

DELEGATION OF IRAQ ORGANISATION FOR STANDARDISATION (31 January 1979). The following three senior officers, accompanied by Dr. B. N. Singh, Indian Standards Organisation.

1. MR. MUSTAFA-AL-QASBLE, National Centre for Consulting and Management Developments.
2. MR. MOASHIN AL-LUAIBI, Directorate-General, Industrial Research and Control.
3. MR. YASSIN AL-RUBAIC, Iraqi Organisation for Standards.

### XV. HONOURS, AWARDS AND SPECIAL ASSIGNMENTS

15.1. *Honours and Awards*: Shri P. Bhattacharyya, Senior Research Fellow (*Electronics*) was admitted to the Ph.D. degree, Calcutta University, in 1978.

Dr. B. R. Bhat (*Delhi Centre*) was elected President, Statistics Section, Indian Science Congress, in January 1979.

Shri A. K. Chattopadhyay, Hydraulic Study Department, Calcutta Port Trust, who worked under the supervision of Professor A. Ghosh (*Electronics*) was admitted to the Ph.D. degree, Calcutta University in 1979.

Professor D. Dutta Majumder (*Electronics and Communication Science*) was awarded the first prize of the International Norbert Wiener Award for 1977 for his work on theoretical and historico-philosophical investigation on the need for an unified approach to cybernetics and general systems theory.

Shri S. R. Mohan (*SQC & OR*) was awarded the Ph.D. degree of I.S.I. for his thesis in Operations Research.

Shri Kirit Parikh (*Delhi Centre*) was awarded the Vikram Sarabhai Award 1977, for outstanding contributions in the field of system analysis and management problems.

Shri K. B. Parthasarathy (*Delhi Centre*) was awarded the Shanti Swarup Bhasnagar Prize, 1978, for outstanding contributions in probability theory and quantum mechanics.

Shri N. T. V. Ranga Rao (*SQC & OR*) was the recipient of the Taneja Award from the All India Management Association for the best case study on quality management.

Shri Jayanta Kumar Roy, Trainee Programmer (*Applied Statistics, Surveys and Computing*) was awarded the Ph.D. degree, Calcutta University.

Shri J. Siddhanta, Lecturer, Charuchandra College, Calcutta, who worked under the supervision of Shri P. Bandyopadhyay (*Electronics*) was awarded the Ph.D. degree, Calcutta University.

Dr. B. P. Sinha and Dr. P. K. Srimani (*Electronics*) were awarded the S. K. Mitra Memorial Award of the Institution of Electronics and Telecommunication Engineers, India, for 1977.

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Shri P. K. Srimani and Shri B. P. Sinha (*Electronics*) were admitted to the Ph.D. degree, Calcutta University, in November 1978 and March 1979, respectively.

15.2. *Special Assignments* : Shri L. S. Bhat (*Delhi Centre*) participated in the programme of (i) research in regional planning in Uttar Pradesh as a member, Economic Advisory Council, Uttar Pradesh, and (ii) research and teaching of the Centre for Regional Development, Jawaharlal Nehru University.

Shri Durgaprasad Bhattacharyya (*Pre-Census Population Studies*) was offered the position of an empanelled roster-consultant by the United Nations, New York, under the U.N. Development Programme in the field of population activities, for occasional assignments. Shri Bhattacharyya was nominated a Fellow, Economic Research, Bangiya Sahitya Parishad. He continued to serve as (i) Member, Standing Committee, Indian Historical Records Commission, (ii) Member, Advisory Committee, Project on Historical Statistics of India, (iii) Honorary Director, Project on Economic Writings in Bengali, and (iv) Secretary, Socio-Economic Research Institute, Calcutta.

Dr. N. Bhattacharya (*Economic Research*) served on different expert working groups formed by the Central Road Research Institute (CRR), New Delhi, in connection with their project on Road User Cost Study. He served as a member, West Bengal Government Expert Committee set up for reviewing the activities of the West Bengal Bureau of Applied Economics and Statistics. He also served as one of the representatives of the Indian Statistical Institute on the NSSO Governing Council.

Dr. D. K. Bose (*Economic Research*) was nominated as member, (i) Indian National Committee for the World Energy Conference, and (ii) Eleventh Annual Power Survey Committee.

Dr. D. K. Bose and Shri N. K. Chatterjee (*Economic Research*) were nominated members, West Bengal State Level Coordination Committee for Integral Rural Development.

Shri R. L. Brahmachary (*Embryology*) was elected a member, Executive Council, Indian Council for Invertebrate Reproduction. He was invited by the Ministry of Education, Government of India, to serve as an expert on molecular biology on the Selection Board of Commonwealth Scholarships.

Dr. S. Chattopadhyay (*Economic Research*) was co-opted as Member (i) Executive Council, Council, Micropolitics Research Centre, Calcutta University, and (ii) Advisory Council, Centre for Himalayan Studies, North Bengal University.

Dr. D. Coondoo (*Economic Research*) served as member (i) Expert Committee for Reviewing the Price of Country Spirit set up by the Government of West Bengal; and (ii) Task Force on Projection of Minimum Needs and Effective Consumption Demands, initiated by Planning Commission, Government of India.

Shri Anis Dasgupta (*Sociology*) was nominated as member, Refugee Rehabilitation Committee, Government of West Bengal.

Dr. N. S. Iyengar (*Economic Analysis, Bangalore*) was elected member, International Statistical Institute, Netherlands.

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Dr. P. Maiti (*Economic Research*) participated in the series of discussions on the Draft Sixth Plan organised by the State Planning Board, Government of West Bengal, and presented a paper, "Some Exercises on the Monetary and Price Implications of the Sixth Plan Draft."

Dr. K. C. Malhotra (*Anthropometry*) accepted the following assignments :

- (i) President, Indian Society of Human Genetics, 1978-80 (elected).
- (ii) Member, Organising Committee, International Symposium on Population Structure and Human Variation, Bombay, December 1978.
- (iii) Member, Programme Committee, Tenth International Congress of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.
- (iv) Chairman, Session on Ethno-Genetics, Tenth International Congress of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.
- (v) Member, Editorial Board, *Journal of Human Evolution*, U.K.

Dr. S. K. Mitra (*Delhi Centre*) was elected to the Committee on Statistics in the Physical Sciences of the Bernoulli Society of Probability and Statistics of the International Statistical Institute, for the term 1979-83.

Professor R. Mukherjee, Distinguished Scientist (*Sociology*), was elected :

- (i) Member, Executive Committee, and Editorial Committee, International Sociological Association.
- (ii) Member, Editorial Board, Social Indicator Research, Ontario, Canada.
- (iii) Member, Panel on Sociology and Social Anthropology, University Grants Commission, Delhi.
- (iv) Government nominee for a second term on Indian Council of Social Science Research, for three years from 1 April 1978.

Dr. K. Pakraai (*Anthropometry*) acted as a member, Selection Board, Mysore University.

Shri S. M. Sundara Raju (*SQC & OR*) assisted the National Thermal Power Corporation as an expert member in the United Kingdom for quality assurance systems for Indian power industry, 25 February 1978-5 March 1978.

Shri S. B. Rao (*Stat-Math*) was a Visiting Professor, Madurai Kamaraj University, 25 November 1978-20 December 1978. He delivered 20 lectures on several topics of graph theory to college teachers and M. Phil students.

Dr. A. Rudra (*Economic Research*) accepted a short-term assignment offered by the UNCTAD, Geneva, to work as an expert consultant for the preparation of a book on "Technology Planning."

Shri M. R. Saluja (*Delhi Centre*) has been assisting the State Planning Institute, in finalisation of the Sixth Five Year Plan for Uttar Pradesh.

Professor A. Sen (*Electronics*) has been serving as a member, Science and Technology Committee, Government of West Bengal, since July 1978.

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XVI. SCIENTIFIC TOURS AND ASSIGNMENTS ABROAD

Shri R. L. Brahmachary (*Embryology*) returned from Zaire, Central Africa, on 2 May 1978, after three months' study on ecology, on an invitation from the Zaire Institute.

Dr. Sankar Chatterjee (*Geology*) was awarded the Henry-Marsh Fund by the National Academy of Sciences, U.S.A., in vertebrate paleontology and continued to teach geology at the George Washington University and George Mason University as Assistant Professor. He continued to work at the Smithsonian Institution as a Research Associate on the Indian Gondwana vertebrates and the paleoecology of India before the drift. He attended the annual meeting, Society of Vertebrate Paleontology, Toronto, Canada, 28-30 October 1978, and presented a paper on the evolution of rhynchosaurs. He acted as a reviewer of the National Science Foundation Grant proposal in Biology and Systematics, 1978.

Dr. Arijit Chaudhuri, Associate Professor (*Applied Statistics, Surveys and Computing*) joined the Department of Mathematics and Statistics, University of Lund, Sweden, as a Visiting Professor.

Shri V. K. Chetty (*Delhi Centre*) visited Italy and organised the autumn course in mathematical economics in Trieste, 25 September 1978-28 October 1978. He gave seminars at the University of Bonn, Federal Republic of Germany, Core University of Louvain, Belgium and University of Paris IX.

Shri F. J. Devadasan (*DRTC*), Research Assistant, attended the International Symposium on Bibliographic Exchange Formats, Taormina, Sicily, Italy, 27-29 April 1978, and presented a paper. Shri Devadasan visited the AGRIS (Global Computer-based Information System for Agricultural Sciences and Technology) at the Food and Agricultural Organisation, Rome, 2 May 1978, to study the working of the international working system.

Professor D. Datta Majumder (*Electronics and Communication Science*) attended the Fourth International Congress on Cybernetics, Amsterdam, 20-26 August 1978, to receive the first prize of Norbert Wiener Award for 1977. He also visited scientific institutions and universities in Amsterdam, London, Wales, Paris and Vienna in August and September 1978.

Shri M. A. Gopinath (*DRTC*) attended, as a member, UNESCO's Advisory Committee on Education and Training Policy and Programme for Library and Information Manpower, Paris, 4-7 October 1978. He also visited some important national information centres in Paris and Frankfurt.

Shri N. K. Jaiswal (*Delhi Centre*) worked as Visiting Professor at the Department of Industrial Engineering and Operations Research, University of Michigan, Ann Arbor, U.S.A., 1 May 1978-30 June 1978. He attended the Eighth International Conference on Operation Research, Toronto, Canada, 19-23 June 1978.

Dr. K. C. Malhotra (*Anthropometry*) visited the USSR, 9 May-10 June 1978, and gave seminars at the Institute of Ethnography Moscow. He visited the United Kingdom, 10-23 June 1978, and gave seminars at the University of New Castle-upon-Tyne and Durham University. On an invitation from the Ministry of Education and Culture, Government of Iran, Dr. K. C. Malhotra visited the Centre for Iranian Anthropology, 5-18 September 1978, and gave a series of lectures on Indian anthropology.

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Dr. S. K. Mitra (*Delhi Centre*) visited the Central Institute for Mathematics and Mechanics, Academy of Sciences, Berlin, under the Indo-GDR Cultural Exchange Programme, 20 May 1978-30 June 1978. *Lectures*: Generalised inverses of matrices and its applications. He also gave invited lectures at the University of Dortmund and at the Frankfurt-Heidelberg joint seminar in Statistics held at the University of Heidelberg.

Dr. Mitra presented a paper at the Sixth International Conference on Mathematical Statistics, 7-13 December 1978, Wisla, Poland. He also chaired a session of invited papers at the conference. The visit was arranged under the Indo-Polish Programme in Co-operation in Science and Technology. He was invited by the Academy of Agriculture, Poznan, Poland, to give a seminar talk.

Professor R. Mukherjee, Distinguished Scientist (*Sociology*) left India on 3 August 1978 and returned on 3 September 1978, on the following assignments:

(i) Max-Planck Institute, Sarnberg, Federal Republic of Germany, to deliver lectures, 2-12 August.

(ii) Ninth World Congress of Sociology, Uppsala, as a Chairman, Plenary session and Executive Member, International Sociological Association. 13-19 August.

(iii) UNESCO meeting, Bullagio, Italy, as a member, Social Indicator Committee, 20 August-2 September.

Professor Mukherjee left India on 28 March 1979 for the State University of New York, where he has been offered an Adjunct Professorship at the Department of Sociology for the period 1977-80 to teach for six weeks every year.

Shri S. Bandopadhyay, Senior Lecturer, (*Sociology*) is now at the McGill University, Montreal, Canada, for completing his Ph.D.

Dr. K. S. Parikh (*Delhi Centre*) attended the following:—

(i) Meeting for a World Energy Study from a Southern Perspective, Sao Paulo, Brazil, 26-29 November 1978. He presented a paper.

(ii) Meetings of the research review and advisory panel on industry and trade of the World Bank, Washington D.C., 17-24 July 1978 and 30 November-1-2 December 1978. He wrote the report of the Review Panel along with six other panelists.

(iii) A Workshop of Energy Futures for Developing Countries, Institute of National Planning, Cairo, Egypt, 26-30 January 1979. He wrote the conference report as one of the two rapporteurs.

Dr. K. R. Parthasarathy (*Delhi Centre*) visited the United Kingdom as British Council Visiting Professor, 15 January 1979-16 March 1979. He delivered lectures at the Universities of Warwick, Nottingham, Manchester, Swansea, and London.

Dr. A. Rudra (*National Income Research*) spent three weeks in May 1978 as an expert with the Asian Regional Team for Employment Promotion, and prepared a paper, "Basic Needs of Planning—The Indian Experience."

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Sarvasri C. A. Sotiy, C. Y. Krishna Murti, S. Sengupta and B. Ramachandrudu (*SQC & OR*) attended the Third International Conference on Quality Control, Tokyo, 17-20 October 1978.

Shri S. M. Sundara Raju and Dr. N. K. Jaiswal (*SQC & OR*) attended the IFOBS Conference on Operation Research, Toronto, Canada, 19-20 June 1978.

XVII. SCIENTIFIC ASSIGNMENTS IN INDIA

Shri D. K. Bagchi (*Leaf Protein*) attended the International Seminar on Biological Applications of Solar Energy, Madurai, 1-5 December 1978.

Dr. A. Bazu (*Diatropometry*) attended the following :

- (i) Annual Meeting, Indian Anthropological Society, November 1978.
- (ii) Tenth International Congress on Anthropological and Ethnological Sciences, New Delhi, 10-16 December 1978. He co-chaired the session on Anthropology and Disease.
- (iii) Seminar on Ecology of Eastern Himalayas, North Bengal University, December 1978.
- (iv) Post-plenary session. Tenth International Congress of Anthropological and Ethnological Sciences on Population Structure and Human Variation, Bombay, 19-21 December 1978.
- (v) Fifth Annual Conference, Indian Society of Human Genetics, Bombay, 22-24 December 1978.

Shri L. S. Bhat (*Delhi Centre*) attended the following :

- (i) Standing Committee Meeting, Conference on Central and State Statistical Organisation, New Delhi, 5 October 1978.
- (ii) Indo-French Seminar on Urbanization, New Delhi, 11-16 December 1978.
- (iii) Conference on Regional Perspectives of Development—Indian and Canadian Experiences, New Delhi, 4-5 January 1979.

Shri Durgaprasad Bhattacharyya (*Pre-Census Population Studies*) attended the following :

- (i) Seminar on Economic Writings in Bengali, 1818-1947, Calcutta, 22-23 April 1978. He presented a paper.
- (ii) Standing Committee Meetings, Indian Historical Records Commission, Government of India, New Delhi, 27 November 1978.
- (iii) Tenth International Congress of Anthropological and Ethnological Sciences, New Delhi, 10-17 December 1978. He presented a paper.
- (iv) Indian History Congress, Thirtieth Session, Osmania University, Hyderabad, 28-30 December, 1978. He presented a paper.



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(v) Indian Historical Records Commission, Forty-sixth Session, Aurangabad, 14-16 January, 1979. He presented a paper and moved a resolution on the preservation of periodicals in Indian languages.

(vi) Seminar on Village Industries and Village Development, Calcutta, 7 February 1979.

(vii) Seminar on Agrarian Reforms, Calcutta, 16 March, 1979.

(viii) International Conference on Rural Development and Land Reforms, Calcutta, 17-18 March, 1979. He was a commentator on the session on Egypt.

Shri Kulada Ranjan Biswas and Shri Sailesh Sengupta (*Pre-Census Population Studies*) attended the Seminar on Economic Writings in Bengali, 1818-1947, and presented a joint paper.

Shri S. K. Biswas, Lecturer (*Sociology*) attended the following :

(i) Annual Conference, Indian Anthropological Society, Calcutta, 19-20 November 1978.

(ii) Seminar on Appropriate Technology for Rural Development, Calcutta, 17-18 February 1979.

(iii) Panel Discussion, Community and Agriculture, Calcutta, 9 March, 1979.

Shri R. L. Brahmachary (*Embryology*) attended the following :

(i) Symposium on Cells and Molecules, Calcutta, 26-29 November 1978.

(ii) Seminar on Cell Differentiation, Delhi, 26-28 March 1979. He presented a paper.

Shri A. K. Chakravarty (*Delhi Centre*) attended the following :

(i) Seminar on Population, Employment and Inequality—Bachus Model, 12-13 May 1978.

(ii) Seminar on Child in India, Delhi, 22-24 March 1978.

Sarvasri B. Chakravarti and C. R. Malakar (*Demography*) participated in the Fourth Annual Conference, Indian Society for Study of Population, New Delhi, 22-24 March 1979, and presented papers.

Shri K. Chattopadhyay, (*Sociology*), attended the Expert Committee meeting on problems of Scheduled Castes and Scheduled Tribes of West Bengal, Calcutta, 28 March and 19 April 1978.

Sarvasri K. Chattopadhyay, S. K. Biswas, P. Chakravarti and T. N. Ghosh (*Sociology*) participated in the Tenth International Congress Anthropological and Ethnological Sciences, New Delhi, 10-16 December, 1978. They presented papers.

Dr. S. Chattopadhyay (*Economic Research*) participated in a Seminar on West Bengal and the Recent Flood, Calcutta, December 1978.

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Shri Ajit Das (*Stat. Math.*) participated in the Thirtysecond Annual Conference, Indian Society of Agricultural Statistics, Ludhiana, 21-25 December 1978, and presented a paper.

Sarvasri Binod Bihari Das and Satyabrata Ghosal (*Library*) attended the Eighth IASLIC Conference, Madras 23-28 December 1978, and contributed a joint paper.

Shri B. N. Das (*Delhi Centre*) attended a Seminar on Strategies for Rural Development, Calcutta, 1-3 December 1978.

Sarvasree A. K. Dutta and S. K. Pal (*Electronics and Communication Science*) presented papers at the National Systems Conference, Ludhiana, 4-6 September 1978.

Sri. Nanda De, Sri Anupam Guha Thakurta and Sri Arunabha Sen (*Applied Statistics, Surveys & Computing*) attended a Symposium on Mini-micro Computers and Automation, Roorkee, March 1979.

Sarvasree A. K. De and J. Das (*Electronics and Communication Science*) participated in the Computer Society Conference, Bangalore, 22-25 January 1979.

Sri. J. Duttagupta (*Electronics*) attended and presented papers in the National Systems Conference, Ludhiana, September 1978.

Sri. J. Duttagupta and Dr. P. K. Srinani (*Electronics*) attended and presented papers in the Symposium on Mini-micro Computers and Automation, Roorkee, March 1979.

Professor D. Dutta Mazumder (*Electronics and Communication Science*) chaired the general session, Second Symposium on Interdisciplinary Mathematics, Jaipur, 22 July 1978.

Shri Ajoy Kumar Ghosh and Sm. Rama Deb Roy (*Pre-Census Population Studies*) attended the Seminar on Economic Writings in Bengali, 1818-1947, and presented papers.

Dr. J. K. Ghosh (*Stat. Math.*) was an invited speaker at the Seminar on Probability and Statistical Inference, Pune, 12-14 March 1949 and presented a paper.

Shri K. B. Goswami (*Sanskrit*) participated in the Seminar on Primary Communications in Science and Technology in India, Bangalore, 4-8 December 1978, and contributed a paper.

Dr. S. L. Jain (*Geology*) attended the Symposium on Ecology of Animal Populations, Calcutta, 26-28 October 1978.

Shri C. Juyal (*Delhi Centre*) attended the Fifth Data Base Seminar on the Unorganised Sector, Madras, May 1978.

Mrs. Avinash Khurana (*Delhi Centre Library*) attended the All-India Public Library Convention, Delhi, 16-18 November 1978.

Dr. K. C. Malhotra (*Anthropometry*) attended the following and presented papers :

(i) Annual Meeting, Indian Anthropological Society, Calcutta, November 1978.

(ii) Tenth International Congress of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.

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(iii) International Symposium on Population Structure and Human Variation, Bombay, 19-21 December 1978.

(iv) Fifth Annual Conference, Indian Society of Human Genetics, Bombay, 22-24 December 1978.

Shri S. Matal (*Leaf Protein*) attended the following :

(i) Coordination Committee, Leaf Protein Research in India, Mysore, 3-4 July 1978.

(ii) Eleventh Convention, Indian Society of Agricultural Chemists, Karnal, 27-28 November 1978.

Dr. H. P. Mazumdar (*Electronics*) attended the Twenty-third Conference, Indian Society of Theoretical and Applied Mechanics, Warangal, December 1978, and presented two papers.

Shri B. N. Mukherjee (*Anthropometry*) attended the following :

(i) Tenth International Congress of Anthropological and Ethnological Sciences, Delhi, 10-16 December 1978.

(ii) Educational meeting-cum-Workshop organised by the Blood Group Reference Centre, Indian Council of Medical Research, Bombay, 6-18 November 1978.

Professor R. Mukherjee, Shri P. Chakravarti and Shri M. Chattopadhyay (*Sociology*) attended the workshop on Modernisation and Political System, Calcutta, March 1979.

Professor R. Mukherjee and Shri P. Chakravarti (*Sociology*) attended the International Conference on Agrarian Reform and Rural Development, Calcutta, 17-18 March 1979. Professor Mukherjee chaired the session on South Asia.

Professor A. Neelamrghan (*DRTC*) participated, as an invited member, in the expert group meeting on the Impact of Information Services on National Development, Bangalore, 18-20 May, 1978.

Dr. K. Pakrasi (*Anthropometry*) attended the Tenth International Congress of Anthropological and Ethnological Sciences, New Delhi, 10-16 December, 1978 and presented four papers in three plenary sessions. He acted as the Chair-person of a plenary session on Biometrical Approach to Physical Anthropology.

Sarvasri S. K. Paul and B. B. Chowdhury (*Electronics and Communication Science*) attended the Mini-micro Conference, Roorkee, 28-30 March 1979.

Shri M. V. Raman (*Demography*) attended the Second Census Data Users conference, New Delhi, 21-23 December 1978.

Dr. (Mrs.) Bina Roy (*National Income Research*) attended the Twentieth Annual Conference, Indian Society of Labour Economics, Ahmedabad, 28-30 December 1978.

Dr. J. Roy, Dr. Subir Bandyopadhyay and Sri D. P. Roychowdhury (*Applied Statistics, Surveys & Computing*) attended a Seminar on Impact of Computers on Statistical Systems<sup>2</sup> in India, New Delhi, 1-3 November 1978. They presented papers.

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Dr. J. Roy, Dr. Subir Bandyopadhyay, Dr. A. Sengupta (*Applied Statistics, Surveys & Computing*) attended the Annual Convention, Computer Society of India, Bangalore, 22-25 January, 1979.

Shri M. R. Saluja (*Delhi Centre*) attended the following :

(i) Fifth Data Base Seminar on the Unorganised Sector, Madras, May 1978.

(ii) Standing Committee Meeting, Conference of Central and State Statistical Organisation, Delhi, 22 March 1979.

Shri B. N. Sarkar (*Demography*) attended the following and presented papers :

(i) Seminar on Demographic and Socio-economic Aspects of Child in India, Bombay, 26-28 February 1979.

(ii) Fourth Social Science Congress, Santiniketan, 22-25 March 1979. Shri S. Guha Roy also attended.

Sm. K. Sarasdamoni (*Delhi Centre*) attended the following :

(i) Seminar on Strategy for Rural Development, New Delhi, 30 July 1978.

(ii) International Congress of Anthropological and Ethnological Sciences, New Delhi, 10-16 & 19-20 December 1978.

(iii) Diamond Jubilee, Indian Economic Association, Bombay, 24-26 December 1978.

Shri S. Seetharama (*DRTC*) attended the IASLIC Conference, Madras, 28-30 December 1978, and presented a paper.

Dr. Abhijit Sengupta (*Applied Statistics, Surveys & Computing*) participated and presented two papers at the Fifth National Systems Conference, Ludhiana, September 1978.

Shri A. Sitarum (*Stat.-Math.*) attended the International Colloquium on Representation Theory and Arithmetic, Bombay, January 1979.

Dr. P. K. Srimani (*Electronics*) attended a two-week winter school on Digital Signal Processing, Kharagpur, December 1978.

Shri P. K. Tapaari (*Embryology*) attended the following :

(i) Seminar on Bio-mathematics and Mathematical Ecology, Jadavpur University, May 1978, and gave a talk.

(ii) Seminar on Cell Differentiation, Delhi, 26-28 March 1979. He presented a paper.

The undermentioned staff members attended the Sixty-sixth session, Indian Science Congress, Hyderabad, 3-7 January 1979.

Dr. Parimal Mukherjee and Shri R. Arnab (*Applied Statistics, Surveys & Computing*).

Shri B. N. Sarkar (*Demography*).

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### XVIII. EIGHTY-FIFTH BIRTH ANNIVERSARY OF THE LATE PROFESSOR P. C. MAHALANOBIS

A meeting of the workers of the Indian Statistical Institute was held on 29 June 1978 to observe the eighty-fifth birth anniversary of late Professor P. C. Mahalanobis, Founder-Director of the Institute. Professor Pratul Chandra Gupta, Vice-Chancellor, Rabindra Bharati University, the chief guest, and Professor G. Kallianpur, Director, I.S.I., spoke on the occasion.

Exhibitions organised on the occasion consisted of photographs and manuscripts depicting the life and work of Professor Mahalanobis and illustrations regarding current research work in the science units.

### Part III : Administration and Office-bearers

#### XIX. GENERAL ADMINISTRATION

19.1. *Membership* : During the year, 72 persons were enrolled as ordinary members of the Institute. The membership of 63 ordinary members were terminated in terms of Clause 2.1 of the Regulations of the Institute, membership of 3 ordinary members were revived after termination, 3 ordinary members became life members, 4 ordinary members resigned and one life member and one ordinary member died. Thus, the membership position as on 31 March 1979 was 418 (Ordinary—280, Honorary Life—4, Life—124 and Institutional—10). During the year, 310 student members were enrolled for one-year term.

19.2. *General Meetings* : The Annual General Meeting of members, Indian Statistical Institute, was held on 28 June 1978.

19.3. *Meetings of the Council* : The Council of the Institute met seven times on (i) 23 May 1978, (ii) 28 June 1978, (iii) 4 August 1978, (iv) 5 August 1978, (v) 18 September 1978, (vi) 22 January 1979, and (vii) 28 March 1979.

19.4. *Meetings of the Finance Committee* : The Finance Committee met twice on 18 September 1978 and 22 January 1979.

A list of names of the President, Chairman and members of the Council of the Institute together with a list of members of different Committees are given in Chapter XVIII.

19.5. *Election of President and Office-bearers* : During the year, election was held for the post of President of the Institute and also for various offices of the Council and Academic Council for a two-year term commencing from 25 July 1978.

Shri T. D. Gupta, Chief Administrative Officer-cum-Controller of Finance, was appointed as Election Officer to conduct the election.

The members of the Indian Statistical Institute approved the Council's nominations of Shri S. Dutta, ICS (Retd.) as President of the Institute and Dr. P. K. Bose, M.Sc., Ph.D., F.S.S. (Lond.) and Dr. P. V. Sukhatma M.A., Ph.D., F.N.A., as two representatives of the members of the Institute and they were elected uncontested for a two-year term, commencing from 25 July 1978.

The results of the elections were approved by the Annual General Meeting held on 28 June 1978.

19.6. *Institute Staff* : The following senior members of the staff have been functioning in the posts mentioned during the year. (i) Dr. Ashok Mitra, M.Sc., Ph.D., functioned as Officiating Director from September 1978, in the absence of Dr. G. Kallianpur, Director; (ii) Dr. S. K. Mitra, Head of Delhi Centre, (iii) Dr. T. Krishnan, Dean of Studies; (iv) Shri N. Srinivasan, Technical Officer (SQC), functioned as Officer-on-Special Duty (Administration and Finance) from August 1978.

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Shri O. K. Ghosh, LAAS (Retd.), former Director, Hindustan Petroleum Corporation, Bombay, and former Honorary Treasurer, Delhi University, joined as Special Adviser, Finance and Personnel Management, for one year from 1 October 1978.

19.7. *New Appointments* : The senior staff of the Institute was strengthened during the year by the addition of the following :

1. Dr. B. K. Basu, MBBS, MRCP (Lond), Medical Officer.
2. Dr. Joseph Mathew, Lecturer, Statistics-Mathematics Division.
3. Dr. Parimal Mukhopadhyay, Lecturer, Computer Science Unit.

Professor N. S. Iyengar rejoined as Professor in the Economic Analysis Unit, Bangalore Centre, on 1 January 1979.

19.8. *Retirements and Resignations* : Shri Benoy Bhuvan Chakravarty, M.A., Selection Grade Executive Officer, retired on superannuation.

Dr. Prithwish Dasgupte, Professor, Demography Research Unit, resigned.

19.9. *Obituary* : Shri Ajit K. Sinha, M.Sc., Three-year Advanced Statistician's Course, Senior Lecturer, died on 4 December 1978.

### 19.10 *Land and Construction : Calcutta*

1. *Library Building* : The following were the main developments in the construction of the composite library building during the year.

- (i) The construction of the third and fourth floors was almost completed.
- (ii) Sanitary works for the third and fourth floors are being constructed by Messrs. S. C. Dey.
- (iii) Tenders received for electric installation are being scrutinised by the consultants Messrs. Ballardie Thompson and Mathews.
- (iv) The air-conditioning of a part of the accommodation on the ground floor for the Computer Science Unit and Reprography Unit was completed by Messrs. Voltas Ltd.

2. *Hostel Complex* : The first building of the hostel complex is being constructed from the previous year at 206 B. T. Road by Messrs. Engineers Collaborated. About 60 per cent of the work was completed during the year.

3. *Water Supply* : The construction of the overhead water reservoir with a capacity of 60,000 gallons was completed in all respects.

Water distribution pipe lines at 205 and 206 B. T. Road with a connexion to the composite library building have been constructed.

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4. *Minor Construction* : Several minor constructions were undertaken :

- (i) The construction of one car shelter and car repairing stand was completed by Messrs Das & Co.
- (ii) The boundary wall of the Baranagar campus was raised.
- (iii) Two buildings for housing generators and one pump room were constructed at 202 and 206 B. T. Road.

*Delhi :*

- 1 The construction of the undermentioned staff quarters, started in the previous year, is nearing completion : (i) A type (8 flats), (ii) B type (3 flats), and (iii) C type (5 flats).
2. The work for the fabrication and fixing of cupboards and some other items was entrusted to Messrs Kishori Lal & Sons in January 1979.
3. The construction of roads and paths and earthfilling in the staff housing area was entrusted to Messrs H. K. Baweja & Co. in February 1979

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, Central Statistical Organisation, Department of Statistics, Ministry of Planning.
3. (ii) Shri N. K. Panda, Joint Secretary, Ministry of Finance, Department of Expenditure.
4. (iii) Dr. (Mrs.) A. R. Rajeshwari, Principal Scientific Officer, Department of Science and Technology.
5. (iv) Shri V. V. Divatia, Executive Director, Reserve Bank of India.

*Scientists not employed in the Institute (7)*

*Representative of ICSSR (1)*

6. Professor Bhabatosh Datta

*Representatives of INSA (4)*

7. (i) Professor M. S. Narasimhan, School of Mathematics, Tata Institute of Fundamental Research, Bombay.



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8. (ii) Professor S. S. Shrikhande.
9. (iii) Professor B. K. Bachhawat, Director, Indian Institute of Experimental Medicine, Calcutta.
10. (iv) Dr. S. C. Bhattacharya, Director, Bose Institute, Calcutta.

*Scientists co-opted by the Council (2)*

11. (i) Professor R. P. Bambah, Department of Mathematics, Centre for Advanced Studies in Mathematics, Punjab University.
12. (ii) Dr. R. Narasimhan, Head, Computer Group, Tata Institute of Fundamental Research Bombay.

*Elected representatives of the Institute*

*Members not employed in the Institute (2)*

13. (i) Dr. P. K. Bose, M.Sc., Ph.D., FSS (London), Head, Department of Statistics, University of Calcutta.
14. (ii) Dr. P. V. Sukhatme, M.A., Ph.D., F.N.A., Honorary Professor of Biometry Maharashtra Association for Cultivation of Science.

*Elected representatives of the employees of the Institute (2)*

15. (i) Dr. (Mrs.) K. Saradamoni, Senior Lecturer.
16. (ii) Shri Kamalendu Bhattacharya, Section Officer.

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

17. (i) Dr. G. Kallianpur, Director.

*Professors-in-charge of Scientific Divisions (5)*

18. (ii) Dr. Asok Maitra, Professor, Division of Theoretical Statistics & Mathematics.
19. (iii) Shri Debdas Chaudhuri, Applied Statistics, Surveys & Computing Division.
20. (iv) Dr. Asok Rudra, Professor, Social Sciences Division.
21. (v) Dr. Ambarish Ghosh, Professor, Physical and Earth Sciences Division.
22. (vi) Dr. Kanti Bhusan Pakrasi, Biological Sciences Division.
23. (vii) Shri C. R. Prasad, Head of Statistical Quality Control and Operations Research Division.
24. (viii) Dr. S. K. Mitra, Head, Delhi Centre.
25. (ix) Dr. T. Krishnan, Dean of Studies.
- Shri N. Srinivasan, Officer-on-Special Duty, acted as non-member Secretary.

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LIST OF MEMBERS OF DIFFERENT COMMITTEES

1. *Finance Committee of the Council :*

- (1) Director of the Indian Statistical Institute or his nominee (*ex-officio* Chairman).
- (2) Dr. P. K. Bose, Head Department of Statistics, University of Calcutta.
- (3) Dr. Bhabatosh Dutta.
- (4) Dr. B. P. Adhikari
- (5) Dr. J. Roy
- (6) Shri S. M. Sundara Raju
- (7) Dr. S. K. Mitra
- (8) Dr. K. B. Pakraai
- (9) Dr. Ambarish Ghosh

(10) & (11) Two representatives nominated by the Government of India (Dr. K. C. Seal, Director, C.S.O. and Sri N. K. Panda, Joint Secretary, Department of Expenditure, Ministry of Finance).

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

2. *Examination Committee :*

1. Dr. P. K. Bose, Head, Department of Statistics, University of Calcutta; 2. Professor H. K. Nandi, Department of Statistics, University of Calcutta; 3. Professor A. M. Goon, Presidency College, Department of Statistics; 4. Professor T. V. Abhadhani, University of Andhra; 5. Dr. T. P. Abraham, Additional Director, C.S.O. Ministry of Planning, Government of India; 6. Dean of Studies, Indian Statistical Institute; 7. Dr. B. Ramachandran; 8. Dr. J. Roy, 9. Dr. K. R. Parthasarathy; 10. Shri Tarce Maitra, *Secretary-Convenor*.

3. *Journal Committee of the Institute :*

(i) *Committee for Sankhyā, Series A :*

1. Dr. R. R. Bahadur; 2. Dr. D. Basu; 3. Dr. V. S. Hazarbasar; 4. Dr. K. R. Parthasarathy; 5. Dr. S. S. Srikhande and 6. Dr. Malay Ghosh.

*Co-editors :* 1. Dr. B. V. Rao and 2. Dr. K. R. Parthasarathy

(ii) *Committee for Sankhyā, Series B :*

1. Dr. T. V. Hanurav, 2. Dr. Sujit Kumar Mitra, 3. Dr. K. G. Ramamurthi; 4. Dr. J. Roy and 5. Dr. Malay Ghosh.

*Co-editors :* 1. Dr. J. C. Gupta and 2. Dr. Sujit Kumar Mitra.