

INDIAN STATISTICAL INSTITUTE

FORTYSIXTH ANNUAL REPORT

April 1977—March 1978



203 Barrackpore Trunk Road
CALCUTTA 700 035

INDIAN STATISTICAL INSTITUTE

President : Shri Subimal Dutt, IOS (Retd.)

The Council

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

Members of the Council

Representatives of Government of India (4)

2. (i) Shri V. R. Rao, Director, Central Statistical Organisation and Additional Secretary, Department of Statistics. 3. (ii) Shri S. Vasudevan, Joint Secretary, Ministry of Finance (Department of Expenditure) and Financial Advisor to the Department of Statistics. 4. (iii) Dr. R. D. Deshpande, Director, Department of Science and Technology, Cabinet Secretariat. 5. (iv) Shri V. V. Divatia, Statistical Advisor, Department of Statistics, Reserve Bank of India.

Scientists not employed in the Institute (7)

Representative of ICSSR (1) 6. Dr. Bhabatoah Dutta.

Representatives of I.N.S.A. (4)

7. (i) Dr. B. R. Seth, Honorary Professor, Delhi University. 8. (ii) Professor V. S. Huzurbazar, FNA, Senior Professor & Head, Department of Statistics and Mathematics, University of Pune and Visiting Professor, Department of Statistics, University of Manitoba, Winnipeg, Canada. 9. (iii) Professor A. K. Sharma, FNA, Professor and Jawaharlal Nehru Fellow, Department of Botany, University of Calcutta. 10. (iv) Dr. S. K. Chakraborty.

Scientists co-opted by the Council (2)

11. (i) Dr. S. S. Shrikhande, Head, Department of Mathematics, University of Bombay, (co-opted on 14.8.76). 12. (ii) Dr. M. G. K. Menon, FRS, Chairman, Electronics Commission; Secretary to the Government of India, Department of Electronics. (proposed on 14.8.76 and finalised on 25.10.76).

Elected representatives of the Institute

Members not employed in the Institute (2)

13. (i) Dr. P. K. Bose, M.Sc., Ph.D., F.S.S.(Lond.), Head, Department of Statistics, University of Calcutta. 14. (ii) Dr. P. V. Sukhatme, M.S., Ph.D., FNA, Maharashtra Association for the Cultivation of Science.

Elected representatives of the employees of the Institute (2)

15. (i) Shri Tapan Basu Mallick, Senior Lecturer. 16. (ii) Shri Rakhal Chandra Paul, Section Officer.

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

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

Professors-in-charge (5)

18. (ii) Dr. J. K. Ghosh, Theoretical Statistics and Mathematics Division (in his absence Dr. B. P. Adhikari). 19. (iii) Dr. J. Roy, Applied Statistics, Surveys and Computing Division. 20. (iv) Dr. D. K. Bose, Social Sciences Division. 21. (v) Shri Asish Sen, Physical and Earth Sciences Division. 22. (vi) Professor S. K. Roy, Biological Sciences Division. 23. (vii) Dr. Asok Maitra, Dean of Studies. 24. (viii) Shri S. M. Sundara Raju, Head, SQC & OR Division. 25. (ix) Dr. S. K. Mitra, Head, Delhi Centre (Acting from 14 September 1977).

Shri P. G. Sarkar and Shri T. D. Gupta, Principal Officers in charge of Administration, acted as non-member Secretary in their respective terms.

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. Bhabatoah Dutta; 4. Dr. B. P. Adhikari; 5. Dr. J. Roy; 6. Shri S. M. Sundara Raju; 7. and 8. Two representatives nominated by the Government of India (Shri V. R. Rao, Director, CSO and Additional Secretary, Department of Statistics and Shri S. Vasudevan, Joint Secretary, Ministry of Finance, Department of Expenditure; 9. Shri P. K. Chatterjee, Senior Accounts Officer, Indian Statistical Institute (*Non-member Secretary*)).

2. Examinations 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. Dr. J. Roy; 4. Professor M. S. Abhadhani, University of Andhra; 5. Shri N. G. Sardana, Joint Director, C.S.O., Ministry of Planning, Government of India; 6. Dr. Asok Maitra, Dean of Studies, Indian Statistical Institute; 7. Dr. S. D. Tondulkar, Department of Statistics; 8. Professor A. M. Goon, Presidency College, Calcutta; 9. Shri Tarosh Maitra, *Cum-senior*.

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

I. TEACHING AND TRAINING

1. *Teaching for Degrees and Diplomas* : Three thousand two hundred sixtyfour 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 spread all over the country for primary selection and appeared for interviews and the final selection in Calcutta. Special admission tests were also held for admission to the (i) Evening Course in Statistics in Calcutta and Delhi, (ii) One-year certificate course in Data Collection and Processing Methods, and (iii) Courses on Operation of Punch Card Machines. The annual examinations of the B.Stat. and M.Stat. courses were held in May-June 1977. The 1977-78 academic year commenced on 1 August 1977.

A new full-time course, the one-year Certificate Course in Data Collection and Processing Methods was introduced during 1977-78. Candidates with a post-graduate degree are admitted to the course. The purpose of the course is to impart professional training in data processing methods with a view to turning out persons who will be able to undertake junior level statistical and computer assignments immediately on successful completion of the course, in government departments, scientific, industrial, commercial and other organisations.

A list of the number of candidates admitted to the different degree and training courses during 1976-77 and 1977-78 is given below :

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

							<i>Number of students</i>	
							1976-77	1977-78
1.1	Bachelor of Statistics with Honours, [B.Stat. (Hons.)]							
	1st year	...	...	...	...	10	15	
	2nd year	...	...	...	...	15	17	
	3rd year	...	...	...	...	20	15	
	4th year	...	...	...	...	17	19	
1.2	Master of Statistics (M.Stat.)							
	1st year	...	...	...	...	8	5	
	2nd year (including students of Delhi Centre)					...	10	15
	3rd year (including students of Delhi Centre)					...	41	27
1.3	Junior and Senior Research Fellows, Visiting Fellows (including Delhi Centre)							
	59	85	

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		<i>Number of students</i>	
		1976-77	1977-78
2. Specialised Courses in Applied Statistics, leading to Diplomas :			
2.1	Statistical Quality Control and Operations Research ...	10	19
2.2	Diploma in Econometrics and Planning ...	2	2
3. Courses in Statistics for Persons in Employment :			
3.1	Statistical Officers Training Course (jointly with the C.S.O.) ...	15	—
3.2	Specialisation Course for Statistical Officers (jointly with the C.S.O.)	—	9
3.3	Junior Certificate Course in Statistics (jointly with the C.S.O.)	—	14
3.4	Indian Statistical Service: Probationers' Training Course (jointly with the C.S.O.) ...	15	—
3.5	Short duration courses for officers on deputation ...	2	1
3.6 Short-term courses in Special subjects :			
	(i) Courses conducted by Computer Science Unit for participants of the ICSSR ...	—	23
	(ii) One/Two months Practical Training in Electronics and Communication Sciences ...	—	7
	(iii) Special Practical Training in SQC and OR (3 months) ...	5	—
4. Evening Courses :			
4.1 Statistical Methods and Applications (One year) :			
	(i) Calcutta ...	37	46
	(ii) Delhi ...	40	37
4.2 Two-year Post-graduate Diploma in Statistical Quality Control and Operations Research (Bombay and Madras) :			
4.2.1	Bombay—1st year ...	21	17
	Bombay—2nd year ...	10	9
4.2.2	Madras—1st year ...	16	24
	Madras—2nd year ...	16	9
4.3	Six-month Evening Course in Statistical Quality Control at Bangalore (July to December and January to June) ...	61	63
5. Electronic Computer Courses :			
5.1	Diploma in Computer Science ...	13	13
5.2	Intensive Course on Programming Applications ...	28	22
5.3	Course on Operation of Punch Card Machines ...	10	12
5.4	One-year Course on Data Collection and Processing Methods ...	—	9
5.5	Course on Statistical Craftmanship ...	7	—
6.	Documentation Training Course, Bangalore ...	12	22
		509	556

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2. INTERNATIONAL STATISTICAL EDUCATION CENTRE (I.S.E.C.), CALCUTTA

The International Statistical Education Centre (ISEC), opened in 1950, 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 functioned under a Board of Directors consisting of *Chairman* : C. R. Rao, *Members* : M. Macura, A. E. Sarhan, E. Lunenberg (ex-officio members representing the International Statistical Institute); B. D. Pandey (Cabinet Secretary, representing the Government of India); G. Kallianpur and N. Bhattacharya, *Member-Secretary*, (representing the Indian Statistical Institute).

2.1 During the year, there were 26 trainees in the Regular Course from 12 countries in South and South-East Asia, the Far East, and the Commonwealth countries of Africa in the thirtyfirst term of the Centre. In addition, four trainees from Nigeria attended a Three-month Special Course in Sample Surveys from June to September 1977, and one trainee from Malaysia was admitted to One-year Special Course in Statistical Methods and Applications in August 1977, which continued into the next year (1978-79).

2.2 Five Special Course trainees, admitted during the previous year, completed their training programme during the current year : four trainees from the Maldives completed a One-Year Special Course in Census Procedures in June 1977 and one trainee from Ethiopia completed One-Year Special Course in Sample Surveys in January 1978.

2.3 The Government of India awarded 14 fellowships for the foreign trainees attending the Regular Course—8 under the Technical Cooperation Scheme of the Colombo Plan and 6 under the Special Commonwealth African Assistance Plan (SCAAP); 8 Regular Course trainees were supported by fellowships granted by the Commonwealth Fund for Technical Cooperation (CFTC); and the remaining 4 trainees were supported by their governments. Among the Special Course trainees, the trainee from Malaysia was supported by the CFTC and the four Nigerians were supported by the Nigerian Government.

2.4 The Regular Course of the Thirtyfirst Term was started on 1 June 1977. The programme of training followed the same pattern as in previous years with the difference that the trainees underwent the course in Official Statistics conducted by the Central Statistical Organisation, Government of India, during mid-December to January, instead of from October to mid-November.

2.5 In the Special Courses in Sample Surveys, the trainees from Nigeria attended courses in probability theory, descriptive statistics, sampling techniques, and planning and organizational aspects of large-scale sample surveys. They also studied the methodology adopted for various enquiries by the National Sample Survey Organisation (NSSO) and by the ISI, visited the offices of the NSSO at Delhi and Calcutta, and the Registrar General's office in Delhi. The programme for the trainee from Ethiopia was broadly similar, but he studied statistical methods, sampling theory and data processing techniques in greater depth and also participated in live survey projects and visited a larger number of organisations.

2.6 The four Special Course trainees from Maldives received training at the Registrar-General's office in Delhi in census procedures and some further training in demography and data processing at the Indian Statistical Institute, Calcutta.

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2.7 The Special Course trainee from Malaysia attended the One-Year Evening Course in Statistical Methods and Applications conducted at the ISI, Calcutta. He also studied various problems of official statistics, especially health statistics, under the guidance of experts at the ISI and at other governmental institutions, e.g., the All-India Institute of Hygiene and Public Health, Calcutta.

2.8 Dr. R. Shimizu, Institute of Statistical Mathematics, Tokyo, was the Visiting Professor at the Centre during October-December 1977.

3. PROFESSIONAL EXAMINATIONS

The Statistician's Diploma and Computer's Certificate examinations were held as usual in May and November during 1977-78. Due to inadequate response from candidates, the Punched Card Machine and Statistical Field Survey examinations were not held.

3.1 The professional examinations were held during the year 1977-78 at Bangalore, Bombay, Calcutta, Delhi, Lucknow, Madras and Shillong, both in May and November. The number of candidates for the Statistician's Diploma Examination remained at a stable level, while a general decline was noted in the number of candidates for the Computer's Certificate Examination. The largest number of candidates appeared for the Statistician's Diploma examinations and most of them were from the centres in Calcutta and Delhi. The candidates for the Computer's Certificate examinations were practically all confined to the Calcutta Centre during the May term and to Calcutta and Madras during the November term.

The details of the number of candidates who registered, appeared and passed in one or more papers of the professional examinations during 1977-78 are given below :

Statistician's Diploma Examination (1977-78) : One hundred and twelve candidates registered (85 in May; 47 in November) for the examinations but 29 candidates (15 in May; 14 in November) failed to appear in any of the papers. Of those who finally appeared, 40 candidates (22 in May; 18 November) passed in one or more papers.

Computer's Certificate Examination (1977-78) : Nineteen candidates (10 in May; 9 in November) registered for the examinations but 3 candidates (1 in May; 2 in November) failed to appear in any of the papers. Of those who finally appeared, 6 candidates (2 in May; 4 in November) passed in one or more papers.

Number of successful candidates qualified during 1977-78 for the award of Diploma and Certificates in Professional Examinations :

The number of candidates who had successfully completed the entire professional examinations and qualified for the award of Diplomas and Certificates is given below :

Statistician's Diploma : Three candidates (2 in May; 1 in November).

Computer's Certificate : Two candidates (none in May; 2 in November).

Change in the system of examinations : The Examinations Committee which felt the need for a revision of syllabus and reorganisation of the existing system of professional examinations had appointed a Committee to examine the matter. The Committee

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recommended the discontinuation of (i) the three Statistical Field Survey examinations, and (ii) the two examinations on Punch Card Machine. The Committee also recommended that the Statistician's Diploma and Computer's Certificate examinations be reorganised into three examinations of five papers each. The new syllabi of these examinations were formulated after wide consultations with important statistical offices of the State and Union Governments.

The Council of the Indian Statistical Institute adopted new bye-laws with effect from 8 February 1978, in place of the old ones, introducing the new set of examinations, viz., (i) Statistical Assistantship Certificate, (ii) Junior Diploma in Statistics, and (iii) Senior Diploma in Statistics.

The May 1978 term of the professional examinations was held under the new system.

II. THEORETICAL STATISTICS AND MATHEMATICS

2.1 Calcutta

2.1.1 *In descriptive set theory*, a systematic study was made of various special Borel spaces like atomless Borel spaces and Blackwell spaces. Various investigations into lattice theoretic structure of Borel subspaces of a given Borel space were carried out. Investigations were carried out regarding the extension of a measure on a substructure to a larger Borel structure. Certain undecidability results were established. Important advances were made in the theory of measurable selections for G valued multifunctions. Various ramifications relating to the theory of measurable selections for closed valued multifunctions were examined and connections with extensions of measurable functions established. Separation theorems for analytic sets with convex sections were established. A study of analytic sets with countable sections was made, leading to a unification of various results of Luzin. A study of the properties of the constituents of analytic and coanalytic sets induced by ordinal solutions of open games was made.

2.1.2 *In functional analysis*, research work was carried out on orderings and dilations of complex representing measures and on convex functions on the dual ball of a complex Lindenstrauss space.

2.1.3 *In graph theory*, research work was carried out on characterizations of forcibly line graphic degree sequences, frequency partitions of Eulerian graphs, planar distance-convex simple graphs and self-complementary graphs with 2 factors were carried out. The following items were investigated: Cycles in self-complementary graphs, the range of the number of triangles in self-complementary graphs of given order, intersection graphs of K -uniform linear hypergraphs and some aspects of the structure theory of self-complementary graphs and digraphs. An Erdos-Gallai type result on the clique number of a realization of a degree sequence was obtained; work was also carried out on Nordhaus-Gaddum type problems.

2.1.4 *In topology*, work was carried out on Lindelof spaces and closed projections and in differential topology work was done on triangulation and smoothing problem. Studies were made on some problems in perfect measures and in ergodic theory.

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2.1.5 In *probabilistic number theory*, distributions of additive arithmetic functionals was carried out. Work was done on probabilities of large and moderate deviations, Bahadur representation of quantiles and rates of convergence of statistics. Several characterization problems such as that of exponential and uniform distributions was carried out.

2.1.6 In *statistical inference*, several types of problems about admissibility of estimators, efficiency of estimators and tests, parametric and non-parametric tests of some specific problems, robustness of estimators etc. were investigated. Results were reported and sent for publication. Work is also carried out on estimation problems, choice of optimal sampling strategies and other problems in sampling.

2.1.7 *Advanced Research* : Seminar courses were conducted in Functional Analysis, Differential geometry, Graph theory, Stochastic processes, Algebraic topology, Comparison of experiments and Second order efficiency. Several research courses were conducted in Probability, Analysis, Topology, Algebra and Statistical inference for junior research fellows. A total of 38 seminars were given in a weekly colloquium organized in the Division. The seminars and lectures by visiting scientists is listed elsewhere in the report.

2.2 Delhi

2.2.1 *K. K. Mukherjee* has been looking into the rate and manner in which the spectrum of a linear operator changes, if the operator is itself changed in a differentiable fashion. He has also undertaken the writing of an advanced textbook on Algebraic Topology.

2.2.2 *S. K. Mitra* continued his work on generalized inverse of matrices, solution of matrix equations and on inferences on non-estimable on linear parametric functions in Gauss Markov models.

2.2.3 *K. G. Mehrotra* worked on distribution functions.

2.2.4 *K. R. Parthasarathy* has been conducting research in the areas of stochastic process and the perturbation theory of linear operators.

2.2.5 *R. L. S. P. Rao* has been studying problems of parametric as well as non-parametric estimation for Gaussian processes. He is also investigating characterisation theorems for multivariate normal distributions. He has obtained some limit theorems for backward martingale arrays. Work has been completed on a book on Statistical Inference for Stochastic Processes, jointly authored with I. V. Basaiva, La Trobe University, Australia.

2.3 The Delhi group of economists and statisticians had 18 papers published in journals, 33 papers were submitted/accepted for publication and 22 technical report/discussion papers were prepared.

The statisticians in Calcutta had 30 papers published and sent 56 papers for publication. Three technical reports were issued in the Theoretical Statistics and Mathematics Division.

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.

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III. APPLIED STATISTICS, SURVEYS AND COMPUTING

3.1 The Division of Applied Statistics, Surveys and Computing had a Divisional Committee of Scientific Workers (DCSW) and a Technical Advisory Committee (TAC) which came into existence after the introduction of the new Memorandum of Association of the Indian Statistical Institute in 1976-77. The DCSW met twice during the year to formulate proposals for research and developmental programmes, while the TAC met once to finalise the annual programme and budget for the year 1978-79.

The activities of the Division during the year are broadly described under the following heads: 1. Teaching and Training, 2. Research, 3. Project Work, 4. Computer System, and 5. Sankhyā, Series C.

Some details of these activities are given below :

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

3.2.1 *Diploma in Computer Science* : Eight students in the 1976-77 session successfully completed their course work. Eighteen students were admitted to the 1977-78 session. The course has been upgraded to a two-year advanced programme from 1978-79.

3.2.2 *Specialisation in Applied Statistics and Data Analysis* : Nine students in the final year of the M.Stat. course completed the course successfully in 1976-77. All of them were placed in the first division.

3.2.3 *Course on Operation of Punched Card Machines* : Eight students completed successfully the 1976-77 session of the course. Eleven students were admitted to the course for 1977-78.

3.2.4 *Intensive Course on Programming and Application of Electronic Computers (13th Session : 29 August 1977-5 November 1977)* : Of the 22 trainees admitted to the course, 19 were awarded Certificates of Merit, while three received Certificates of Attendance. Trainees for the current sessions were sponsored by organisations like the Fertiliser Corporation of India, Sindri; Reserve Bank of India, Bombay; Geological Survey of India, Calcutta; Institute of Social and Economic Change, Bangalore; and Indian Telephone Industries, Bangalore.

3.2.5 *One-year Certificate Course in Data Collection and Processing Methods* : The purpose of the course, started during the current year, is to impart professional training in data collection and processing methods with a view to turning out persons who should be able to take junior level statistical and computer assignments in scientific and commercial organisations and Government departments. Eight students were admitted to the course for the session, 1977-78.

3.2.6 *Summer School on Computer-Oriented Statistical Methodology, Madras, 29 May 1977-18 June 1977* : The school conducted by the Applied Statistics, Surveys and Computing Division in collaboration with the Indian Institute of Technology, Madras, was organised for statisticians who are not familiar with electronic computers. Of the 111 who applied, 50 candidates were selected and 43 joined the course. Partial financial support for the course was provided by the University Grants Commission and the Indian Council of Social

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Science Research. Trainees came mostly from engineering and technical institutes in social sciences, universities, colleges and also from commercial firms like the Tata Iron and Steel Co. Ltd. and Tata Engineering and Locomotive Co. Ltd.

3.2.7 *Courses on Survey Methodology for Social Scientists, Calcutta, 6 March 1978-29 April 1978* : Twentytwo young social scientists from all over India participated in the introductory course sponsored by the Indian Council of Social Science Research.

3.2.8 *Short Course* : A short course on FORTRAN programming was offered to students of public health engineering during January 1978, on a request from the All India Institute of Hygiene and Public Health, Calcutta.

3.3 *Research* : The Division conducted research which encompassed both theoretical investigations of a methodological nature and the applications of existing mathematical-statistical methods to the solution of practical real-life problems with social relevance.

The main areas of research in the Division are : Sample Surveys, Multivariate Analysis, Design of Experiments, Computer Software, Systems Simulation and Biometry. In the area of sample surveys, research was carried out on the following topics : Sampling on successive occasions, double sampling for tackling misclassification problems, choices of sample size for Horvitz-Thompson estimation; non-negative estimation of variance functions, estimation of variance in two-stage sampling and adoption of appropriate sampling strategies under various super-population models. In multivariate analysis and related areas, research work is being conducted on the application of generalised inverse of matrices to statistics, in the use of clustering techniques to pattern recognition problems, in the area of testing problems under violations of standard assumptions and mixed model analysis for unequal cell frequencies. Theoretical studies in factorial experiments and search theory are in progress. Computational aspects of MINQUE for variance components are being studied. The development of a computer language for the analysis of survey and census data and the designing of data base systems are topics of research in computer software. A study on the behaviour and control of environmental and biological systems is under way, using computer simulation.

Staff members had 11 papers published in journals, 15 papers were sent for publication, while 8 papers were presented at conferences.

3.4 *Seminars* : Twentyone seminars were organised on different topics in Applied Statistics, Survey Methodology and Computer Science.

3.5 *Project Work* : The Division undertook a number of projects on request from Government organisations and research institutions. The projects give an opportunity to staff members to acquaint themselves with live problems requiring statistical methods for their solution. Most of the undermentioned projects were continued from the previous year.

(i) *Cost benefit Study of Rural Electrification Projects in West Bengal sponsored by the Rural Electrification Corporation, Government of India* : A draft report on the findings based on a study of four selected projects has been sent to the sponsors whose comments are now awaited before finalisation of the report.

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(ii) *Urban Poverty Survey, Calcutta* : The field work of the Survey, partially supported by a research grant from the Indian Council of Social Sciences Research, was completed. The data, transcribed on to the Honeywell H-400 magnetic tape, were validated.

(iii) *Calcutta Health Survey* : The health and socio-economic survey of the Calcutta Metropolitan Area, is being conducted in collaboration with the Calcutta Metropolitan Development Authority. The survey of medical institutions (hospitals, nursing homes, dispensaries etc.) has been completed and part of the data processing is over. The data for the first phase of survey of households have been transcribed into punched cards and data processing is continuing.

(iv) *Household Survey on Distribution of Public Expenditure on Social Services in West Bengal* : Data processing is in progress.

(v) *Pavement Dwellers' Survey, Calcutta* : The field work and the manual scrutiny of schedules were completed. Further processing is continuing.

3.8 *H-400 Computer System* : Nineteen major jobs were undertaken on the H-400 Computer System. Three major jobs had to be executed at the Regional Computer Centre, Jadavpur, due to the inadequacy of the computer system at the Institute.

3.8.1 *Installation of a new computer* : Arrangements to instal a EC-1033 third generation computer at the Institute are in progress. An agreement for the supply, installation, commissioning and servicing of the computer system has been made with the Electronics Trade and Technology Development Corporation Ltd. (a Government of India undertaking), New Delhi.

3.7 *Sankhyā, Series C* : Editorial work relating to *Sankhyā, Series C, Parts 1 and 3* (Sample Surveys—Theory and Practice) and Parts 2 and 4 (Quantitative Economics) has been transferred from the Publication Unit of the Theoretical Statistics and Mathematics Division to the Applied Statistics, Surveys and Computing Division from August 1977.

IV. PHYSICAL AND EARTH SCIENCES

4.1 Chemistry

(i) Thermodynamic aspects of the interaction between different aluminosilicates and surface active substance is emphasised in the current year's work. Enthalpy and entropy of adsorption has been measured from experimental data. A viable model of orientation of adsorbed molecules on solid-solution interface is offered with supporting experimental data.

(ii) It was earlier claimed by surface chemists that data on surfactant adsorption from aqueous solution may provide essentially the same information as gas and vapour adsorption. It has been shown for the first time that within a fairly wide limit adsorption data in Kaolinite surfactant system fit BET equation strikingly and the dissolved molecules behave like gas molecules in this respect just as in the case of Van't Hoff's Osmotic pressure relation.

Two scientific papers and one technical report were published.

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4.3 *Electronics*

The following are the research 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 the mechanism of interaction between water sediment mixture and mobile sand bed.

4.2.3 *Digital Systems Research* :

- (i) Fault detection, diagnosis and tolerance in digital hardware.
(ii) Graph Theory.
(iii) Switching Theory.
(iv) Microprogramming.
(v) Design and development of a signal processing system using FFT.
(vi) Programme verification and parallel computation.
(vii) Study of microprocessors.

4.3 *Flume Project* :

An interdisciplinary programme of study of the process of grain-size sorting during sediment transportation by running water was launched in 1975 by a geologist of the Institute in collaboration with statisticians and mathematicians. The study is expected to aid in the interpretation of hydrodynamic conditions of flow in ancient fluvial regimes from grain-size distributions of the transported sediments. During the year, the construction of a hydraulic flume of a novel design was completed in the Institute for conducting experiments on sediment transportation. The development of a semi-empirical model for sediment transportation is also in progress.

Eighteen papers were published and one paper read at a conference.

4.4 *Electronics and Communication Science* :

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

- (i) Advances in computer memory technology including biological memory and Neural modelling. Current work is on Associative Memory Systems and Neural modelling.
(ii) Digital communication. Current work is on the development of a dual channel, one for speech and the other for data channel communication system.
(iii) Pattern recognition, acoustic phonetics and artificial intelligence.

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(iv) Systems analysis and design-control systems synthesis, large scale system and circuit design, development of fuzzy algorithms for systems analysis and pattern recognition problems.

(v) Application of pattern recognition techniques in bio-medical picture processing, PR techniques in natural resources estimation, and PR techniques in system modelling.

(vi) Cybernetic studies on foundation of information sciences and man-machine communication.

The Unit has been participating in the short-term training of post-graduate students from academic institutions for the last 15 years. During the current year, 12 post-graduate students were given practical training on Computer Technology and Systems Science.

Nine papers were published in scientific journals, 12 papers sent for publication and 11 papers read at conferences/published in conference proceedings.

4.5 Geology :

A. An integrated programme of research was conducted in the Pranhita-Godavari Valley.

(i) *Palaeontology of the Gondwana* : The studies were mainly conducted on the Sauroop dinosaur from the Lower Jurassic Kota formation, *Burapasaurus tagorei*, whose skeleton has already been mounted in the Geology Museum.

(ii) *Sedimentology and stratigraphy of the Gondwana* : The studies have been centred around the Upper Gondwana clastic sediments of the Lingal-Metpalle-Yamanpalli region. Studies were continued on near-shore sedimentation of Proterozoic time in the Godavari Valley.

For a better understanding of the problems of ancient environment, the work on recent near-shore environment was carried out jointly with Professor J. D. Howard, Skidaway Institute of Oceanography, Georgia, U.S.A.

(iii) *Structural Geology* : Studies have been primarily concerned with working out the structural history and stratigraphy of the Delhi group of rocks around Kharwa, Ajmer District, Rajasthan.

B. *Fluvial Sedimentation* : Studies on fluvialite sedimentation in the Usri river valley near Giridih, Bihar, were continued with a view to obtaining clues to the condition of sediment transportation and deposition in ancient fluvial regions.

Six research papers were published in journals, 9 papers were accepted for publication and one technical note was prepared.

4.6 Physics :

(i) *Studies in Biomechanics* : The research project aims at the determination of the strength of biological materials, particularly of human origin, e.g., skin, hair, tendon, bone cartilage, by the application of the principle of mechanics.

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(ii) *Interaction of Physics and Medicine*: The studies were continued and investigations have been conducted into the applications of physical modalities in dermatology, in collaboration with some dermatologists of Calcutta.

(iii) Studies were conducted on the applications of control theory to electrical machines and power systems.

Two research papers were sent for publication, and one technical note prepared.

V. BIOLOGICAL SCIENCES

5.1 *Anthropometry and Human Genetics*

(i) *Social Biology*: (a) Biosocial and medico-genetical study of the Kaoras, an extremely backward scheduled caste community of West Bengal; (b) pattern of fertility and reproductive wastages by parity and social class; (c) first pregnancy births in adolescent mothers; and (d) pattern of marriage couple-formation and family organization in Greater Calcutta.

(ii) Biomedical study of (a) Portuguese descendants of Mirpur village, Midnapore district, West Bengal, (b) rural population of Gopalchak, a neighbouring village of Mirpur.

(iii) Impact of altitude on human population: surveys on the Sherpas were conducted in Upper Khumbu, Nepal and Kalimpong, West Bengal, to collect data on anthropometry, demography, haematology, nutrition and also medical plants.

(iv) Micro-evolutionary dynamics among the Mahars of Maharashtra: a number of villages under three tehsils, viz., Murbad, Washim and Nagpur of Maharashtra were surveyed to collect relevant anthropological and serological data from amongst Mahars, Marathas, Mangs and other populations.

(v) Bio-anthropological study of the Tirumali Nandiwalas, a semi-nomadic population of Maharashtra.

(vi) Genetic variation among the local population of North Sikkim: survey of two hilly villages, viz., Lachen and Lachung was completed. Academic collaboration with the scientists of several organizations like the Anthropological Survey of India, Government of India, Cultural Research Institute, Government of West Bengal, University Departments of Anthropology of Calcutta and Tirupati, B. J. Medical College, Poona, Government of Maharashtra, were pursued to carry out researches on anthropological, biological and genetical problems.

A programme of practical training in electrophoresis techniques employed in the study of biochemical polymorphism was for the first time undertaken during 13-26 June 1977 and four research scholars from the Universities of Tirupati, Omania, and Patiala were given training.

The anthropologists of the Institute were actively associated with the organization of the Tenth International Congress of Anthropological and Ethnological Sciences, 1978, National Seminar on Indian Nomads, United Nations Workshop of ESCAP Correspondents, and Annual Conferences of Indian Anthropological Society of Human Genetics.

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Twelve papers were published in journals, 15 papers sent for publication, 15 papers read at conferences/published in conference proceedings and two technical notes prepared.

Staff members taught physical anthropology and human genetics in the B.Stat. course.

5.2 Biochemistry

- (i) Inorganic pyrophosphatase in green leaves.
- (ii) Phosphate level in germinating green gram.
- (iii) Toxicity of Cassia Tora leaf extract in mice.

Four papers were published and two technical notes prepared.

5.3 Botany

(i) *Crop breeding programme*, which aims to evolve high-yielding rice varieties from indigenous germ plasm, is in progress.

(ii) *Intra-specific and inter-specific competitions and interactions in crop plants*: The investigations try to detect biological competition and interactions between rice varieties and between crop species like wheat and gram, wheat and pea, rice and pigeon pea, and to exploit co-operative interaction for higher yield. The field work is in progress.

(iii) *Effect of electro-magnetic field on plants*: The instrumentation was completed and the experimental work is in progress.

5.4 Crop Science

5.4.1 *Studies on the levo- and dextro-rotatory phenomenon occurring in plants and animals*: In *Hibiscus Cannabinus* Linn., a negative association exists between the foliar spirality and the activation of corolla. However, it is seen that fruits of better quality develop from the left-twisting flowers of left-spiralled plants and the right-twisting flowers of right-spiralled plants.

5.4.2 *Application of Mathematics to Biology*: The association of the Fibonacci system on the spirality of the shell curvature of the *Chambered Nautilus* was investigated.

5.4.3 Morphological and anatomical studies on young and adult palms of different species were continued.

Further investigation on behaviour studies of the Baya weaver bird was continued.

Seven papers were published and six papers sent for publication/read at conferences.

5.5 Embryology

(i) Investigation of lipid synthesis in different stages of embryonic development in *Limnaea*.

(ii) Investigation on the pheromones (i.e., scent used for intraspecific communication) of tigers.

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(iii) Further development of the process of immobilization of carbonic anhydrase B in polyacrylamide gel to minimize the leakage process of the enzymes from the gel by using DVC coating on demobilized enzyme.

(iv) Immobilization of the enzyme in ion exchange resin (DEAE-cellulose).

(v) Biomathematical investigation on cellular growth and growth control.

Five papers were published.

5.6 Entomology

1. Behaviour and physiology of mosquitos.

One research paper was published and three papers sent for publication.

5.7 Leaf Protein

(i) Statistically-designed experiments were carried out to establish the effect of fertilizer dose, harvesting time and seed rate on the total and fractionated L.P.C. (Leaf Protein Concentrate) yields in food crops, beet root, turnip and radish.

(ii) Preliminary experiments were carried out to estimate quantitative uptakes of NPK by water hyacinth.

(iii) Qualitative and quantitative analysis of left over fluid from cauliflower, mustard, turnip, radish and spinach are being conducted.

(iv) Work is being continued on various aspects of utilization of water hyacinth.

(v) A detailed report on the various aspects of utilization of water hyacinth was submitted to the State Planning Board by Sri S. Matai as the convener of the task force appointed for the purpose by the State Planning Board.

(vi) Work for isolation of organisms for proteolytic and lipase enzymes has been started recently.

Two papers were published and two papers sent for publication.

VI. SOCIAL SCIENCES

6.1 Demography

6.1.1 Analysis of couple particulars relating to various aspects of family planning (based on data from the Calcutta Fertility Survey, 1970).

6.1.2 Differential reporting of contraceptive practice by husband and wife (based on data from the Calcutta Fertility Survey, 1970).

6.1.3 Study of fertility pattern among literate and illiterate females (based on data from Calcutta Fertility Survey, 1970).

7.1.4 On methodologies for measuring demographic impact of family planning programme.

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- 6.1.5 Analysis of district level fertility in India (based on data from 1961 census).
- 6.1.6 Fertility and family planning survey in West Bengal districts around Calcutta, 1977-79.
- 6.1.7 Current evaluation of family welfare programme in West Bengal districts around Calcutta.
- 6.1.8 Study on collection of birth statistics.
- 6.1. Socio-psychological study on family size and family planning in Barasat, West Bengal.
- 6.1.10 Study of the effects of econo-demographic structure on fertility and mortality.
- 6.1.11 Study on internal migration in relation to the development of Indian economy.
- 6.1.12 Study on marriage patterns in Calcutta.
- 6.1.13 Generalization of stable population theory.
- 6.1.14 Two-sex population growth models.
- 6.1.15 Estimation of Indian fertility based on NSS reproductive history data.

Teaching

Specialization classes in demography with particular reference to census were conducted for four Maldivian trainees (sponsored by the United Nations Organisation) attending the course organised by the International Statistical Education Centre (ISEC), Calcutta, 3 May 1977-26 June 1977.

Five trainees of the I.S.E.C., Calcutta, underwent specialized training in demography, 1 February 1978-18 March 1978.

Specialisation training in demography was given to the statistical officer trainees.

Staff members participated in the teaching of demography in the B.Stat. (Hons.) and M.Stat. degree course.

The staff members had the following published: Papers published in journals : 5; papers sent for publication : 7; papers read at conference/published in conference proceedings : 9; technical reports : 12; and articles published in books : 2.

6.2 *Research in Economics and Econometrics*

6.2.1 Research in economics and econometrics was conducted in Calcutta and Delhi Centre of the Indian Statistical Institute, during the year.

6.2.2 The Economic Research Unit (ERU), Calcutta, conducted studies in applied economic problems, macro-economics, and problems of planning as well as methodological studies in mathematical economics and econometrics.

Besides teaching economics and econometrics in the B.Stat. and M.Stat. courses, the staff members also conducted the advanced course in economics leading to the Ph.D. Degree of the Institute.

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6.2.3 The major research projects in Calcutta were the following :

(i) *Study on Wage Differentials* : The work relating to the measurement of inter-regional wage differences on the basis of data published by Labour Bureau, Simla, was completed for the years 1961-71. The tabulation and measurement of inter-regional and inter-industrial wage differences for the years 1961-72 from unpublished data collected specifically for this study from the Labour Bureau was partially completed.

(ii) *Study on Labour Mobility of Workers in Engineering Industry* : Preliminary work relating to the sampling of a survey on the mobility of industrial workers in the engineering industry in Greater Calcutta has been started.

(iii) *Study on Utilisation of Energy Resources* : An analysis of energy accounting method and its economic implications was made in a discussion paper. The work for a review of the power position in West Bengal over the past decade was undertaken.

(iv) *Economics of Power Generation* : A study is on progress on the economics of thermal and nuclear power generation in India. The objective of the study is to critically examine the policy for use of nuclear energy for power generation in the context of growing demand for power in the country.

(v) *Firewood Forestry* : The adverse effects on forests from the free collection of firewoods in the rural areas were noted. A study was undertaken to examine the feasibility of afforestation with quick growing species and the economics of such a programme.

(vi) *Macro-econometric Model for India* : Further progress was made in the collection and analysis of data relating to India's export trade for the period 1964-76. Detailed investigations were also made into the principles and practices of price fixation of agricultural products by the Agricultural Price Commission.

(vii) *Study on Agrarian Relations* : Preliminary work relating to the study of agrarian relations is nearing completion. All the schedules of the eighth, sixteenth and seventeenth rounds available at Calcutta were located. Sixteenth and seventeenth round schedules relating to four States were serially arranged and are now ready for tabulation.

6.2.4 The activities of the economists in the Delhi Centre are noted below :

V. K. Chetty is engaged in the (i) formulation of economic models in which prices of commodities are not fully flexible; and (ii) formulation of a planning model with administered prices and rationing for a monetary economy.

S. K. Jain has been investigating into the problems connected with the stability of social decision rules and the consistency of social decision functions in the theory of social choice.

S. M. Kansal has been studying the changes in the levels of living in India during 1960-61 to 1975-76. The study is expected to be completed by the end of July 1978.

O. Ramaswami continued her research on International Trade.

M. E. Saluja has completed the compilation as well as the report on the Input-Output Table for India, 1970-71. This report is expected to be incorporated in a monograph being

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prepared to examine the changes in the structure of the Indian economy over the period 1964-65 to 1970-71. A report on the problem of methods of construction of I-O Tables and their application has also been completed. He was also engaged in the working of capital output ratios. This work is near completion.

K. Saradamoni has been examining the socio-economic conditions of agricultural labour in Kerala *vis-a-vis* other socio-economic classes to study the level of poverty and inequality at the village level. Two field studies were undertaken in Kerala—one in a predominantly coconut area, which has already been completed; and the other in a paddy area, which is being conducted. Other areas of research relates to 'Development and its impact on women'.

K. L. Sehgal continued the study of the changing structure of district-level agricultural growth in Punjab and Haryana since 1900.

A. N. Sharma is involved in a case study of Haryana in relation to the market centres and spatial development.

H. C. Sharma has been working on the relationship between trade strategies and employment pattern in collaboration with V. R. Panchamukhi of the T.D.A. The work involves estimation of ERP's at sector levels, identifying labour content (in the production induced) of exports by sectors, in different directions of trade.

L. R. Jain continued his research in the general area of consumer behaviour. He collaborated with S. D. Tendulkar on the ICSSR project mentioned below.

S. D. Tendulkar is involved in a two-year research project sponsored by the ICSSR on "An alternative plan with the basic social objective of ensuring the minimum levels of living to the poor as core." The work on this project started on 1 November 1977. He is also working on a paper, 'Economic Inequality', which is likely to form a part of a book entitled 'Aspects of Inequality in India' edited by Professor Andre Beteille, Department of Economics, University of Delhi.

6.2.5 Regional Planning

L. S. Bhat is involved in a regional study of Goa. He is also working on a two-year ICSSR-sponsored project—A case study of North Kanara District (with B. N. Das and A. N. Sharma). He has also been participating in developing a regional and district planning framework for the State of Uttar Pradesh in collaboration with the State Planning Institute, Lucknow. Dr. Bhat supervised (i) the work of two students working for Ph.D., and (ii) the preparation of a dissertation entitled 'A Rural Development through Growth Centres'. Dr. Bhat organised a workshop of geographers on Block Level Planning.

Fiftyfour seminars were organised in the Delhi Centre during the year.

The economists in Calcutta had (i) Published papers : 5; (ii) Papers sent for publication : 7; (iii) Papers presented at conferences/published in conformance proceedings : 5; technical reports/discussion papers : 6. Nine seminars/lectures by visiting scientists and members of the staff were organised.

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6.3 Linguistic Research

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

6.3.1 The study of the phonetic structure of Indian languages and the application of results in the area of speech pathology, teaching of second language and the cultivation of the mother tongue.

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

6.3.2 Problems relating to the structure of meaning. Research is being conducted on the behaviour and stability of speech sounds.

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

6.3.4 *Training* : A six-month theoretical training course on the education of the hearing-impaired was conducted in Calcutta, 1 July 1977-31 December 1977. Practical training for three months was conducted till 31 March 1978.

A One-year Diploma Course in Speech Pathology has been proposed for introduction in the Indian Statistical Institute, and the Osmania and Delhi Universities.

Audiometric tests were carried out in the Unit throughout the year. Cases have been referred from hospitals, clinics and schools for the deaf.

6.3.5 Publications

(i) English Pronunciation for Bengali by Djordje Kostic and Alokananda Mitter. (in preparation for publication).

(ii) English Speech Sounds for Hearing-Impaired Children (for Indian standards) by Djordje Kostic and Alokananda Mitter (in preparation for press).

(iii) A Short Outline of Punjabi Phonetics. *Co-authors* : Mrs. Vaishna Naraug, Central Hindi Institute, Delhi and Dr. R. N. Srivastava, Delhi University (first draft under discussion).

(iv) Basic Principles of Speech Habilitation of Hearing-Impaired Children by Djordje Kostic, Indian Statistical Institute, pp. 16.

Three technical papers were prepared during the year by Professor D. Kostic.

6.4 National Income Research

6.4.1 Studies on national accounts with some emphasis on preparation of component tables of regional accounts for West Bengal were continued along with the preparation of indicators of development for this State. A paper was prepared on the basis of the preliminary results of this study.

6.4.2 An investigation was completed on the distribution of income and amenities amongst categories of occupations in the Central Government services. This is the part

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of the new study on the distribution of income amongst different earners in various industry-occupation categories which was taken up during the year.

6.4.3 A report was completed on the variation in the pattern of cash and kind expenditure and index of monetization in rural India by States and regions on the basis of National Sample Survey (NSS) eighteenth round (February 1963-January 1964) consumption expenditure data.

6.4.4 The work on the shifting and incidence of indirect taxes through Leontief's input-output model, undertaken last year, was completed.

6.4.5 NSS data on consumer expenditure are being increasingly used by researchers and planners for various purposes including planning and policy making at regional and national levels. Grave doubts, have, however, been expressed on the validity of such data. It is, therefore, felt desirable that we take a close look at NSS household budget data and try to assess its quality in depth by undertaking an analysis of the errors associated with such data. Such an attempt was made in a paper while analysing NSS eighteenth round (February 1963-January 1964) data on consumer expenditure from the point of view of variation in prices of items consumed by households, between urban and rural areas of the country and between different States in the rural areas.

6.4.6 Professor A. Rudra finalised the manuscript of the book, *Quantitative Studies in Agricultural Economics* and submitted it for publication to the Indian Council for Social Science Research (ICSSR). This book was prepared in fulfilment of the terms of his fellowship of the ICSSR. Along with Professor P. K. Bardhan, he also studied the interlinkage of land, labour and credit relations.

One paper was published in a scientific journal, two papers sent for publication and four papers read at conferences/published in conference proceedings.

6.5 Pre-Census Population Studies

The Pre-Census Population Studies Unit (P.O.P.S.U.) continued the undermentioned research projects during the year :

6.5.1 *Pre-Census Population of India* : The purpose of the project, sponsored by the Registrar-General, India, is primarily to collect materials bearing on population and allied socio-economic variables. A part of a volume containing data (1811-1920) on the Eastern Region, has been finalised and is being edited for publication.

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 on the finalisation of a draft volume was continued.

6.5.4 *Analytical studies on historical data* : The purpose of the studies is to trace changes in society during the last two centuries on a quantitative basis and to ascertain the deficiencies of historical data.

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The undermentioned topics are now being studied :

- (a) Economy of Bengal, 1750-1800.
- (b) Socio-economic changes in 20 villages of Aligarh district.
- (c) Socio-economic changes in Ballavpur village, Birbhum, West Bengal.

One paper was published, four papers read at conferences/published in conference proceedings, two articles published in books, and two technical notes prepared.

6.6 Psychometry

6.6.1 *Usefulness of aptitude, achievement and personality variables in industrial selections* : Technical assistance was provided by the Psychometric Research and Service Unit (PRSU) to organisations in the public sector in selection and promotion. The utility of the procedure has to be assessed through follow-up studies. The PRSU is at present engaged in the collection of long-term validity data for selections made about seven years ago. Data have been collected from such organisations and experimental studies conducted in this connection are being analysed.

6.6.2 *Neuroticism, environment and delinquency* : Data collected earlier about delinquent and alum children are being analysed intensively. The final phase of the analysis is being conducted.

6.6.3 *Personality pattern and success* : In course of the technical assistance mentioned above in 6.6.2, data on personality traits were collected from different groups of applicants. The cluster analysis of the data are in progress.

6.6.4 *Biographical information, scholastic achievement, and job success* : It has been observed in foreign countries that certain biographical and environmental factors are significant determinants of success in different fields of life. A study was undertaken to ascertain the corresponding status in India. Some data have been collected.

6.6.5 *Popular conceptions of mental health* : The aim of the study was to survey popular opinion and attitudes regarding mental health problems, and to compare them with the views of experts in the field. Data for a pilot study were obtained from a sample of Institute employees and a number of experts. A seminar on preliminary results was given.

6.6.6 *Studies on creativity* : The aim of the study was to examine the relationship between creativity (divergent thinking), reasoning and some personality variables among high school students. Data collected from six schools are being processed.

6.6.7 *Serum uric acid and achievement motivation* : The aim of the study was to investigate the relationship, if any, between the level of uric acid in blood and achievement motive. Data were collected in collaboration with the Biometry Unit. The first phase of data collection has been completed and data are being processed.

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.

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6.6.9 *Locus of control and family planning* : A preliminary investigation has been undertaken to study the relationship between internal-external locus of control, family planning behaviour (knowledge-attitude-practice) and demographic variables. Data have been collected as part of the Family Planning Survey being conducted by the Demography Research Unit. Tabulation of the data is going on.

6.6.10 *Service* : The PRSU took part in the selection programmes within the Indian Statistical Institute and for outside organisations, mainly in the public sector and for educational institutions. As a previous years, tests were conducted on behalf of the Educational Testing Service, Princeton, and Psychological Corporation, U.S.A.

Four papers were published in scientific journals.

6.7 *Sociology*

6.7.1 *Social sciences research projects and problems : an inventory/study* : The objective is to prepare an inventory of social science research projects/studies being conducted in the contemporary situation; to ascertain the problems faced by the social science researchers (in universities and research institutions) in producing data and to suggest some measures for their solution. The field work of the project is continuing.

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

6.7.3 *Socio-economic structure and change in some selected villages of Birbhum, West Bengal* : The first phase of field work which is a repeat survey to compare data collected by Professor P. C. Mahalanobis at Sriniketan, in 1937, was completed during 1976-77. A working paper was prepared. The rest of the survey materials are being analysed.

6.7.4 *Study of pilgrim centres : a comparative study of Hindu pilgrims and their pilgrimage activity in eastern India* : The study aims to examine the structure of spiritual traditions and also to (i) identify social groups along with relevant dimensions, and (ii) examine the nature of inter-connections between the social group traditions of pilgrimage in the contemporary period. Data relating to 300 pilgrims, collected from Puri, are now being analysed. The field survey and analysis of data relating to Tarakeswar was completed and the report is being prepared.

6.7.5 *Inequality in a Third World State* : The concepts and measures of inequality-inequality of Indian situation. Twin concepts, inequality and social mobility, have emerged as important sociological fields of enquiry in India. A brief outline of the project was prepared and the preliminary field work has been started.

6.7.6 *Socio-cultural and biological adaptation in contrasting eco-systems* : This is a collaborative survey scheme between the Sociological Research Unit and Anthropometry and Human Genetics Unit of the Indian Statistical Institute, Calcutta. A brief survey was made in some of the sub-Himalayan regions. Taped-recorded interviews and observations are now being processed for preparing working papers.

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6.7.7 *Law, society and change—a case study of the Indian situation during 1947–1964, (Nehru era of Indian politics)* : The study proposes to undertake an in-depth enquiry as to the extent law has been able to play its appointed role as an agency of social engineering in the Indian context. The project will be based partly on bibliographical data and partly on interviews and field-inquiries. The field inquiry and interviews are being conducted.

6.7.8 *Field research in various (e.g., socio-religious-economic) 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.

(b) Sample survey in certain backward tribal areas in Palamau district (Bihar) and Sundarbans area (West Bengal). The field work in the Palamau region has been started.

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

6.7.9 *Violence as a tool of change in Indian polity : 1857—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 elections 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 first phase of the field work was completed. A seminar on the study was taken by Dr. Partha N. Mukherji of Jawaharlal Nehru University, an ICSSR Fellow.

6.7.11 *Publications* :

Indo-British Cultural Confrontation : Gooroodas Banerjee and His Time by Bhola Chatterjee (in press).

Nine papers were published, three papers sent for publication, one paper read at a conference, and one technical note was prepared.

VII. STATISTICAL QUALITY CONTROL AND OPERATIONS RESEARCH

The Statistical Quality Control and Operations Research (SQC & OR) Division was set up in 1952 with the financial support of the Government of India with the objective of promoting SQC & OR in Indian industry and undertaking education, training and research in the tools and techniques for improvement of industrial productivity and quality of products manufactured in India. The Division has at present 11 centres in various parts of the country. It has 55 specialists with expertise in the application and development of quality, reliability and operational research. The Division has been handling over 20 new projects, apart from servicing about 60 factories to help them in the establishment of quality assurance divisions.

The Division has so far trained over 21,000 managers and technologists, scientists and operators, produced over 500 specialists and published about 425 research and application papers in the field. Heavy electricals and electronics, engineering, precision tools, drugs,

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pharmaceuticals, chemicals and textiles are some of the industries covered by the education and training and special studies aimed at the improvement of quality and economic control of manufacture.

Service : The development of quality assurance manuals covering both manufacture and field operations of power plants was another major activity of the Division. The manuals were extremely useful in undertaking quality assurance and reliability checks of various hardware and erection, cover activities in power plants of 200, 235, 120, 60 and 30 mg. watt capacities. In order to implement the manuals, large-scale training was undertaken in all the manufacturing plants of Power Project Division, Bharat Heavy Electricals Ltd. Live examples drawn from the field were presented and 1,100 engineers and others received such training.

Arising out of the efforts of the Institute, the National Thermal Power Corporation (NTPC), another important organisation in the public sector, set up a Quality Assurance Division in order to monitor quality assurance programmes in contractors' organisations. Singrauli and Korba power projects are covered by intensive quality assurance systems drawn up by the NTPC in consultation with the specialists of the Institute.

The design and analysis of experiments received fillip with a number of interesting applications which were undertaken to cover electrical motor insulators and switch gears manufacture. Special Orthogonal Array techniques received widest support and appreciation for continuing applications. Special lectures and training programmes were conducted for engineers and technologists in these selected industry groups.

Promotional efforts were intensified in a number of ancillary and other industries concerned with the supply of spare parts for power plants and utilities. Seminars and training courses were conducted for managers and engineers drawn from such organisations.

The Division serviced about 60 factories during the year and handled over 20 projects. One hundred eightyone technical reports were sent to various member plants including a few special study reports on projects undertaken for useful cost reduction, quality and output improvement in a number of factories.

Education and Training : 2316 engineers and managers were trained in 27 in-plant courses. The special feature of the year was the diversification in the training programmes offered in some of the centres—Pune, Madras and Bangalore. The courses on reliability engineering, orthogonal array designs, and industrial experiments attracted active interest from some of the premier organisations. Operative training was another useful programme appreciated by a number of factories.

One hundred thirty-six persons underwent professional training at the post-graduate level in courses at Madras, Bombay and Calcutta and at the certificate course in Bangalore. Training was also imparted to 41 students of the M.Stat. third-year course with specialisation in SQC & OR in Calcutta and Delhi.

The training of trainers specially to suit efficient power plant operations is a unique programme implemented by the Division during the year.

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Thirty engineers from manufacturing plants of steam turbine generators, boilers, motors, feed pumps and the switch gear and the other auxiliary power plant systems were given intensive training and on-the-job development in quality assurance, reliability and operations research. The training is for one year and after completion of the first programme, the field training commenced in various manufacturing plants.

Promotion : The Division organised a number of seminars, symposia and special lectures and talks to popularise quality, reliability and operations research in the country.

The Seventh National Conference on Quality Control was organised in New Delhi, 19-21 December 1977 and 525 delegates participated.

The Division also organised in collaboration with the Operational Research Society of India, a convention on Operations Research, 20-25 December 1977, New Delhi, to discuss the latest techniques and trends in operation research.

Promotional visits were paid to 68 plants. Twenty-six pilot studies were completed and 28 reports were sent to factories.

Research : Twentyone papers were published in journals and 8 were sent for publication. Thirtyseven manuals and technical reports were produced by staff members during the period. Three staff members were awarded Ph.D. degrees.

Some of the areas in which research work is carried out include linear complementary problems with X-matrices, deterministic shop sequencing problems and Bayesian single sampling 3-decision plan as well as problems of rotor balancing.

VIII. LIBRARY, DOCUMENTATION AND INFORMATION SCIENCES

1. *Library* :

1.1 The most important event during the period was the shifting of the Central Library from the old premises to the new Library Building.

With the addition of 4,744 new books and 3,020 bound volumes, the total collection of the Central Library at Baranagar rose to 1,50,008 volumes at the close of the year. The library has also a collection of 33,962 reprints, 3,75,000 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.

1.2 *Acquisition* : Four thousand two hundred and twentyeight books were accessioned during the period.

1.3 *Technical Processing* : The Library classified and catalogued 3,261 and 4,744 books respectively. Three issues of the *Quarterly Bulletin* (classified list or current additions to the library) were brought out during the period.

Professor W. A. Shewhart's collection of 3,086 books and 571 reprints were classified and catalogued within the stipulated period of six months. The collection has been kept in a separate sequence.

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1.4 *Periodicals* : The library received 2,570 periodicals during the year, of which 778 were received through subscription, 921 on exchange and 880 on a complimentary basis.

1.5 *Membership* : The total membership of the Library during the period was 2,910, the break-up of which was as follows : General members including staff, research scholars, students and guests : 2354; student members (outside) : 471 and Institute Members : 85. Altogether 659 persons were given special permission to use the reading room.

1.6 *Documentation Service* : The Documentation Unit prepared the following three bibliographies ; (i) A select bibliography on nutritional surveys based on ISI collection, (ii) A select bibliography on nutritional surveys based on ISI collection, (iii) A select bibliography on nutritional surveys—supplement, and (iv) A select list of articles on nutritional surveys. The publication of the *Index to Statistical Literature* (April 1976–March 1977) was resumed.

The following work on the preparation of bibliographies was in progress : (i) wage structure and wage differentials; (ii) selected articles on energy, published in journals; (iii) books on computer science available in the ISI Library, and (iv) a list of periodicals on computer science with their holdings, available in the ISI Library.

1.7 *Photographic and Reprographic Services* : The Photographic Unit prepared 7,060 pages of microfilm negatives from documents, 5,711 photoprints, 3,913 bromide enlargements and 1,100 pages of microfiche, and also a large number of photographs of scientific subjects, specimens and functions held in the Institute.

The Reprography Unit prepared 15,231 pages of prints from documents, books and periodicals by Xerographic process and reproduced 3,015 copies of prints by offset printing process (Rotaprint).

1.8 *Translation Services* : The Translation Unit provided English translations of two documents, of which one was from Russian (*Limit Theorem* by V. A. Statutiarichys) and one from Japanese (*Contribution to Multivariate Analysis*, ed. by Professor T. Kitagawa).

1.9 *Reports and Records* : One thousand and fifteen reports and data books were accessioned and 217 research papers, published in the *Sankhyā*, were indexed at the Reports and Records Unit. Altogether 4,307 volumes were processed and shelved according to the new classification scheme.

1.10 *Collection of Special Materials* : The Special Materials Unit accessioned 466 Russian books and processed 176 books.

1.11 *Circulating Library* : The Workers' Circulating Library had a collection of 28,280 books. Eight hundred and fifty books were added to the Circulating Library which issued 39,580 books during the period.

1.12 *Delhi Library* : During the year, 2910 books and periodicals were issued to members and 80 outsiders consulted the library. In the exchange with other libraries, 90 titles were loaned from 18 libraries and 60 titles were booked out to outside libraries.

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Other figures were : (i) Periodicals acquired : 150 foreign and 50 Indian titles, (ii) Books acquired : 990; (iii) Books/bound volumes accessioned : 1900; (iv) Back-run of periodicals received : 3916; (v) Binding completed : 600 periodicals and 770 books; (vi) Xeroxed : 2140.

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

2.1 *Training* : Eleven candidates were admitted to the 1977-79 course in Documentation and Information Science which commenced on 1 August 1977.

2.2 The main subjects of research in documentation and information science which formed the basis of several scientific papers were :

- (i) Computer-based Information System.
- (ii) Thesaurus Construction.
- (iii) Classification and Indexing.
- (iv) Information Systems and Services : Planning.
- (v) Study of National Information Systems and Programmes for Science and Technology.
- (vi) Publication of Research Papers—difficulties encountered by scientists.

2.3 Seminars and Workshop

(i) The Second Workshop on Selective Dissemination on Information, Secunderabad, 5-10 September, 1977, was sponsored by the DRTC and Bharat Heavy Electricals Ltd. to train information analysis.

(ii) Seminar on Patent Documentation and Information Services, Bombay, 1-3 December, 1977, was conducted by the DRTC in collaboration with the Indian Institute of Technology, Bombay and the Patent Office, Bombay and sponsored by the Department of Science and Technology, Government of India.

2.4 Collaboration and Consultation Work

(i) At the request of the Research and Development Division, Bharat Heavy Electricals Ltd., Hyderabad, the DRTC prepared the course material for a User-Orientation Course on Industrial Information.

(ii) The fourth training course on Documentation and Information Services, sponsored by the Department of Science and Technology, Government of India in collaboration with the Indian National Scientific Documentation Centre, was held in New Delhi, 28 March 1977-30 April 1977. The DRTC faculty members participated in the teaching programme.

(iii) At the request of the Indian Institute of Technology, Bombay, the DRTC undertook the completion of a bibliography of documents available in the libraries of research and academic institutions in Bangalore on Technology Assessment and Alternative Technology.

(iv) The DRTC continued to collaborate with the Sarada Ranganathan Endowment for Library Science in the publication of the quarterly journal, *Library Science with a slant to documentation*.

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(v) Advisory service was provided to international organisations like the Regional Centre for Science and Technology (Economic and Social Commission for Asia and the Pacific), Bangalore and public sector establishments in Bombay, Bangalore, Lucknow, Madras, Mysore, Ranchi, Secunderabad and Waltair.

2.5 *Publications* : (i) Volume of papers, DRTC Annual Seminar (15), Bangalore, 5-9 December 1977, pp. 500 (mimeographed).

2.6 *Research papers* : (i) Papers sent for publication : 5; (ii) Papers presented at conferences : 28; (iii) Technical Reports prepared : 2.

IX. CONFERENCES, SYMPOSIA AND SEMINARS

Among different conferences, symposia, seminars and workshops organised by the Indian Statistical Institute or in collaboration with other scientific organisations were the following :

United States-India Seminar on Information Science Education, Bangalore, 18-22 July 1977 : The seminar, sponsored by the Government of India, was organised by the Documentation Research and Training Centre of the Indian Statistical Institute at Bangalore. Professor A. Neelamegham (DRTC) was the leader of the Indian delegation.

Annual Seminar, Documentation Research and Training Centre, Bangalore, 5-9 September 1977 : About 80 documentation officers and librarians participated. Twenty-one papers on the following themes were discussed (a) Classification and indexing in the social sciences, and (b) Information for development planning.

Third Meeting, Directors of the International Statistical Education Centres, Calcutta, 28-30 November 1977 : The meeting was held under the auspices of the International Statistical Training Institute and the Indian Statistical Institute. In addition to two separate sessions, there was a joint session with the Fifth Round Meeting on the Teaching of Statistics. Thirty-six Directors participated.

Fifth Round Table Meeting on Teaching of Statistics, Calcutta, 30 November-2 December 1977 : The meeting was held under the auspices of the International Statistical Institute and the Indian Statistical Institute. In addition to two separate sessions, there was a joint session with the third meeting of Directors of International Statistical Training Institutes. There were 34 participants from different countries.

Forty-first Session, International Statistical Institute, New Delhi, 5-15 December 1977 : The conference, organised by the Government of India in close collaboration with the Indian Statistical Institute, was inaugurated by Shri Morarji Deesai, Prime Minister of India. Four hundred and thirty-seven foreign scientists from different parts of the world and 286 Indian scientists attended the session. Fifty-one sessions on theoretical and applied statistics and allied subjects were held and nearly 300 invited and contributed papers were presented.

Regional Meeting, Institute of Mathematical Statistics, New Delhi, 16-18 December 1977 : The meeting, jointly sponsored by the Institute of Mathematical Statistics and the

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Indian Statistical Institute, was attended by 133 foreign and 81 Indian scientists. Forty-seven delegates participated in the nine invited sessions. Over 100 invited and contributed papers were presented and 10 special lectures were given.

Seventh National Conference on Quality Control, New Delhi, 19-21 December 1977 : The conference, organised by the Statistical Quality Control Division of the Indian Statistical Institute, was inaugurated on 19 December 1977 by Shri Mohan Dharis, Minister of Commerce, Civil Supplies and Co-operation, Government of India. Shri P. N. Haksar, Chairman, I.S.I., gave the introductory speech and Dr. G. Kallianpur, Director, I.S.I., welcomed the delegates who numbered about 525.

A unique feature of the conference was a whole-day session held on 21 December to discuss integrated quality assurance systems in the power industry. There was broad participation of the delegates in the question sessions following the nineteen key-note addresses by eminent professionals and leaders in the field.

Conference on Operations Research, New Delhi, 20-23 December 1977 : The Indian Statistical Institute sponsored the conference with special reference to public utilities in collaboration with the Operations Research Society of India.

Seminar for Teachers of Deaf Children, Calcutta, 5 March 1978 : The invitational seminar, sponsored by the Indian Statistical Institute, was conducted by Visiting Professor D. Kostic, Director, Institute for Experimental Phonetics and Speech Pathology, Belgrade, on the following three topics : (i) Classification of hearing-impaired children in five groups, and the characteristics of each group, (ii) Selective Auditory Filter Amplification and its efficiency in the treatment of certain groups of hearing loss, (iii) Types of audiometry : the relevance of phonetic audiometry to speech habilitation.

X. PUBLICATIONS

The following 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. 38, Parts 1, 2, 3 & 4; Vol. 39, Parts 1, 2, 3 & 4.

Series B : Vol. 38, Parts 1, 2, 3 & 4; Vol. 39, Parts 1 & 2.

Series C : Vol. 38, Parts 2 & 4; Vol. 39, Parts 1 & 3.

(ii) *Technical Reports* : Thirty-nine Technical Reports were issued in the Theoretical Statistics and Mathematics Division.

XI. SOCIETY-TYPE ACTIVITIES : BRANCHES

1. Karnataka Branch

1.1 *Membership* : There were 51 members at the end of the year (Life members : 19; Institutional members : 6; and Ordinary members : 26).

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1.2 Surveys :

(i) At the request of the Karnataka Small-Scale Industries Association, the Karnataka Branch had earlier furnished a frame-work for conducting a survey of small-scale industries in the Bangalore Metropolitan area. Revised proposals for a more limited survey were forwarded in accordance with their request.

(ii) At the request of the National Association for the Blind, Karnataka State Branch, a detailed proforma for an information survey for organising and to rehabilitate the blind was drawn up and sent to them.

1.3 Karnataka State : Sixth Five-year Plan, 1979-1984 :

A plan was drawn up to organise a seminar to consider the statistical exercises required in connexion with the preparation of the Sixth Five-year Plan, Karnataka State, identifying the gaps and suggesting how these may be filled.

1.4 Lectures : The undermentioned lectures were arranged under the joint auspices of the Officers Association of the Bureau of Economics and Statistics and the Karnataka Branch :

(i) Shri B. V. S. Rao, Chief Electrical Engineer (Retd.), Western Railways, 24 August 1977. *Lecture* : Urban transportation.

(ii) Dr. N. Somesekhara, Department of Industrial Engineering, Indian Institute of Science, Bangalore. *Lecture* : Planning and development of Karnataka.

(iii) Dr. P. V. Sukhatme, former Chief, Statistics Division, F.A.O. *Lecture* : Concept of poverty line.

(iv) Dr. K. Srinivasan, Director, Population Centre, Indian Population Project, Bangalore. *Lecture* : Population policy in India.

1.5 *New Programme of work and development* : In a meeting with members of the Branch, Professor G. Kallianpur, Director, Indian Statistical Institute, explained the plans to introduce new research programmes in Bangalore and also to develop the campus at the ISI land in Bangalore for development of the existing and new activities.

Among the areas of research proposed by Professor Kallianpur were the following :

- (i) Control theory, including not only engineering but also eco-biological problems;
- (ii) Reliability theory and Operations Research;
- (iii) Statistical Quality Control;
- (iv) Design of Experiments and Sample Surveys;
- (v) Information and Communication Theory; and
- (vi) Numerical Mathematics and Automata Theory.

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XII. LIST OF SCIENTIFIC PAPERS AND PUBLICATIONS

12.1 *List of Papers Published*

A. THEORETICAL STATISTICS AND MATHEMATICS

1. BABU, G. J. (1977) : Some results on the distributions of additive arithmetic functions. *Sankhyā, A*.
2. CHATTOPADHYAY, A. K. (1977) : Effects of non-normality on four test criteria for testing equality of two covariance matrices. *Sankhyā, B*, 39, 45-56.
3. — (with Bandyopadhyay, S. and Kundu, S. C.) (1977) : On estimation of population total. *Sankhya, C*, 39, 28-42.
4. GHOSH, J. K. (with Bhattacharya, R. N.) (1978) ; On the validity of the formal Edgeworth expansion. *Ann. Statist.* 6, 434-451.
5. — (with Sinha, B. K. and Sinha, B. K.) (1977) : Multivariate power series distributions and Neyman's properties for multinomials. *J. Multivariate Analysis*, 7, 3, 397-408.
6. GHOSH, M. (with Babu, G. J.) (1978) : A random functional central limit theorem for martingales. *Acta Math. Acad. Sci. Hungary*, 27, 301-306.
7. — (with Arnold, B.) (1978) ; A characterization of geometric distributional properties of order statistics. *Scandinavian Acta J.*, 232-234.
8. — (with Meeden, G.) (1977) : On the non-attainability of Chebychev bounds. *Am. Statist.*, 3, 35-36.
9. — (with Babu, G. J.) (1977) : Probabilities of moderate deviations for stationary mixing processes. *Ann. Prob.*, 5, 232-234.
10. — (with Meeden, G.) (1977) : Admissibility of linear estimators in one parameter exponential family. *Ann. Statist.*, 5.
11. JAIN, L. R. (1978) : An empirical evaluation of the system of indirect addilog Engel Function. *Sankhyā, C*, 38, 4, 106-107.
12. MITTA, S. K. (1977) : Matrix equation $AXB + CXD = E$. *SIAM. J. Appl. Math.*, 32, June, 823-826.
13. — (with Khatri, C. G.) (1977) : Some converses of the Gauss Markov Theorem. *Gujarat Statistical Review*, IV, 2, October, 51-80.
14. PARTHASARATHY, K. R. (1977) : Central limit theorems for positive definite functions on Lie groups. *Symposia Mathematica*, 21, 245-250.
15. RAO, A. R. (with Borge, C.) (1977) : A combinatorial problem in logic. *Discrete Mathematics*, 17, 23-26.
16. RAO, B. L. S. P. (1977) : Whittle's inequality in Hilbert Space. *Teor. Verovatnost. Mat. Statist.*, (in Russian), 16, 102-107.

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17. RAO, B. L. S. P. (1977): On a characterisation Gaussian measures on locally compact abelian groups. *Matem-Zametki*, (in Russian), 22, 761-765.
18. — (1977): Berry-Essen bound for density estimators of stationary Markov processes. *Bull. Math. Statist.*, 17.
19. — (1977): On the rate of approximation in the multidimensional central theorem. *Lietuvos Matem. Rinte*, 17.
20. RAO, K. P. S. B. (with Rao, B. V. and Rao, M. B.): Subsequences, subsequies and rearrangements. *Proc. Am. Math. Soc.*
21. RAO, S. B. (1977): Characterisation of forcibly line graphic degree sequences. *Utilitas Mathematica*, 11, 357-366.
22. — (1977): Cycles in self-complementary graphs. *J. Combinatorial Theory*, 22, 1-9.
23. — (1977): Characterisation of self-complementary graphs with 2 factors. *Discrete Mathematics*, 17, 225-235.
24. — (with Bhat-Naynk, V. N. and Naik, R. N.) (1977): Frequency partitions: Forcibly pancyclic and forcibly non-Hamiltonian degree sequence. *Discrete Mathematics*.
25. — (with Ravindra, G.) (1977): A characterization of perfect total graphs. *Ind. J. Math. Phy. Sci.*, 11, 25-26.
26. RAO, T. J. (1977): Optimum allocation of sample size and prior distributions—a review. *Inter. Statist. Review*, 45, 173-179.
27. — (1977): Estimating the variance of the ratio estimator for the Midzune-Sen sampling scheme. *Metrika*, 24, 203-208.
28. — (with Reddy, V. N.) (1977): Modified PPS method of estimation. *Sankhyā*, C, 39, 185-197.
29. — (with Ramachandran, G.) (1977): Probability proportional to size sampling strategy. *Bull. Inter. Statist. Inst.*, 41 Session, 410-412.
30. — (1977): Estimation of change in proportions. *Bull. Inter. Statist. Inst.*, 41 Session, 418-421.
31. — (1977): Review of "Case Studies in Sample Design" by Rosander, A. C. *Aust. J. Statist.*, 10, 158-160.
32. SIKDAR, K. (1977): On topological machines. *J. Computer and Systems Sci.*, 14, 17-48.
33. SINGH, K. (1977): On relative efficiencies of L -estimators. *Sankhyā*, B, 39.
34. SINHA, B. K. (with Wicand, J. S.): Bounds on the efficiencies of four commonly used nonparametric tests of location. *Sankhyā*, B, 39.

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35. SINGHA, B. K. (with Wicand, J. S.) (1977): Multivariate nonparametric tests of independence. *J. Multivariate Analysis*, 7, 4, 572-583.
36. SITARAM, A. (1978): Positive definite distributions on KG/K . *J. Functional Analysis*, 27, 179-184.
37. TRIPATHI, T. P. (with Das, A. K.) (1977): Admissible estimators for quadratic forms in finite populations. *Bull. Inter. Statist. Inst.*, 41 Session, 132-135.

B. ANTHROPOMETRY AND HUMAN GENETICS

1. BASU, A. (with Mazumder, P. P.) (1977): A note on methods of estimation of ridge counts on "missing" finger. *Mitt. Anthrop. Ges. Wien.*, 107, 26-31.
2. MALHOTRA, K. C. (with Haydon, R. M.) (1977): Dispute processing among a group of non-pastoral nomads: the Nandiwallas. *The Eastern Anthropologist*, 31, 111-132.
3. — (1977): A nomadic caste-cluster in a new culture setting: a study in culture adaptation. *D. D. Kosambi Commemoration Volume*, (Banaras Hindu University), 298-308.
4. — (1977): Serological and biochemical investigations among five endogamous groups of Delhi. *Ann. Hum. Biology*.
5. — (1978): Morphological composition of the people of India. *J. Hum. Evol.*, 7, 45-54.
6. — (1978): Gene differentiation among the Dhangar caste-cluster of Maharashtra, India. *Hum. Hered.*, 28, 26-36.
7. — (1978): Variation in allele frequencies among caste-groups of the Dhangars of Maharashtra, India: An analysis with Wright's FST statistics. *Ann. Hum. Biol.*, 4, 275-280.
8. MURHERJEE, B. N. (with Das, S. K., Malhotra, K. C. and Kati, S. L.) (1977): Sickle cell trait, haemoglobin variants, G-0-PD deficiency and colour blindness amongst the Santals of Hooghly, West Bengal. *Science and Culture*, 43, 264.
9. — (with Das, S. K., Malhotra, K. C. and Das, S. R.) (1977): Haptoglobin and acid phosphatase gene distributions in Dhangars of Maharashtra, India. *J. Genetics*, 63, 39-44.
10. — (with Das, S. K., Malhotra, K. C. and Majumder, P. P.) (1977): A note on Esterase D polymorphism in some Indian populations. *Hum. Hered.* 27, 393-395.
11. PAKRASI, KANTI (with Halder, A.) (1977): The study of family health in India: a prospective view. *Indian Medical Journal*, 71, 7 & 8, 102-103, 119-120.

C. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. BANDYOPADHYAY, SHIBDAS (with Chattopadhyay, A. K. and Kundu, S. C.) (1977): On estimation of population total. *Sankhyā*, C, I.

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2. BANDYOPADHYAY SHIBDAS (with Dasgupta, S.) (1977): Asymptotic expansions of the distributions of some classification statistics and the probabilities of misclassification when the training samples are dependant. *Sankhyā*, B, 1,
3. — (1977) Probability inequalities involving estimates of probability of correct classification using dependent samples. *Sankhyā*, B, 2.
4. BOSE, TAPAS KUMAR (1977): Onset of alkaline phosphatase synthesis during the embryonic development of *Lymnaea* Sp. *Indian Experimental Biology*, 15, 7, July, 554-555.
5. CHAUDHURI, ARIJIT: On the efficiencies of some sampling strategies. *Calcutta Statistical Association Bulletin*, 25, 119-128.
— (1977): Some applications of the principles of Bayesian sufficiency and invariance for inference problems with finite populations. *Sankhyā*, 39, C, 140-149.
7. — (1977): On some properties of the Horvitz-Thompson estimator based on Midzuno's "PS" sampling schemes. *Indian Society for Agricultural Statistics*, 29, 47-52.
8. GANGULY, SUKUMAR (1977): Studies on cholesterol level in relation to smoking habit. *IMLTA Chronicle*, 9-11.
9. GHOSH, SUBIR (with Srivastava, J. N.) (1977): Balanced 2^m factorial designs of resolution V which allow search and estimation of one extra unknown effect, 4 m 8. *Communications of Statistics—Theor. Math.*, A6(2), 141-166.
10. — (with Srivastava, J. N.) (1978): A series of balanced 2^m factorial designs of resolution V which allow search and estimation of one extra unknown effect. *Sankhyā*, B, 38, 280-289.

D. BIOCHEMISTRY

1. PAL, P. R. (1977): Emodin from the leaves of *Cassia tora* Linn. *Indian J. Pharmacy*, 39, 116.
2. — (1978) The toxicity of *Cassia tora* leaf extract in mice. *Indian Drugs*, 15, 49.

E. CROP SCIENCE

1. DAVIS, T. A. (1977): *Hibiscus radiatus*, magnificent annual for autumn. *The Seed Pod*, 27, (4): 9, 19, 22.
2. — (1977): Attempts at mechanical climbing of palms with special reference to the coconut palm. *J. Plantation Crops*, 5(1), 31-35.
3. — (1977) Biology and geometry of chambered nautilus. *Science Reporter*, 14: (12), 762-767.
4. GHOSH, S. S. (1978): Asymmetry in aestivation of the female flowers in an unusually large spadix of coconut (*Cocos nucifera* L.). *Indian Coconut Journal*, 8: (10), 3-6.
5. — (with Davis, T. A.) (1978): Foliar spirality and aestivation of flowers in *Hibiscus cannabinus*. *Experientia*, 34, 3: 348-349.

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F. DEMOGRAPHY

1. DAS GUPTA, P. (1978) : A general method of decomposing a difference between two rates into several components. *Demography* (U.S.A.), 15, 1 February.
2. — (1978) : A period analysis of parity distribution of white and non-white women in the United States, 1940-1974. *Social Biology* (U.S.A.), 24, 1 January.
3. RAMAN, M. V. (1977) : Legislation for fertility control. *Population Education Notes* (PEN), A monthly publication of FPAI, Haryana Branch, May 1-3.
4. SARKAR, B. N. (1977) : Attitude to induced abortion in Calcutta. *J. Family Welfare*, XXXIV, 1, September, 47-58.
5. — (1977) : Population control in India. *Proc. International Statistical Conference Volume*. December, 470-473.

G. DIGITAL SYSTEMS

1. DUTTAGUPTA, J. (with Musgrave, G.) (1977) : Fault graph and its use in the analysis of faulty logic networks, *Proc. Twentieth Midwest Symposium on Circuits and Systems*, Texas, U.S.A., August, 562-566.
2. SRIMANT, P. K. (with Sinha, B. P. and Choudhury, A. K.) (1977) : Non real-time realization of any finite state sequential machine using a single shift register. *Proc. Institute of Electrical and Electronics Engineers*, U.S.A., 65, 9, November. 1618-1619.
3. — (with Sinha, B. P. and Choudhury, A. K.) (1977) : On certain investigations on control memory minimization in microprogrammed digital computers. *Proc. Institution of Electronics and Telecommunication Engineers*, India, 23, 9, September, 532-548.
4. — (with Sinha, B. P. and Choudhury, A. K.) (1977) : Some studies on optimal specification of read-only memories in microprogrammed digital computers. *Proc. Institution of Electronics and Telecommunication Engineers*, India, 23, September, 9, 535-541.
5. — (with Sinha, B. P. and Choudhury, A. K.) (1977) : Optimal job scheduling scheme in multiprocessor systems. *Proc. National Systems Conference*, Coimbatore, India, June.
6. — (with Sinha, B. P. and Choudhury, A. K.) (1977) : Minimal test point location in a system graph. *Proc. Twentieth Midwest Symposium on Circuits and Systems*, Texas, U.S.A., August. 567-570.
7. — (with Sinha, B. P. and Choudhury, A. K.) (1977) : Single shift register realizability of any arbitrary sequential circuit. *Proc. Twentieth Midwest Symposium on Circuits and Systems*, Texas, U.S.A., August, 86-89.

H. DOCUMENTATION AND LIBRARY SCIENCE

1. SUBBARAO, C. V. (with Verma, S. L.) (1977) . Initial hurdles for data banks. *Herald of Library Sciences*, 16, 1, January, 3-15.

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2. SUBBARAO, C. V. (1976) : Enochantressa : The Delhi Public Library. *IJA Bulletin*, 11, 2, April/ June.
3. KHURANA, AVINASH (with Gupta, Rama) (1978) : Bibliographic tools in sociology. Part : 1. *Library Herald*. 16, 1 & 2, April/September, 62-72.

I. ELECTRONICS AND COMMUNICATION SCIENCE

1. CHOWDHURY, E. B. (1978) : Microprocessor and its use in industry. *JIEE (India)*, 11, S4, 149-151.
2. DUTTA MAJUMDER, D. (with DAS, J.) (1977) : Some fast switching in toroidal memory core. *J.I.E.T.E. (India)*, 23, 8, 511-516.
3. — (1977) : Science and technology policy in developing countries. *Eastern Economist*, 69, 24, 1130-1131.
4. PAL, S. K. (1978) : On automatic plosive identification using fuzziness in property sets. *IEEE Trans. Syst. Man & Cybern.* SMC-8, 4, U.S.A.

J. EMBRYOLOGY

1. BRAHMAHARY, R. L. (with Datta, J.) (1978) : Amins as a possible pheromone system in the tiger. *Science and Culture*, 86(3), 112.
2. ROY, B. (1977) : Purification and immobilisation of human carbonic anhydrase B by using poly acrylamide gel. *Experientia*, 22(11), 1493.

K. ENTOMOLOGY

1. DASOHAUDHURI, P. C. (1977) : Seasonal incidence and relative abundance of owl midges (Diptera : Psychodidae) in Calcutta. *Proc. Zoological Society, Calcutta* 28, 55-69.

L. GEOLOGY

1. CHATTERJEE, S. (1978) : A primitive parasuchid (phytosaur) reptile from the Upper Triassic Maleri Formation of India. *Palaeontology* 21(1), 83-127.
2. CHAUDHURI, A. K. (1977) : Influence of colian processes on Precambrian sandstones of the Godavari valley, South India. *Precambrian Research*, 4, 339-360.
3. SENGUPTA, SUPRIYA (1977) : Fluvialite cross-stratification : ancient, recent and experimental. *Geological Mining and Metallurgical Society of India (Golden Jubilee Volume, 1974)*, 87-99.
4. — (1977) : Experimental approach to grain size data interpretation. *Ind. J. Earth Sciences (S. Ray Volume)*, 96-102.

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M. LEAF PROTEIN

1. BAGCHI, D. (with Matai, S. and Chanda, S.) (1977) : Effect of nitrogen and seedrate on the yields of root and extractable protein from tops of radish under West Bengal condition. *Ind. J. Agron.*, 22, 3, 190.

N. LINGUISTIC RESEARCH

1. KOSTIC, DJORDJE (with Mitter, Alokananda) : English Pronunciation for Bengali (In preparation for publication).
2. — (with Mitter, Alokananda) : English Speech Sounds for Hearing-Impaired Children (In preparation for press).
3. — : Basic Principles of Speech Habilitation of Hearing-Impaired Children. (Indian Statistical Institute) 16 pp.

O. PHYSICS OF FLUIDS

1. MAZUMDER, B. S. (1977) : Combined effects of Hall current and relation on hydro-magnetic flow over an oscillating porous plate. *Int. J. Engg. Sci.*, 15, 601-606.

P. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BOSE, D. K. (1977) : A strategy for economy in use of coal : coal after nationalisation. *Coal Consumers Association of India*, Calcutta, 299-302.
2. CHAKRABARTY, S. K. (1977) : Satisfying basic human needs : relevance in the development strategy. *Capital*, Annual Number, 149-151.
3. CHATTOPADHYAY, S. (1978) Planning in India. *West Bengal*, Republic Day Number XX, 11, January 16, 271-274 and 290.
4. COONDOO, D. : Effect of household composition on consumption pattern : a note. *Arthaniti*, XVII, 1975 & 1976, 51-59.
5. DASGUPTA, D. (with Chetty, V. K.) (1978) : Temporary competitive equilibrium in a monetary economy with uncertain technology and money planning periods. *J. Mathematical Economics*, 5, 23-42.
6. PAL, M. N. (with Subramanian, C.) (1977) : An optimal evaluation of spatial linkages in South India. *Indian J. Regional Sci.*; 9, 95-110.
7. RUDRA, ASHOK (with Bardhan, P. K.) (1978) : Interlinkage of land, labour and credit relations. *Economic & Political Weekly*, XIII, 6 & 7, Annual Number, February, 367-384.
8. SARADAMONI, K. (1977) : Land reforms : next step in Kerala. *Mainstream*, XV, 35, April 30.
9. — (1977) : Today and tomorrow : people's views. *Mainstream*, 41, June 11.

FORTYSIXTH ANNUAL REPORT: 1977-78

10. SARADAMANI, K. (1977) : Measuring welfare and development in India. *Mainstream*, XVI, 27, December 24.
11. TRENDULKAR, S. D. (1977) Planning Commission and roll-over planning in India: some basic issues. *Economic & Political Weekly*, XII, 42, October, 15.

Q. PSYCHOMETRY

1. BASUMALLIK, TAPAN (with Bhattacharyya, K. P.) (1977) : Prediction of attitude test scores from biographical data. *Indian J. Applied Psychology*, 14, 79-83.
2. CHATTERJI, S. (with Mukherjee, M. and Chakraborty, P.) (1977) : Validity study of a selection test battery used for a business management course. *Productivity*, XVIII, 3, 425-437.
3. — (with Mukherjee, M.) (1977) : Objective assessment in industrial recruitment. *BEACON*, Technical Journal. NGEF Engineer's Association, Bangalore, 19-22.
4. — (with Mukherjee, M., Chakraborty, S. N. and Hassan, M. K.) (1977) : Comparison of social prejudice and their correlates for male and female college students. *Psychological Studies*, 22, 43-48.

R. PRE-CENSUS POPULATION STUDIES

1. BHATTACHARYA, DURGA PRASAD (with Deb Roy Malakar, Rama) (1977) Agricultural Wages in Bengal and Bihar 1793-1972. *Social Scientist*, 61, 65-73.

S. SOCIOLOGY

1. CHATTOPADHYAY, M. : Some aspects of employment and unemployment in agriculture. *Economic and Political Weekly*, Review of Agriculture, 12, 39, Sept. 24, A-67 to A-76.
2. — (with Chattopadhyay, K.) Concentration of labour force in the surrounding villages of Giridih, Bihar. *Indian Anthropological Society*, 12, 125-131.

T. STATISTICAL QUALITY CONTROL

1. ACHUTHAN, N. R. (1977) : A special case of the $(n/m/F/F_{ms})$ problem. *Opsearch*, 14, 2, 71-87.
2. IYER, V. NARAYANA (1977) : Improved methodology to help mill modernisation. *Indian Textile J. Bombay*, 87, 7, 163-167.
3. MOHAN, S. R. (1977) : Existence of solution rays for linear complementarity problem with Z-matrices. *Mathematical Programming Study*, 7, 108-119.
4. MUKHERJEE, S. P. (1977) : On the estimation of quality of area reserve through statistical models and sequential decision process. *Indian J. Earth Science*, 137-141.
5. NARAYANA, V. (1977) : The what and why of annual quality audit. *Quality* (BHEL News Letter).

INDIAN STATISTICAL INSTITUTE

6. RAO, N. T. V. RAMANA (1977): Quality management—a case study. *Indian Management*, 16, 9.
7. RAU, Y. R. (1977): Statistical aids in QC: frequency distribution. *Quality* (BHEL News Letter).
8. — (1977): Statistical aids in QC: measures of central tendency and dispersion. *Quality* (BHEL News Letter).
9. — (1977): Statistical aids in QC: prediction from stable process. *Quality* (BHEL News Letter).
10. — (1977): Statistical aids in QC: process capability. *Quality* (BHEL News Letter).
11. — (1977): Statistical aids in QC: control charts. *Quality* (BHEL News Letter).
12. — (1977): Statistical aids in QC: control charts—contd. *Quality* (BHEL News Letter).
13. — (1977): Statistical aids in QC: control charts—examples.
14. — (1977): Statistical aids in QC: Pareto analysis.
15. — (1977): Statistical aids in QC: ishikawas, cause and effect diagram.
16. — (1977): Statistical aids in QC: scatter diagram. *Quality* (BHEL News Letter).
17. — (1978): Statistical aids in QC: Scatter diagram—an example. *Quality* (BHEL News Letter).
18. — (1977): Acceptance sampling in India. *OR Journal*, 4, 4.
19. — (1977): Development of vendor quality control. *OR Journal*, 5, 1.
20. — (1977): On the problem of suiting the mating parts for a one shot assembly. *Sankhyā*, 39, B, 1.
21. SENGUPTA, S. (with Lakshminathan, P. R.) (1977) Control of runner defects in cycle rim manufacture. *OR Journal*, 4, 3, 179-180.

U. THEORETICAL PHYSICS

1. BANDYOPADHYAY, PRATUL (with Bhattacharya, Subrata) (1977): Lepton-Hadron relation and the Neutrino induced Dimyon and Trimyon production in high energy PP scattering. *Lettere al Nuovo Cimento*, December.
2. — (with Bhattacharya, Subrata): Lepton-Hadron relation and the puzzle of prompt muon production in high energy PP scattering. *Lettere al Nuovo Cimento*, January.
3. — (with Bhattacharya, Subrata) (1978): Lepton-Hadron relation, multiparticle production phenomena and average multiplicities in deep inelastic pp, N and eN scattering. *Nuovo Cimento*, February.

FORTYSIXTH ANNUAL REPORT : 1977-78

4. BANDYOPADHYAY, PRATUL (with Bhattacharya, Subrata) (1978) : Lepton-Hadron relation, average multiplicities of various charged secondary particles in pp. scattering and some comments on the rising pp total cross section at ISR energies. *Nuovo Cimento A*, February.
 5. — (with Sen, K.) (1978) : Disintegrate of deuteron by neutrino-deuteron scattering and the photon-neutrino weak coupling theory. *Physical Review*, March.
 6. — (with Sen, K.) (1978) : Disintegration of deuteron by neutrino-deuteron scattering and the photon-neutrino weak coupling theory. *Physical Review*, March.
 7. RAY, SISEB (1978) Comments on uncertainty and quantum numbers. *Nuovo Cimento B*, 42, p. 237.
 8. РОУСНОУННУВ, РАЖУМАР (1977) : Pion production spectrum from primary cosmic ray spectrum and scaling constants. *Canad. J. Phys.*, 55-164.
 9. — (1978) : Dao scaling model and sea level cosmic ray muon spectrum from Gaddord space flight group measured primary proton spectrum. *Annalen der Physics*, 34.
 10. — (1978) : Cosmic antiproton flux ratio at the top of the atmosphere. *Canad. J. Phys.*, 56.
- 12.2. *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. J. : On the distribution of multiplicative functions. (*Acta Arithmetica*).
2. — (with Singh, K.) : Probabilities of moderate deviations for some stationary strong mixing processes. (*Sankhyā*).
3. — : On probabilities of moderate deviations for dependent processes. (*Sankhyā*).
4. — : On deviations between empirical and quantile processes for dependent random variables. (*J. Multivariate Analysis*).
5. — (with Ghosh, M. and Singh, K.) : On rates of convergence to normality for mixing processes. (*Sankhyā*).
6. CHATTOPADHYAY, A. K. : Gammaization and Wishartness of dependent quadratic forms. (*Ann. Statist.*).
7. CHETTY, V. K. : Temporary competitive equilibrium in a monetary economy with uncertain technology and many planning periods. (*J. Mathematical Economics*).
8. — (with, Nayak P. R.) : Price speculation and commodity currencies. (*Sankhyā*).
9. GHOSH, J. K. (with Basu, A. P.) : Identifiability of the multinomial distribution under competing risk model. (*J. Multivariate Analysis*).

INDIAN STATISTICAL INSTITUTE

10. GHOSH, J. K. (with Anderson, R.): Some optimal stopping problems in reliability theory. (*Ann. Statistics*).
11. — (with Chandras, T.): Comparison of tests with the same Bahadur efficiency (*Sankhyā*).
12. — (with Sinha, B. K. and Wieand, H. S.): Second order efficiency of the MLE with respect to any bounded bowl shaped loss function. (*Ann. Statist.*).
13. GHOSH, M. (with Huang, J. S. and Arnold, B.): On characterizations of the uniform distributos spacings. (*J. Appl. Prob.*).
14. — (with Sotres, D. A.): Asymptotic properties of linear functions of order statistics for non-stationary mixing processes. (*South African J. Statist.*).
15. —: Rate of convergence to normality for random means and U statistics applications to sequential estimation. (*Ann. Statist.*).
16. — (with Sinha, B. K.): On the robustness of least squares procedures in multivariate models. (*J. Multivariate Analysis*).
17. — (with Dasgupta, R.): On some non-uniform rates of the convergence to normality. (*Ann. Prob.*).
18. JAIN, L. R. (1977): On fitting a three parameter lognormal distribution to consumer expenditure data. (*Sankhyā*).
19. —: On methods of demand projections. (*Sankhyā*).
20. —: On specification of the pattern of income redistribution in a demand projection exercise. (*Review of Economics and Statistics*).
21. MAITRA, A. (with Rao, B. V. and Rao, K. P. S. B.): A problem in the extension of measurs. (*Illinois J. Mathematics*).
22. — (with Rao, B. V.): Generalizations of coasting selection theorem. (*Coll. Math.*).
23. —: Extensaions of measurable functions. (*Coll. Math.*).
24. —: Analytic sets with countable sections. (*Fund. Math.*).
25. —: Ordinal solutions of open games and analytic sets.
26. MAZUMDER, B. S.: Dispersion of solutes in combined free and forced convective flow through a channel. (*Acta Mechanica*).
27. MITRA, S. K. (with Bose, N. K.): Generalized inverse of polynomial matrices. (*IEEE Transactions on Automatic Control*).
28. — (with Puri, M. L.): Shorted operators and generalized inverse of matrices. (*Linear Algebra and its Application*).
29. MUKHERJEE, A.: On alternative definitions of homology groups. (*J. Indian Math. Soc.*).

FORTYSIXTH ANNUAL REPORT : 1977-78

30. PARTHASARATHY, K. R. : A martingale orthogonal to all stochastic integrals. (*Stochastic Processes and Applications*).
31. — : An n -dimensional Pythagoras theorem. (*Mathematical Scientist*).
32. — : An exact bound for the coulomb potential with respect to the Dirac operator. (*Letters in Maths. Phys.*).
33. RAHA, A. B. : Lindelof spaces and closed projections. (*Proc. Amer. Math. Soc.*).
34. RAMCHANDRAN, D. : Existence of independent complements in regular conditional probability. (*Ann. Prob.*).
35. — : Perfect mixture of perfect measures. (*Ann. Prob.*).
36. — (with Subramanian, R.) : On independent complements. (*Colloq. Math.*).
37. — (with Nadkarni, M. G.) : On a question of D. Maharam concerning tail fields. (*Sankhyā*).
38. RAO, A. R. : An Erdos-Gallai type result on the chique number of a realisation of a degree sequence.
39. RAO, B. L. S. P. : Bounds for the equivalence of Bayes and maximum likelihood estimator for Markov processes. (*Z. fur Wahrscheinlichkeits theorie*).
40. — Characterization of multivariate normal distribution from samples of random size. (*J. Multivariate Analysis*).
41. — : On central limit theorems of backward martingale arrays. (*Z. fur Wahrscheinlichkeits theorie*).
42. RAO, HEBBARE, S. P. : A class of regular graphs. (*J. Comb. Theory*).
43. — (with Gangopadhyay, T.) : Paths in r -partite self-complementary graphs. (*Discrete Mathematics*).
44. — : r -partite self-complementary graphs. (*J. Aust. Math. Soc.*).
45. RAO, K. P. S. B. (with Rao, B. V.) : Borel spaces. (*Rozprawy Mat.*).
46. — : On the isomorphism problem for analytic sets. (*Bull. Pol. Acad. Sci.*).
47. — : Atomless structures and δ -independence. (*Bull. Pol. Acad. Sci.*).
48. — : Lattice of Borel structures. (*Bull. Pol. Acad. Sci.*).
49. ROY, A. K. : Convex functions on the dual ball of a complex Lindenstrauss space.
50. — : Orderings and dilations of complex representing measures.
51. RAO, T. J. : Unbiasedness and convexity in ratio estimation. (*J. Statistical Planning and Inference*).
52. SHANTARAM, R. : Problems and solutions (*SIAM*).
53. — : On two equal determinants. (*SIAM Review*).

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54. SARABADHIKARI, H. : A selection theorem for multifunctions. (*Proc. Am. Math. Soc.*)
55. — : Selection theorems for partitions of complete metric spaces. (*Bull. Acad. Pol. Sci.*)
56. — (with Srivastava, S. M.) : A separation theorem for analytic sets with convex sections. (*Proc. Am. Math. Soc.*)
57. SARMA, Y. R. (with ADHIKARI, B. P.) : Some tests of hypotheses for cluster sampling. (*Sankhyā*).
58. — (with BELL, C. B.) : Some characterizations of distributions based on linear functions of ordered and unordered observations. (*J. Appl. Prob.*)
59. SIKDAR, K. : On quasi transitive semi-group actions. (*Semi Group Forum*).
60. SINGH, K. : Some asymptotic representations and approximation to normality of L -estimator. (*Sankhyā*).
61. SINHA, B. K. (with Clement, B. and Raja Rao, B.) : Behren's-Fisher problem under the assumption of homogeneous coefficients of variation. (*Communications in Statistics*).
62. — (with Clement, B. and Giri, N.) : Effect of additional variates on the power function of multiple correlation. R^2 -test. (*Sankhyā B*).
63. — (with Giri, N. and Clement, B.) : Tests for means with additional information. (*Sankhyā*).
64. — (with Ghosh, M.) : On the robustness of least squares procedures in regression models. (*J. Multivariate Analysis*).
65. — : Is the MLE of the common mean of several normal populations admissible ? (*Sankhyā, B*).
66. SITARAM, A. : A note on L^p ($SL(2, IR)$). (*Michigan Mathematical J.*)
67. SIVASTAVA, S. M. : Selection theorems for G_4 valued multifunctions metric space. (*Proc. Am. Math. Soc.*)
68. — : A note on the space of probability measures on a compact metric space. (*Proc. Am. Math. Soc.*)
69. TRIPATHI, T. P. : A note on optimum weights in multivariate ratio, product and regression estimators. (*J. Indian Soc. Ag. Statist.*)
70. — and DAS, A. K. : Use of auxiliary information in estimating finite population variance. (*Sankhyā*).
71. — (with Sinha, S. K. P.) : Estimation of ratio on successive occasions.

B. ANTHROPOMETRY AND HUMAN GENETICS

1. BASU, A. (with Mazumder, P. P., Ghosh, A. K. and Biswas, S. K.) : Human biological variations in Asia, with special reference to India. J. Hiernaux (Ed.). (*Biological Variations in Human Populations*), Masson et cie, Paris.

FORTYSIXTH ANNUAL REPORT : 1977-78

2. MALHOTRA, K. C. : Natural selection and colour blindness : fresh data on Indian castes. (*Genet. Research*), Cambridge.
3. — : Serological investigations among the Dhangers of Maharashtra. (*J. Physical Anthropology and Human Genetics*), Lucknow.
4. — : G-6-PD deficiency and haemoglobin variants among ten population groups of India. (*Human Genetics*).
5. — : Inheritance of cleft chin in Man. (*Indian Anthropological Society*), Calcutta.
6. — : Effect of socio-cultural factors on marriage distance. (*Anthropologist*), Delhi.
7. — : Marriage distance, in-breeding and population size : Dhangar data. (*Ann. Hum. Biol.*).
8. — : Incidence of colour blindness in 15 populations of India. (*Social Biology*), U.S.A.
9. — (with Das, S. K., Mukherjee, B. N., Undevia, J. V., Bhanu, B. V. and Yes, S.) : Distribution of blood groups among 21 Dhangar castes of Maharashtra. (*Indian Physical Anthropology and Human Genetics*).
10. MUKHERJEE, B. N. (with Malhotra, K. C., Das, S. K., Mazumder, P. P., Roy, M., Kate, S. L. and Sainani, G. S.) : Investigation of cloven biochemical genetic markers in ten endogamous population groups of Maharashtra and West Bengal. (*Human Heredity*).
11. — (with Mazumder, P. P., Malhotra, K. C., Das, S. K., Kate, S. L. and Chakraborty, R.) : Genetic distance analysis among nine endogamous population groups of Maharashtra. (*Human Heredity*).
12. — (with Malhotra, K. C. and Kate, S. L.) : Incidence of red-green colour blindness in some populations of Maharashtra and West Bengal : examination of selection relaxation hypothesis. (*J. Biosocial Science*), London.
13. — (with Malhotra, K. C. and Kate, S. L.) : Distribution of PTC taste threshold among 13 endogamous castes and tribes of Maharashtra. (*Indian J. Anthropological Society*).
14. — (with Das, S. K., Malhotra, K. C., Kate, S. L., Mutalik, G. S., Sainani, G. S. and Bhidya, S.) : Placental enzyme polymorphism amongst Maharastrians : study of alkaline phosphate and lactate dehydrogenase. (*Ann. Human Biol.*), London.
15. PAKRABI, KANTI (with Malaker, C. R.) : Marriage and population policy in India. (*J. Indian Anth. Soc.*), Calcutta.

C. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. BHIMASANKARAM, P. (with Majumdar, D.) : Hermitian and non-negative definite solutions of certain matrix equations connected with distribution of quadratic forms. (*Sankhyā*).

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2. CHAKRABORTY, S. R. : On some tests in *Manocova* model with different dispersion matrices. (*J. Multivariate Analysis*).
3. CHAUDHURI, ABIJIT : On estimating the variance of a finite population.
4. — : On the choice of sample size for a Horvitz-Thompson estimator. (*J. Indian Soc. Agri. Statist.*).
5. — : A comparison of the relative efficiencies of sampling strategies under a model. (*J. Indian Soc. Agri. Statist.*).
6. — (with Arnab, Raghunath) : A simple strategy for sampling on two occasions and some results concerning its efficiency. (*Calcutta Statistical Association Bull.*).
7. — : On the role of sample size in determining efficiency of Horvitz-Thompson estimators. (*Sankhyā*).
8. — : On estimating the mean of a finite population sampled on two occasions with varying probabilities. (*Aust. J. Statist.*).
9. — : On the relative efficiencies of sampling strategies under two customary models. (*Sankhyā*).
10. DAS, B. C. : Post maturational changes with age.
11. GHOSH, SUBIS : On main effect plus one plans for 2^m factorials.
12. — : On single and multistage factor screening procedures.
13. GUPTA, SANJIB KUMAR : Interactions of hormones with the genes. (*Science Reporter*), New Delhi.
14. MUKHOPADHYAY, A. C. : On the resolvability of block designs.

D. CROP SCIENCE

1. DAVIS, T. A. : Locomotion and agonistic behaviour in robber crab. (*Wild Life*).
2. — : Asymmetry in *Costus speciosus* (Scitamineae). (*Phytomorphology*).
3. — : Some unusual formation in palms. (*Principes*).
4. — : Association of coconut foliar spirality with latitude. (*Proc. Roy. Soc.*).
5. — (with Ghosh, S. S. and Ghosh, M. (1977)) : Morphology of juvenile areca palm. (*J. Indian Bot. Soc.*).
6. GHOSH, S. S. : Tender coconut, source of delicious drink and products of utility. (*Indian Coconut J.*).

FORTYSIXTH ANNUAL REPORT: 1977-78

E. DEMOGRAPHY

1. CHAKRABORTY, B. (with Malakar, C. R.): Fertility differential, family planning and birth reduction in Calcutta, *The Calcutta Couples. A Biosocial Profile*, Ed. Pakrasi, K. B., Banerjee, A. R., and Halder, M. K. Editions Indian, Calcutta (in press).
2. DAS GUPTA, P.: An alternative formulation of birth function in a two-sex model. (*Population Studies*). U.K.
3. —: Estimation of the parameters of a censored gamma exponential distribution and its application to data on conception delays. (*Demography India*).
4. GUHA ROY, S.: A rural fertility field. (*Demography India*).
5. —: Data base of abortion investigation—methodological issues. (*Genus*), Rome.
6. RAMAN, M. V.: Sex preference for children and contraceptive practice by women wanting no more children: A Calcutta study, *The Calcutta Couples: A Biosocial Profile*, Ed. Pakrasi, K. B., Banerjee, A. R., and Halder, A. K., Editions Indian, Calcutta (in press).
7. SARKAR, B. N.: Marriage patterns in Calcutta, *The Calcutta Couples: A Biosocial Profile*, Ed. Pakrasi, K. B., Banerjee, A. R., and Halder, A. K., Editions Indian, Calcutta (in press).

F. DOCUMENTATION AND LIBRARY SCIENCE

1. NEELAMEGHAN, A.: Guidelines for formulation of a policy on education, training and development of library and information personnel. (*UNESCO*), Paris.
2. —: Information needs and information sources of small enterprises: a synoptic view. (*Library science with a slant to documentation*).
3. —: Technology choice and technology transfer. (*Library science with a slant to documentation*).
4. — (with Gopinath, M. A.) Colon classification schedule for macro-documents in political science. (*Library science with a slant to documentation*).
5. SEETHARAMA, S.: Institutional interlinks and information for small industries. (*Library science with a slant to documentation*).

G. ELECTRONICS AND COMMUNICATION SCIENCE

1. CHOWDHURY, F. B.: A simple and automatic logic monitor. (*J. Electronic Engineering*), U.K.
2. DAI, J. (with Chowdhury, F. B.): Dual mark synchronization for PCM/TDMA. (*Electronic Design*).
3. DATTA, A. K. (with Ganguli, N. R. and Ray, S.) Transition, a cue for identification of ploives. (*Acoustical Society of India*).

INDIAN STATISTICAL INSTITUTE

4. DATTA A. K. (with Ganguli, N. R. and Dutta Majumdar, D.): Acoustic features of consonants: A study based on Telugu speech sounds. (*Acoustica*), Germany.
5. DUTTA MAJUMDER, D. (with Dutta, A. K. and Ganguli, N. R.): (1978): Some studies on acoustic phonetic features of Telugu vowels. (*Acoustica*), Germany, 40, III.
6. — (with Das, J. and Chatterjee, N.): Some studies on minimization of inter-symbol interference by coding technique. (*CSIR J. Technology*), India.
7. — (with Das, J. and Chatterjee, N.): On error probability due to inter-symbol interference and estimation for M-ary CPSK systems. (*J. Alta Frequenza*), Italy.
8. MAJUMDER, A. K.: Impulse response realization algorithm of linear systems. (*Sankhyā*).
9. —: Sensitivity minimization of linear system. (*Int. J. Control*).
10. PAI, S. K. (with Dutta Majumder, D.): Effect of fuzzification on plosive cognition systems. (*Int. J. Syst. Sci.*), U.K.
11. — (with Dutta Majumder, D. and Dutta, A. K.): Adaptive learning algorithm in classification of fuzzy pattern, an application to vowels in CNC context. (*Int. Syst. Sci.*), U.K.
12. — (with Dutta, A. K. and Dutta Majumder, D.): Computer recognition of vowel sounds using a self-supervised learning algorithm. (*Acoustical Society of India*).
13. — (with Dutta Majumder, D.): Vowel identification using piece-wise separation technique. (*Indian J. Technology*).

H. EMBRYOLOGY

1. BRAHMAHARY, R. L. (with Dutta, J.): On the pheromones of the tiger *Carnivora*. (*Burke Museum*), Washington.
2. TAPASWI, P. K.: Mathematical simulation of RNA and protein synthesis rhythm during embryogenesis. (*Cybernetica*), Belgium.

I. ENTOMOLOGY

1. DASGUPTA, P. C.: Mosquito research in India. (*Science and Culture*).
2. —: On variation of *Chaoborus crystallinus* De Geor. (*Diptera: Culicidae*) with a note on its taxonomy. (*Proc. Zoological Society*), Calcutta.
3. —: Biology of alimentation in the larva of *Chaoborus crystallinus* De Geor (*Diptera: Culicidae*) and its significance. (*Proc. Zoological Society*), Calcutta.

J. GEOLOGY

1. CHATTERJEE, S.: A new traversodont reptile from the Upper Triassic Maleri Formation of India. (*Bull. Museum of Comparative Zoology*), Harvard University.

FORTYSIXTH ANNUAL REPORT : 1977-78

2. CHATTERJEE, S. : A new theroodontian reptile from the Late Triassic of India. (*Philosophical Trans., Royal Society of London*).
3. — (with Sohn, I. G.) : Freshwater ostracodes from the Late Triassic ooprolites of India. (*J. Paleontology*).
4. — : *Indosuchus* and *Indosaurus*, cretaceous carnivorous from India. (*J. Paleontology*).
5. JAIN, S. L. : A new fossil plumedusid turtle from the Upper Cretaceous Pisdura sediments, Central India. (*J. Paleontological Society of India*), Academician Orlov Commemorative Volume.
6. — (with Kutly, T. S., Roychowdhury, T. and Chatterjee, S.) (1977) : Some characteristics of *Barapasaurus tagorei*, a sauropod dinosaur from the Lower Jurassic Deccan, India. (*Proc. Fourth International Gondwana Symposium*), Section III.
7. SENGUPTA, SUPRIYA : Grain-size distribution of suspended load in relation to bed materials and flow velocity. (*Sedimentology*).

K. LEAF PROTEIN

1. CHAKRAVARTY, S. (with Matai, S. and Chandra, A. L.) (1978). Isolation of a lipase producing streptomycete from Indian soil. (*Indian J. Micro.*).
2. CHANDA, S. (1978) : Detection of some sugars in protein free leaf extracts of some common vegetable plants. (*Current Science Association*), Bangalore.
3. MATAI, S. (with Bagchi, D. and Chanda, S.) (1978) : Yield of extracted leaf protein from EC 4218, a fodder variety of cow pea. (*Indian J. Agron.*).

L. PHYSICS

1. GUPTA, A. B. : Laser : its physical principle and biomedical applications. (*Indian Practitioner*), Bombay.

M. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BHAT, D. R. : Emergence of a metropolis in the process of rapid urbanization—a case study of Delhi. (*Bombay Geographical Magazine*), Bombay.
2. BHAT, L. S. : Recent trends in geography. (*Proc. Refresher Course in Geography*), University of Udaipur.
3. — : Block-level planning. (*Indian J. Regional Sci.*), Kharagpur.
4. — : Regional planning : survey of research in geography. (*Indian Council of Social Science Research*), New Delhi.
5. CHATTERJEE, G. S. (with Halder, A. K.) : On errors in National Sample Survey household budget data. (*Economic and Political Weekly*).

INDIAN STATISTICAL INSTITUTE

6. CHETTY, V. K. (with Dasgupta, D. and Raghavan, T. E. S.): Absenteeism, efficiency and income distribution. (*Rev. Economic Studies*).
7. — (with Dasgupta D.) Power and distribution of income. (*Rev. Economic Studies*).
8. — (with Dasgupta D.): The role of capital markets in income distribution and production efficiency. (*Econometrica*).
9. — (with Nayak, P. R.): Dreze equilibria for polyhedral and strictly convex price sets. (*Econometrica*).
10. NAYAK, P. R.: Efficiency of non-Walrasian equilibria. (*Econometrica*).
11. — Production and rationing equilibria. (*International Economic Rev.*).
12. PAL, M. N. (with De, R. N. and Malakar, B.): A statistical revision of 1961 agricultural workers for the comparability with 1971 Census estimates by Indian districts. (*Indian J. Regional Sci.*).
13. —: The generalised class of regional indices with the recognition of varying specific representations of the constituent variables.
14. — (with De, R. N.): On an identification of contributory factors to spatial dynamism in agricultural growth in India. (*Sankhyā*).
15. — (with De, R. N.): On the detection of discontinuities in the spatial relation between agricultural growth and its major contributory factors in India.
16. RAMASWAMI, C.: Population control for economic prosperity. (*National Finance and Investment Weekly*).
17. RAY, BISWANATH: A study of housing and residential environment in the city of Calcutta. (*Bull. Cultural Research Institute*), Government of West Bengal.
18. SHARMA, A. N.: Identification of settlement hierarchy in a micro-region. (*J. Behavioural Sciences*), NICD, Hyderabad.

N. SEDIMENT TRANSPORTATION STUDIES

1. MAZUMDAR, B. S. (1977): Dispersion of solutes in combined free and forced convection flow through a channel. (*Acta. Mech.*).

O. SOCIOLOGY

1. BISWAS, S. K.: Resource utilisation and social planning. (*Economic and Political Weekly*), Bombay.
2. CHATTOPADHYAY, M.: Agricultural labourer of Birbhum. (*Economic and Political Weekly*), Bombay.

FORTYSIXTH ANNUAL REPORT : 1977-78

P. STATISTICAL QUALITY CONTROL

1. BASU, P. K. : Batch representation for coating to evaluate the TOR of metal film resistors. (*J. Electro Components Science & Technology*), London.
2. CHAKRAVARTY, S. C. (with Gupta, A.) : Performance rating — a means for improving productivity. (*Lok Udyog*), monthly journal, Bureau of Public Enterprise & the Public Sector.
3. MOHAN, S. R. : On the complementary cones with empty interior of K_0 -matrix. (*Mathematical Programming*).
4. PANDEY, R. J. : Single sampling 3-decision plan by attributes providing average quality protection. (*Sankhyā*).

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

A. THEORETICAL STATISTICS AND MATHEMATICS

1. RAO, A. R. : The clique number of a graph with a given degree sequence. *Proc. Symp. on Graph Theory*, I.S.I., 1976.
2. RAO, S. B. : Explored, semi-explored territories in the structure theory of self-complementary graphs and digraphs. *Proc. Symp. Graph Theory*, ISI, 1976.
3. — The range and number of triangles in self complementary graphs of given order. *Proc. Symp. Graph Theory*, ISI, 1976.
4. — (with Bhat-Nayak, V. N. and Naik, R. N.) : Characterization of frequency partitions of Eulerian graphs. *Proc. Symp. Graph Theory*, ISI, 1976.
5. — (with Rao Hobbaro, S. P.) : Characterizations of planar distance convex simple graphs. *Proc. Symp. Graph Theory*, ISI, 1976.

B. ANTHROPOMETRY AND HUMAN GENETICS

1. BASU, A. (with Majumder, P. P. and Chakraborty, G.) : Anthropometric variations—India. Seminar on Human Variations in India, Calcutta, 29 June–4 July, 1977.
2. MALTHOTRA, K. C. : Dermatoglyphic variation among the people of Maharashtra. Seminar on Human Variations in India, Calcutta, 29 June–4 July 1977.
3. — : ABO gene dynamics. Seminar on Human Variations in India, Calcutta, 29 June–4 July, 1977.
4. — : Marriage distance, population size and inbreeding coefficient. Seminar on Genetical Demography, Calcutta, 16–18 January, 1978.
5. — : Excommunication as a process leading to the formation of new groups. Seminar on Genetical Demography, Calcutta, 16–18 January, 1978.
6. — : Some aspects of medicogenetic problems among the Indian tribes. International Workshop on Medical Genetics, Pondicherry, October 17–19, 1977.

INDIAN STATISTICAL INSTITUTE

7. MALHOTRA, K. C. : Population genetics of the Dhangars of Maharashtra : phenotypic bioassay. Fourth Annual Conference, Ind. Soc. Hum. Genetics, Madras, 21-24 December, 1977.
8. — : Native-customs and beliefs among the Nandiwallas of Maharashtra. National Seminar on India-Nomads, Mysore, 14-16 February, 1978.
9. — : Nomadism and pollution—some thoughts. International Conference on Environmental Pollution, Hyderabad, 27 February-3 March, 1978.

C. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. HALDAR, A. K. (with Chatterjee, G. S.) : On errors in NSS household budget data. 65th session, Indian Science Congress, Ahmedabad, January, 1978.
2. CHAKRABORTY, S. R. : On some tests in Manova model with different structured covariance matrices. IMS Conference, New Delhi, December, 1977.
3. BANDYOPADHYAY, SUBIR : An algorithm for testing a Boolean function for realisation by a Moitra cascade. National Systems Conference, 1978.
4. SENGUPTA, A. (with Chattopadhyay, D. K. and Chowdhury, A. K.) : Identification of Linear machines through homomorphism. National Systems Conference, 1978.
5. — : Linear time varying machines—identification procedure. National Systems Conference, 1978.
6. BHIMASHANKARAM, P. : On conditions for a quadratic form to be positive definite under linear constraints. IMS Conference, New Delhi, 1977.
7. CHAUDHURI, ABHJIT : On some problems of choosing the sample-size in estimating finite population totals. Proc. 41st session of International Statistical Institute, New Delhi, December, 1977.
8. ROY, J. : Statistical surveys and computing—presidential address, Statistics Section, 65th session, Indian Science Congress, Ahmedabad, January, 1978.

D. BIOCHEMISTRY

1. PAL, P. R. : Purgative action of emodin isolated from *Cassia tora* leaves and its effect on the peristaltic movement of intact cat intestine. Proc. Decennial Conference, Indian Pharmacological Society, 201, 1977.
2. — : Inorganic pyrophosphatase level in leaves of different family of plants. Proc. 65th Indian Science Congress Session, Ahmedabad, January.

E. CROP SCIENCE

1. GHOSE, M. : Ontogenetic study of stomata and trichomes in some palms. Proc. 65th session, Indian Science Congress, Part-III, 58-59, Abs. No. 137, 1978.
2. GHOSE, S. S. : A morphological study of juvenile palms of *Veitchii amerrillii* (Beco.). Proc. 65th Session, Indian Science Congress, Ahmedabad, Part-III, 59, Abs. No. 138.

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F. DEMOGRAPHY

1. CHAKRABORTY, B.: An analysis of spatial distribution of the district level fertility data in India, Third Annual Conference, Indian Association for the Study of Population, Hyderabad, 16-18 March, 1978.
2. —: Review of the methodological development in the measurement of demographic effect of family planning programmes: *Proc., General Conference, International Union for the Scientific Study of Population, Mexico City, 8-13 August, 1977.*
3. GUHA ROY, S.: Data base of abortion investigation: Methodological issues. *Proc. General Conference, International Union for the Scientific Study of Population, Mexico City, 8-13 August, 1977.*
4. MALAKAR, C. R.: Forecasting population by marital status: Some methodological problems, *Proc. General Conference, International Union for the Scientific Study of Population, Mexico City, 8-13 August, 1977.*
5. SARKAR, B. N.: Population control in India, Fortyfirst International Statistical Conference, New Delhi, 5-15 December, 1977. *Proc. International Statistical Conference, Volume: Contributed Papers, 470-473.*
6. —: School enrolment of females in village. *Proc. Seminar on Population Aspects of Rural Development, Indian Institute of Population Studies, Bombay, 10-11, October, 1977.*
7. —: Female education in villages. 65th session, Indian Science Congress, Ahmedabad, 3-7 January, 1978. *Proc. Sixty-fifth Session, Indian Science Congress Committee on Science and Economic Development, 5-6.*
8. —: Studies on reproduction of females (based on data from Calcutta Fertility Survey, 1970, 65th session, Indian Science Congress, Ahmedabad, 3-7 January, 1978. *Proc. Sixty-fifth Session, Indian Science Congress (Section on Statistics), 58.*
9. —: Development of Indian economy and migration, *Proc. Third Annual Conference, Indian Association for the Study of Population, Hyderabad, 16-18 March 1978.*

G. DOCUMENTATION AND LIBRARY SCIENCE

1. BHATTACHARYYA, G.: Ranganathan's Five Laws and networks of libraries and information centres. Eleventh IASLIC Conference, Dharwar, 2-5 November, 1977
2. —: A code for standard bibliographic description of patent documents. Seminar on Patent Documentation and Information Services, Bombay, 1-3 December, 1977
3. DEVADASON, F. J.: BIRS/1900 Bibliographic Information Retrieval System: A software for SDI and retrospective search services. Eleventh IASLIC Conference, Dharwar, 2-5 November 1977
4. —: Using taxonomy of concept by subject specialists for thesaurus construction: A case study. DRTC Seminar 15, 5-9 December, 1977

INDIAN STATISTICAL INSTITUTE

5. GOPINATH, A.: Information-seeking behaviour of scientists. Seminar on User Needs in Scientific and Technical Information, Bangalore, 24 April. 1977
6. —: Research in library and information science (as an integral part of education in information science). Second US-India Seminar on Information Science Education and User Education, Bangalore, 18-22 July. 1977
7. —: UN efforts in information service to small industries. Seminar on Information for Industry, Madras, 5-7 August. 1977
8. —: Data centres in the biomedical sciences in India: a small survey. Seminar on Medical Library Services, Madras, 22-28 November. 1977
9. — (with Maitra, Gopinath): Postulate-based permuted subject indexing: Methodology applied to social sciences. DRTO Seminar 15, 5-9 December. 1977
10. —: Classification of patents. Seminar on Patent Documentation and Information Services, Bombay, 1-3 December. 1977
11. MAITRA, RANJIT: Semi-automatic method of generating microthesaurus: a case study in the field of social sciences. DRTO Seminar 15. 5-9 December. 1977
12. NEELAMEGHAN, A.: Training of university students of engineering in the use of information. Second US-India Seminar on Information Science Education and User Education, Bangalore, 18-22 July. 1977
13. — (with Parthasarathy, S.): Master of science in information science. Second US-India Seminar on Information Science Education and User Education, Bangalore, 18-22 July. 1977
14. Neelameghan, A.: Guidelines for formulation of a policy on education, training and development of library and information personnel. Seminar on Library and Information Science Education in India, New Delhi, 3-8 October, 1977
15. —: Information service for small enterprises. Seminar on Information for Industry, Madras, 5-7 August. 1977
16. —: Integrated course for Master's degree in library and information science: Design considerations. Seminar on Library and Information Science Education in India, New Delhi, 3-8 October, 1977
17. —: Coordinating agency for the national STI system. Eleventh IASLIC Conference, Dharwar, 2-5 November, 1977
18. —: Steps in planning a national science and technology information system. Eleventh IASLIC Conference, Dharwar, 2-5 November, 1977
19. —: A user-oriented information network for the health and family welfare sector: Some planning considerations. (keynote paper). National Workshop on Documentation in the Field of Health and Family Welfare, Delhi, 3-8 November, 1977
20. — (with Maitra, Ranjita): Non-hierarchical associative relationships in social sciences: Identification and typology. DRTO Seminar 15, 5-9 December. 1977

FORTYSIXTH ANNUAL REPORT : 1977-78

21. NHELAMKOHAN, A. : Information for technology choico and management. Seminar on Information for Engineering Industry, New Delhi, 10 February, 1978
22. — : Population information flow : Global, regional and national networking. ESCAP Population Correspondents' Workshop I, New Delhi, 23-25 February, 1978
23. — ; Conceptualization of the structural framework and flow of information, ESCAP Population Correspondents' Workshop II, Bombay, 6-8 March, 1978
24. PARTHASARATHY, S. (with Maitra, Ranjita) : Management information system for planning of national information system. Eloventh IASLIC Conference, Dharwar, 2-5 November, 1977
25. SEETHARAMA, S. : Information network for small industries in Tamil Nadu. Seminar on Information for Industry, Madras, 5-7 August, 1977
26. — : Information networks : Models and interlinking. Eloventh IASLIC Conference, Dharwar, 2-5 November, 1977
27. — : Subject categories in DEVSIS and SPINES : a study. DRTC Seminar 15. 5-9 December, 1977
28. — : Demographic input for development planning. DRTC Seminar 15. 5-9 December, 1977

H. ELECTRONICS AND COMMUNICATION SCIENCE

1. DAS, J. (with Majumder, A. K.) : On the response characteristics of artificial neural networks. *Proc. IEEE Conference on Cybernetics & Society*, Washington, DC, Sept. 19-21.
2. Das, J. (with Chowdhury, F. B.) : Microprocessor based industrial processor. *Proc. International Conference on Instrumentation*, Calcutta, January 14-17, 1978.
3. — : Studies with artificial neural model. *Proc. VIII, Annual Conference on Simulation & Modelling*, University of Pittsburgh, April 22-24, 1977.
4. DATTA, A. K. (with Ganguli, N. R. and Ray, S.) : Computer recognition of consonantal speech sound. Fourth International Joint Conference on Pattern Recognition, November 7-10, Kyoto, Japan. 1978.
5. — (with Ganguli, N. R., Ray, B. and Mookherjee, B.) : Cinoyster recognition of plosive speech sounds. *Proc. Comp. Soc. of India, Div. III, No. O2-107*, 122-134, Calcutta, February 5-8, 1978.
6. DUTTA MAJUMDER, D. (with Pal, S. K.) : Fuzzy recognition system for pattern of biological origin. *Proc. Fourth International Congress, Cybernetics and Systems*, Amaterdam, 21-35 August, 1978.
7. — (with Pal, S. K.) : On fuzzification, fuzzy language and multicategory fuzzy classifier, *Proc. IEE Conference on Cybernetics & Society*, Washington, D.C. September 19-21, 1977.

INDIAN STATISTICAL INSTITUTE

8. DUTTA MAJUMDER, D. : (with Pal, S. K. and Datta, A. K.) On some adaptive methods in recognition of speech sound. *Proc. Comp. Soc. of India, Div. III, No. O2-108, 318-335, Calcutta, February 5-8, 1978.*
9. — : Some modern applications on computer technology. Seminar on All India Electronics & Electrical Exhibition, Calcutta. February 12-15, 1978.
10. — : Appropriate technology for developing economy. *Interdisciplinary Conference on Price Stabilization, Calcutta, December 30-31, 1977.*
11. — : Computers in national policy formulation and monitoring. *South East Asia Regional Computer Conference-78, Manila, Philippines, September 4-8, 1978.*
12. — : On some aspects of application of computer technology for national development. *Proc. South East Asia Regional Computer Conference-78, Manila, Philippines, September 4-8, 1978.*
13. GANGULI, N. R. (with Ray, S.) An application of maximum likelihood criterion in consonant recognition. *Fifth National Systems Conference, Ludhiana, India. September 4-6, 1978.*
14. PAL, S. K. (with Dutta Majumder, D.) : Application of fuzzy recognition system in speech patterns. *Fifth National System Conference, Ludhiana, India. September 4-6, 1978.*

I. PHYSICS

1. GUPTA, A. B. : On the modelling and decoupling of a d.w.r. synchronous machine via State-space techniques. *Proc. Fifth National System Conference, 1978.*

J. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BOSE, D. K. : On the State-Centre relations in respect of planning. *Fifth All-India Conference on Problem of Federal Policy, Indian School of Social Sciences, Calcutta, January 20-23, 1978.*
2. CHAKRABARTI, S. : Money output and price : guidelines for macro credit policy. *Seminar on Recent Developments in Monetary Theory and Policy, Reserve Bank of India, Bombay.*
3. CHATTERJEE, G. S. (with Halder, A. K.) : On errors in National Sample Survey Household Budget Data. *65th Session, Indian Science Congress, Ahmedabad, 3-7 January, 1978, Symposium on Data Analysis and Statistical Computation.*
4. CHATTOPADHYAY, S. : Technology, surplus-value and Indian industrial development. *Seminar Workshop on Technological Choice in the Indian Environment, Indian Institute of Management, Bangalore, 10-12 October, 1977.*
5. — : Inflation in India : its causes and remedies. *Dam Bandho Samrochan, Calcutta, 30-31 December, 1977 and 1 January 1978.*

FORTYSIXTH ANNUAL REPORT : 1977-78

6. CHATTOPADHYAY, S. : Devaluation of taxes between the Centre and the State in India. Fifth All-India Conference on Problems of Federal Polity, Indian School of Social Sciences, Calcutta, 20-23, January 1978.
7. ROY, BINA : Preparation of regional accounts and supporting tables for West Bengal : sources, methods and problems. Eleventh General Conference, IARNIW, Shillong, October, 1977.
8. — : Index of monetization in rural India by states. 17th Annual Conference, Indian Econometric Society, Trivandrum; 19-21 December, 1977.
9. — : Long-term growth of capital formation in India : 1900-1952. 17th Annual Conference, Indian Econometric Society, Trivandrum, 19-21 December, 1977.
10. PAL, M. N. : Disparities in development in North Eastern Region of India. Seminar on Resource Base and Problems of Regional Development in North-Eastern Region (India NEH University, Shillong.), 30 September—2, October 1977.
11. — (with De, R. N.) : An index of agricultural labour pressure on cropped land and production for a classification of Indian districts. Eleventh Regional Science Seminar, Regional Science Association, 24-26, February 1978, School of Planning, Ahmedabad.

K. PRE-CENSUS POPULATION STUDIES

1. BHATTACHARYA, DURGA PRASAD (with Bhattacharya, Archana) : Some pioneer quantitative economic studies in Bengali, 1802-1915 : 17th Annual Conference, Indian Econometric Society, Trivandrum 19-21 December, 1977.
2. BHATTACHARYA, DURGA PRASAD : Glimpses of population history of India, 1801-1961 : 38th Session, Indian History Congress, Bhubaneswar, 26-28 December, 1977.
3. DEB ROY MALAKAR, RAMA : Some quantitative aspects of Bengal economy 1750-1800 : 17th Annual Conference, Indian Econometric Society, Trivandrum, 19-21 December, 1977.
4. — : Tax structure of Calcutta and its dependencies in 1788. 38th Session, Indian History Congress, Bhubaneswar, 26-28 December, 1977.

L. STATISTICAL QUALITY CONTROL

1. LAKSHMANAN, P. : Quality assurance for industrial prosperity. Silver Jubilee Symposium on Quality Assurance, A. C. College of Engineering & Technology, Karaikudi, 23 & 24 January, 1978.
2. — : Human technology for quality control.
3. — : Improvement of Quality and Productivity in Cable Industry through SQC methods. Seminar on Productivity & Quality in Cable Industry, Small Industries Service Institute, 6 March, 1978.
4. SENGUPTA, S. : Optimisation in quality—a decision theoretic approach. International Conference on QC, 1978.

INDIAN STATISTICAL INSTITUTE

12.4. Books Published

A. THEORETICAL STATISTICS AND MATHEMATICS

1. PANTHASARATHY, K. R. (1977): Introduction to Probability Measure. Macmillan (India) Ltd.

B. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. HALDAR, A. K. (1977): Role of Information in National Planning in a Developing Country, Ed. Pite and Veenhuis, IBI, Rome.

C. DOCUMENTATION AND LIBRARY SCIENCE

1. Volume of papers of the DRTO Annual Seminar 15.
2. Area A : Classification and indexing in the social sciences.
3. Area B : Information for development planning.

D. ELECTRONICS AND COMMUNICATION SCIENCE

1. DUTTA MAJUMDER, D. (with Das, J.): Digital Computers 'Memory Technology' (in press), John Wiley (Eastern India) Ltd., New Delhi.
2. — : Infrastructure of Digital Data Communication, *SEACC-76* (ed.) Kohli, Joseph, North Holland Publishing Co.

E. PHYSICS

1. GUPTA, A. B. : Modern Physics : Book Home, Calcutta, Second revised ed., 1978.

F. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BHATTACHARYA, DURGAPRASAD (1977) : Preparatory Note. Research Project : A case study of agrarian relations in a village in West Bengal. Socio-Economic Research Institute, Calcutta, 3-4.
2. BHATTACHARYA, N. (with Iyengar, N. S.) (1978) : The Survey of Indian Econometric Literature. Statistical Publishing Society.
3. CHAKRABARTI, S. K. (1978) : Behaviour of Prices in India, 1952-70. xiii and 202, The Macmillan Co. of India Ltd.
4. RUDRA, ASHOK : Quantitative Studies in Agricultural Economics. Indian Council of Social Science Research.

G. SOCIOLOGY

1. CHATTERJEE, BHOJA : Indo-British Cultural Confrontation : Gooroodas Banerjee and His Time.

FORTYSIXTH ANNUAL REPORT : 1977-78

3. CHATTERJEE, BHOLA (1977) : *Nepal's Experiment with Democracy*. Ankur Publishing House, Delhi.
3. — (1977) : *Gooroodas Banerjee and his times : A Study of Socio-Political Conditions in Bengal, late nineteenth—early twentieth century*. Ankur Publishing House, New Delhi.
4. MUKHERJEE, R. (1977) : *Some Introductory Remarks, Scientific and Technological Revolution : Social Aspects*. Sage Publication in International Sociology, London.
5. — (1977) : *What will it be ?* Allied Publishers, New Delhi.

12.5. *Articles published in Books*

A. THEORETICAL STATISTICS AND MATHEMATICS

1. GHOSH, M. (with Sen, P. K.) : *Asymptotic theory of sequential tests based on linear functions of order statistics*. *Essays in Probability and Statistics in honour of J. Ogawa* (1976), 485-499.
2. JAIN, L. R. : (with N. S. Iyengar and T. N. Srinivasan), *Economics of Scale in Household Consumption : A Case Study, Economic Theory and Practice in the Asian Setting—Volume 2 : Microeconomics*, Ed. Committee on Economics Teaching Material for Asian Universities, Wiley Eastern Limited, New Delhi.

B. DEMOGRAPHY

1. CHAKRABORTY, B. (1977) : *The census and the NSS data on internal migration, Population Statistics in India*, Ed. Bose, A., Gupta, D. B. and Roychoudhuri, G., Vikash Publishing House Pvt. Ltd., New Delhi, 317-326.
2. RAMAN, M. V. (1977) : *Fertility and mortality—Some problems in data collection, Population Statistics in India*, Ed. Bose, A., Gupta, D. B. and Roychoudhuri, G., Vikas Publishing House Pvt. Ltd., New Delhi, 239-243.

C. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BHAT, L. S. : *Spatial profile and priorities for regional development. Planning for Development of Uttar Pradesh (Chapter IV)*.

12.6 *Technical Reports*

A. THEORETICAL STATISTICS AND MATHEMATICS

1. ANDERSON, R. L. (1977) : *Recent developments in designs and estimators for variances components, Discussion Paper No. 7727, December*.
2. BABU, G. J. : *Lectures on complex variable theory*. 1-128.
3. KUMAR ASHOK (1977) : *Simultaneous confidence interval of structural parameters in small samples for a single equation in simultaneous equation model, Discussion Paper No. 7713, June*.

INDIAN STATISTICAL INSTITUTE

4. JAIN, L. R. (1977) : On methods of demand projections, *Discussion Paper No. 124* (Revised version) May.
5. — (1977) : On fitting a three-parameter log-normal distribution to consumer expenditure data, *Discussion Paper No. 122* (Revised version), June.
6. — (1977) : On specification of the pattern of income redistribution in a demand projection exercise, *Discussion Paper No. 7721*, September.
7. JAIN, S. K. (1977) : The stability of binary social decision rules, *Discussion Paper No. 7710*, April.
8. — (1977) : Stability and transitivity, *Discussion Paper No. 7712*, June.
9. — (1977) : Characterisation of rationality conditions in terms of minimal decisive sets, *Discussion Paper No. 7715*, July.
10. — (1977) : Weak stability of pareto inclusive, binary neutral social decision rules, *Discussion Paper No. 7716*, July.
11. MUKHERJEE, A. (1977) : On alternative definitions of homology groups, 1-26.
12. MUKHERJEE, K. K. (with Bhatia, R.) (1977) : On the rate of change of spectra of operators, *Discussion Paper No. 7720*, August.
13. NAYAK, P. R. (1977) : Efficiency of non-Walrasian equilibria, *Discussion Paper No. 7723*, September.
14. — (1977) : Production and rationing equilibria, *Discussion Paper No. 7726*, October.
15. — (1977) : On rationing equilibria, *Discussion Paper No. 7719*, July.
16. RAO, B. L. S. P. (1977) : Characterization of multivariate normal distribution from samples of random size, *Discussion Paper No. 7714*, July.
17. — (1977) : On central limit theorem of backward martingale arrays, *Discussion Paper No. 7725*, September.
18. RAO, S. B. (with Naik, R. N., Shrikhande, S. S. and Singh, N. M.) : Intersection graphs of K -uniform linear hypergraphs, 1-40.
19. RAMASUBRAMANIAN, S. (1977) : On some ergodic group actions in Wiener and in certain associated spaces, *Discussion Paper No. 7729*, December.
20. SHANTARAM, B. : Some combinational identities generated by a problem in characterisation.
21. VASUDEVAN, S. (1977) : Poter balancing problem, *Discussion Paper No. 7717*, July.
22. — (1977) : Efficiency of automatic winding machine with spindles on a straight line, *Discussion Paper No. 7718*, July.

FORTYSIXTH ANNUAL REPORT: 1977-78

B. ANTHROPOMETRY AND HUMAN GENETICS

1. PAKRASHI, KANTI (1977): A study on abortion by social groups in Calcutta: *Anthrop* 4/77, 20 January 1-51.
2. — (1978): A resume of information about population research activities in the Indian Statistical Institute, Calcutta—a report submitted to the UN Workshop for ESCAP Population Correspondents in India, New Delhi, 23-25 February, 1-10.

C. APPLIED STATISTICS, SURVEYS AND COMPUTING

1. BHIDMASANKARAM, P. (with Majumdar, D.) (1977): Hermitian and non-negative definite solutions of some matrix equations connected with distribution of quadratic forms. *ASC*/8, August.
2. CHAKRABORTY, S. R. (1977): On some tests in MANOVA model with different structured covariance matrices. *ASC*/4, August.
3. CHAUDHURI, A. (with Arnab, R.) (1977): On unbiased variance—estimation with various multistage sampling strategies. *ASC*/7, August.
4. GHOSH, SUBIS (1977): On single and multistage factor screening procedures. *ASC*/5, August.
5. — (1978): On main effect plus one plans for 2^m factorials. *ASC*/8, January.

D. BIOCHEMISTRY

1. PAL, P. R.: Purification and urea inactivation of alkaline pyrophosphatase from green leaves of *Amaranthus blitum* Linn.
2. —: Changes in the phosphate level in the germinating green gram.

E. DEMOGRAPHY

1. CHAKRABORTY, B.: An analysis of the spatial distribution of the district level fertility data in India: Preliminary observations (cross-sectional data from 1961 Census).
2. —: Review of methodological development in the measurement of demographic effect of family planning programmes.
3. GUHA ROY, S.: Data base abortion investigation—methodological.
4. MALAKAR, C. R.: Forecasting population by marital status—Some methodological problems.
5. PAKRASHI, K. (with Malakar, C. R.): Marriage and population policy in India, *Anthrop* 3/77.
6. SARKAR, B. N.: Female education in villages.
7. —: Studies on reproduction of females.

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8. SARKAR, B. N. : Collection of birth statistics.
9. — : Development of Indian economy and migration.
10. — : Marriage patterns in Calcutta.
11. — : Population control in India.
12. — : School enrolment of females in India.

F. DOCUMENTATION AND LIBRARY SCIENCE

1. NEELAMEGHAN, A. : A note on programming for the National STI Plan.
2. — : Information manpower development.

G. GEOLOGY

1. SENGUPTA, SUGATA : Structural history of Delhi metasediments east of Kharwa, Ajmer District, Rajasthan. P. & E./Geo/1/78, 1-22.
2. — : Transportation and deposition of sand by suspension current : an experimental study. Naturgeog Institute, Uppsala University, Sweden.

H. LINGUISTIC RESEARCH

1. KOSTIC, DVORJJE : The linguistic syndrome of stuttering. Indian Statistical Institute, 1-25.
2. — : Problem of modernization to news media language. Indian Statistical Institute, 1-12.
3. — : Organization of grammar, Indian Statistical Institute, 1-12.

I. PHYSICS

1. GUPTA, A. B. : Studies on the mechanical properties of human biomaterials : Outlines of a project.

J. PLANNING, ECONOMIC STATISTICS AND ECONOMETRICS

1. BOSE, S. (with Mallick, A.) (1978) ; What is economics ? 30 March.
2. CHAKRABARTI, S. K. (1977) : The general theory model : a graphical exposition, 12 July.
3. — (1978) ; Money, output and price ; guide-line for macro credit planning. 28 January.
4. — (1977) : Basic human needs oriented development. 26 November.

FORTYSIXTH ANNUAL REPORT : 1977-78

5. LAHRI, R. K. (1978) : Land reforms in West Bengal—some implications. 3 February.
6. SARADAMANI, K. (1978) : Harijan disabilities, primarily economic, report submitted to the ICSSR 'Pulayas in a changing society.' March.
7. SARKAR, NITYANANDA (1978) : A large sample test for identification of the causes of autocorrelation and a general method of estimation, 30 March.

K. PRE-CENSUS POPULATION STUDIES

1. BHATTACHARYA, DURGOAPRABAD (with Sen, Anarendralal) (1977) : A note on sub-division of land and fragmentation of rights with a brief outline of tenancy legislation, 1793-1976. IV, 26 p. Socio-Economic Research Institute, Calcutta, Studies on Writings in Indian Languages.
2. — (1977) (with Deb Roy Malakar, Rama and Bhattacharyas, Archana) : Trends in Bengali writings on science and technology 1818-1947. i, 5, 3, Socio-Economic Research Institute, Calcutta.

L. STATISTICAL QUALITY CONTROL

1. Analysis by Szwarz's dominance criteria for the $(n/n/P/F_{max})$ problem.
2. Study on factors affecting Nepe/gm. of Sliver, fused fibre and C.S.P. at Swadeshi Polytex Ltd., Ghaziabad.
3. Study of consumption/usagr of fuel oil and steam in fibre line, poly and GRU at Swadeshi Polytex Ltd., Ghaziabad.
4. Study on variation in weight of bread at Modern Bakery, New Delhi.

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

XIII. TWELFTH CONVOCATION : INDIAN STATISTICAL INSTITUTE

13.1 The Twelfth Convocation of the Indian Statistical Institute, held on 7 February 1978, was presided over by Shri Subimal Dutt, President of the Institute. Shri P. N. Haksar, Chairman, Indian Statistical Institute, welcomed the guests. Shri Morarji Desai, Prime Minister of India, delivered the Convocation Address. Dr. C. R. Rao, Jawaharlal Nehru Professor, Indian Statistical Institute, spoke on the "Development of Statistics in India." Professor G. Kallianpur, Director, Indian Statistical Institute, presented the annual review of research and training.

The degree of Doctor of Science (*honoris causa*) was conferred by the Chairman on Professor L. V. Kantorovich, Nobel Laureate (Economics), USSR Academy of Sciences, and on Shri Morarji Desai.

Four candidates were awarded the Ph.D. degree, 38 the M.Stat. degree by examination and 15 the B.Stat. degree. In the post-graduate diploma in applied statistics, twenty-nine candidates were awarded diplomas in Statistical Quality Control and Operations Research after successfully completing their training in Bombay, Calcutta and Madras. Seven candidates were awarded diplomas in computer science.

13.2 Convocation : International Statistical Education Centre, Calcutta :

The International Statistical Education Centre (ISEC), Calcutta, held its annual convocation on 25 March 1978. Certificates were awarded to 28 trainees from 12 countries who successfully completed the thirty-first term of the ISEC (June 1977-March 1978) and the Special Courses. Professor Sushil Kumar Mukherjee, Vice-Chancellor, Calcutta University, delivered the Convocation Address. Professor G. Kallianpur, Director, Indian Statistical Institute, welcomed the guests. Dr. N. Bhattacharyya, Member-Secretary, ISEC, presented the report of the term.

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.

Mr. I. BABA, SQC expert from Japan (28 February 1978-May 1978) came to the Institute under a Colombo Plan scheme. He carried out a number of interesting application of projects in the area of design and industrial experiments and also conducted training programmes.

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DR. JULIAN BESAG, Reader in Mathematical Statistics, University of Durham, England (1 December 1977-14 January 1978) came to the Delhi Centre under an exchange agreement between the Royal Society, U.K., and the Indian National Science Academy. He attended the Joint Meeting, ISI-IMS, Delhi. He also visited the Punjab University, Gujarat University and ISI, Calcutta. *Seminars* : Statistical analysis of spatial data, I & II.

DR. JOHN MICHAEL BIBBY, Faculty of Mathematics, The Open University, Milton Keynes, U.K., accompanied by Mrs. Bibby came to the Institute under the programme of exchange of visits by younger scientists between India and U.K. sponsored by the University Grants Commission. He conducted research on theory and applications of multivariate analysis (Delhi : 15 March 1978-8 April 1978; Calcutta : 2-24 May 1978). He also visited the universities of Delhi and Mysore. *Lecture* : Improvements, proximation and multivariate statistical analysis (Delhi).

PROFESSOR OLAF BUNKE, Head Department of Statistics, Humboldt University, Berlin, German Democratic Republic (5-30 December 1977) attended the Forty-first Session, International Statistical Institute, New Delhi, 6-15 December 1977, and presented papers at the invited sessions, Joint IMS-ISI Meeting, New Delhi, 16-18 December 1977.

DR. MUKUL K. DEY, Department of Psychology, Jersey City State College, Jersey City, USA (10 August 1977-28 December 1977) worked as a Visiting Fellow in the Demography Unit, mainly on social and psychological aspects of fertility and family planning behaviour. *Seminars* : Behavioural science approach to population research.

PROFESSOR M. P. HEBLE, University of Toronto, Canada (31 January 1978-29 April 1978). *Lectures* : (i) Some topics in representation theory, Ergodic theory, (ii) Lie theory and applications to Entropy and approximation.

ACADEMICIAN LEONID VITALEVICH KANTOROVICH, Nobel Laureate (Economics), Institute of System Analysis, USSR Academy of Sciences, visited the Institute twice during the year (5-16 December 1977 and 4-15 February 1978). During the first visit, he attended the forty-first session, International Statistical Institute, 5-15 December 1977, New Delhi. On the next visit, Academician Kantorovich accompanied by Mrs. Kantorovich attended the Twelfth Convocation, Indian Statistical Institute, on 7 February 1978, when he was awarded the degree of Doctor of Science (*honoris causa*). *Lectures* : (i) Application of economics in mathematics, (ii) Analysis of the model of economic dynamics with technical progress, and (iii) The mathematical models of technical progress (Delhi and Calcutta).

DR. JUERGEN KLEFFE, Central Institute of Mathematics and Mechanics, Academy of Sciences, German Democratic Republic (10 December 1977-8 February 1978) came on his second visit to the Delhi Centre under the Indo-GDR agreement on Scientific Co-operation. He attended the meeting of the Institute of Mathematical Statistics, New Delhi, 16-18 December 1977. *Seminar* : Quasi inner products and their use in MINQUE theory.

PROFESSOR DJORDJE KOSTIC, Director, Institute for Experimental Phonetics and Speech Pathology, Belgrade, Yugoslavia (14 December 1977-30 March 1978) came to the Institute on his tenth visit in connexion with the programme of fundamental linguistic research being conducted in collaboration between the Indian Statistical Institute and the

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Institute of Experimental Phonetics and Speech Pathology. His visit was arranged under the Indo-Yugoslav Cultural Exchange Programme.

Professor Kostic visited Agartala, Hyderabad and New Delhi in connexion with his research work. In Agartala, Tripura State, he conducted a ten-day Seminar-cum-Workshop, at the Institute for Speech Rehabilitation (15-24 February 1978).

He had discussions with the Minister for Education, Minister for Social Welfare, Director of Education, Tripura State, and the Principal and speech educators of the Institute for Speech Rehabilitation regarding linguistic research and the future work and programme of the Institute.

In Hyderabad, Professor Kostic conducted a Seminar for Teachers of the Deaf (30 January 1978) and a Seminar on Modernisation of Languages in News Media (1-3 February 1978). He participated in group discussions regarding the prospectus for a One-year Diploma Course in Speech Pathology and on methodology for speech habilitation in the Telegu language at the Osmania University. He also met a group of speech therapists of the All India Institute of Speech and Hearing, Mysore. He had discussions at the Department of Linguistics, Osmania University on (i) materialisation of the programme of speech habilitation of hearing-impaired children, and (ii) tripartite programme of collaboration between the Institute for Experimental Phonetics and Speech Pathology, Belgrade, Indian Statistical Institute and the Osmania University.

In New Delhi, he had discussions with the Yugoslav Ambassador and the Director, Indian Statistical Institute, on the programme of collaboration between the Indian Statistical Institute and the Institute for Experimental Phonetics and Speech Pathology, Belgrade. He also had discussions at the (i) Department of Linguistics, Delhi University, on the possibility of setting up a One-Year Diploma Course in Speech Pathology at the Delhi University, (ii) the Central Hindi Institute on the preparation of a book on the phonetics of the Punjabi language, and (iii) 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.

In Calcutta, he conducted a seminar for Teachers of Deaf Children (5 March 1978) and awarded certificates to trainees of the training course for speech educators of hearing-impaired children. He guided research work in the Linguistic Research Unit on the following main items: (i) Statistical processing of linguistic and phonetic data, (ii) Study of supra-segmental elements in the Bengali language, (iii) Problems of translation with particular emphasis on modern poetry language, and (iv) Study of speech forms in schools for hearing-impaired children as well as in schools for normal children.

Lectures: (i) Classification of hearing-impaired children according to the quality and quantity of hearing remnants and time of onset of hearing loss, Hyderabad, 28 January 1978; (ii) Language, speech and deviant speech, Agartala, 22 February 1978; (iii) Organisation of Grammar, New Delhi, 16 March 1978.

PROFESSOR HARUJI MORIMOTO, Department of Mathematics, Osaka City University, Japan (22 February 1978-8 May 1978) came for research collaboration with the mathematicians and statisticians of the Institute. *Lectures:* Generalizations of Neyman factorization theorem.

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PROFESSOR S. NAGARV, Institute of Mathematics, Siberian Branch, USSR Academy of Sciences, Novosibirsk (1 March 1978-28 May 1978) came under the Indo-Soviet Cultural Exchange Programme. He visited Bombay, Calcutta and Delhi. *Lectures* : Inequalities for large deviation probabilities.

PROFESSOR H. NIEMI, Department of Mathematics, University of Helsinki, Finland (9 December 1977-11 February 1978) presented papers at the invited sessions, IMS-ISI Meeting, New Delhi and attended the fortyfirst session, International Statistical Institute, New Delhi. *Lectures* : Spatial analysis and linear prediction of non-stationary process. (Delhi and Calcutta).

PROFESSOR J. SETHURAMAN, Florida State University, Tallahassee, U.S.A. (19 September 1977-19 December 1977) presented papers at the invited sessions, Joint IMS-ISI Meeting, New Delhi, 16-18 December 1977. He visited Bangalore, Hyderabad and Madras. *Lectures* : (i) Partial ordering among probability measures, (ii) Probability inequalities (Delhi and Calcutta).

DR. K. R. SHAH, Department of Statistics, University of Waterloo, Ontario, Canada, came to the Delhi Centre, as Visiting Professor (19 July 1976-30 April 1977)

PROFESSOR R. SHIMIZU, Institute of Statistical Mathematics, Tokyo, Japan (13 October 1977-January 1978) attended the Joint Meeting, Institute of Mathematical Statistics and ISI, New Delhi, 16-18 December 1977. He was the Visiting Professor, Thirtyfirst Term, International Statistical Education Centre, Calcutta. *Lectures* : (i) Decomposition of stable laws, (ii) Approximation to distribution function, (iii) Characterisation of stable distribution on related topics, and (iv) Generating random normal deviates (Delhi and Calcutta).

PROFESSOR G. TAGUCHI, Tokyo University, Japan (15 December 1977-1 January 1978) came to the Institute to deliver lectures on some of the advanced topics of quality assurance and design of experiments. His visit was arranged in collaboration with the International Management Co-operation Committee, Japan.

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

PROFESSOR R. L. ANDERSON, University of Kentucky, U.S.A., visited the Delhi Centre (October-December 1977). He attended the ISI-IMS Meeting, New Delhi. *Seminar* : Use of prior information in regression analysis.

DR. M. S. AHLUWALLA, Department of Research Centre, World Bank. 22 July 1977. *Lecture* : Rural poverty and agricultural growth in India.

PROFESSOR R. R. BAHADUR, Department of Statistics, University of Chicago, USA (16-22 December 1977) attended the ISI-IMS Meeting, New Delhi, 16-18 December 1977, as a delegate and presented a paper. *Lectures* : Deviations.

PROFESSOR A. V. BALAKRISHNAN, University of California, Los Angeles (December 1977) attended the IMS-ISI Meeting, New Delhi. *Lecture* : On stochastic control.

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PROFESSOR R. BARTOSZYNSKI, Institute of Mathematics, Polish Academy of Sciences (2 December 1977). *Lecture*: On survival in a hostile environment.

SHRI DIPAK BASU, Senior Systems Engineer, Telenet Communications Corporation; Director, Anudip Microsystems Co., Calcutta and California. *Lecture*: Data communications network-packet switching (27 August 1977).

PROFESSOR R. J. BHANSALI, Department of Computational and Statistical Sciences, University of Liverpool, U.K. (5-27 April 1977). *Lectures*: (i) The spectral analysis of time-series with applications to economics and meteorology, (ii) Box-Jenkins approach to forecasting.

PROFESSOR R. R. BEAT, Karnataka University (24-30 March 1978). *Lectures*: Some problems of estimation for dependant observations.

PROFESSOR DAVID BLACKWELL, University of California, Berkeley, U.S.A. (27 November 1977-1 December 1977). *Lecture*: Applications of zero-one laws to set theory.

DR. C. M. BUCKLEY, Science Policy Research Unit, University of Sussex, U.S.A. (25 April 1977). *Lecture*: On energy policy.

DR. MICHAEL CALAVAN, Department of Anthropology, Illinois State University, U.S.A. (5 July 1977). *Lecture*: Food selection on Northern Thailand.

PROFESSOR J. C. CALDWELL, Head of Department of Demography, Research School of Social Sciences, Australian National University, Canberra. *Seminar*: The conditions of stable high fertility: a report on recent African research in an attempt to find Indian parallels and contrasts. 18 February 1978.

PROFESSOR K. C. CHANDA, Department of Mathematics, Texas Technical University, U.S.A. (10 July 1977-9 August 1977). *Lectures*: (i) Asymptotic probability law of sample quantiles computed from mixed samples, (ii) Non-parametric rules of classification based on ranks and density estimates.

PROFESSOR HERMAN CHERNOFF, Massachusetts Institute of Technology, Cambridge, U.S.A. (December 1977) attended the invited sessions, ISI-IMS Meeting, New Delhi, 16-18 December 1977, as a delegate and gave a special lecture. *Lecture*: Another optimal stopping problem.

PROFESSOR D. B. COX, Imperial College of Science and Technology, London, attended the ISI-IMS Meeting, New Delhi, 16-18 December 1977 and gave a special lecture (December 1977). *Lectures*: (i) Bivariate point processes, (ii) Tests of multivariate normality, (iii) Survival data: recent development and unsolved problems.

DR. SUHBIT DEY, Eastern Illinois University, USA (7-18 November 1977). *Lecture*: Numerical solution of partial differential equation.

DR. I. DAHLBERG, Editor-in-Chief, International Classification, Frankfurt, Federal Republic of Germany. *Lectures*: Ontical structures and universal classification (5-8 December 1977).

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SM. KRISHNA DAS GUPTA, Head, Learning Resources Centre, Technical Services, Worcester State College, Massachusetts, U.S.A.; Visiting Fellow, Indian Statistical Institute. Lectures : (i) Ohio College Library Centre, (ii) On-line Circulation Section. (24-26 March 1978).

MR. DENNIS GROGAN, Head, Department of Bibliography, College of Librarianship, Wales, U.K. Lecture : Trends in Education in Library and Information Science in the U.K. (22 September 1977).

PROFESSOR E. J. HANNAN, Australian National University (17 November 1977-18 December 1977) presented papers at the invited sessions, Joint IMS-ISI Meeting, New Delhi, 16-18 December 1977. Lectures : Linear rational transfer function system (Calcutta).

PROFESSOR JOHN HAJNAL, London School of Economics, U.K. (5-20 December 1977) attended the fortyfirst session, International Statistical Institute, New Delhi, 5-15 December 1977. Lecture : Marriage and household composition in pre-industrial Europe—comparison with India (Calcutta).

DR. J. E. JAYNE, University College London (4 April 1977-15 May 1977). Lectures : (i) On isomorphisms between Banach spaces of Baire functions, (ii) Recent advances in analytic sets.

PROFESSOR K. KRICKBERG, U.E.R. de Mathematique, Logique Formelle et Information, Universite Rene Descartes, Paris (December 1977). Lecture : An example of filtering in stochastic geometry. He attended the IMS-ISI Meeting, New Delhi.

SHRI K. A. KRISHNAN, Deputy Director, Small Industries Service Institute, Bangalore. Lecture : Intra-organisational information transfer (13 March 1978).

DR. E. V. KRISHNAMURTHY, Head, Department of Mathematics, Indian Institute of Science, Bangalore. Course of ten lectures : Non-numeric computation and data structure (May-June 1977).

PROFESSOR HEROKISHI KUNDO, Faculty of Science, Kwansoo Gakuin University, Michinomiya, Japan (15-29 December 1977) attended the Joint IMS-ISI Meeting, New Delhi, 16-18 December 1977. Lectures : (i) Duality between parameters and samples, (ii) Asymptotic sufficiency (Calcutta).

PROFESSOR A. LANCASTER, Department of Economics, University of Hull, U.K. (1 April 1977). Lecture : Measurement of the duration of unemployment.

PROFESSOR V. MANDREKAR, Department of Statistics, Michigan State University, USA (16-30 December 1977) presented papers at the invited sessions, Joint ISI-IMS Meeting, New Delhi. Lectures : (i) On topological solutions to Bochner's theorem and the geometry of Banach spaces, (ii) On Markov property in dimensional time, (iii) Necessary and sufficient conditions for Markov property in the Gaussian case. (Delhi and Calcutta).

PROFESSOR M. MASUYAMA, Science University of Tokyo, Japan (13-16 December 1977). Lecture : Human biochemical individual variability.

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DR. K. G. MEHROTRA, University of Syracuse, U.S.A., visited the Delhi Centre (August-December 1977). He attended the fortyfirst session, International Statistical Institute, New Delhi. *Seminar* : A test for multivariate normality.

DR. CURDS MEHTA, Graduate School of Business, University of Pittsburgh, U.S.A. (29 August 1977) delivered a lecture on quality control.

DR. SAMARENDRA NATH MITRA, Department of Sociology, Emory University, Atlanta, U.S.A. (11 January 1978). *Lecture* : Some characteristics of life table functions.

PROFESSOR P. A. P. MORAN, Australian National University, Canberra (19 November 1977-December 1977) attended the fortyfirst session, International Statistical Institute, New Delhi, as a delegate. He presented papers at the invited sessions. Joint ISI-IMS Meeting, New Delhi. *Lectures* : (i) 'Wandering distributions' in genetics, (ii) Calculation of stirling numbers using local control limit theorems, and (iii) Covering a space by randomly distributed sphere.

SHRI K. S. NAGARAJAN : Office-in-Charge, INSDOC Regional Centre, Bangalore. *Course of lectures* : Ropography (March 1978).

PROFESSOR M. S. NARASIMHAN, Tata Institute of Fundamental Research, Bombay (28-30 November 1977). *Lecture* : A theorem in Riemann matrices with application to Riemann surfaces.

DR. DEEPAK NAYYAR, University of Sussex, U.K., visited the Delhi Centre (September 1977-April 1978). *Seminar* : Industrial development in India, growth and stagnation.

PROFESSOR MASATOSHI NEI, Department of Population Genetics, Centre for Demography and Population Genetics, University of Texas, Health Science Centre at Houston, USA. (5 December 1977). *Lecture* : Genetic differentiation of human races.

PROFESSOR MARCEL F. NEUTS, Department of Statistics and Computer Science, University of Delaware, U.S.A. (January 1978). *Lectures* : (i) Computational method in applied probability, (ii) Two classes of partitioned stochastic matrices arising in probability models. (Delhi and Calcutta).

PROFESSOR J. NEVEU, Academic de Paris, Laboratoire de Calcul des Probabilities, Paris (16-21 December 1977) gave a special lecture at the invited sessions of the IMS-ISI Meeting, New Delhi, 16-18 December 1977. *Lecture* : Chacon Ornstein Ergodic Theorem (Calcutta).

PROFESSOR M. NISIO, Department of Mathematics, Kobe University, Japan (15-24 December 1977), attended the invited sessions, Joint Meeting, Institute of Mathematical Statistics and Indian Statistical Institute, 16-18 December 1977 and presented a paper. *Lecture* : Optimal stopping problem (Calcutta).

PROFESSOR H. OODAIRA, Yokohama National University, Japan (16-25 July 1977). *Lecture* : Functional law of the iterated logarithm for stochastic processes.

DR. W. R. PABST, Quality Control expert, U.S.A. (4-22 December 1977), came to the SQC Division and delivered lectures on quality control and reliability assurance,

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DR. E. C. FISLOU, Killam Research Professor, Dalhousie University, Halifax, Canada (26 November 1977-16 December 1977), attended the fortyfirst session, International Statistical Institute, New Delhi, 5-15 December 1977. She gave lectures at the University of Delhi and the Institute of Agricultural Research Statistics, Delhi. *Lectures* : (i) Ecological diversity indices, are they informative? (ii) The structure of ecological communities, (iii) On diversity indices in ecology (Calcutta and Delhi).

PROFESSOR N. U. PRABHU, Cornell University, Ithaca, New York (5-29 December 1977) attended the fortyfirst session, International Statistical Institute, New Delhi, and the IMS-ISI Meeting, New Delhi. *Lectures* : (i) Wiener-Hopf factorization of Markov semi-groups, (ii) Wiener-Hopf equation II.

MR. G. RANSON, Coordinating Manager, PERA, Leceister, U.K. *Lecture* : PERA and its information services. (30 June 1977).

DR. RANGA RAO, Department of Mathematics, University of Illinois, Urbana, USA (November 1977-March 1978). *Lectures* : (i) Unitary representations defined by boundary conditions, (ii) Weil representation.

DR. G. RAVINDRA, Regional College of Education, Ajmer (4 January 1978). *Lectures* : (i) Strong perfect graphs conjecture, (ii) Perfect product graphs.

PROFESSOR P. REVESZ, Mathematical Institute, Hungarian Academy of Sciences, Budapest (5-27 December 1977) attended the fortyfirst session, International Statistical Institute, New Delhi and the ISI-IMS Meeting, New Delhi. *Lectures* : (i) A problem of coin tossing, (ii) On the fluctuation of a Wiener process (Calcutta).

MR. EDWARD A. REYNOLDS, Quality Control Expert, Mattituck, New York. (28 November 1977-5 January 1978) came to the SQC Division and delivered lectures on quality control and reliability assurance.

PROFESSOR V. V. SAZANOV, USSR Academy of Sciences (15-22 December 1978). presented papers at the invited sessions, Joint IMS-ISI Meeting, New Delhi, 16-18 December 1977. *Lecture* : Some recent results on the central limit theorem (Calcutta).

PROFESSOR ESTHER SEIDEN, Department of Statistics of Probability, Michigan State University, U.S.A. (16-25 December 1977) attended the invited sessions, IMS-ISI Meeting, New Delhi, as a delegate and presented a paper. *Lectures* : (i) Construction of mutually orthogonal latin squares by the method of semi composition, (ii) Construction of generalised Youden design, (iii) On the repeated measurement design.

PROFESSOR GEORGE R. SELL, University of Minnesota, Minneapolis, U.S.A., was accompanied by Mrs. Sell (25-27 July 1977). *Lecture* : Controllability of deterministic dynamical systems. He also visited Delhi.

DR. R. SHANTARAM, University of Michigan, U.S.A. visited the Delhi Centro (August 1977-July 1978). *Seminars* : (i) Preservation of infinite divisibility under mixing, (ii) Some determinants connected with the Arc-Sine Law and the equation $X + Y = XY$.

PROFESSOR S. S. SHRIKHANDI, University of Bombay (17-18 January 1978). *Lecture* : Embedding of orthogonal arrays.

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PROFESSOR V. M. SIMCHERRA, State Committee for Service and Technology Research, Institute of Management, Moscow (11-15 December 1977) attended the fortyfirst session, International Statistical Institute, New Delhi. *Lecture*: Integrated systems for collecting and processing international information.

DR. M. S. SRIVASTAVA, University of Toronto, Canada, visited the Delhi Centre (December 1977-July 1978). *Seminar*: Asymptotic distribution of the characteristic roots of a covariance matrix in principal component analysis.

PROFESSOR V. A. STATULEVICIUS, Institute of Mathematics and Physics, Academy of Sciences, Lithuanian SSR; University of Vilnius, USSR, presented papers at the invited session, IMS-ISI Meeting, New Delhi (18-23 September 1977). *Lecture*: Large deviation in limit theorems for random processes (Calcutta).

PROFESSOR P. K. TRIVEDI, Australian National University, (November 1977-March 1978) came to the Delhi Centre. *Lectures*: (i) Inertia and comparison effect in wage determination: an econometric case study of Australia (Delhi), (ii) Estimation of distributed log model under quadratic laws.

DR. VLADIMIRO VALERIO, Università Degli Studi Di Napoli, Rome, came to the Delhi Centre. He attended the joint meeting, IMS-ISI, New Delhi (September 1977-January 1978). *Seminar*: Generalised inverse of a partitioned matrix.

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

MR. AVRAMOVICH, Director, World Bank (31 October 1977).

MR. TRAN HAI BANG, Deputy Director-General, Central Office of Statistics, Republic of Viet Nam (11-13 December 1977).

DR. A. FAROUK, Member, Planning Commission, Bangladesh (8 December 1977).

PROFESSOR L. FOX, Director, University Computing Laboratory, Oxford, U.K. (5-8 February 1978).

DR. G. GLATZ, Institute for Applied Mathematics, University of Karlsruhe, Federal Republic of Germany (24-25 March 1978).

MR. B. J. MACDONALD, U.S. Officer of Naval Research, Tokyo, Japan (22-23 December 1977).

DR. A. M. MATHAI, Department of Mathematics, McGill University, visited the Delhi Centre (1-25 December 1977).

DR. D. NICULESCU, Ambassador of the People's Republic of Romania (20 March 1978).

PROFESSOR M. E. RAABEN, a leading expert on algal stromatolites and Pro-Cambrian biostratigraphy, Geological Institute, USSR Academy of Sciences, held discussions on current research conducted in the Geological Studies Unit (29 March 1978).

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CAPTAIN, V. M. SHAHANE, Head, Faculty of Decision Analysis, Institute of Defence Management, Indian Navy, Secunderabad (18 March 1978).

MR. JAMES THOMPSON, Librarian, Reading University Library, United Kingdom; specialist on the planning and design of library buildings (22 March 1978).

BRIGADIER B. P. UFASANI, Director, Institute of Defence Management, Hyderabad (18 March 1978).

MR. ARTHUR H. VESPRY, Director, International Programmes of IDRC (International Development Research Centre, Ottawa) in Asia and Mr. SULTAN KASSUM, In-Charge, International Set of Information Systems Programme of IDRC (23 February 1978).

DR. HARUO YANAI, Department of Epidemiology, Faculty of Medicine, University of Tokyo, visited the Delhi Centre (25 January 1977-6 April 1977; 22 January 1978).

XV. HONOURS, AWARDS AND SPECIAL ASSIGNMENTS

15.1 *Honours and Awards* : Professor G. Kallianpur, Director, became a member, International Statistical Institute, 1978.

Professor G. Kallianpur became a member, Committee for the construction of a planning model, set up by the Karnataka Government.

Shri A. B. Gupta (*Physics*) was elected (i) Fellow, Indian Physical Society, (ii) Member, Indian Association for the Cultivation of Science.

Shri C. R. Malakar (*Demography*) was nominated a Fellow, International Advisory Committee for Population Reports, George Washington University Medical Centre, U.S.A.

15.2 *Special Assignments* : Professor G. Kallianpur, Director, Indian Statistical Institute, was elected President, Plenary Session, Fifth All India Social Sciences Conference, 1978.

Shri Tapan Basumallik (*Psychometry*) served on the interview board for the Industrial Entrepreneurship Training Course organised by the Small Industries Service Institute, Government of India, Calcutta.

Shri Durgaprasad Bhattacharyya (*Pre-Census Population Studies*) was nominated a member, Advisory Committee, Research Project on Historical Statistics of India up to 1947, sponsored by the Indian Council of Social Science Research. He continued to serve as (i) Member, Standing Committee for Indian Historical Records Commission, (ii) Honorary Director, Project on Economic Writings in Bengali, 1818-1947, sponsored by the ICSSR, (iii) Secretary, Socio-economic Research Institute, Calcutta, (iv) Council member, Bangiya Sahitya Parishad.

Dr. N. Bhattacharyya (*Economic Research*) became a member of a Committee for reviewing the activities of the Bureau of Applied Economics and Statistics, Government of West Bengal.

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Dr. Bhattacharyya was called upon to give expert evidence before the Rath Committee set by the Government of India to examine the current series of official consumer price index numbers. He represented the Indian Statistical Institute on the Government Council, NSS Organisation. He was appointed co-editor, *Sankhyā*, Series C (Quantitative Economics).

Shri Nirmal Kumar Chatterjee (*Economic Research*) was nominated a member, Pay Committee for the revision of pay-scales for the employees of the Government of West Bengal.

Professor T. A. Davis (*Crop Science*) left for Indonesia on 1 July 1977, to take up a UNDP/FAO assignment which is expected to continue upto 31 December 1978.

Dr. P. Das Gupta (*Demography*) was invited to serve as Associate Editor, *Theoretical Population Biology*, an international journal published in the U.S.A., for a three-year term from 1 January 1978 through 31 December 1980.

Professor D. Dutta Mazumdar (*Electronic and Communication Science*) acted as a member of the Selection Board, Indian Institute of Science, Bangalore.

Dr. S. L. Jain (*Geology*) was nominated Chairman, Working Group on Vertebrate Palaeontology for the Sub-commission on Gondwana Stratigraphy, June 1977.

Dr. A. Mitra (*Economic Research*) who was elected to the Legislative Assembly in June 1977 was appointed as Minister of Finance in the Government of West Bengal.

Shri Anish Mukhopadhyay (*SQC*) left for Tanzania on 11 June 1974 and returned to India on 11 March 1977 after completion of his assignment. He joined the Applied Statistics, Surveys and Computing Division.

Shri F. B. Chowdhury (*Electronics and Communication Science*) was awarded a gold medal for outstanding presentation of his technical paper on "Microprocessor based industrial controller" at the Gauhati Conference of the Institute of Engineers.

XVI. SCIENTIFIC TOURS AND ASSIGNMENTS ABROAD

Professor G. Kallianpur, Director, left for the U.S.A. on 13 April 1977. He visited the Department of Mathematics, University of Minnesota. He gave a invited talk at the Department of Statistics and Probability, Michigan State University. He returned to India on 26 April 1977.

Professor Kallianpur left for Australia on 14 May 1977, on invitation. He visited the Division of Mathematics and Statistics, CSIRO, Canberra, Australia. He also visited units of the Division of Mathematics and Statistics at Canberra (Headquarters), Melbourne, Sydney, Adelaide and Perth. He gave invited talks at the Department of Mathematics, University of Western Australia. He also gave a invited talk on the "Indian Statistical Institute' at the Canberra Branch, Australian Statistical Society. He returned to India on 4 June, 1977.

Professor Kallianpur left for Moscow on 23 June 1977, on invitation by the USSR Academy of Sciences. He participated on the International Conference on Probability and Statistics, Vilnius, Lithuanian SSR. He attended the Conference on Measure Theory in

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Function Space (as a co-organiser of the conference), Oberwolfach, Federal Republic Germany, 2-9 July 1977. He also gave a invited talk at the Department of Mathematics, University of Erlangen-Nuremberg at Erlangen, Federal Republic of Germany. He returned to India 13 July 1977.

Professor Kallianpur left for Canada on 22 September 1977. He gave a invited talk on Stochastic Filtering Theory at the Department of Mathematics, University of Alberta, Edmonton, Alberta, Canada. He returned to India on 16 October 1977.

Shri T. S. Arthanari (*Statistical Quality Control*) went to Iran to work with School of Planning and Computer Applications, Tehran, as a visiting scientist, in the middle of January 1977 for one year.

Shri Sunit Bose (*Library*) attended the XVII International Seminar for Russian Language Teachers from Asia, Africa and Latin America, organised by the Patrice Lumumba Friendship University, Moscow, 10 June 1977-10 July 1977. Sm. Rama Bhaduri (*Library*) also attended.

Shri R. L. Brahmaachary (*Embryology*) left for Zaire, Central Africa, in February 1978 to conduct ecological research. The arrangement was made through the Indian Embassy in Zaire and Zairian Institute for Conservation of Nature and partially sponsored by the ISI.

Dr. S. K. Chakravarti (*Economic Research*) participated in the OECD (Organisation for Economic Co-operation and Development) Expert Meeting on Development Programme and Policies for meeting Basic Human Needs, Paris, 5-6 October 1977.

Sarvaari B. Chakraborty, S. Guha Roy, C. R. Malakar and M. V. Raman (*Demography*) participated and presented a paper each at the General Conference, International Union for the Scientific Study of Population, Mexico City, 8-13 August 1977. They left India together on 3 August and returned on 26, 18, and 26 August respectively.

Dr. Sankar Chatterjee (*Geology*) joined the Smithsonian Institution, U.S.A., as a post-doctoral fellow. He completed the study of a new thecodontian reptile which he found in the gastric contents of "twin" paracerasaurids from the late Triassic Maleri formation. In collaboration with Dr. I. G. Sohn, U.S. Geological Survey, he recovered and described Triassic ostracodes from the Maleri coprolites. His work on the paleogeography of India before the drift is in final form. He is working at present on Cretaceous crocodiles from Texas.

Dr. Sankar Chatterjee attended the following :

(i) Annual Meeting, Society of Vertebrate Paleontology, Los Angeles, USA, 10-12 November 1977, and (ii) 144th National Meeting, American Association for the Advancement of Science, Washington DC, 12-17 February 1978.

Dr. Dipankar Coondoo (*Economic Research*) went to Czechoslovakia under the Indo-Czechoslovak Cultural Exchange Programme (5 February 1978-7 March 1978). The object of the visit was mostly confined to the exchange of ideas and discussions with the scientific workers of the Institute of Economics, Czechoslovak Academy of Sciences, Prague, and the Computing Research Centre, Bratislava.

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Dr. B. C. Das (*Applied Statistics, Surveys and Computing*) attended a conference organised by the Polish Hydrobiological Society, Warsaw, Poland, 23-28 August 1977. He presented a paper at a special seminar conducted by the Hydrobiological Conference of Aquaculture, Warsaw, 3 October 1977.

Shri P. J. Devadason, Research Fellow, DRTO, participated in the Ninth Seminar on the Processing, Storage and Retrieval of Documentary Information, Paris, 7-10 November 1977. The steps involved in the automated processing of documents were discussed at the seminar.

Shri M. Ghosh (*Stat-Math*) attended the joint meeting, American Statistical Association and Institute of Mathematical Statistics, Wisconsin, U.S.A., 15-18 May 1977. He presented a paper.

Dr. K. O. Malhotra (*Anthropometry and Human Genetics*) went to the Centre for Demographic and Population Genetics, Houston, U.S.A., as Visiting Associate Professor, 1 April 1977-18 June 1977.

Dr. S. K. Mitra (*Delhi Centre*) visited the Indiana University at Bloomington, Indiana, USA, under a NSF research project. He left on 13 June 1977 and returned on 18 August 1977. While in the United States, he gave two seminars, one on 1 August 1977 at the Department of Statistics, University of Kentucky, Lexington, Kentucky and the other on 11 August, 1977 at the Data Analysis Group, Bell Telephone Laboratories, Murray Hill, New Jersey.

He acted as an external examiner at the University of Dar-es-Salaam, Tanzania, 13-27 March 1978, where he also delivered two seminar lectures.

Dr. R. Mukherjee (*Sociology*), Distinguished Scientist, was offered an Adjunct Professorship for the period 1977-80 to teach for six weeks every year at the Department of Sociology, State University of New York, Binghamton, U.S.A. He left India for the USA on 28 March 1977 in connection with the teaching programme at Binghamton and also for visits to other universities in the U.S.A. He returned in May 1978.

At the invitation of the Iranian Documentation Centre, Professor A. Neelameghan (*Documentation Research and Training*) participated in a UNISIST (World Information System for Science and Technology) Seminar on Development of Iranian National Science Information Policy, Tehran, 25-29 April 1977. He presented a note on "Programming for the National STI Plan."

Professor Neelameghan was one of the invited speakers at the International Symposium on Technical Information and its Users, Sofia, Bulgaria, 15-17 June 1977. He contributed a paper for discussion at the symposium, organised by the Committee of Engineering Information of the World Federation of Engineering Organization and the Central Council of Scientific and Technical Unions of Bulgaria. The two main themes discussed were: (i) Information requirements of engineers, and (ii) Education and training of engineering information users.

On invitation by the Hungarian Central Technical Library and Documentation Centre, Professor Neelameghan visited the Centre in Hungary, 19-24 June 1977, and gave lectures on "National Information Systems in India."

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On invitation by the Brazilian Government, Professor Neelameghan visited Brazil, 26 June 1977-6 July 1977, to participate in the Ninth Brazilian Congress and Fifth Rio-Grandoso Meeting of Library Science and Documentation, Porto Alegre, 3-6 July 1977. He gave a course of lectures on Analytico-Synthetic Classification, at the Conference. While in Brazil, Professor Neelameghan gave lectures on Analytico-Synthetic Classification at the University of Minas Gerais, Belo Horizonte and the University of Brasilia.

On invitation, Professor Neelameghan participated as an UNESCO consultant in the UNESCO Seminar on Scientific and Technical Information Services in South-East Asia, Bali, Indonesia, 8-11 July 1977. He also prepared a working document on Information Manpower Development.

Professor Neelameghan participated as a UNESCO Consultant in the first UNESCO-UNISIST Meeting on Regional Information Policy and Planning in South-east Asia, Bali, 12-16 July 1977.

Professor Neelameghan attended the first session of the UNESCO's Advisory Committee for the General Information Programme, Paris, 11-14 October 1977. He was elected chairman of the committee.

On invitation from the UNESCO Division for the International Development of Social Sciences, Professor Neelameghan participated in the meeting of the *ad-hoc* committee on Social Science Information, Paris, 14-18 November 1977. He was elected chairman of the meeting.

Professor Neelameghan participated in the first session, Inter-governmental Council, UNESCO's General Information Programme, Paris, 19-26 November 1977.

At the request of the Industrial Development Centre for the Arab States (IDCAS), Professor Neelameghan conducted a three-week course, Khartoum, Sudan, 3-22 December 1977, for the benefit of industrial information centres in the Arab States, on a UNIDO assignment.

Professor Neelameghan attended the Preparatory Committee meeting, Paris, 29-31 March 1978, for organizing the Second UNESCO-UNISIST Intergovernmental Conference to be convened in 1979.

Dr. K. R. Parthasarathy (*Delhi Centre*) visited the University of Dar-es-Salaam, Tanzania, 1-10 April 1977, as an external examiner for the B.Sc. and M.Sc. examinations. He delivered two lectures. He also visited the University of Western Australia, Perth, La Trobe (Melbourne) and the Australian National University, Canberra, at the invitation of the Australian CSIRO, 5 June-31 July 1977. He delivered two lectures.

Shri B. L. S. Prakasa Rao (*Delhi Centre*) went to the Soviet Union on an Indo-Soviet Scientific and Cultural Exchange Programme between the USSR Academy of Sciences and the Indian Statistical Institute. While in the USSR between 23 May 1977-5 July 1977, he gave lectures at the Mathematical Institute and presented an invited paper at the Second Vilnius Conference on Probability Theory and Mathematical Statistics. He was also an invited speaker at the Conference on Asymptotic Methods of Statistics, Oberwolfach,

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Federal Republic of Germany, 20-26 November 1977. He gave lectures at the Central Institute of Mathematics and Mechanics, Sofia, Bulgaria, and at the University of Patras, Greece, on his way back from Germany.

Shri S. M. Sundara Raju (*Statistical Quality Control*) visited Japan and South East Asia (13 May 1977-2 July 1977) and delivered a number of lectures on quality, reliability and operations research for managers, technologists and engineers.

As a member of a technical delegation from the National Thermal Power Corporation to the United Kingdom, Shri Sundara Raju visited a number of organisations including the Central Electricity Generation Board, British Electrical International and some power plants (25 February 1978-9 March 1978).

Shri M. V. Raman (*Demography*) attended the following :

(i) General Conference, International Union for the Scientific Study of Population, Mexico City, 8-13 August 1977.

(ii) Fifth General Assembly, Committee for International Co-operation in National Research in Demography (CICRED), Mexico City, 10 & 12 August 1977.

Shri Raman left India on 3 August 1977 and returned on 18 August 1977.

Shri B. Ramachandran (*Delhi Centre*), was an invited speaker at the colloquium on the Methods of Complex Analysis in Probability Theory and Statistics, Debrecan, Hungary, 20 September-3 October 1977. He delivered two lectures. He also spent a month at the Department of Mathematics, McGill University and visited the University of Manitoba, Winnipeg, to deliver a seminar lecture.

Dr. T. J. Rao (*Stat-Math*) worked as a senior research scientist at the Division of Mathematics and Statistics, CSIRO, Melbourne, Australia, upto November 1977 before re-joining ISI on 1 December 1977 on the expiry of leave of about 29 months. During the year, he visited the CSIRO, Adelaide, on 24 October 1977, the University of Western Australia, Nedlands, on 27 October 1977 and the CSIRO, Wembley, on 28 October 1977 and gave lectures. He visited the Department of Census and Statistics, Hongkong Government, on 31 October 1977 and the Hongkong University on 1 November 1977 where he gave seminars. He also worked as a consultant on statistical problems with special reference to sample design for several projects.

Dr. T. J. Rao (*Stat-Math*) attended the Second Conference on Sample Surveys, organised by the C.S.I.R.O., Melbourne, Australia, 28 September 1977, and presented a paper.

Professor Ashok Rudra (*National Income*) attended the following :

(i) Planning meeting for a Sub-Committee on South Asian Political Economy sponsored by the Social Sciences Research Council, New York, 13-15 June 1977. He left India on 10 June 1977 and returned on 1 July 1977.

(ii) He stayed in Switzerland, 4-8 April 1977, to work on an assignment with the International Labour Organisation for preparing a paper, "Organisation of Agriculture for Rural Development—The Indian Case." He left India on 28 March 1977 and returned on 7 May 1977.

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(iii) He visited Switzerland, 10 December 1977-22 January 1978, to work as a consultant for the Technology Transfer Division, United Nations Conference on Trade and Development (UNCTAD). He also visited Geneva in connexion with this assignment. He left India on 17 December 1977 and returned on 27 January 1978.

XVII. SCIENTIFIC ASSIGNMENTS IN INDIA

Dr. G. Kallianpur, Director, Indian Statistical Institute, attended the following :

(i) Meeting of the Joint Indo-Soviet Project on Statistics and Probability, New Delhi, 7 August 1977.

(ii) Third Meeting of Directors, International Statistical Education Centre, Calcutta, 28-30 November 1977.

(iii) Fifth Round Table Meeting on Teaching of Statistics, Calcutta, 30 November 1977-2 December 1977.

(iv) Fortyfirst session, International Statistical Conference, New Delhi, 5-15 December 1977. Dr. Kallianpur was a member, Advisory Committee of the Biennial Session, set up by the Department of Statistics, Ministry of Planning, in January 1977.

(v) Regional Meeting, Institute of Mathematical Statistics (I.M.S.) jointly sponsored by the Indian Statistical Institute, and I.M.S., New Delhi, 16-18 December. Dr. Kallianpur was a member, Programme Committee, and chaired the special lecture session on 16 December 1977.

(vi) Seventh National Conference on Quality Control, New Delhi, 19-21 December 1977.

(vii) International Conference on Optimisation in Statistics, Bombay, 20 December 1977. Dr. Kallianpur delivered the banquet speech.

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

(i) Seventh Meeting, Standing Committee, Union Ministry of Education for Indian Historical Records Commission, New Delhi, 28 November 1977.

(ii) Meeting of the Indian Council of Social Science Research to consider a research project on historical statistics of India upto 1947, New Delhi, 13 December 1977.

(iii) Thirty-eighth session, Union History Congress, Bhubaneswar, 26-28 December 1977. He presented a paper.

(iv) Regional Seminar on Land Reforms, Jadavpur University, 4-5 February 1978. Sm. Rama Deb Roy Malakar also participated.

Sarvasri L. S. Bhat, B. N. Das and A. N. Sharma (*Delhi Centre*) participated in a specialised training programme in regional planning organized by the Central Statistical Organisation, New Delhi, 27 June 1977-2 July 1977.

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Shri L. S. Bhatt (*Delhi Centre*) participated in the following :

(i) Seminar on Imports as a Cause of Market Disruption, New Delhi, 19 December 1977.

(ii) Refresher Course on Recent Trends in Geography, Udaipur University, 10-12 July, 1977.

(iii) Meeting of Economic Advisory Council, Government of Uttar Pradesh, as a member, Lucknow, 8-9 September 1977.

Shri P. Bhattacharyya and Dr. A. Ghosh (*Electronics*) attended the Fifth CASAMCU Research Symposium on Mechanics of Continuous Media, Calcutta, 20-22 March 1978, and presented a paper.

Shri S. K. Biswas (*Sociology*) attended, as a discussant, the Annual Conference, Indian Anthropological Society, Calcutta, 14-15 January 1978.

Dr. D. K. Bose (*Economic Research*) attended the following :

(i) Seminar on the Problems of Federal Polity, Calcutta, 20-30 January 1978. The seminar was organised during the Fifth All India Conference, Indian School of Social Sciences, Trivandrum. Dr. S. Chattopadhyay took an active part in organising the seminar.

(ii) Seminar on Industrialisation in India organised by the Centre for Studies in Social Sciences, Calcutta, 20-22 December 1977. Dr. Bose acted as commentator in one of the sessions.

Shri Tapas Bose (*Applied Statistics, Surveys and Computing*) presented a paper in the Biochemistry Section, All India Convention of Chemists Conference, Jaipur, 26-29 December 1977.

Sarvasri B. Chakraborty and B. N. Sarkar (*Demography*) participated in the Third Annual Conference, Indian Association for the Study of Population, Hyderabad, 6-8 March 1978, and presented papers.

Dr. S. Chakraborty (*Economic Research*) participated in the following :

(i) Conference on Price Stability (Dam Bandho Sammelan), Calcutta 30-31 December 1977 and 1 January 1978. Dr. S. Chattopadhyay also participated.

(ii) Seminar on Recent Developments in Monetary Theory and Policy with special reference to Developing Countries, organised by the Reserve Bank of India, Bombay, 14-15 January 1978.

Dr. S. Chattopadhyay (*Economic Research*) attended a Workshop on Problems of Public Distribution of Foodgrains in Eastern India, Calcutta, 7-9 March 1978.

Shri K. Chattopadhyay (*Sociology*) attended the Expert Committee Meeting on the problems of scheduled castes and scheduled tribes of West Bengal, Calcutta, 28 March 1978 and 19 April 1978.

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Dr. A. Chaudhuri and Dr. S. Ghosh (*Applied Statistics, Surveys and Computing*) presented papers at a Seminar on Quantitative Methods for Decision Making, organised jointly by the Department of Statistics, Calcutta University, and the Indian Statistical Institute, Calcutta, 27-29 March 1978.

Dr. A. K. Chaudhuri (*Geology*) participated in the Seminar and Group Discussion on Recent Near Shore Environments, Calcutta, 27 February 1978.

Shri V. K. Chetty (*Delhi Centre*) attended the Annual Meeting, Econometric Society, Trivandrum, 19-21 December 1977. He gave a lecture.

Sarvasri A. K. Datta, S. K. Pal and S. Roy (*Electronics*) attended and presented papers at the (i) All-India Interdisciplinary Symposium on Speech and Hearing, (ii) Annual Meeting, Acoustical Society of India, Bangalore, 30 January 1978-1 February 1978.

Dr. P. Das Gupta and Shri M. V. Raman (*Demography*) attended the All-India Meeting of Demographers of the D and E Cells and DCAR Centres organised by the Department of Family Welfare, Government of India, New Delhi, 17-19 November 1977.

Dr. A. Ghosh (*Electronics*) attended the Symposium on Problems and Prospects of Large-Scale Computerisation of the 1981 Census organised by the Indian Association for the Study of Population and the Central Statistical Organisation, New Delhi, 4-5 November 1977.

Dr. S. Ghosh, Dr. J. Roy and Shri A. K. Adhikari (*Applied Statistics, Surveys and Computing*) presented papers at a Seminar on Probability, Stochastic Modelling and Inference sponsored by the Indian Institute of Management, Calcutta, 24 January 1978.

Shri S. Guha Roy (*Demography*) participated in the Data Users' Conference—1981 Census sponsored by the Office of the Regional-General and Census Commissioner of India, New Delhi, 13-15 February 1978.

Shri T. Maitra (*Applied Statistics, Surveys and Computing*) acted as commentator in the Workshop on Problems of Public Distribution of Foodgrains in Eastern India, Calcutta, 7-9 March 1978.

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

- (i) Seminar on Human Variation, Calcutta, 29 June 1977-4 July 1977.
- (ii) International Workshop on Medical Genetics, Pondicherry, 17-19 October 1977.
- (iii) Fourth Annual Conference, Indian Society of Human Genetics, Madras, 21-24 December 1977.
- (iv) Seminar on Genetical Demography, Calcutta, 18-18 January 1978.
- (v) National Seminar on Indian Nomads, Mysore, 14-16 February 1978.

Dr. Jogesh Mishra (*Library*) presided over a Seminar on Libraries and Unemployment, held under the auspices of Indian Association of Scientific Libraries and Information Centres (IASLIC), Calcutta, 14 May 1977.

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Dr. Mishra attended the Fourth D.S.T. Course in Documentation and Information Services, Calcutta, March-April 1977.

Dr. S. K. Mitra (*Delhi Centre*) was an invited participant at the International Conference on Optimization in Statistics, Bombay, 20-22 December 1977. He presented a paper.

Sm. Alokánanda Mitter (*Linguistic Research*) participated in the following :

(i) Seminar for Teachers of the Deaf (*Topic* : Latest trends in habilitation of speech and language in the hearing-impaired), sponsored by the School for Partially Deaf, Hyderabad, 30 January 1978.

(ii) Seminar on Modernization of Indian Languages in News Media, sponsored by the Osmania University, Hyderabad, 1-3 February 1978.

(iii) Seminar-cum-Workshop on problems related to linguistic research, sponsored by the Education Directorate, Government of Tripura, Agartala, 15-24 February 1978.

Shri K. K. Mukherjee (*Delhi Centre*) and Shri A. Mukherjee (*Stat-Math*) attended a Symposium on K-Theory Shillong, Meghalaya, 13-17 May 1977.

Professor A. Neelameghan (*Documentation Research and Training Centre*) was a Visiting Professor at the Delhi University for four weeks during January-February 1978. He delivered lectures at scientific organisations and universities.

Professor A. Neelameghan participated in the following :—

(i) Joint Working Group on Scientific and Technical Information of the Indo-U.S. Sub-commission on Sciences and Technology, Bangalore, 22-23 July 1977. He co-chaired the meeting.

(ii) Third International Training Programme on Information Storage and Retrieval System, Hyderabad, 19 September-11 November 1977. He delivered two lectures.

(iii) Seminar on Library and Information Science Education in India, Delhi, 3-8 October 1977. Professor S. Parthasarathy also participated.

(iv) National Workshop on Documentation in the Field of Health and Family Welfare, Delhi, 3-8 November 1977. Professor Neelameghan presented a paper and acted as the chairman of a plenary session. Shri M. A. Gopinath was a rapporteur.

(v) Seminar on Information for Industry, Madras, 5-7 August 1977. Professor S. Parthasarathy also participated. DRTC staff contributed three papers.

(vi) UNESCO Regional Seminar on Informatics in South and Central Asia, Delhi, 7-9 November 1977.

(vii) Seminar on Information for Engineering Industry, Delhi, 10 February 1978. He presented a paper.

(viii) Asian Writers' Workshop, Delhi, 15 February 1978.

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(ix) Economic and Social Commission for Asia and Pacific—Population Correspondent's Workshop I, New Delhi, 23-25 February 1978 and Workshop II, Bombay, 6-8 March 1978. Professor Neolamghan participated as a Resource Person and presented papers.

Professor S. Parthasarathy and Sri G. Bhattacharyya (*Documentation Research and Training*) participated in the Eleventh Conference, Indian Association of Scientific Libraries and Information Centre, Dharwar, 2-5 November 1977. The DRTC staff contributed six papers.

Dr. Kanti Pakrasi (*Anthropometry and Human Genetics*) participated in the following conferences :

(i) United Nations Workshop for ESCAP Population Correspondents in India, New Delhi, 23-25 February 1978.

(ii) Annual Conference, Indian Anthropological Society, Calcutta, 14-15 January 1978.

Shri M. V. Raman and Shri B. N. Sarkar (*Demography*) participated in the Workshop on Assessment Methodology for Community Health Workers Scheme in India organised by the All-India Institute of Hygiene and Public Health, Calcutta, 24-25 January 1978.

Dr. (Mrs.) Bina Roy (*National Income*) attended the Seventeenth General Conference, Indian Econometric Society, Trivandrum, 19-21 December 1977, and presented two papers.

Dr. J. Roy (*Applied Statistics, Surveys and Computing*) gave a invited key-note address at the Third Annual Convention of Computer Society of India, Rourkela, 8 October 1977.

Professor S. K. Roy (*Botany*) attended the following :

(i) Seminar on Problems of Rodents and their Control, Shillong, Meghalaya, 2-3 December 1977.

(ii) Colloquium on Some Problems in Plant Genetics, Calcutta, 27-28 February, 1978.

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

(i) Seminar on Population Aspects of Rural Development organised by the International Institute of Population Studies in collaboration with the Indian Academy of Social Sciences, Bombay, 10-11 October 1977.

(ii) Seminar on World Fertility Survey, New Delhi, 16 December 1977.

(iii) Third Annual Conference, Indian Association for Study of Population, Hyderabad, 16-18 March 1978.

Sri K. Saradamoni (*Delhi Centre*) attended the following :

(i) Eleventh Conference, Indian Association for Research in National Income and Wealth, Shillong, Meghalaya, 28-31 October 1977. She presented a paper.

(ii) Seminar on Women and Development organized by the United States Education Foundation, Anand, Gujarat, 21-26 November 1977. She presented a paper.

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(iii) Seminar on Multinational Corporations and India's Development organised by the All-India Peace and Solidarity Organisation, New Delhi, 2 October, 1977.

(iv) Seminar on Social, Economic and Political Perspective of Independent India and Socialist Soviet Union, New Delhi, 19-20 November 1977.

(v) Seminar on Planning and Self Reliance, New Delhi, 5 March 1978.

Shri C. H. Sastry (*Applied Statistics, Surveys and Computing*) attended the National Seminar on Software Development in India, Hyderabad, 13-15 October 1977.

Shri H. C. Sharma (*Delhi Centre*) participated in a Seminar on Imports as a cause of Market Disruptions, New Delhi, 9 December 1977.

Shri T. D. Tendulkar (*Delhi Centre*) attended the following :

(i) Seminar on Limits to Growth : Second Phase Models organised by the Ford Foundation, New Delhi, 14-15 April 1977.

(ii) Meeting of the Economic Advisory Council of Uttar Pradesh, Lucknow, 23-24 April 1977. Shri M. R. Saluja (*Delhi Centre*) also attended.

(iii) Meeting of Task Force on Consumer Expenditure and Minimum Needs appointed by the Planning Commission, New Delhi, 8-10 June 1977.

(iv) Seminar on Public Distribution System organised by the Indian Council of Social Science Research, Ahmedabad, Gujarat, 2-3 September, 1977.

Shri T. P. Tripathi (*Stat-Math*) attended the thirtyfirst Annual Conference, Indian Society of Agricultural Statistics, New Delhi, 16-18 December 1977, and presented a paper.

The undermentioned staff members attended the conferences mentioned.

I. Forty-first session, International Statistical Institute, New Delhi, 6-15 December 1977.

1. Dr. B. C. Das, 2. Dr. A. Chaudhuri* and 3. Dr. S. Ghosh (*Applied Statistics, Surveys and Computing*), 4. Dr. K. C. Malhotra (*Anthropometry*), 5. Shri C. Ramaswamy (*Delhi Centre*), 6. Shri T. J. Rao* (*Stat-Math*), 7. Dr. J. Roy (*Applied Statistics*) organised a session on "Empirical Studies on inheritance of rare human traits." 8. Professor S. K. Roy (*Botany*), 9. Shri B. N. Sarkar* (*Demography*), 10. Shri T. P. Tripathi* (*Stat-Math*), (*Denotes presented paper).

II. Joint Meeting, Institute of Mathematical Statistics and Indian Statistical Institute, New Delhi, 16-18 December 1977.

1. Shri A. K. Chattopadhyay, 2. Dr. S. R. Chakraborty and 3. Dr. S. Ghosh (*Applied Statistics*), 4. Shri M. Ghosh, 5. Shri S. P. Rao Hobbare, 6. Shri K. Singh, 7. Shri B. K. Sinha (Nos. 1 & 4 to 7 from *Stat-Math*), 8. Shri P. K. Tapaswi (*Embryology*). (Except No. 4, papers were presented by all the others).

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III. Sixtyfifth session, Indian Science Congress, Ahmedabad, 3-9 January 1978.

1. Shri G. S. Chatterjee (*National Income*), 2. Dr. S. R. Chakraborty & 3. Dr. A. Chaudhuri (*Applied Statistics*), 4. Shri M. Ghosh, and 5. Shri S. S. Ghosh (*Crop Science*), 6. Shri A. K. Halder and 7. Dr. A. C. Mukhopadhyay (*Applied Statistics*), 8. Shri B. K. Pal (*Chemistry*), 9. Dr. P. R. Pal (*Biochemistry*), 10. Shri B. N. Sarkar (*Demography*), 11. Shri P. K. Tapaswi (*Embryology*) (Except No. 8, papers were presented by the all others)

Dr. J. Roy (*Applied Statistics*) was the President of the Statistics Section, Indian Science Congress.

XVIII. EIGHTY-FOURTH BIRTH ANNIVERSARY OF LATE PROFESSOR P. C. MAHALANOBIS

The eighty-fourth birth anniversary of the late Professor P. C. Mahalanobis, founder-Director, Indian Statistical Institute, was celebrated at the Institute premises at Baranagar on 29 June 1977.

Speaking at a meeting held on the occasion, Shri B. Sivaraman, Member, Planning Commission, said that Professor Mahalanobis had built up the reputation of the Indian Statistical Institute in the world of statistics, mainly by building up a strong school of applied statistics.

An exhibition organized 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 1977-78, 51 persons were enrolled as ordinary members of the Institute. The membership of 58 ordinary members was terminated in terms of clause 3.1 of Regulations of the Institute. Three ordinary members became life members. Nine ordinary members and one Institutional member resigned and one life member and one ordinary member died.

Thus, the membership position as on 31 March 1978 and 412 members (Ordinary—276, Life—122, Honorary Life—4 and Institutional—10).

During the year 1977-78, 316 student members were enrolled for one-year term.

19.2 *General Meetings* :

19.2.1 Two meetings of the members of the Indian Statistical Institute were held on 1 April 1977 and 18 January 1978.

19.3 *Meetings of the Council of the Institute* :

The Council of the Institute met three times during the year on (i) 14 September 1977, (ii) 18 January 1978, and (iii) 8 February 1978 (Adjourned meeting).

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A list of names of the President, Chairman and members of the Council of the Institute is given in Chapter XX.

19.4 *Meetings of the Finance Committee* : The Finance Committee of the Council met twice on 13 September 1978 and 17 January 1978.

19.5 In terms of the Revised Regulations and Bye-laws of the Institute, the under-mentioned committees were set up for the smooth functioning of the Institute :

(i) Finance Committee, (ii) Journal Committee, (iii) Examinations Committee, (iv) Works Advisory Committees for Baranagar and Delhi, (v) Technical Advisory Committees for different Divisions, and (vi) Joint Consultative Committee for scientific and non-scientific workers.

The names of members of each committee are given in Chapter XX.

19.6 *Institute Staff* : The following senior members of the staff continued in the posts mentioned during the year :

(i) Dr. G. Kallianpur joined as Director in July 1976, in terms of the Revised Regulations and Bye-laws of the Institute.

(ii) Dr. S. K. Mitra, Acting Head of Delhi Centre.

(iii) Dr. Ashok Maitra, Dean of Studies.

(iv) Shri T. D. Gupta, Chief Administrative Officer-cum-Controller of Finance.

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

1. Shri Asis Ranjan Basu, M.Stat., Technical Officer, SQC, Bombay.
2. Shri K. K. Chowdhury, M.Stat., Diploma in SQC & OR, Technical Officer, SQC, Bangalore.
3. Dr. Prithwis Dasgupta, M.Sc., Ph.D., Professor, Demography.
4. Shri K. M. Dato, M.Stat., Post-graduate Diploma in SQC & OR, Technical Officer, SQC, Pune.
5. Dr. Subir Ghosh, M.Sc., Ph.D., Lecturer, Computer Science Unit.
6. Shri Supriya Gupta, B.E. (Civil), Senior Civil Engineer.
7. Dr. N. K. Jaiswal, Professor, Delhi.
8. Major H. C. Majumdar, Senior Security Officer.
9. Dr. Amiya Mukherjee, M.Sc., D.Phil., Lecturer, Stat-Math.
10. Dr. S. Mukhopadhyay, MBBS, M.D., Medical Officer, Medical Welfare Unit.
11. Shri M. V. Nagarkar, B.E. (Civil).
12. Dr. D. Ramachandran, M.Stat., Ph.D., Lecturer, Stat-Math.
13. Dr. Abhijit Sengupta, M.Tech., Ph.D., Programmer, Computer Science Unit.
14. Shri Arvind Seti, M.Stat., Diploma in SQC & OR.
15. Dr. A. C. Shamihoko, System Numerical Analyst, Computer Science Unit.

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Dr. P. Bhimasankaram, Lecturer (*Applied Statistics*) resumed his duties in May 1977, on expiry of lion.

19.8 *Retirements & Resignations* : Shri Probhat Ranjan Sinha, Selection Grade Executive Officer, and Shri Dobabrata Raj, Officer-in-charge, Translation Unit, Library, retired during the year, on superannuation.

The undermentioned senior staff members resigned :

1. Dr. D. Basu, M.A., D.Phil., AISI, Professor, Stat-Math.
2. Shri G. C. Talukdar, M.Stat., Technical Officer, SQC, Delhi.

19.9 *Land and Construction : Calcutta* : In the previous year's Annual Report, the developments upto March 1977, regarding the construction of the composite library building were recorded.

1. *Library Building* : The following were the main developments in the construction of the library building during the year 1977-78 :

(i) The construction of the ground floor, first and second floors was completed by Messrs Dalmiya & Co. Ltd. at a cost of Rs. 37 lakhs (approx.). The Institute's library was shifted to the new library building in January 1978.

(ii) In accordance with the recommendations of the Baranagar Works Advisory Committee and the consultants, Messrs Ballardie Thompson & Mathews Pvt. Ltd. (architect), the tender for the construction of the third and fourth floors of the library building was awarded for Rs. 20,14,566.00 to Messrs. Engineers Collaborated.

(iii) The construction of the air-conditioning plant room and sub-station required for the Computer Section in the New Library Building was awarded to Messrs Das & Co. for a tendered amount of Rs. 79,925.27. The major part of the work has been completed.

(iv) The air-conditioning work of the computer room at the ground floor of the composite library building was awarded to Messrs. Voltas Ltd. for a tendered amount of Rs. 6,81,740.00.

(v) The sanitary and plumbing work for the ground floor, first and second floors of the library building was completed at a cost of Rs. 1,31,501.30 and the electrification work for the same was completed at a cost of Rs. 2,09,014.90.

2. *Overhead Reservoir* : The overhead water reservoir with a capacity of 60,000 gallons was constructed by Messrs Asoko Bhattacharyya for Rs. 2,73,659.56.

3. *Construction of Boys' Hostel* : In accordance with the recommendations of the Baranagar Works Advisory Committee and the consultants Messrs Ballardie Thompson & Mathews (Pvt.) Ltd. (architect), the tender for the construction of the Boys' Hostel was awarded to Messrs Engineers Collaborated at a tendered amount of Rs. 22,16,541/- in February 1978.

Soil investigation was conducted, before the construction of the Boys' Hostel, by Messrs. K. N. Dadina for Rs. 6,408/-.

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

(i) The construction of the reinforced cement concrete approach to the composite library building was completed at a cost of Rs. 46,862.84. within February 1978.

(ii) The renovation of the exterior walls and sunshades in a residential building in 205 B. T. Road was completed by Messrs Business Development Corporation at a cost of Rs. 1,04,502/-.

(iii) The dismantling and raising of the boundary walls of ISI campus in Baranagar was entrusted to Messrs P. D. Enterprise for a tendered amount of Rs. 1,03,632/-.

(iv) The construction of the Generator House at 205 B. T. Road was started for a tendered amount of Rs. 33,453.20.

(v) One floor of the existing Ladies Hostel Building was extended to construct two flats at a cost of Rs. 1,54,603.70.

5. *Building Models*: Models of the composite Library Building and Boys' Hostel were prepared by Messrs Orion Architects for Rs. 8,650/- and Rs. 7,700/- respectively.

A scheme for lighting for the ISI campus at Baranagar has been prepared.

Delhi:

The construction of the boundary wall and the watchmen's cabin was completed by the contractors, Messrs. Rajdhani Builders, at a cost of Rs. 2,070,000/-.

The undermentioned staff quarters are being constructed: (i) A type (8 flats); (ii) B type (3 flats); and (iii) C type (5 flats).

The construction work of the staff quarters was entrusted to Messrs Rajdhani Builders for Rs. 10,65,619/- which was the lowest tender. The work pertaining to the sanitary system in the staff quarters was entrusted to Messrs. N. K. Channa Brothers against their lowest tender for Rs. 2,70,000/-. The installation of electricity was undertaken by Messrs. Soyuz Electricals against their lowest tender for Rs. 1,12,000/-.

XX. 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.)

Members of the Council

Representatives of Government of India (4)

2. (i) Shri V. R. Rao, Director, Central Statistical Organisation and Additional Secretary, Department of Statistics.

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3. (ii) Shri S. Vasudovan, Joint Secretary, Ministry of Finance (Department of Expenditure) and Financial Adviser to the Department of Statistics.

4. (iii) Dr. R. D. Dospando, Director, Department of Science and Technology, Cabinet Secretariat.

5. (iv) Shri V. V. Divatia, Statistical Advisor, Department of Statistics, Reserve Bank of India.

Scientists not employed in the Institute (7)

Representative of ICSSR (1)

6. Dr. Bhabatosh Dutta.

Representatives of I.N.S.A. (4)

7. (i) Dr. B. R. Seth, Honorary Professor, Delhi University.

8. (ii) Professor V. S. Huzurbazar, FNA, Senior Professor & Head, Department of Statistics and Mathematics, University of Poona and Visiting Professor, Department of Statistics, University of Manitoba, Winnipeg, Canada.

9. (iii) Professor A. K. Sharma, FNA, Professor and Jawaharlal Nehru Fellow, Department of Botany, University of Calcutta.

10. (iv) Dr. S. K. Chakraborty.

Scientists co-opted by the Council (2)

11. (i) Dr. S. S. Shrikhande, Head, Department of Mathematics, University of Bombay, (co-opted on 14.8.76).

12. (ii) Dr. M. G. K. Menon, FRS, Chairman, Electronics Commission; Secretary to the Government of India, Department of Electronics. (proposed on 14.8.76 and finalised on 25.10.76).

Elected representatives of the Institute

Members not employed in the Institute (2)

13. (i) Dr. P. K. Bose, M.Sc., Ph.D., F.S.S.(Lond.), Head, Department of Statistics, University of Calcutta.

14. (ii) Dr. P. V. Sukhatme, M.S., Ph.D., FNA, Maharashtra Association for the Cultivation of Science.

Elected representatives of the employees of the Institute (2)

15. (i) Shri Tapan Basu Mallik, Senior Lecturer.

16. (ii) Shri Rakhal Chandra Paul, Section Officer.

Officers of the Institute (ex-officio) (0)

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