

INDIAN STATISTICAL INSTITUTE

FIFTIETH ANNUAL REPORT

April 1981—March 1982

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

1. TEACHING AND TRAINING

1.1 Degree and Training Courses

During the period under review, 5777 candidates applied for admission and were called for written selection tests for the courses offered by the Institute viz., B.Stat.(Hons.), M.Stat, M.Tech, one year post-graduate diploma in SQC and OR, 2-year part-time post-graduate diploma in SQC and OR (Bombay and Madras), research fellowships in Statistics, Mathematics and Economics, one-year evening course in Statistical Methods and Applications and the course on Operation of Data Processing Equipment. Admission tests were conducted at 14 (fourteen) centres all over the country and successful candidates were called for interview for final selection for admission to various courses during the academic year 1981-82.

1.1.2 Out of 20 foreign applicants who had either been sponsored by the Government or applied directly for admission to the courses, sixteen candidates were given special admission tests conducted through the Indian High Commissions or Embassies at Bangladesh, Ethiopia, Kenya, Uganda, Nigeria and Malaysia.

1.1.3 The annual examinations of the B.Stat. and M.Stat. courses were held in May-June 1981. The 1981-82 academic year commenced on 3 August 1981.

1.1.4 One hundred and sixteen candidates received their degrees, and diplomas at the Sixteenth Convocation of the Institute held in February 1982.

1.1.5 The number of candidates admitted to different degree, diploma and training courses during 1980-81 and 1981-82 and the result of examinations held during the period are given below.

<i>Courses</i>	<i>Number of students</i>		<i>Number passed in annual exam- ination 1981</i>
	<i>1980-81</i>	<i>1981-82</i>	
1. <i>Courses leading to a Degree in Statistics :</i>			
1.1 Bachelor of Statistics with Honours :			
B.Stat. (Hons.)			
1st year	18	28	11
2nd year	21	11	21
3rd year	12	21	12
4th year	14	*	13

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	Courses	Number of students		Number passed
		1980-81	1981-82	in annual examination 1981
4.2	Master of Statistics (M.Stat.):			
	Part I/previous year	6	18	5
	Final year	30	14	30
4.3	Junior and Senior Research Fellows, Visiting Fellows	98	85	10
2.	Specialised courses in Applied Statistics leading to diplomas			
2.1	Statistical Quality Control and Operations Research (one-year)	12	8	11
3.	Courses in Statistics for persons in employment (jointly with the CSO)			
3.1	Junior Certificate Course in Statistics	16	19	16
3.2	Indian Statistical Service Probationers' Training Course	19	37	37
4.	Evening Courses			
4.1	Statistical Methods and Applications (one-year)			
	(i) Calcutta	46	47	12
	(ii) Delhi	10	8	8
4.2	Two-year post-graduate diploma in Statistical Quality Control and Operations Research (Bombay and Madras)			
4.2.1	(i) Bombay—1st year	6	9	3
	(ii) Bombay—2nd year	6	3	5
4.2.2	(i) Madras—1st year	21	23	12
	(ii) Madras—2nd year	9	12	10
4.3	Six-month Evening Course in Statistical Quality Control at Bangalore Centre			
	July—December 1980	30	—	18
	January—June 1981	—	17	14
	July—December 1981	—	—	—

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<i>Courses</i>	<i>Number of Students</i>		<i>Number passed</i>
	<i>1980-81</i>	<i>1981-82</i>	<i>in annual examination 1981</i>
5. <i>Electronic Computer Courses M.Tech. in Computer Science (introduced in 1981-82)</i>	—	41	—
5.1 Two-year advanced diploma in Computer Science		Course discontinued from 1981-82	
1st year	13	9	9
2nd year	13	9	42
5.2 One-year certificate course in Data Collection and Processing Methods	5	Course discontinued	4
5.3 Intensive course on Programming and Applications	31	37	31
5.4 Course on Operation of Punched Card Machines/Course on Operation of Automatic Data Processing Equipment (introduced in 1981)	41	41	41
6. <i>Associateship in Documentation/Associateship in Documentation and Information Science</i>	13	10	8
	460	438	323

* 4-year B.Stat.(Hons.) course was converted to a 3-year one from the session 1978-79; hence there was no student for B.Stat.(Hons.) IV year in 1981-82.

† Not known

1.2 *International Statistical Education Centre (ISEC), Calcutta.*

The International Statistical Education Centre, started 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 joint Board of Directors, consisting of : *Chairman* : Professor C. R. Rao, *Members* : E. Malinvaud, J. M. Gani and E. Lunenberg (ex-officio members representing the International Statistical Institute), Secretary, Department of Statistics, Government of India, and B. P. Adhikari and N. Bhattacharyya (Member-secretary) (representing the Indian Statistical Institute).

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During the year, the Regular Course of the thirtyfourth term of the Centre was conducted with 27 trainees from 9 countries in Asia and Commonwealth Africa. The country-wise distribution of trainees is as below :

Bangladesh	1	India	5	Tanzania	1
Bhutan	3	Iraq	3	UAE (Abu Dhabi)	1
Brunei	2	Sri Lanka	6	Zambia	5

In addition four trainees (two from Afghanistan and one each from Bangladesh and Sierra Leone) attended Special Courses in different fields of Applied Statistics. The Government of India awarded 11 fellowships for the foreign trainees, 5 under the Technical Co-operation Scheme of the Colombo Plan (TCS) and 6 under the Special Commonwealth African Assistance Plan (SCAAP). One foreign trainee in Regular Course and two in Special Course were awarded Commonwealth Fund for Technical Co-operation (CFTC) fellowship. Fifteen trainees (including five Indians) were supported by their respective government/employers. Two trainees from Afghanistan were supported by U. N. fellowships.

The ten-month Regular Course of the thirty-fifth term started on 1 June 1981. During their stay in Calcutta, the trainees were imparted general statistical training including training in mathematics, mechanized data processing, probability theory, descriptive statistics, sample survey techniques, statistical methods and economic statistics. During December 1981—January 1982 they attended a six-week training programme in official statistics conducted by the Central Statistical Organisation in New Delhi, Simla and Bombay. Finally, during February-March 1982 the trainees specialised in particular fields of applied statistics like sample surveys and data processing or economic planning and econometrics. It may be mentioned that in the first phase of their training in Calcutta the trainees were required to take at least four out of thirteen optional courses offered to them.

Of the four trainees who attended Special Courses, two from Afghanistan underwent a One-year Special Course in Demography and Data Processing while one trainee from Bangladesh attended a three-month course in Price Statistics during April-June 1981 and another from Sierra Leone studied National Accounts during the same period. Both these trainees were supported by CFTC fellowships.

Dr. Yoshiaki Itoh of the Institute of Statistical Mathematics, Tokyo, Japan, stayed as a Visiting Professor during November 1981—February 1982.

1.3 Professional Examinations in Statistics

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

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

The number of candidates who registered, appeared and passed during the terms are shown below :

<i>Examination</i>	<i>Number of Candidates</i>					
	<i>Registered</i>		<i>Appeared</i>		<i>Passed*</i>	
	<i>May</i>	<i>Nov.</i>	<i>May</i>	<i>Nov.</i>	<i>May</i>	<i>Nov.</i>
Statistical Assistantship Certificate	12	24	6	13	5	5
Junior Diploma in Statistics	22	26	13	17	2	3
Senior Diploma in Statistics	6	9	6	9	2	6

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

The total number of candidates who have qualified for the award of Certificates and Diplomas in these Professional Examinations in Statistics including the results of November 1981 term are 460 and 233 respectively.

2. RESEARCH WORK

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

2.1 THEORETICAL STATISTICS AND MATHEMATICS

2.1.1 Calcutta

The list of published papers and other technical reports give a detailed idea of the work done on research problems in various disciplines of mathematics and statistics. During the period members of the Division have been engaged in research in the following areas : Stochastic Processes, Probabilistic Number Theory, Probability Theory Asymptotic Theory, Multivariate Analysis, Decision Theory, Inference about Stochastic Processes, Sampling Theory, Design of Experiments, Combinatorial Mathematics and Graph Theory, Descriptive Set Theory, Measure Theory, Functional Analysis, Harmonic Analysis, Algebraic Topology, Algebra, Topological Automata, Sediment Transport, Point-Set Topology.

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In addition to research, all faculty participated in teaching. The Publication Unit, which is a part of the Division has been able to make *Sankhya* regular and up to date. A notable achievement for this year was the bringing out of the cumulative index for *Sankhya*.

Among the other activities, the Division held a Summer School in Probability and Analysis in Bangalore. It shared with the Division of Applied Statistics and Computer Science the responsibility of organising the Golden Jubilee Conference on 'Statistics—Applications and New Directions'; the conference was well attended by eminent statisticians from India and abroad. With the co-operation of faculty from divisions, a two week course of lectures was organised to introduce the scientific staff of Statistical Quality Control & Operations Research Division to recent advances in statistical methods.

2.1.2 *Delhi*

Quantum mechanics and stochastic processes, Operation research in Games theory, theory of continuous tensor products of Hilbert spaces, and a generalisation of stochastic integration to this framework; Estimation of common mean and recovery of interblock information, General homotopy theory (transfers, etc. in particular), Rational homotopy theory and related topics in diff. geometry, Completeness in three body scattering, Algebraic and different differential topology, Asymptotics in sampling theory and integration of surveys.

2.1.3 *Bangalore*

Ergodic and Information theory, Reliability theory, Characterisation of discrete distributions, and Monte Carlo methods for judging certain tests in bivariate normal population.

2.2 APPLIED STATISTICS, SURVEYS AND COMPUTING

2.2.1 *Research* : Research in the division include both theoretical investigation of methodology and applications of the existing methods to the solution of practical real life problems with social relevance. During the year 1981-82, the following four broad areas of research work were covered.

(i) *Research Activities in Applied Statistics* : The research activities of the Division in the above area cover topics in sampling theory, design of experiments, combinatorics, multivariate analysis and psychometrics. The main areas of work in sampling during the past one year are randomised response techniques, optimal sampling strategies under exchangeability and other conditions on variables, replicated and repeated sampling techniques. In design of experiments and combinatorics, the principal areas of research activities are orthogonal arrays, optimality considerations of block designs under mixed effects model, robustness of designs and characterization problems in

graphs. Optimality and robustness properties of estimation and testing procedures are being studied in the context of the general model set up. Research has also been carried out in cluster analysis, growth curve models and analysis of covariance structures.

(ii) *Research in Computer Science* : The main research activities of this Division in the area of Computer Science is in the field of Data Base Management and Fault Tolerant Computing. Studies on consecutive retrieval property in files, integrity in data bases and prevention of deadlocks are under close attention. Two custom-tailored data base management systems for survey data and time series data are under development. The emphasis in fault tolerant computing is on the design of self diagnosable systems under different constraints. In addition, tools for diagnosis of sequential and combinatorial circuits are also being investigated. This Division has also taken up a computer system study for drawing contour maps, identify an effective test of antigen and standardise the method for the survey of immunological profiles of Malaria infection. This is sponsored by the Indian Council for Medical Research, INIEST.

During 1980-84, the Division continued to work for a project entitled 'A Program Package for Analysis and Management of Statistical Data'. The aim of the project is to give the statisticians a facility to define complicated data structure which is typically found in sample surveys carried out in this country. The project envisages the development of a data base management system which allows the users to define data structures similar to that used in survey data. Further, elaborate facilities for editing of data in this data base and for creating tables of different types have also been envisaged. The language design has been completed in 1980-81. The overall theoretical design of the system has also been completed. Further, using the help of students, preliminary work on implementation of the following phases of the projects have been completed.

(a) Processing of the data structure definition statements. In this phase, the structure of the data base as defined by the user is processed to create internal descriptors of the data structure of a particular survey.

(b) Creation of the data base from raw data. In this phase the user specifies, through a special language, the data format. Raw data coded in this format is supplied through a sequential file on card, disk or tape. The package take the data for some basic types of errors and inserts the information in the data base. It is proposed to incorporate more validation in this phase in near future.

I. Large-scale testing and debugging of the phases (a) and (b) described above. These phases include incorporating tools for checking data type and range of each field of data in the phase of the package.

II. Development of programme package for validation of survey data. Both inter record and intra record checking may be carried out in this phase. Validation statements are given by the user in a special language and may involve any number of logical records in the data base.

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III. Preliminary work on creation of classificatory tables of different types. In this year the package has been implemented in such a way that only simple type of tables may be produced. In the next financial year it is proposed to carry out the following parts of the project—

a) Creating a PASCAL version of the phases of data structure definition and data base creation. This version will be made operational on the 16 microprocessor system to be installed shortly at ISI.

b) Complete the program package for creating classified tables. In this phase, all complex types of tables will be considered.

c) Design and implement the interactive system for table formulating.

It is expected that 5-6 man-years will be required to implement the package. To the extent possible, in-house computing facilities will be used to implement this package.

(iii) *Research in Biometry* : During the year 1981-82, Biometry Research Unit has conducted a comprehensive study of Immunological Profiles of Malaria Infested Area in Ajodhya Hills and Jhalda, Purulia District. The objectives of this project sponsored by ICMR are the following—

(a) to examine the immunological, nutriometric and socio-economic profiles of people living in endemic area.

(b) to study the causes of differences and similarity of biochemical indices of blood and influences of other environmental indices in areas,

(c) and to assess the extent to which antibodies represent an additional weapon against rampaging parasites of infectious diseases.

This project terminated on 31 March, 1982. Data were collected twice and each data collection phase lasted for a period of two months. The data are being analysed.

2.2.2 *Projects and Surveys*

(i) *Analysis of Diet Survey Data* : Data processing has started recently after the data from the Honeywell system was converted to the form useable to the present computer. The project would be completed in 1982-83.

(ii) *Household Survey on Distribution of Public Expenditure on Social Services in West Bengal* : A paper entitled 'A Report Enquiry on the Distribution of Public Expenditure on Social Services in West Bengal, has been prepared and sent for publication on invitation. One or two more papers will be prepared from the processed data. A consolidated monograph is also being planned for publication. The project will be completed in 1982-83.

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(iii) *Survey of Farmers* : Most of the data of this project have been analysed and reported under the title 'Expansion of Employment Through Local Resource Mobilisation : A study of a Cluster of Villages in West Bengal, India'. This is being published and is in press now as a monograph by the Asian Regional Team for Employment Promotion (ARTEP) of the ILO, who had sponsored the project. An earlier draft report entitled 'A Study in Local Resource Mobilisation of Tarakeswar Panchayat Samiti Area (West Bengal, India) had been circulated for comments to various experts.

Some more analysis is being done of the data collected. The project will be completed during 1982-83.

(iv) *Survey of Foreign Tourists in India* : The Ministry of Tourism and Civil Aviation, Govt. of India has commissioned this survey to collect information needed to plan for better tourist facilities in different parts of India. The basic object of this study will be to collect and interpret all information necessary for planning various developmental and investment programme to attract more foreign tourists to visit India and to induce them to spend here more of their time and money. On the basis of this sample survey, an attempt will be made (a) to study the socio-economic and demographic profile of foreign tourists, (b) to make an analysis of their expenditure pattern during their stay in India, (c) to study their activity preferences with respect to mode of travel, choice of accommodation and other aspects of living, (d) to analyse their experience of inconvenience, difficulties, if any, during their stay in India and (e) to elicit their suggestions for improving the tourist services.

A total of about 18,000 foreign tourists will be interviewed immediately before their departure from India. For this purpose, all the important exit points in India, viz. Delhi, Bombay, Calcutta, Madras, Amritsar, Varanasi, Patna, and the sea ports of Bombay, Rameshwaram and the land check posts Ravoul, Attari Road and Sonauli would be covered.

(v) *In-House Computer System* : The Divisional Computer Centre maintains two computer systems : (i) EC-1033 system, and (ii) V-77/200 Varian Computer System.

(vi) *Editorial Work* : As in the previous years, the Division was entrusted with the editorial work pertaining to Sankhya, Series C, Parts 1 and 2 (Sample Surveys Theory and Practice). Quite a few members of the faculty of the division have been associated with refereeing and editorial work of Sankhya C and other statistical journals. The first and third parts of Volume 38 of Sankhya, Series C appeared in late 1981. Quite a few members of the Division were actively involved in preparing the cumulative Title Index of Sankhya using the computer.

(vii) Members of the Division participated, as in previous years, in all the regular teaching activities of the Institute and in addition the following courses were organised by the Division :—

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(i) *M.Tech. in Computer Science* : The course has been designed to produce specialists in Computer logic, software and applications with adequate knowledge of hardware. The duration of this course is two years inclusive of the period of practical training at the end of part one of the course and the period of work for dissertation at the end of part two of the course. The course was introduced for the first time at the Indian Statistical Institute with effect from August 1981.

(ii) *Advanced Diploma in Computer Science : Second Batch* : 1979-81. Eleven students have successfully completed the course and passed the oral examination held in June 1981.

Third Batch : 1980-82. Nine Students were promoted to the 2nd year of the course after completing their 1st year course and practical training.

(iii) *Intensive Course on Programming and Application of Electronic Computer (16th Session : 27 October, 1980 to 3 January 1981)* : The objective of this course is to impart training on the use of computer in solving problems. The course covered areas like the use of Unit Record Machines, fundamentals of computer organisation, programming in FORTRAN selected numerical techniques and application in various areas. Each trainee, in addition, carried out a small programming project. There were 34 trainees from government departments, public sector enterprises, educational and research institutes. In addition there were two special observers from Afghanistan who attended this course.

(iv) *One-year Certificate Course in Data collection and Processing Methods (1980-81)* : Five students have successfully completed the requirements for the 1980-81 session of the above course. The course has been withdrawn with effect from the academic year beginning August 1981, in preparation for a total reorganisation of the courses.

(v) *One year Course on Operation of Automatic Data Processing Equipment Session : 1980-81* : Eleven students have successfully completed the above course and ten students have been admitted to the above course for the Session 1981-82.

(vi) *Short Course on Sample Survey Methods in Education Organised at the request of the National Council of Educational Research and Training* : A course on sample survey methods in Education was organised for the staff of the State Institute of Education/SCERTS as well as the Statistics/Survey Units of the Departments of Education in different states and Union Territories at the Indian Statistical Institute, Calcutta from February 9 to February 20, 1982. The course was sponsored by the National Council of Educational Research and Training, New Delhi and jointly organised by the Survey and Data Processing Unit of NCERT and the Computer Science Unit of ISI. The main purpose of the course was to impart training to the participants in the use of sample survey methods for collection of data in conducting survey type studies in the field of education. A total of 23 participants attended this course.

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(vii) *Course on Statistics for Administrators Organized at the request of Administrative Training Institute, Government of West Bengal, Calcutta* : An introductory course on Statistics for Administrators was organized at the request of Administrative Training Institute, Govt. of West Bengal, Calcutta in the month of October 1981.

2.3 PHYSICAL AND EARTH SCIENCES

2.3.1 Chemistry

The research activities during the period have been mainly concentrated on the following :

- (a) Humus dynamics in the arable soils of the alluvial plains of West Bengal, and
- (b) Humus characteristics of hill soils.

Under (a), a survey of 60 soil samples has been carried out with four parameters, namely specific extinction of the pyrophosphate-extractable organic matter, extractibility, humic to fulvic ratio and nitrogen hydrolysability. It has been found that the first of these parameters, which is an inverse function of the degree of humification of the soil organic matter, is highly correlated to the other three. The parameters therefore may be used to study the humus dynamics in soils.

Under (b) the soils of the Darjeeling district lying in altitude range of 1000-2000 m. have been examined for their organic matter characteristics. This soil zone is characterized by low annual temperature, excessive precipitation, percolative soil moisture regime and acid reactions of the soil.

The organic matter is characterized by low humic/fulvic ratio, moderate extractibility, poorly condensed humic acid as evidenced by high E4/E6 value. Humic and fulvic components show close structural resemblance. Specific extinction of pyrophosphate extract is significantly correlated to both humic acid carbon percentage of soil as well as humic acid percentage of total organic matter. The H/F ratio is negatively correlated to the pH of the soil. The extractibility of the organic matter is negatively correlated to the pH , CEC and clay percentage of soil.

2.3.2 ELECTRONICS

The following research and development activities were pursued.

2.3.2.1 Digital Electronics

(i) *Development of Microcomputer Systems* : This is an on-going project. A general purpose Microcomputer has been developed around Motorola 6800 Micro-processor chip. Initially the C.P.U. was connected with a number of peripherals namely (i) a keyboard (ii) a video display unit (iii) a paper tape reader (iv) a paper type punch unit (v) a PR40 matrix printer (vi) a dual drive floppy disk. The main memory

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has been extended to 32k bytes. The secondary storage capability has also been increased by incorporating an Audio Cassette Tape Recorder interface. An Analog-to-Digital-converter input subsystem and a Digital-to-Analog converter output subsystem have been interfaced for communication with the analog world.

Various software packages, namely assembler, basic, interpreter, text editor etc. have been provided to the system to enhance the flexibility of the system.

Work is in progress for updating the existing 6800 based system into a 6809 based system by simply changing a single card. The 6809 based system with its hardware multipliers and more powerful instruction set will be a much more powerful system than the existing one.

(ii) *Development of microprocessor based special purpose system* : The microprocessor hooked up with relatively small sized hardware logic has led to dramatic result in the area of process control and automation. Their low cost flexibility and fairly attractive performance make them a viable tool for stand problem solving jobs. With the availability of general purpose system in the laboratory, several microprocessor based special purpose systems have been developed. They are :

(a) *Microprocessor based line voltage monitoring system* : The line voltage is converted to a low D.C. signal to make it acceptable to the input of A/D converter by a simple stepdown transformer (220 : 3). It is then rectified and filtered. A/D converter of successive approximation type is then used to convert the above D.C voltage to digital form. It then interfaces with the microcomputer system through one of its I/O port. Software has been developed to receive this information and display the line voltage deviations on a CRT screen.

(b) *Microprocessor based line frequency monitoring system* : There are many situations where it is necessary to monitor the line frequency continuously and take necessary action whenever the frequency does not remain within some specified limits. The system developed will work in a real time situation. It continuously measures the frequency and displays the deviation from 50 Hz on a C.R.T. screen.

(c) *Development of Microprocessor based PROM programmer* : Since our laboratory is engaged in the development of various microprocessor based system, the PROM programmer has become an essential tool. So a low cost microprocessor based stand-alone EPROM programmer has been developed. The system is built around a 6800 microprocessor chip. Although the cost of the system is much less than any commercially available system, several feature like interactive mode of operation and other flexibility have been provided.

(d) *Development of Microprocessor-based off-line paper tape preparation unit* : In order to relieve the general purpose computing system from the trivial and time consuming job of preparing paper tapes, a stand-alone paper tape punch unit with faci-

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ilities for data entry and editing has been developed. The system may be used for developing machine language programs for M6800 up and also for punching the off-line data.

(iii) *Design and Development of a Dedicated Signal Processing system using F.F.T. :* This is an on-going project. A microprocessor based on-line F.F.T. processor has already been developed around the existing M6800 processor. The power spectrum of the fast fourier transformed signal can be seen on an oscilloscope screen via the D/A converter. This signal processing system is being used to study the ECG and EEG signal for possible detection or diagnosis of certain types of human diseases. Work is in progress to build the F.F.T. processor around the 6809 microprocessor. The developed system will be much more powerful in terms of speed and flexibility due to the more powerful instruction set and availability of hardware multipliers in 6809 processors. Work is also in progress to extend the system as a powerful signal processing system.

(iv) *Data Acquisition System :* With the advent of microprocessor, digital control and computation techniques are becoming increasingly important because of their inherent advantages. Since digital control and processing work in an analog domain there must be a link between the analog world and the microprocessors which function in the digital domain. Here is where the data acquisition system comes in. They convert the analog signals into microprocessor acceptable form and act as a reliable low cost and efficient link. A 6800 micro computer based data acquisition system is being developed which will be able to monitor eight analog variables, convert them to digital form, process the information and then take on-line action if necessary. A high speed analog multiplexure and a 12 bit A/D converter has been connected with the 6800 microcomputer for acquisition of analog information. The developed data acquisition system is an inexpensive portable data acquisition system. The system is being used to collect on-line data for F.F.T. processing.

2.3.2.2 *Theoretical Physics*

Papers published as well as under preparation as listed under 'Theoretical Physics' will give an idea about the studies made in different areas.

2.3.2.3 *Fluid Mechanics*

The studies carried out may be classified into the following four main topics though they overlap to a great extent :-

(1) Analytical and numerical study of some fluid mechanics problems arising in industries so that the results obtained are of immediate practical importance.

(2) Investigation of the phenomenon of transition from laminar to turbulent flow treating it as a problem of stability.

(3) Study of some fluid mechanics problem likely to be applicable in bio-mechanics problems such as blood phenomenon, glucose, insulin and glucagon levels in human

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circulatory blood during a prolonged and severe muscular exercise and modelling of mechanical behaviour of left ventricular annurisyam.

(4) Investigation of certain turbulence problems of determining the statistical structure of smoothed quantities such as correlation of fluctuations of velocity, pressure, temperature, etc.

2.3.3 *Electronics and Communication Science*

Research is being carried out dealing with the same under-mentioned areas as was being done in the previous year.

(i) *Research in Biomedical Signal Processing for Diagnostics and Development of a Patient Monitoring System* : Characteristics of bio-medical signals have been studied and the results have been reported. The nature of the bio-medical signals under different conditions is under investigation. A project sponsored by the Electronics Commission, Govt. of India is now in the second phase of its completion. The project deals with the noise-free display of ECG signals of patients. The system can be used in rural areas where experts are not available.

Works on partitioned adaptive filtering for parameter estimation using Kalman filters and its potential for parallel computation are also going on side by side. A fuzzy approach for medical diagnostics have also been undertaken.

(ii) *Research in Digital Communication Area* : A microprocessor based communication model suitable for computer communication network has been developed and some related works are under progress.

(iii) *Pattern Recognition and Artificial Intelligence Techniques* : Various types of statistical, syntactic and fuzzy set theoretic algorithms for machine recognition of diverse patterns mainly of biological origin such as speech, hand written characters, finger print, EEG etc. have been developed. Work for the development of algorithms for satellite imagery patterns is in progress and in some cases the results are satisfactory. 2-Dimensional as well as 3-Dimensional image analysis problems undertaken in the previous year are now in progress. A syntactic grammar for generation and recognition of some handwritten scripts has been developed and communicated. Some important work in connection with symmetry analysis by computers have been computed. A new approach for estimation of fuzzy membership functions has been developed.

(iv) *Automatic Speech Recognition and Speech Processing* : Work on phoneme structure of some Indian languages and their application in ASR is under investigation. Linear prediction coefficient (LPC) analysis has been applied and the results have been reported at different conferences. Syntactic approach in ASR is under investigation.

(v) *Studies on the Methodology for Image Analysis and Image Understanding System* : Some preprocessing algorithms for image restoration, enhancements and

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edge detection have been developed. Computer recognition of 3-D objects is in progress. Some methodologies in image analysis have been developed in this period and the results have been communicated. A work on image understanding system is in progress.

(vi) *Studies on Cybernetics and System Theory* : Several studies in this field such as Generalised Fuzzy Set Theoretic Approach for biological systems, application of possibility theory in man-machine systems are in continuation and the results obtained at various stages have been reported. Some work on power systems modelling, and socio-economic systems modelling using fuzzy approaches have been undertaken.

2.3.4 Geology

Research activities in the Pranhita-Godavari Valley were mainly concentrated in the following areas :

(i) *Stratigraphy and Palaeontology of the Gondwanas* : Saurapsid reptiles from the Yerrapally Formation ; excavation and exploration of therapsid reptiles from Yerrapally formation ; study of Permian vertebrate fauna ; examination of the fauna of Late Upper Triassic Dharmaram formation ; examination of Upper Cretaceous fish fauna from Central India ; Braincase of a Late Cretaceous saurpoid dinosaur from India ; study of cynodont reptile from Upper Triassic and study of spirally coiled coprolites from Upper Triassic.

(ii) *Stratigraphy and sedimentology of the Gondwanas* : Geology of an area around Yamampalli-Lingal-Metapalli in Adilabad district A.P. ; geology of the N.W. part of Pranhita-Godavari valley ; stratigraphic inter-relationships between different Gondwana formations in and around Chinnor, A.P. ; studies on calcareous litho-units in Late Triassic Maleri formation ; studies on genesis and significance of Maleri red clay ; Gondwana stratigraphic classification by statistical methods and trace fossils from the Triassic continental Gondwana red beds.

(iii) *Structure, stratigraphy and sedimentology of the Precambrians* : Structural analysis of Delhi metasediments of a part of Central Rajasthan and Pakhal rocks in A.P. ; early diagenetic glauconitization of feldspar grains in Middle Proterozoic tidal flat complex ; trace fossils from Proterozoic sediments of Godavari valley and studies on tidal flat siliciclastic sequence of Pakhal Group in the Ramagundam area.

PLAN PROJECT

(i) *Gondwana stratigraphy of the Manthani Doab and adjoining areas in the Godavari valley*. Analysis of stratigraphic interrelationship between different Upper Gondwana formations has revealed that the Anarum Beds and the Sironcha sandstones are not separate lithostratigraphic units. Re-examination of newly collected plant fossils from the Anarum Beds suggests a possible affinity with the *Dicroidium* flora, not with

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the Ptilophyllum flora as mentioned by earlier workers. Further, the Kota limestones extend through the area as a single rock-stratigraphic unit.

(ii) *Geological controls of Arkose formation in marine and continental environments* : Further work on the identification of arkosic units of the sullaval Group in Ramagundam and Manthani has been carried out.

2.3.5 Physics

The research activities for the period had been the continuation and further extension of the project (Studies on the Mechanical Properties of Human Tissues and Organs). Along with the continuation of the tensile and tearing tests, bursting strength test was taken up and satisfactory progress had been made. Many new organs and tissues, both normal and pathological, were put to test and interesting results had been obtained and communicated to journals.

Apart from pursuing the above *project under plan activities* the unit continued the theoretical study on the application of the Control theory to Electrical Machines and power systems and also the interesting Medico-Physical studies.

2.3.6 Flume Project

Data obtained from Flume experiments on deposition of grain sizes from suspension have been analysed and interpreted. Flume experiments show that some fractions of all grain sizes in suspension deposit simultaneously, when the flow velocity is decreased. A mathematical model is proposed for calculation of pattern of deposition for different grain sizes.

Experiments are being conducted to study the effects of interaction of grains of different sizes during suspension transportation.

2.4 BIOLOGICAL SCIENCES

2.4.1 Anthropometry and Human Genetics

The progress of different projects carried out under plan activities during April 1981 to March 1982 has been noted below :

(i) *Study of fertility, sex-ratio and biochemical genetic markers* : 1500 blood samples including 100 father-mother-newborn combinations were collected from R.K.M. Hospital. ABO and Rh (D) blood groups, several enzyme and serumprotein systems were studied to examine association of any particular phenotype with reproductive wastage and selective advantage of biochemical markers on sex-ratio and fertility.

(ii) *Study of placental enzyme polymorphism in Indian population* : 400 placental samples were collected from five populations from north Bengal. Laboratory analysis for placental enzymes like Alk Ph ; PGM 1, Est.—D., LDH etc. is in progress.

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(iii) *A genetic survey of some endogamous groups of Eastern India with special reference to Gm, Inv., Gc and Ib markers systems* : 1300 blood samples from 10 endogamous groups of W. Bengal were collected. Relevant analysis of blood samples is in progress, including iso-electric focussing screening of PGM₁ system.

(iv) *Bioanthropological study of a migrant African group, the Sidhis of India* : Extensive field work in 84 Sidhi Settlements had been carried out to collect benchmark data on demography, population structure, anthropometry, somatoscopy, socio-economic characteristics. Necessary analysis is in progress.

(v) *Bioanthropological studies among the Nandiwalas and Dhangers* : Genetics and diversity of finger palm and sole prints : Population, family and twin data had been extensively analysed to throw further light on the evolution of ridged skin in primates.

(vi) *Pattern of Fertility and Reproductive Wastages by parity and social class* : Utilising hospital record of 6070 newborns extensive analysis had been carried out to study interrelationship between low birthweight and several biosocial factors like mother's age, parity, socio-economic status, gestation period, season of birth etc.

(vii) *Study of physical growth of Bengali boys* : Family survey of 600 students of Scottish Church Collegiate School was carried out to collect for each student exact date of birth, social origin, socio-economic status, general health condition and daily dietary habit etc. Anthropometric survey has begun.

(viii) *Biostatistical study on Vitiligo : a skin disease* : Records on 6000 skin patients, 100 pedigrees, clinical examination of probands & family members and 100 blood samples were collected and examined.

(ix) *Impact of altitude on human populations* : (i) Ophthalmological data were collected among the Sherpas, Lepchas and Nepalese in collaboration with Professor H. Forsius of the University of Oulu, Department of Ophthalmology, Finland ; (ii) Demographic data were collected from the Urban Buddhist and Christian Lepchas as well as rural Buddhist Lepchas and (iii) Anthropometric (adult) data had been collected among the urban Lepchas. (i) Analysis of the blood pressure data had been completed (ii) Analysis of demographic data from the Urban Lepchas had partially been completed (iii) Analysis of Ophthalmological data was in progress.

(x) *Biomedical study of the Portuguese descendant of Mirpur village, district Midnapore, West Bengal* : Collection of demographic data from a Muslim village was in progress. Analysis of the demographic data collected earlier from three neighbouring Hindu villages had been completed.

(xi) *A study on the relationship between socio-economic condition, nutrition and health* : Collection of medical data from the three economic subgroups of the village population under study had been completed in collaboration with the Indian Association of Occupational Health, Calcutta. Analysis of anthropometric (adult and children of both sexes) and intestinal parasites data had been completed.

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2.4.2 Biochemistry

(i) *Affinity chromatographic purification of inorganic pyrophosphatase from green leaf* : Development of a novel technique of one step purification of inorganic pyrophosphatase from the crude extract of the leaf is in progress. Hexamethylenediamine Sepharose has been used as solid matrix in which the pyrophosphate ligand has been fixed. The method of elution of pure enzyme by the substrate gradient is in progress.

(ii) *Studies on inorganic pyrophosphatase during germination of Phaseolus aureus seed* : Inorganic pyrophosphatase in relation to germination of *Phaseolus aureus* seed has been studied. Inorganic pyrophosphatase profile in different parts of the seed eg. Cotyledon, embryo during germination has been investigated. The effects of temperature, protein synthesis inhibitors and plant hormones on the enzyme synthesis have also been studied. This indicates some role of inorganic pyrophosphatase in protein biosynthesis.

(iii) *Correlation of cyanomethaemoglobin and oxyhaemoglobin in adult human being* : To examine if any relationship exists between the technically complicated measurement of cyanomethaemoglobin and the simpler oxyhaemoglobin (and other haematological parameters).

Analysis of 75 blood samples from adult male and female for oxyhaemoglobin and cyanomethaemoglobin have been carried out along with estimation of total red cell count and haematocrit values. Further the samples were screened electrophoretically for abnormal haemoglobins.

The data collected so far tentatively suggest that the parameters are highly correlated, implying that the technically simpler parameter of oxyhaemoglobin may provide as much information as cyanomethaemoglobin and, therefore, may profitably be used under field situations.

(iv) *A study on dietary intake pattern, body measurement, parasitic load and other health indicators among the inmates of two old age homes in Calcutta city (run in collaboration with Dr. A. Basu, AHGU)* : To evaluate the health status of Calcutta's elderly population, and the effects of socio-cultural factors on the same.

Investigations & data collection on socio-cultural conditions, anthropometric measurements, intestinal parasites, urine analysis, clinical status and dietary intake have been done last year. Analysis of the dietary data is in process. Contract with another old-age home for collection of similar types of data is also in progress.

(v) *Impact of Altitude On Human Population (Collaboration with Dr. A. Basu, AHGU)* : (a) Examined about 230 Lepcha faces samples in the Kalimpong area in October—November '81 for intestinal parasites.

(b) *Ophthalmological survey* : Participated in an ophthalmological survey by Dr. Henrik Forsius, Professor of Ophthalmology, University of Oulu, Finland, on about

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450 Sherpas, Lepchas and other Nepalis in the Kalimpong area during October—November 81.

(vi) *Distribution of intestinal Parasites in West Bengal. (Collaboration with Dr. A. Basu, AHGU) :* Some data on the distribution of intestinal parasites in different regions of West Bengal exist, but there are large gaps both in terms of spatial and ethnic coverages. Detailed survey of these types and prevalences of these infestations, should help formulate medical welfare programme with appropriate emphasis on medical assistance (Curative health education, and other preventive measures to these major health problems.

As a pilot investigation, 107 faeces samples were examined among the labours of Birpara and Lankapara tea garden on northern West Bengal in September 81, with the immediate purpose of comparing our data with that of Chandler's collected about 50 years back. Also about 235 adult blood samples were collected and examined for anemia (haemoglobin & haematocrit) and blood films were drawn for differential leucocyte count. Blood pressures were also measured on these 235 subjects.

2.4.3 Botany

(1) Crop Improvement and Pre-harvest Loss of Grains

(a) Plant Breeding Programme to evolve high-yielding varieties of rice and performance trial of one dual-purpose high-yielding *aman* rice variety, named Subarna, evolved by the Unit, was conducted in 33 cultivator's fields under different agro-climatic conditions. Further trials in more cultivator's fields are contemplated with this rice variety.

(b) Intra-specific and inter-specific interaction and competition in crop plants.

This investigation tries to assess the biological effects on the components of varieties and species grown in mixture and to utilize cooperative interaction for higher production. This investigation is on-going. Nine varietal combinations of rice and 7 species mixtures were under field trial. Some rice varietal as well as crop combinations showed promising results demanding further investigations.

(c) Study on the behaviour and ecology of field rodent :

The investigation on ecology and behaviour of field rodent is in progress.

(2) Deforestation : Nature, cause and consequences :

Initial work on collection of basic information has been started through document and household surveys. Further work is in progress.

2.4.4 Crop Science

(1) General problems on levo-and dextro-rotatory situations present in different

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plants structures : Alternate phyllotaxy usually leads to spiral arrangement of leaves and accordingly, a shoot or a palm crown may be left-spiralled or right-spiralled.

Data have been collected on the distribution of stomata and trichomes present in the different halves of the bifid juvenile leaves of left- and right-spiralled seedlings of *Areca catechu*.

(ii) *Exploratory work on the family Arecaceae (Palmae)* : The study relates to the external and internal morphology of different commonly cultivated economical and ornamental palms e.g. *Cocos nucifera*, *Areca catechu*, *Areca triandra*, *Phoenix sylvestris*, *P. rupicola*, *P. zeylanica*, *P. dactylifera*, *Veitchia merrillii*, *Elacis guineensis* etc.

Morphological and anatomical study on four species of *Phoenix* seedlings upto twelve months of their age after germination have been completed.

Length and width of vessel elements in the roots of young palms, stomatal frequency in leaves of young and adult palms and anatomy of roots in some species of young palms have been worked out.

(iii) *Studies in the field of Natural history of animals, birds, insects etc.* : This includes the study of reversible and irreversible lateralities in some animals and the general behavioral and ecological studies on some animals, birds etc.

2.4.5 Embryology

(i) *Cellular and Molecular Biology* : Investigations on the cellular cement that keeps the building blocks of life together have continued. In connection with the morphological changes observed through optical and scanning electron microscope, namely that Tunicamycin loosens the cells of *Limnaea* embryos, biochemical experiments have been performed. The purpose was to test whether part of biological glue, i.e., the cell cement, is a class of glycoproteins. In this connection, incorporation of ¹⁴C-mannose and ¹⁴C-N-Acetylgluco-samine into glycoproteins has been tested. Tunicamycin is known to inhibit the glycosylation of glycoprotein. In *Limnaea* as in sea-urchin, Tunicamycin does not significantly inhibit the incorporation of mannose into glycoprotein.

(ii) *Biomathematical and Biostatistical investigations of Morphogenesis and Differentiation.*

A reaction-diffusion mechanism of cellular differentiation and morphogenesis has been proposed. Based on the concept of positional information and concentration gradient this reaction diffusion model can exhibit a spatial heterogeneous structure. A stochastic model of transcription during embryogenesis has been posed. The model system can exhibit limit cycle oscillation which is biologically most fascinating. Further search on the mathematical laws working behind the complicated biological problem of pattern generation during development is in progress.

2.4.6 Entomology

A study was carried out in the course of the year under review and a paper published.

2.5 SOCIAL SCIENCES

2.5.1 Demography

(A) Provisions of plan programme were utilised by the unit since 1976-77 to collect data on education, health, family welfare planning and migration in rural areas of West Bengal with a view to examine the difficulties experienced by the village population in utilising the plan development programme of the Government. The following studies were completed during the period under reference.

(i) *Fertility and Family Planning Survey 1977-79* : The scheme was worked out by the Demography Research Unit not only to study the quality and quantity of family planning practice and service among the rural population of the districts around Calcutta but also to review the growth of education among males and females of different social groups with emphasis for identifying factors responsible for large scale non-enrolment and drop out in village schools before attaining literacy status.

A report on the socio-demographic and econo-demographic aspects of population, marriage pattern, education, fertility and family planning in respect of rural areas of districts around Calcutta based on survey data has been completed. The results of the survey in the form of a report was published from the Demography Research Unit in August, 1981.

The survey population in rural areas of districts around Calcutta, 1978 exhibited a birth rate of 37 corresponding to a net reproduction rate of 1.54. The estimated birth rate of 37 was higher than the rate of 34 obtained by SRS for rural West Bengal in 1976. The report showed the prevalence of old age fertility among the couples living in rural Bengal particularly among the agricultural or manual labour households. It was found from the survey that services from primary health centers were available to the upper caste Hindus in general and non-manual households in particular more conveniently than to other socio-economic groups.

Applying the method of two generation education mobility net upward education mobility of 25.4% between mother and daughter over 25 years and 31.6% between father and son over 35 years were observed. Literacy increase figures were 16.3% and 19.1% for males and females respectively indicating annual literacy growth rate of 0.65% and 0.55%. Literacy growth rate among males was found to be higher than the rate of 0.3% obtained from censuses.

(ii) *Education of Family Planning Acceptance* : The project was taken up in 1980 in respect of 48 villages of Murshidabad, Nadia and Birbhum. The survey has

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been extended to 24 villages of Maldah and West Dinajpur districts during 1981-82. Data collection was completed during October 1981 to January, 1982, Examination of data is in progress.

(iii) *Evaluation of Hindu Marriage Act 1955* : Data on the court cases under Hindu Marriage Act of 1955, upto 1978 were collected from the records of Hooghly District Court. 270 divorcees (male and female) were interviewed. The processing of the data is in progress.

(iv) *Cohort Nuptiality for Indian Women* : Nuptiality models are being investigated by eminent demographers abroad with reference to nuptiality data of developed countries. Cohort nuptiality data for 13 birth cohorts of Indian women have been collected. A number of models are being tried by use of the Institute electronic computer. The work is under progress.

B. (i) *Study Relating to Timing of the First Child* : The study examines data from a fertility survey in Calcutta (1970) on couples' opinions concerning age when a man or a woman should have the first child. The preferred median ages were 27.4 and 20.2 years for men and women respectively. The influence of education upon opinions regarding commencement of parenthood seemed to be more relevant than that of the other factors considered. The analysis highlights the difficulties in enforcing the current legal prescription regarding minimum age of marriage for girls, namely 18 years, particularly among illiterate sections of the population whose median response indicated a value of 18.6 years for the start of childbearing.

(ii) *Study Relating to Arranged Marriage* : As part of a fertility survey in Calcutta (1970), the opinions on arranged marriage were canvassed from married couples. The findings revealed that about 90 percent of male respondents wanted that marriages should be primarily arranged by parents/relatives. Public support of marriage by free choice was not conspicuous. Those educated beyond high school level were more favourable to the exercise of this conjugal freedom by the spouses-to-be. The data do not indicate a rapid marriage transformation.

(iii) *Population Control Planning* : Small family may be achieved by married women by recourse to late marriage, lengthening of pregnancy interval by practice of conventional contraceptives and by termination of pregnancy by 30 to 35 years of age of wives. Motivation for practice of conventional contraceptives does not come unless wives are educated above primary. Governmental drive and programme to educate rural females upto literacy status only are largely responsible for little practice of conventional contraceptives in rural areas. Old age fertility control by protecting all married women after 30 years of age would have halved the birth rate but it is not achieved due to want of education among the couples about the implications of old age fertility.

(iv) *Fertility Differential between two Major Communities in Bengal* : To examine, firstly, the validity of the concept that the Muslims have a higher birth rate than other communities and, secondly, to identify the socio-economic factors responsible

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for the differences, if any, the data collected from 1018 Hindu and 518. Muslim women during 1st socio-demographic survey of Gaiganagar in 1976 were utilised. The study shows that the Muslims have a higher fertility rate than the Hindus. The declining trend in fertility with increased educational level is more apparent in case of females than for males. The desire for more children decreases after two children for the Hindus but for the Muslims it decreases only after they have three children. Average age at marriage for the Muslim girls is about two years lower than that of the Hindus, and this difference is visible at all levels of their education. In sum, the socio-economic and cultural standing of the Muslims favour higher fertility.

(v) *Female Nuptiality in India : A Reconstruction* : Inadequacy of census data on marital status due to unknown reliability is the crux of the problem. A reasonable accuracy in the available data may be achieved by using a logistic linear model.

A structural graduation formula appears to provide a fairly good approximation of the schedules of female proportions single and a set of short run projections (1981-86). The proportions ever married estimated by Coale's three parameter model are being matched with the proportions indirectly obtained from the estimated proportions single. From the combined estimates of widowed-divorced-separated, a consistent set of estimates of female proportions married is derived. Using a computer model, the risk of widowhood is worked out.

A new index termed "Sexual dimorphism Percentage" is used to indicate availability of marriage partners.

(vi) *Socio-economic Survey on Constraints to Development* : A socio-economic study on the present condition and development potential of the Basanti Police Station areas, in the wider perspective of the Sundarbans, West Bengal, was initiated in May, '81. The first phase consisting of survey of households under two-stage PPS sampling method has been completed. Work on the next phase is in progress. The study is aimed at identifying the constraints to development and making policy prescriptions for regional development.

(vii) *Population Estimates* : (a) Using an adaptation of Makeham's formula, population for children of 0-7 years have been estimated by a few demographers but no robust procedure seems to have been adopted in estimating the parameters of the model. Using iterative method, a procedure was developed and it was tested by use of electronic computer in a study to get efficient estimates of these parameters.

(b) Six sets of population projections have been worked out for less developed regions (LDR) on the basis of reconstructed base population assuming stable model and future assumed levels of birth rate and life expectancy at birth. A logistic model has been fitted to the medium variant projected populations for the period 1985-2000 and the fit has been found to be satisfactory. It is interesting to note that under this model, population of the LDR is expected to stabilise at 7.2 billion around the middle of the 22nd century.

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(viii) *On specifications of marriage curves in India* : The marriage curves have been specified more rigorously by investigating the moments of the age distribution of marriage in India. Hajnal's original method of calculation of SMAM has been utilised with suitable modifications and numerical methods have been used for actual computation of moments of various orders.

There are variations over states in the mean and the variability of the marriage curves. The curves are found to be positively skewed for both sexes. They are sharply peaked, more so in females than in males.

2.5.2 *Economics, Econometrics and Planning*

2.5.2.1 *Calcutta* :

During the period under review, research work in the Economic Research Unit has progressed covering a wide field of problems of both theoretical and applied interests. Members of the Unit have taken part not only in teaching at the graduate and undergraduate levels and in supervising students for Ph.D., but also in research guidance and individual and group research work. They have served also as experts in the work of different committees, institutions and organisations. A brief account of the activities of the unit is given in the following paragraphs.

(a) *Economic theory* : Research in economic theory continued on classical and post-classical theories of value and distribution, nature and evolution of technology, analytical representation of productive process in various sector and associated process of investment, accumulation and innovation, theory of rent, marketed surplus and agricultural pricing. A number of Ph.D. theses are nearing completion on the topics.

(b) *Econometric Methods* : Studies in this area have analysed statistical problem in the estimation of single equation econometric models arising from (i) heteroskedastic disturbances', (ii) transformation of variables, (iii) errors in variables ; (iv) omission of regressors and misspecification of the equation ; (v) Bayesian Inference ; (vi) Time series Analysis and Forecasting.

(c) *Measurement of Poverty, Inequality and Income Distribution* : Some studies in progress in this area concern issues relating to measurement of poverty, inequality and tax progression. One study examined the procedure for measuring incidence of undernutrition advocated by Professor Sukhatme.

(d) *Regional Planning* : Research work in progress in this area seeks to cover the following aspects : (i) manufacturing, industrialisation and regional production functional analysis in India ; (ii) monetization of agricultural products and regional surplus-deficit analysis in India (iii) spatial linkage and growth centre analysis in Eastern Region of India ; (iv) synthetic statistical analysis for regional planning in Nepal

(e) *Applied Economic Problems* : (i) Economic Planning : One study in progress seeks to work out a plan outline, complete with a monetary, fiscal, price and

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production policy frame, the objective of meeting basic human needs within a planning horizon.

(ii) *Problems of the Rural Economy* : The report on the first phase of a survey on the potentialities and institutional constraints of rural development based on four villages in Bankura is being finalized.

The second phase of the survey, covering two clusters of villages in the Memari Block of Burdwan district, was initiated during the period. The project will study the impact of Integrated Rural Development Programme in the selected areas.

A benchmark survey of the Integrated Rural Development Programme in two blocks in Coochbehar has also been taken up. Socio-economic investigation of some 30,000 village households has been completed and sample tabulation of data for one mouza has also been worked out.

(iii) *Consumer Behaviour and Level of Living* : Interregional and intertemporal variation in the level of living is being studied on the basis of 28th round NSS household budget data. The processing of the data on the ISI computer is in progress.

Another study of consumer expenditure pattern using NSS time-series data (7th to 28th round) has been undertaken. As a part of this study, a system of demand equations is being used.

(iv) *Agriculture* : As part of a broader study of Government policy in respect of pricing, production procurement and distribution of agricultural commodities, acreage response functions are being estimated for particular crops from state-level time-series data.

(v) *Industry* : A study on the measurement of productivity in selected manufacturing industries using Annual Survey of Industries data since the mid-sixties is in progress. Another study seeks to analyse trends in the mark-up factor for manufactured products during the Plan period for major individual industries as well as for output of manufactures as a whole.

(vi) *Labour* : Data collected in the ICSSR-sponsored survey of unorganised transport workers in Calcutta are under scrutiny and tabulation in ISI computer in Calcutta.

(vii) A paper presenting analysis of methods of accounting for nuclear power in India was published.

(viii) *Survey on Social Forestry* : A sample survey of households in the villages around the Arabari forest range in Midnapur was taken up during the period. The objective of the survey is to study the pattern of utilization of forest products by the villagers, their relationship with the forest agency and the prospect of adoption of the social forestry programme by the villagers.

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(ix) *Money and Banking* : One study has sought to develop an econometric model for forecasting demand for bank credit of the sector in India. A related study aims at analysing the changing seasonal pattern of such demand.

(x) *Foreign Trade* : An econometric study of the behaviour of India's imports both total imports and imports of various groups of commodities—over the period 1950-51 to 1977-78 is being carried on. Another empirical study is being made of trends in India's exports during the period 1964-65 to 1975-76, with particular emphasis on changing direction and commodity composition of export trade.

One note prepared during this period discussed alternative export policy options for the country taking a perspective view of the eighties.

2.5.2.2 *Delhi*

(i) Impact of the metropolitan city of Bombay on the surrounding region, (ii) Integrated development case study of North Kanara, (iii) Theory of decentralized Planning, (iv) Pricing distribution policies in India, (v) Specification of the pattern of income distribution, (vi) Deforestation, (vii) Employment and earnings in the handicrafts sectors, (viii) Foreign trade and development, (ix) Implications of providing optimum schooling facilities in Alwar district, (x) Input-Output table for the Indian economy (xi) Women and rice cultivation, selected villages in Kerala, Tamil Nadu and West Bengal, (xii) Estimating the requirements of fertilizers, componentwise for Punjab keeping in view the changing cropping pattern, (xiii) Rural agricultural market and spatial development in Haryana.

2.5.2.3 *Bangalore*

The Economic Analysis Unit carried out studies leading to the following results :

(a) The LIML estimators, as proposed to be modified through a simple adjustment, in a study entitled 'Modified LIML Estimators' would preserve the effect of the adjustment factor on both the endogenous and exogenous coefficient estimators and the adjusted LIML estimators not only possess finite moments but are also simpler than the estimators obtained earlier.

(b) In a study 'On Poverty Indicators' a simple method for estimating poverty line in rural and urban sectors of India has been developed using the available concentration curves.

(c) A composite index has been proposed in a study entitled 'On a Method of Classifying Regions from Multivariate Data' for measuring the spatial differentials in the level of development in the districts of Andhra Pradesh and Karnataka.

(d) In making out a case for quality insurance for packed products it has been demonstrated that improvement of the quality of products and services to the consumers could be achieved through a system of insurance.

2.5.3 Linguistic Research

The programme of fundamental and applied research is grouped as follows :

(1) *Survey of the articulatory and acoustic phonetic structure of Indian languages and application of the results in the areas of (a) speech pathology, (b) second language learning and (c) cultivation of mother-tongue, (2) Studies on bi-lingualism and retention of mother-tongue, and (3) Statistical processing of linguistic data.*

(1) Survey of Phonetic structure of Indian languages and application of the results :

(i) *Bengali phonetics*

(a) *Articulatory Norms in school-going children* : Data were collected and evaluation made.

(b) *Educational problems of hearing-impaired children attending schools for children with normal hearing* : Collection of data is in progress to examine the actual linguistic problems encountered by hearing impaired children who are attending schools for normal children and competing with them in school examinations, following the regular prescribed curriculum.

(ii) *Hindi phonetics*

Suprasegmentals of Hindi language : Studies were in progress in collaboration with experts on the Hindi language on suprasegmentals (prosodic features) of the Hindi language.

(iii) *Telugu phonetics*

Suprasegmentals of the Telugu Language : Studies were in progress on the Suprasegmentals (prosodic features) of the Telugu language in collaboration with the Department of Linguistics, Osmania University,

(iv) *Oriya phonetics*

(1) *Study of the articulatory and acoustic phonetic structure of the Oriya language* : Preliminary discussions with experts in the Oriya language were held and data collection was commenced.

(2) *Studies on bi-lingualism and retention of mother-tongue* : A project was initiated on 'language interference and the mother tongue preservation factor among Bengali children outside Bengal'. Data were collected in a Telugu speaking area.

(3) *Statistical Processing of linguistic data* : Some statistical studies were in progress and further studies planned on quantitative linguistic and phonetic data from the following languages : Bengali, Hindi, Telugu, Punjabi, Sarbo-Croat and English.

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2.5.4 National Income Research

(i) *Studies on inter-state disparities in purchase power of the rupee* : This study was followed up by applying the Gery-Khamis method for working out a set of consistent inter-state comparisons of purchasing power of the rupee in rural India comparing 15 of the states using prices of 43 common items of consumption obtained from the NSS 18th round rural survey.

In another study, the construction of a composite consumer price index number was attempted from the available consumer price index number of different states and in rural and urban areas and a comparison of this with the national income deflator.

(ii) *Monetization*: In a recent study, the degree of non-monetization in rural and urban areas was analysed with an emphasis on the welfare aspects of national income. The major outcome of this in the field of researches in non-monetization is that the non-monetary activities both within a narrowly defined field of economic activities and again within a larger field of human social activities are to be considered. Secondly, while the problem of micro behaviour of producer-consumer in traditional economics yet remains unsolved with the enhancement of do-it-yourself activities in advanced countries a new class of producer consumers with a sizeable output is emerging.

(iii) *Preparation of series of capital formation and national income in India from the year 1857 to 1900* : Estimation of capital formation in the public sector has nearly been completed. In view of the gaps in the data available with the National Library and other libraries in Calcutta, the work would be pursued in the National Archives in Delhi during 1982-83.

Collection of data required for the estimation of the series of national income is continuing. Extensive data have been collected. There are large gaps in the material and search for further materials would be made in the National Archives in Delhi.

(iv) *Studies on size distributions of income* : Income distributions among earners in different industry-occupations and in different sectors of the economy are being analyzed. Preliminary work was completed for designing the pilot survey on distribution of income *within* and wage-differentials *across* different categories of occupations in small-scale industries in districts around Calcutta.

(v) *Studies on national accounts* : Studies on the estimation of state domestic product of West Bengal, with districtwise breakdown, are in progress. The ultimate aim is to build up all the component tables of a consolidated regional accounts for the state. The estimation of capital formation and capital stock for the state is also nearing completion.

(vi) *Studies on level of living* : A study of inter-state variation in level of living in the rural sector has been carried out. Another study brought out estimates of intake of calorie, protein and other nutrients in rural areas of different states, separately by fractile groups of the population.

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(vii) *Studies on Social Indicators and Economic Development* : An attempt was made to form a correlation matrix for 22 indicators based on data from 115 countries and to find out the relative weights for different indicators with a view to constructing an index for each country combining all the indicators.

(viii) *Estimation of generalised capital* : This project has been taken up to construct indices of human capital formulation for the major Indian States and to study inter-state and inter-temporal variation in these indices. The impact of human capital formation of GDP or SDP will be examined.

(ix) *Investigation into the process of financial resource mobilisation for the 6th Five Year Plan* : The project has been laid out under the budget proposals for 1982-83. Already some part of the work has been initiated to collect data to estimate financial resources for the 6th Five Year Plan of West Bengal. This may further be extended for similar studies on other states.

2.5.5 Pre-Census Population Studies

The main object of the unit is to conduct historical studies based on quantitative data.

(i) *Pre-Census Population Project* : Work on the third, fourth and fifth volumes are continuing.

(ii) *Analysis of Socio-Economic Trends in Bengali Writings, 1818-1947* : The Proceedings of a Seminar on Economic Writings in Bengali, 1918-1947 organised by the Indian Statistical Institute with other organisations were published during the year. The volume was edited by Bhabatosh Datta, Satyendra Nath Sen, Atindra Mohan Goon and Durgaprasad Bhattacharyya.

(iii) *Economy of Bengal, 1750-1800* : A monograph on the subject is under preparation. It contains a series on population, production and revenue.

(iv) *Editing of Manuscripts of Francis Buchanan* : Materials on Gorakhpur are being edited for publication. Work on the district of Rungpore continued.

(v) *Economic Change in Rural India* : The purpose of these studies is to bring out socio-economic changes in a historical perspective. Reports on the studies on the village of Ballavpur and on 20 villages of Aligarh are being finalised.

2.5.6 Psychometry

(i) *Development of Intelligence Tests for Hearing Impaired Children for Diagnostic purpose* : The objective of the project is to develop an Intelligence test for the Hearing Impaired Children to detect the level of intelligence at the time when they come for training. The Experimental Form of the test was administered on several groups of

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deaf children along with Goodenough's 'Draw a Man' test. The data are being analysed and further collection of data and other relevant details about the children are going on. Revised version of Aptitude test along with 'Draw a Man' test have administered at Agartala, Delhi and several schools at Calcutta. The preliminary report would be available shortly.

(ii) *Usefulness of Aptitude, Achievement and Personality Assessment in Industrial and Educational Selections* : This study aims at testing the hypothesis that the candidates selected through objective tests are better than those who are selected through traditional methods like interview etc. Several reports in this connection are already complete and a consolidated report is being prepared.

(iii) *Isolation of common pattern of some personality traits and its significance for vocational fields* : A preliminary report is complete and further analysis with equivalent groups are going on.

(iv) *Development of a scale for measuring managerial ability and skills* : The object is to develop a scale for assessing managerial skill for use under Indian conditions. Managerial skill is to be measured in five different areas viz. decision making, leadership, conceptual skill, human relations and communication. It is planned to use forced-choice method where faking may not be so easy, specially if the vocational significance of the statements are made somewhat ambiguous. Pilot study has already been done. On the basis of the pilot study set of statements in each of the five areas have been written. Responses from managers working in various organizations have been collected for finding out the preference values for these statements. On the basis of these preference values triads have been formed and by using these triads the experimental version of the inventory have been prepared. On the basis of data collected with this experimental version, tentative scoring keys will have to be developed. Reliability and validity of the scale will also be established.

(v) *Popular conceptions of mental health* : The purpose is to undertake sample surveys with urban and rural population to ascertain their level of knowledge and attitudes toward mental health problems, and their relation to demographic variables. A suitable methodology is being devised in consultation with experts and in the light of the results obtained from an exploratory study undertaken earlier. Field work in this connection in the villages of Malda & West Dinajpur districts of West Bengal is over. Analysis of data is going on.

(vi) *Rorschach Psychogram through Computer Programming* : Assessment of personality through Rorschach Psychogram is a very much complex task and time consuming too. In order to simplify and minimise the labour the present study aims to draw a computer model of scoring and interpretation manual of Rorschach Psychogram. But so far few study is known to sponsor in the fashion it is proposed to be done in the present scheme. So, only the scoring guide and interpretation devised with the aid of modern computers can replace the existing system and also minimise the labour and further increase the objectivity by making inter-scorer differences negligible.

At present the computer model of scoring of Rorschach responses has been achieved and a paper in this connection is also ready for publication. Simultaneously, the other portion of the study i.e., the computerised interpretation manual of Rorschach responses is also in progress.

2.5.7 Sociology

(i) *Social ecology of Sundarbans* : Field enquiries for exploring the possibility of a study of the social ecology of Sundarbans—a backward region of West Bengal are being carried out presently with special reference to the communities connected with fishing industry.

(ii) *A study of group relations in Giridih and surroundings with special reference to the development of the scheduled castes and tribes* : Exploratory enquiry and testing of the schedule-questionnaire with respect to the project in the surrounding areas of Giridih has been completed. Sample surveys are being carried out.

(iii) *Field research in various (e.g. socio-religious-economic) aspects societal problems of backward region—Palamau, Bihar* : Preliminary analysis of the information on the nature and degree of social backwardness of the ethnic groups inhabiting a backward region of Bihar in Palamau has been completed.

(iv) *Impact of rural development programmes in West Bengal and Bihar* : Pilot investigation began in January 1982. Collection of data is in progress.

(v) *Village resurvey* : Further data collection on migration, land transfer and border trade has been in progress.

(vi) *Problem of deforestation in India (under socio-cultural and biological adaptation in contrasting eco-system)* : Canvassing of tested structured schedules on the use of forest products in two States, namely, Bihar and West Bengal began. Tabulation work on domestic use of the *minor* forest products by rural population has been in progress.

(vii) *Problems of adjustment of the retired persons in their family life* : Interviews with the retired pensioners residing within the Calcutta Corporation limit, from a selected sample drawn on the basis of certain socio-economic characteristics, have been completed. Scrutiny and coding of information is in progress.

(viii) *The study of 'registry marriage' and impact of legislation in West Bengal* : As a part of the pilot study on the Registry Marriage and the impact of Legislation, documentary evidences on the registered couples under Hindu Marriage Act have been collected from different district levels around the city of Calcutta.

(ix) *Content analysis of views on an aspect of societal change in India : the Hindu-Muslim relations in the 18th century Bengal* : Data collection was done in the State

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Archives, in the Manuscript Section of Visva Bharati and in the Record Rooms of different District Collectorates of West Bengal. Analysis of the materials, so far collected, are being carried out.

(x) *Conflict, Structure and Change* : The study is in progress. On the basis of data collected in the course of field work for the project, mauzas which constituted the intersection between the sampled units and the movement belt were selected for an in-depth understanding of the agrarian social structure in the areas of peasant revolt in the Siliguri sub-division in 1967. The information collected is being manually tabulated for analysis. A further selection of mauzas, matching the intersection mauzas' was made from non-movement areas to enable inference being based on a controlled experimental situation. Collection of data from these mauzas is continuing. In addition to the rural revenue units, two tea plantations have been selected from the sampled mauzas, with a view to understand their structure and relationship with the agrarian social reality.

(xi) *Caste, class, location and unequal exchange* : It deals with the pattern of distributive system in rural society, i.e., who gets what and why, specially in the context of class, ethnic group, market contact and local administrative system.

(xii) *Palamau project* : Sample survey in Palamau district of Bihar has been completed and data have been scrutinized. Tabulations are being done, together with the processing of primary data. Collection of secondary data is also continuing.

(xiii) *A study of the Nepalese system of Panchayat Democracy* : A publication on the study is under way.

2.6 Statistical Quality Control and Operations Research

2.6.1 As in the past years the activities of the Division were organised through comprehensive programmes under the broad classification of (i) promotion, (ii) training, (iii) plant services and (iv) research. Promotional activities were conducted in public and private sectors. Inplant training of technologists, trainees, inspectors and operatives including operative programme in local languages, radio talk, T.V. programme, film shows and services continued to have support from a number of public and private sector organisations. The units of Bharat Heavy Electricals Ltd.—Hyderabad, Hardwar, Bhopal and Jhansi continued as servicing plants of the Division besides a number of other plants both in public and private sectors. Several organisations were added to the list of servicing plants during the year. The Division undertook new project assignments during the year, apart from rendering consultative services to factories already on its rolls. The Division has so far produced about 700 specialists and prepared over 550 research and application papers in the field of SQC & OR. The Division continued liaison with various academic and technical institutions, productivity councils, societies, associations and several other national and international bodies by way of its academic and promotional activities.

2.6.2 During the period under review 15 plants joined the SQC services scheme. 116 technical reports were sent to factories and 11 factories discontinued. A total of 50 factories are taking consultative services as in March 1982. Special studies involving applications of SQC and OR methods were taken up in the areas : improving formation of tissue paper, reducing rejection of broke, quality improvement in heavy machine shop of turbine and generators, degassing of H₂ in steel, effect of inoculation of mechanical properties of cast iron, technological improvement in manufacture of solid core insulators, evaluation of performance of V.T. pumps; vendor rating; simulation test using OA technique for study of Motor burn-outs in compressor, optimum process parameters for spiral welding, productivity improvement in assembly of energy meters, etc.

2.6.3 Inplant training programme of various factories continued. A series of training programme for senior executives of Bharat Heavy Electricals Ltd. continued on regular basis besides regular programme for executives at various levels. One-year special training programme in SQC and OR for BHEL engineers at fairly advanced level blended with practical application continued for second and third batches of trainees at Madras. The Division organised short-term specialisation training programme in the area of SQC and OR for Indian Statistical Services (ISS) probationers; ISEC trainees and participants from various organisations like RITES, NPC polytechnics and a large number of industrial establishments. During the period under review 2915 managers and technologists, etc. were trained in various inplant, general and other courses. 189 trainees underwent professional training in SQC & OR at a Post-graduate level and in part-time courses in Calcutta, Bombay, Madras, Delhi, Bangalore and Hyderabad.

2.6.4 Some of the areas in which applied research work is carried out include combinatorial optimisation in flowshop scheduling problem, Bayesian three-decision acceptance sampling plans, role of inspection error in acceptance sampling plans, acceptance sampling by gauging, pseudo-semi-Markov processes, reliability, uniqueness of solution in some non-linear programming problems, control of ovality, degenerate complimentary cones etc.

2.7 Library, Documentation and Information Sciences

2.7.1 *Central Library* ; (i) With the addition of 2,803 new books and 1,323 bound volumes of journals the total collection of the Central Library at Baranagar rose to 1,69,365 at the close of the year. The Library has a collection of 34,023 reprints, 3,75,000 maps and a large collection of microfilms, microfiches and photoprints. The services of the branch Libraries at Bombay, Giridih and Delhi are co-ordinated with those of the Central Library to serve researchers, students and staff of the Institute.

(ii) *Acquisition Unit* ; The Acquisition Unit was able to acquire a total of 2,803 title of which 1,965 were purchased, 807 were received as gifts and 31 were received on exchange.

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(iii) *Technical Processing Unit* : This unit classified 1,605 and catalogued 2,236 books and other documents. The unit added 3,837 and 1,511 cards to alphabetical and classified catalogues respectively. The unit brought out 15 issues (some combined) of weekly list of additions to the Library and 2 issues of Quarterly Library Bulletin : a classified list of additions to the Library.

The unit also completed a project work on "Subject Index to classified Catalogue" during this period.

(iv) *Periodicals Unit* : Altogether 2,302 periodicals were received in the Library of which 650 were received against subscription, 1012 on complimentary basis and 619 on exchange arrangements with national and foreign organisations. The Library subscribed to 21 new journals during this period. This library also acquired 244 back volumes of journals. The Unit completed technical processing including accessioning of 1,323 bound volumes of journals.

(v) *Membership and Circulation* : The total membership of the Library during the period was 3,844 including students, research scholars, staff as well as members of the Institute and student members of other institutions. On loan and reference 42,402 books and journals were issued. Special permission was given to 596 readers to use the Library for a short period. The Library borrowed 49 books and journals and issued 79 books and journals under inter-library lending arrangements.

(vi) *Reprographic and Photographic Unit* : The Library provided 4,26,439 xerox prints, 5,878 bromide enlargements, 1,416 photocopies from microfilms, 6,687 contact prints, 2,787 frames of microfilm and microfiche of books, journals, charts, drawing etc. to the researchers, students and staff. 805 frames of photographs were taken for identity purpose.

(vii) *Translation Unit* : 8 documents from different languages were translated during the period : 3 from Russian ; 2 from German ; 1 from French and 2 from Japanese.

(viii) *Special Materials Unit* : The Unit processed 3,509 microfiche, 25 microfilms ; and prepared 1,200 and 50 cards respectively for the microforms under reference. 130 titles of Russian books were processed and 136 titles were transliterated. These were technically processed, arranged and indexed. It translated 125 Russian titles, classified 120 and catalogued 120 and prepared 430 cards.

(ix) *Circulating Library* : The Workers' Circulating Library acquired 604 new books bringing the total collection to 30,979. It issued 32,440 books to the members.

2.7.3 Documentation Research and Training Centre (DRTC), Bangalore

(i) *Research* : (a) Refinement of the structural theory of subject indexing language ; (b) Systematisation of the methodology of designing the vocabulary control

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device called "Classaurus"; (c) Formulation of rules of procedure for different version of the Postulato-based permuted subject indexing (POSI) language; (d) Examination of the analytico-synthetic features of Colon Classification (forthcoming edition) including identification of elemental relations and typology of the relators and relations; (e) Application of the principles of classification enunciated by S.R. Ranganathan to compilation, arrangement and presentation of numerical data; (f) Analysis of the classification schemes for subjects medical sciences for the purpose of identifying compatibility between general and special schemes on the subjects concerned; (g) Design and development of depth classification versions in the field of medical sciences; (h) Planning and management of information systems and services; (i) Systems-analysis of document circulation system in libraries and information centres with a special emphasis on the identification of the various components; (j) Bibliometric studies for the evaluation of library and information services with special emphasis on academic libraries; (k) Refinement of the system for computer aided generation of information retrieval thesaurus and classaurus; (l) Computer generation of different types of subject indexes from a single heading formulated according to the structural theory of subject indexing languages.

(ii) *Training* : The 1981-83 session of the DRTC course leading to the award of Associateship in Documentation and Information Science commenced on 1 August 1981. In all 10 candidates were admitted to the course. There were three deputed candidates. One of the candidates joined on study leave.

(iii) *Seminars* : About 32 seminars were organised.

3. CONFERENCES, SEMINARS AND SYMPOSIA

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

(i) A symposium on Economic Theory and Planning was held at the Bangalore Centre of the Institute from 3-5 December 1981. 35 participants took part in this symposium of whom four were from abroad. Twelve papers on different topics were presented at this symposium.

(ii) A conference on Statistics Applications and New Directions was held at Calcutta from 16-19 December 1981. The following topics were covered at this conference : (a) Data analysis and statistical computing, (b) Cluster analysis and multivariate analysis, (c) Non-parametrics, (d) Sampling and sample surveys, (e) Stochastic modelling and forecasting. 82 participants took part in this conference of whom 37 were from abroad.

(iii) A conference on Review of the Indian Planning Process was held at Calcutta from 30 December 1981 to 3 January 1982. The following topics were covered at this conference : (a) Perspective planning : objectives, constraints, instruments, (b) Indian Plan models : logic, relevance and scope for improvement, (c) Industrial

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planning in India : critical choices, (d) Agricultural planning in India : experience and critique, (e) Social dimensions of Indian planning : Social welfare and removal of social backwardness, (f) Problems of plan implementation : machinery, levels and resources. 97 participants took part in this conference of whom 12 were from abroad.

(iv) A conference on Theory and Applications of Random Fields (in collaboration with the International Federation of Information Processing) was held at Bangalore centre of the Institute from 4-1 January 1982. The following topics were covered at this conference : (a) Statistical problems involving random fields, (b) Markov random fields, (c) Stochastic differential models for random fields, (d) Random field in quantum mechanics, geophysics and other areas of application. 34 participants took part in this conference of whom 20 were from abroad.

(v) A conference on Advances in Information Sciences and Technology was held at Calcutta of the Institute from 11-14 January 1982. The following topics were covered at this conference : (a) Information storage retrieval and processing, (b) Pattern recognition and image analysis (c) Digital communication, (d) Microprocessor based computer architecture. 145 participants took part in this conference, of whom 11 were from abroad.

(vi) A conference on Human Genetics and Adaptation (in collaboration with the Indian Society of Human Genetics and the International Association of Human Biologists) was held at Calcutta from 1-5 February 1982. The following topics were covered at this conference. (a) Evolutionary and population genetics, (b) Population structure, (c) Quantitative genetics, (d) Genetics of common diseases, (e) Genetics of isolates polymorphism and disease. (g) Altitude adaptation, (h) Circumpolar adaptation, (i) Tropical adaptation, (k) Island adaptation, (l) Biocultural adaptation. Nearly 100 participants took part in this conference of whom 34 were from abroad.

4. PUBLICATIONS

The following were published during the year 1981-82 :-

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

Series A : Volume 42, Parts 3 & 4
Volume 43, Parts 1, 2 & 3
Volume 44, Part 1

Series B : Volume 42, Parts 3 & 4
Volume 43, Parts 1, 2 and 3
Volume 44, Part 1

Series C : Volume 41, Part 2
Volume 42, Parts 1 & 2

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- Series D : Volume 40, Part 2
Volume 41, Parts 1 & 2
Volume 42, Parts 1 & 2

A remarkable progress has been made in regularising and restoring publication schedule of *Sankhya* during the year under review. All back logs have been cleared and the issues of volume 43 of Series A and B have been published and mailed to the subscribers on time.

As was scheduled *Sankhya* Cumulative Index has been published on the day of the inauguration of the Golden Jubilee Conferences.

It may be mentioned that two other publications (1) Statistical Quality Control and Operation Research in Indian Industries-165 Case Studies and (2) Organising for Quality—Prospects and Proposals are going through final printing.

(ii) *Technical Report* : Twenty-three technical reports from the Statistics-Mathematics group have been issued during 1981

Apart from the above, the following publications were brought out on the occasion of the Golden Jubilee celebrations of the Institute :

- (i) Indian Statistical Institute and Professor Prasanna Chandra Mahalanobis.
(ii) Brief History and Activities of the Indian Statistical Institute.

5. LIST OF SCIENTIFIC PAPERS AND PUBLICATIONS

5.1 *List of Papers Published*

A. Theoretical Statistics and Mathematics

1. Bagchi, S. C. 1982 : Invariant subspaces of vector valued function spaces on Bohr groups and multivariate prediction theory. *Statistics and Probability : Essays in honour of C. R. Rao*, North-Holland Publ. Co. 25-37.
2. Chandra, T. (with J. K. Ghosh) (1982) : Deficiency for multiparameter testing problems. *Statistics and Probability : Essays in honour of C. R. Rao*, North-Holland Publ. Co., 179-192.
3. Das, Prabir (1981) : Characterization of unigraphic and unidigraphic integer-pair sequences. *Discrete Mathematics*, 37, 1, 51-66.
4. — (1981) : Eulerian trails with prescribed degrees in tournaments. *Ars Combinatoria*, 12, 47-50.

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5. Ghosh, J. K. (with M. R. Saha and S. Sengupta) (1981) : Gondwana stratigraphic classification by statistical method. *Down-to-Earth Statistics ; Solutions Looking for Geological Problems*, Ed. D.F. Merriam, Syracuse University Geology Contribution, 8.
6. — (with Sinha, B. K.) (1981) : A necessary and sufficient condition for second order admissibility with applications to Berkson's bioassay problem. *Annals of Statistics* 9, 6, 1334-1338.
7. — (with H. Morimoto and S. Yamada) (1981) : Neyman factorization and minimality of pairwise sufficient subfields. *The Annals of statistics* 9, 3, 514-530.
8. — (with B. S. Mazumder and S. Sengupta) : (1981) : Methods of computation of suspended load from bed materials and flow parameters. *Sedimentology* 28, 781-791.
9. — (with B. S. Mazumder) (1981) : Size distribution of suspended particles— unimodality, symmetry and lognormality. *Statistical distribution in Scientific work*, Ed. C. Taillie et al., 6, Reidel Publisher, 21-32.
10. Mazumder, B. S. (1981) : Taylor diffusion for a natural convective flow through a vertical channel. *Int. Jour. Engg. Sci., Pergamon Press*, 19, 771-777.
11. Rao, A. R. (1981) : Degree sequences of cacti in Combinatorics and Graph Theory, *Proc. Calcutta* 1980 (Ed. S. B. Rao), Lecture Notes in Math., 885, Springer-Verlag, 410-416
12. Rao, K. P. S., Bhaskara (with E. Barone) (1981) : Misure di probabilita finiteamente additive continue invarianti per trasformazioni. *Bollettino U.M.I., Serie V, VIII, C. 1*, 175-184.
13. — (with E. Barone) (1981) : Poincare recurrence theorem for finitely additive measures. *Rendiconti di Matematica* (4) 1, 521-526.
14. — (with P. S. S. N. V. P. Rao) (1981) : On generalized inverses of Boolean Matrices— II, *Linear algebra and its applications*.
15. Rao, S. R. (1981) : A survey of the theory of potentially P-graphic and forcibly P-graphic degree sequences. *Combinatorics and Graph Theory* (Ed. S. B. Rao). *Lecture Notes in Mathematics*, 885, 417-440.
16. — (1981) : Towards a theory of forcibly hereditary P-graphic sequences. *Combinatorics and Graph Theory* (Ed. S. B. Rao). *Lecture notes in Mathematics*, 885, 441-458.

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17. — (with N. M. Singhi, and K. S. Vijayan) (1981) : The minimal forbidden subgraphs for generalized line-graphs. *Combinatorics and Graph Theory* (Ed. S. B. Rao). *Lecture Notes in Mathematics*, 885, 459-472.
18. — (with N. M. Singhi and K. S. Vijayan) (1984) : The spectral characterization of the line graph of K_n . *Combinatorics and Graph Theory* (Ed. S. B. Rao). *Lecture Notes in Mathematics*, 885, 473-480.
19. Rao, T. S. S. R. K. (with A. J. Ellis, A. K. Roy and U. Uttersrud) (1981) : Facial characterizations of complex Lindenstrauss spaces. *Trans. Amer. Math. Soc.*, 268, 173-186.
20. Roy, A. K. (1981) : A short proof of a theorem on Complex Lindenstrauss spaces. *Israel Journal of Mathematics*, 38, 41-45.
21. Saha, G. M. (with A. Dey and M. Singh) (1981) : Efficiency balanced block designs. *Communications in Statistics*, A10, 237-247.
22. — (1981) : Balanced arrays from association schemes and some related results. *Proc. Symposium on Combinatorics & Graph Theory* (Ed. S. B. Rao). *Lecture Notes in Mathematics*, 885, 473-480.
23. Sastry, N. S. Narasimha (1984) : Finite groups admitting extensions of automorphisms of a largest elementary abelian 2-group. *J. Algebra*, 71, 37-43.
24. Srivastava, S. M. (with R. D. Mauldin) (1984) : Paramétrisations des ensembles coanalytiques à compes relativement non maigres. *C. R. Acad. Sci. Paris*, 292, 1, 743-745.
25. Tripathi, T. P. (with Pulakesh Maiti) (1984) : Some T_n -class of estimators better than H-T estimator. *Aligarh Journal of Stat.*, 1, 52-58.

B. Applied Statistics, Surveys and Computing

1. Mukhopadhyay, A. C. : Some series of SFDO's with the Dual Property, BOD's and BIBD's in *CSA Bull.* 30, 115-122.
2. Vijayan, K. S. : The minimal forbidden subgraphs for generalised line-graphs. *Lecture Notes in Mathematics*, Springer Verlag No. 885.
3. — : Spectral characterisation of the line graphs of K_n . *Lecture notes in Mathematics*, Springer Verlag No. 885.
4. Chaudhuri, Arijit (1984) : Non-negative unbiased variance estimators—in *Current Topics in Survey Sampling* edited by Platek, Krewski and J. N. K. Rao, *Academi Press*, 317-328.

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5. — (1982) : Some results concerning strategies of sampling on two occasions (jointly with R Arnab) *J. Ind. Soc. Agri. Statist.* 34, 61-72.
6. ——— On unbiased various-estimation with various math. stage sampling strategies. *Sankhya*, B, 44, 92-101.
7. Chakravorti, S. R. : Tests for the mean vector under Intra-class covariance structure—(jointly with B. Choment, N. Giri and B. K. Sinha) *Journal of Statistical Computing and Simulation*, 12, 237-245.
8. Maitra, Tares : The potential of Non-Group Activities for Employment Generation in Selected West Bengal Villages—Published in *Employment Expansion Through Local Resource Mobilisations*, Center on Integrated Rural Development for Asia and the Pacific and ILO—Asian Regional Team for Employment promotion December 1981.
9. Adhikari, Ajoy Kumar (1981) : A study of NSS operations. *Sankhya* 38, C, 177-183.
10. Mukherjee Bishwa Nath (1982) : 'What type of Predictive Validity does the Aptitude Diagnostic Test Reveal? Comments on Dr. Yanai's paper, *Hiroshima Forum for Psychology*, 7, 25-32.
11. Roy, J. (1981) : A study of NSS operations (jointly with Ajoy Kumar Adhikari) *Sankhya*, 38, Parts I and III, 177-183.
12. Arnab, Raghunath : Two stage sampling over occasions—*Aust. Jour. Statist.* 22, 349-357.
13. — (1979) : An addendum to Singh and Singh's paper on random non-response in unequal probability sampling' *Sankhya*, C, 41, 138-140.
14. — (1979) : On strategies of sampling finite populations on successive occasions with varying probabilities, *Sankhya*, C, 41, 141-155.
15. Bandyopadhyay Shibdas (1981) : (Joint authorship) Growth of the newborn by feeding habit from birth to twelve months *Anthropologiai Kozlemenyek*, 24, 61-80.
16. Mukherjee, Bishwa Nath (jointly with K. Takeuchi and H. Yanai) (1982) : *The Foundations of Multivariate Analysis* : Wiley Eastern Private Ltd., New Delhi, February 1982.

C. Physical and Earth Sciences

(1) Electronics

1. Sinha, B. P. , Dattagupta, J., Srimani, P. K., and Guhathakurta, A. (1981) : Application of associative memories in designing assemblers, *Information Sciences*, 24, 201-215.

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2. Pal, A. : An iterative algorithm for testing 2-assumability of boolean function, *Proceedings of the I.E.E.E.*, 69, 9, 1164-1166.
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4. — (1981) : Interfacing 16 or 12 bit DAC to a 8 bit up KDN 168, Nov.
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9. Malhotra, K. C. (with Vijayakumar, M. and Karmakar, B.) (1981) : Methodology for counting sole pattern ridge counts in Man. *Ind. Soc. Hum. Genet.*, Pune, Nov.
10. Malhotra, K. C. (with others) : A serological and biochemical Genetic study among the coastal and plateau Yanadis : A Tribal population of Andhra Pradesh.
11. Malhotra, K. C. (with Karmakar, B. and Vijayakumar, M.) (1982) : Frequency distribution of TMPRC and the relationship between TMPRC, TFRC and TPPRC Conference on Human Genetics and Adaptation, ISI, Calcutta, Feb.

12. Malhotra, K. C. (with Vijayskumar, M., Karmakar, B and Banerjee, D.) (1982) : Genetics of Sole pattern ridge counts and correlation between ridge counts on different sole configurational areas. *Conference on Human Genetics and Adaptation*, ISI, Calcutta, Feb.
13. Malhotra, K. C. (with others) (1982) : Spatial and social variation in sickle-cell trait, G-6-PD deficiency and Malarial incidence in north Maharashtra. A preliminary report. *Conference on Human Genetics and Adaptation*, ISI, Calcutta, Feb.
14. Malhotra, K. C. (with Gadgil, M.) (1982) : Questioning Bedthi Hydell Project : An experiment in peoples participation. Symposium on Action Research for local level Interventions. *Ind. Inst. of Pub. Admn.*, New Delhi, March.

B.2 Crop Science

1. Davis, T. A. and Ghosh, S. S. (1981) : Phylloidy of palm spadices and flowers. All India Symposium on "Normal and pathological structure and development of Economic palms" held at Sardar Patel University, Vallabh Vidyanagar, Gujarat, during 2-5 November.
2. Ghose, M. (1981) : The anatomy of roots in young palms. *J. Ind. Bot. Soc.* 60 : 43. Abs. Suppl. Presented at the *IV All Indian Botanical Conference held at Calicut*.
3. — (1982) : On the anatomy of the stems of seedling palms. Pub. 69th *Ind. Science Cong.* held at Mysore. Abs. No. 163 p. 76.

B.3 Biochemistry

1. Mazumder, P. P., Mitra, P., Bhattacharya, S. K. & Basu, A. (1982) : Pterygium : Likelihood Analysis of Four Sherpa pedigrees. Presented at the *Golden Jubilee Conference 'On Human Genetics and Adaptation'*, ISI, Calcutta Feb. 1-5.

C. Social Sciences

C.1 Demography

1. Chakraborty, B. (1982) : Female education, female labour force participation and fertility : An interactive casual model approach, paper read at the Sixty-ninth Session of the Indian Science Congress Association, 3 to 8 January, 1982, University of Mysore, Mysore. (*Proceedings of the Sixty ninth Session of the Indian Science Congress Association, University of Mysore, 1982*).
2. Ghosal, A. K. (1982) : Population control planning in the Indian perspective, paper read at the seminar on Population Control Planning, 26th March, 1982, Social Science Division, Indian Statistical Institute, Calcutta, (*Proceedings of the Seminar on Population Control Planning, Social Science Division, Indian Statistical Institute, Calcutta, 1982*).

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3. Guha Roy, S. (1981) : Demography of sterilization, Indian experience, paper read at the General Conference of the IUSSP, 9-16 December, 1981, Manila, (*Proceedings of the General Conference of IUSSP, Manila, 1981*).
4. Malakar, C. R. (1981) : Population projections of the less developed regions : 1980-2000, paper read at the General Conference of the IUSSP, 9-16 December, 1981, Manila, (*Proceedings of the General Conference of IUSSP, Manila, 1981*).
5. — (1981) : On specification of marriage curves in India, paper read at the Data Analysis and Statistical Computing Session of the Indian Statistical Institute Golden Jubilee Celebration Conference, Calcutta, 16-19 December, 1981, (*Proceedings of the Indian Statistical Institute Golden Jubilee Celebration, Calcutta, 1981*).
6. Saha, A. K. (1982) : Family welfare planning in rural Bengal, paper read at the Seminar on Population Control Planning, 26th March, 1982, Social Science Division, Indian Statistical Institute, Calcutta, (*Proceedings of the Seminar on Population Control Planning, Social Science Division, Indian Statistical Institute, Calcutta*).
7. Sarkar, B. N. (1981) : Failure of developmental efforts in creating better social order, paper read at the Symposium on Social Perspective of Development of Science and Technology in India, 25-29 September, 1981, Indian Academy of Social Sciences, Allahabad, (*Proceedings of the Symposium on Social Perspective Development of Science and Technology in India, University of Kanpur*).
8. Sarkar, B. N. (1981) : Evaluation of national integration efforts, paper read at the Seminar on National Integration and Development, 10th September, 1981, organised jointly by the Eastern Regional Centre of the Indian Academy of Social Sciences and NCC Club House, Calcutta, (*Proceedings of the Seminar on National Integration and Development, NCC Club House, Calcutta*).
9. — (1982) : Literacy development among females in family life in rural areas of districts away from Calcutta, paper read at the Sixty ninth Session of the Indian Science Congress Association, 3 to 8 January, 1982, University of Mysore, Mysore, (*Proceedings of the Sixty ninth Session of the Indian Science Congress Association, University of Mysore*).
10. — (1982) : Studies on migration from rural areas of Bengal, paper read at the National Symposium on Problems of Labour Migration and Regional Development in India, 1-3 February, 1982, Department of Geography, Viswa Bharati, Santiniketan, (*Proceedings of the Symposium on Problems of Labour Migration and Regional Development in India, Viswa Bharati University*).
11. — (1982) : Population control planning, background paper read at the Seminar on Population Control Planning, 26 March, 1982, Social Science Division, Indian Statistical Institute, (*Proceedings of the Seminar on Population Control Planning, Social Science Division, Indian Statistical Institute, Calcutta*).

FIFTIETH ANNUAL REPORT : 1981-82

C.2 National Income Research

1. Datta, Pranati (with Roy, Bina) (1981-82) : Estimation of the stock of some consumer durable goods in India in 1980, TECH. Report No. NIRU/4/81. Read at the 13th Biennial conference of the Indian Association for Research in National Income and Wealth held at Bhubaneswar—(Dec.-January).
2. Datta, Pranati (with Roy, Bina) (1981) : Sharing the gains in productivity in India, submitted to the Annual Conference of the Indian Labour Economic Society held at Jamshedpur in October.
3. Datta, Pranati (1981-82) : An estimate of the value stocks of consumer durables in India in March 1979, TECH. Report No. NIRU/7/81. Submitted to the 13th Biennial Conference of the Indian Association for Research in National Income and Wealth held at Bhubaneswar—Dec.-January 1981-82.
4. Datta, Pranati (with Chattopadhyaya, K.) (1981) : Infrastructure development and regional imbalances in India, published in the proceedings of the Annual Conference of the Bangiya Arthaniti Parishad.
5. Mazumder, Krishna (with Bhattacharya, B.) (1981) : An Inter Class Time Series Analysis in sharing gains in productivity of manufacturing industries—Co-authored with Dr. Biswa N. Bhattacharyay (ERU). Accepted for the conference of the Indian Society of Labour Economics held at Jamshedpur-Oct. 1981 and published in the conference volume of the *Indian Labour Journal*.
6. — (with Bhattacharya, B.) (1981) : Changes in structure of the urbanization of big cities in India—Inter-sectoral comparative Analysis co-authored with Dr. Biswa N. Bhattacharyay (ERU). Read at the conference on urbanization held at the Department of Economics, Calcutta University-Nov.
7. — (1981) : Measurement of the Degree of urbanization—with special reference to Indian States. Read at the Conference on urbanization held at the Department of Economics, Calcutta University-Nov.
8. Majumder, Krishna (1981-82) : Inter-State variations in the purchasing power of rupee. Read at the 13th Biennial Conference of the Indian Association for Research in National Income and Wealth held at Bhubaneswar-Dec.-Jan. 1981-82.
9. Mukherjee, M. (with Saha, S.) (1981-82) : Reliability of National Income and Allied Estimates, presented at the 13th General Conference of the IARNIW held at Bhubaneswar during Dec.-Jan, 1981-82.
10. Mukherjee, M. with Roy, Bina, Saha, S. (1981-82) : On consistent inter-state comparison of purchasing power of rupee in rural India, Tech. Report No. NIRU/5/81 Submitted at the 13th Biennial Conference of the Indian Association for Research in National Income and Wealth held at Bhubaneswar Dec.-Jan, 1981-82.

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11. — (1981-82) : Certain observations on the share of cash expenditure in total consumption by states. Tech. Report No. NIRU/6/81. Submitted to the 13th *Biennial Conference of the Indian Association for Research in National Income and Wealth* held at Bhubaneswar-Dec.-Jan, 1981-82.
12. Roy, Bina (with Mukherjee, M. and Saha, S.) (1981-82) : On consistent inter-state comparison of purchasing power of rupee in rural India. Tech. Report No. NIRU/5/81. Submitted to the 13th *IARNIW Conference held at Bhubaneswar-Dec.-Jan, 1981-82.*
13. — (1981-82) : Certain observations on the share of cash expenditure in total consumption by states. Tech. Report No. NIRU/6/81. Submitted to the 13th *IARNIW Conference held at Bhubaneswar—Dec.—January.*
14. Roy, Bina (with Datta, Pranati) (1981) : Sharing the gains in productivity in India, submitted to the *Annual Conference of the Indian Labour Economic Society* held at Jamshedpur in October.
15. Roy, Bina (with Datta, Pranati) (1981-82) : Estimation of the stock of some consumer durable goods in India in 1980. Tech. Report No. NIRU/4/81. Submitted to the 13th *General Conference of the IARNIW held at Bhubaneswar* during Dec. Jan.
16. Saha, S. (with M. Mukherjee) : Reliability of National Income Allied Estimates. Tech. Report No. NIRU /3/81.
17. Saha, S. (with Mukherjee, M. and Roy, B.) (1981-82) : On consistent inter-state comparison of purchasing power of rupee in rural India. Tech Report No. NIRU/5/81. Submitted to the 13th *General Conference of the IARNIW held at Bhubaneswar* during Dec.—Jan.
18. Saha, S (with Mukherjee, M and Roy Bina) (1981-82) : Certain observations on the share of cash expenditure in total consumption by states. Tech. Report No. NIRU/6/81. Submitted to the 13th *General Conference of the IARNIW held at Bhubaneswar* during Dec.—Jan.

C.3 Pre-Census Population Studies

1. Bhattacharya, Durgaprasad (with Deb Roy, Rama) (1981) : On records of Village Settlements under Regulation VII of 1922. 47th *Session of the Indian Historical Records Commission.* Delhi, 19th-20th May.
2. Bhattacharya, Durgaprasad (with Bhattacharya, Archana) (1981) : Glimpses on Historical Records relating to Calcutta, 1750-1800. 47th *Session of the Indian Historical Records Commission.* Delhi, 19th-20th May.
8. Chattopadhyay, Kunal (with Datta, Pranati) (1982) : Infra-structure Development and Regional Imbalances in India. 2nd *Annual Conference of the Bangiya Arthaniti Parishad,* Calcutta, 6th-7th February.

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4. Bhattacharya, Durgaprasad (1982) : Evaluation of Land Reforms in West Bengal—a Historical Perspective. Seminar on Land Reforms in West Bengal. *Asiatic Society*, Calcutta, 26-27 March.

C.4 Sociological Research

1. Chattopadhyay, K. (1981) : On the problems of tribal adjustment jointly sponsored by the 'Cultural Research Institute' and 'Administrative Training Institute', Government of West Bengal, at Administrative Training Institute, Calcutta, during 7-22 December.
2. Chakrabarti, P. (1981) : Social dimension of municipal town : A case study of pilgrim town, Tarakeswar, in the conference 'Towns and municipal development' during 20. to 22. Nov. at the Centre for Urban Studies, Calcutta University.
3. Mukherjee, P. N. : "Sarvodaya after Gandhi : Contradiction and change", held under the auspices of Lokayan, Centre for Developing Societies, Delhi.
4. — : Delivered a series of three lectures at the Department of Sociology, Madras Kumraj University. They were on :
 - (i) "Social movement and social change",
 - (ii) "The peasant revolt in Naxalbari".
 - (iii) "Sarvodaya after Gandhi : Contradiction and change",

4. Documentation Research and Training Centre

1. Bhattacharyya, G (1981) : Essence of POPSI. (Course material prepared for the Training Course in Indexing, sponsored by DESIDOC (New Delhi) and held in Bangalore during 6-16 May). (Later published as a DRTC Report—1981 : 1).
2. — (1981) : Computer readable data bases and the future of information services. (Paper presented at the Seminar on Entering the Information Age organized by the U.S. International Communication Agency, Madras, and held in Bangalore during 3-4 June. (Later published as item 1.)
3. — (1981) : International cooperative information program and systems. (Course material prepared for the Summer School for Teachers of Library and Information Science, jointly sponsored by the Indian Society for Technical Education, Government of Karnataka, during 1-13 June).
4. — : Information system designing. (Course material for the course mentioned in item 3.
5. — (1981) : Subject indexing language : Its theory and practice. (DRTC Refresher Seminar—13, Paper BA).

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6. — (1981) : Resource mobilization and information processing : Role of standardization of bibliographic description. (Paper presented at the Workshop on "Meeting the Users' Needs", organized by ICRISAT, Hyderabad on 31 October.
7. — (1981) : POPSI : A system for depth indexing. (Paper presented at the National Seminar on Library and Information Services in R/D Organizations, organised by the *Indian Institute of Chemical Biology*, Calcutta, and held on 26-27 November.
8. — (1982) : Collection development and document circulation in the light of Ranganathan's Five Laws. (Inaugural address delivered at the DRTC Annual Seminar—19, 1-5 March.
9. — (1982) : Systems-approach and secondary communication. (Paper presented at the Seminar on Library and Communication, organized jointly by the Osmania University and the British Council, and held in Hyderabad during 19-21 March.
10. Gopinath, M. A. (1981) : Analytico-synthetic classification : Its theory and practice. (DRTC Refresher Seminar 13. New developments in library and information science in India : Bibliometrics, subject indexing languages and classification. Paper CA).
11. Gopinath, M. A. (1981) : Techniques of data compilations in science and technology. IASLIC conference 13, Waltair. Symposium 1 : On Data handling for science and technology.
12. — (1982) : Collection development and usage : An analytical approach (with I.K Ravichandra Rao). (DRTC Annual Seminar 19. Collection Development and Document Circulation. 1982. Paper AA.)
13. — (1982) : Financial norms for collection development in libraries. (DRTC Annual Seminar 19. Collection Development and Document circulation. 1982. Paper AW).
14. — (1982) : Evolution of the analytico-synthetic structures of colon classification for chemical sciences. Paper presented to the American Chemical Society Symposium on Chemical Information at Las Vegas (Nevada, USA). 28-31 March.
15. Ravichandra Rao, I. K. (1981) : Bibliometrics : Its theory and practice. (Paper presented in the DRTC Refresher Seminar. 13 ; Paper AA).
16. — (1981) : Role of CAI in Teaching/Learning of application of statistical analysis in library and information science courses. (Paper submitted in the Seminar on Audio-visual and Computer assisted Instructional Aids in Library and Information Science courses held at the Institute of Library Science of the University of Philippine, Manila, 16-20 Nov.

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17. — (1982) : Quantitative methods in librarianship. (Paper presented in the conference on Services in College Libraries held at the Department of Library Science of the Bangalore University, 24 February, Bangalore.)
18. — (1982) : Collection Development and usage : An analytical approach (with M.A. Gopinath). (Paper presented in the DRTC *Annual Seminar* 19. Collection Development and Document circulation. Paper AA).
19. — (1982) : Automated circulation systems : An over view. (Paper presented at the DRTC Annual Seminar 19. Collection Development and Document circulation. Paper AA).
20. Devadason, F. J. (1981) : Application of general theory of subject indexing language for computer aided generation of information retrieval thesaurus. DRTC Refresher Seminar, 13 ; Paper BB.
21. — (1981) : IFLA Compendium of courses in Library and Information Science : Asian region. Compiled by G. Bhattacharyya assisted by V. Bhavani and F. J. Devadason. The Hague, IFLA.

5.4 BOOKS PUBLISHED

A. Theoretical Statistics and Mathematics

1. Rao, K. P. S. Bhaskara (with Rao, B. V.) (1981) : PWN, Warszawa, 62 pages.
2. Rao, S. B. (1981) : Combinatorics and Graph Theory (Edited), Springer-Verlag, Berlin, 885, Lecture Notes in Mathematics, 500 pages.

Besides these above quoted papers twenty three technical reports have been prepared and thirty one papers have been sent to various journals for consideration for publication.

B. Applied Statistics, Surveys and Computing

1. Mukherjee, Biswa Nath (with Takenchi, K. and Yanai, H.) (1982) : The Foundations of Multivariate Analysis : Wiley Eastern Private Ltd., New Delhi, February 1982.

C. Biological Sciences

C.3 Anthropometry & Human Genetics

1. Malhotra, K. C. (with Gulati, R. K. and Undevia, J. V.) (1981) : Field work. In Biology of the people of Tamil Nadu, Ess. L. D. Sanghvi *et al.* pp. 26-34.

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2. Malhotra, K. C. (with Balakrishnan, V. and Karve, I) (1981) : Anthropometric variation in Tamil Nadu. In *Biology of the people of Tamil Nadu*. eds. L.D. Sanghvi *et al.* pp. 50-74.
3. Mukherjee, B. N. (with Voronov, A. A. and Das, S. K.) (1980) : Anthropological characteristics of the population of union territory of Delhi according to Haematological data : *New data on the Anthropological findings of N. India*. *Academy of Sciences, USSR, Moscow*.

D. Social Sciences

D.1 Demography

1. Sarkar, B. N. (1981) : Report on Education and Family Welfare Planning. Demography Research Unit, *Indian Statistical Institute, Calcutta*, pp. 1-313.

D.2 Pre-Census Population Studies

1. Bhattacharya, Durgaprasad (with Bhattacharya, Archanna) (1981) : *Economic Writings in Bengali, 1818-1947 with a foreword by Bhabatosh Datta*. Socio-Economic Research Institute, C-19, College Street Market, Calcutta-14, ii, 37p.

D.3 Sociological Research

1. Chattopadhyay, M. (1982) : Mahalanobis Survey Revisited : Prospects of Agrarian Change in West Bengal. Indo-Overseas Publications, Calcutta, March, No. of pages 105.
2. Chatterji, Bhola : *Portrait of a Revolutionary* : B. P. Koirala. New Delhi, Ankur Publishing House. (to be published)
3. Chakrabarti, Prafulla : *Profile of a pilgrim town*. New Delhi, Concept Publishing Company. (to be published).

E. Documentation Research and Training Centre

1. Bhattacharyya, G. (1981) : IFLA COMPENDIUM of courses in library and information science : Asian region, Compiled by G. Bhattacharyya, Assisted by V. Bhavani and F. J. Devadason. Published by International Federation of Library Associations and Institutions (IFLA), the Hague.

5.5 ARTICLES PUBLISHED IN BOOKS

A. Physical and Earth Sciences

A.1 Geology

1. Chatterjee, S. (1981) : Review of 'Aspects of Vertebrate History' in *Journal of Vertebrate Paleontology*, 1, No. 2, pp. 235-237.

FIFTIETH ANNUAL REPORT : 1981-82

2. Jain, S. L. (1981) : Dinosaurs : Cold or Warm-blooded. *Science Reporter (CSIR)*, 18, 10, 586-592.

B. Social Sciences

B.1 Pre-Census Population Studies

1. Bhattacharya, Durgaprasad (Deb Roy, Roma) (1982) : A Brief Historical Survey of Educational Statistics in India. *Social Statistics : Health Education*. Edited by Ashish Bose, Devendra B. Gupta, Mahera K. Premi. Vikas Publishing House Pvt. Ltd., 5 Ansari Road, New Delhi. 211-219.

B.2 Sociological Research

1. Biswas, S. K. (& others) (1980) : "Human biological variations in Asia, with special reference to India", in *La Diversite Biologique Humaine* (Human Biological Diversity), Masson, Les Presses De L'Universite, De Montreal, Canada.

C. Statistical Quality Control and Operations Research

1. Chowdhury, A. K. of the SQC Unit, Bangalore with Prabhakar, B. S. & Subramanian, R. of BIHEL, Bangalore (1981) : Quality Deficiency : Diagnosis and Remedy—A Case Study. *QR Journal*, May.
2. Chowdhury, A. K. & Chowdhury, K. K. of the SQC Unit, Bangalore (1981) : Detecting & Diagnosing Latent Quality Losses. *QR Journal*, September.
3. Anand, K. N. of the SQC Unit, Bangalore (1981) : Quality Assurance for Foundry Raw Materials. *QR Journal*, September.
4. Chowdhury, A. K. of the SQC Unit, Bangalore, with Boraksar, J. N. & Deone, D. D. of M/s. Kirloskar Bros. Ltd. (1981) : Developing Quality Confidence—an experience. *QR Journal*, January.

D. Documentation Research and Training Centre

1. Bhattacharyya, G. (1981) : Elements of POPSI in Indexing Systems ; Ed. by T. N. Rajan, published by IASLIC, Calcutta.

5.6 TECHNICAL REPORTS

A. Physical & Earth Sciences

A.1 Electronics and Communication Science

1. Chanda, B., Chaudhuri, B. B., Dutta Majumder, D. (1981) : Image Enhancement and Edge detection for human visual systems. Tech. Report No. ESCL ISI, Calcutta.

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B. Social Sciences

B.1 Demography Research

1. Sarkar, B. N. : Failure of developmental efforts in creating better social order (DRU Publication No. 28).
2. Raman, M. V. : Opinion of Calcutta couples regarding age at which one should have the first child (DRU Publication No. 29).
3. Ghosal, A. K. : Fertility differential between two major communities in West Bengal—An appraisal (DRU Publication Number 30).
4. Sarkar, B. N. : Primary education of children in rural Bengal (DRU Publication No. 31).
5. Raman, M. V. : Opinion of Calcutta men on arranged marriage (DRU Publication Number 32).
6. Guha Roy, S. : Females nuptiality in India : A reconstruction (DRU Publication Number 33).
7. Sarkar, B. N. : Studies on migration from rural areas of Bengal (DRU Publication Number 34).
8. — : The population control planning (DRU Publication Number 35).

B.2 Economic Research

1. Gajapathi, P. : On a model of joint production without any qualitatively redundant production process and any realisation problem within the sphere of production. 22.5.81
2. Bhattacharya, B. : Estimation for a varying parameter autoregressive process. 22.5.81
3. Panda, Manoj K. : Fixing Income and Price Targets for the poor in India 29.5.81.
4. Dasgupta, D. : The Hawkins-Simon Theorem : An Input-output Analytic Approach. 10.6.81.
5. Sarkar, Nityananda : Heteroscedasticity and transformation of variables in economics. 11.6.81.
6. — : Autocorrelation and the Box-Cox transformation in econometrics. 11.6.81.

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7. Ghosh, Rama : Procurement and Distribution Scheme : Its impact on the market price and the well-being of different classes. 17.7.81.
8. Bhattacharyya, Biswa N. An interstate trend analysis of purchasing power of a rupee. 11.8.81.
9. Coondoo, D., Mukherjee, R. and Rao, D. S. P. : Engol curve analysis with non-monetized composition. 16.3.82.
10. Dutta, Bhaskar : On robust implementation. 21.12.81.
11. Chakravarty, Satya Ranjan and Dutta, Bhaskar : Ethical indices of mobility. 11.2.82.

B.3 National Income Research

- 1 Datta, Pranati (with Roy, Bina) : Estimation of the stock of some consumer durable goods in India, in 1980. Tech. Report No. NIRU/4/81.
- 2 Dutta, Pranati : An estimate of the value stocks of consumer durables in India in March, 1979. Tech. Report No. NIRU/7/81.
- 3 Mazumder, Krishna : Wage share in a developing economy—with special reference to India, Tech. Report No. NIRU/Y1/81.
- 4 — : Inter-state variation in the purchasing power of rupee, Tech. Report No. NIRU/2/81.
- 5 Mukherjee, M (with Saha, S.) : Reliability of National Income and Allied Estimates. Tech. Report No. NIRU/3/81.
- 6 Mukherjee, M. (with Saha, S., Roy, Bina) : On consistent inter-state comparison of purchasing power of rupee in rural India, Tech. Report No. NIRU/5/81
- 7 — : Certain observations on the share of cash expenditure in total consumption by states, Tech. Report No. NIRU/6/81.
- 8 Mukherjee, M. (1982) : Planning in India. Extracts from speeches by Jawaharlal Nehru, 1952-56, Tech. Report No. NIRU/1/82. March.

C. Biological Sciences

C.1 Anthropometry and Human Genetics

- 1 Bhattacharya, S. K., Dutta, S., Das, S. K., Gupta, R., Roy, D. and Basu, A. (1982) Variations in differential leukocyte count in relation to age and body build in a rural population of West Bengal, India (Presented at the Annual Conference of the Indian Society of Haematology and Blood Transfusion, Calcutta, December, 1981). Indian Statistical Institute.

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D. Statistical Quality Control

(i) *Case Studies*

1. Executive Programme on Orthogonal Array Experimentation (in four volumes).
2. Iyer, V. Narayana : Cost Reduction & Quality Improvement through Linear Programme Technique.
3. — : Power Economy in a Spinning Mill.
4. — : Set up of Internal SQC Cell and the Scheme for Training the Personnel in a composite Mill.
5. — : SQC Programme in Indian Rare Earths Ltd.
6. — : Inspection, Standardisation and Training for reduced Misclassification in a Rayon Factory.

(ii) *Reports*

1. Iyer, V. Narayana : Preliminary Studies conducted in a Tyre Factory.
2. — : Studies conducted in a Fertiliser Factory.
3. — : Study on Burning of Spindle Motors in a Rayon Factory.
4. Thomas, A. G. : Increasing the strength of Phosphoric Acid and the Determination of the optimum process conditions.
5. Thomas, A. G. : Inventory Control Studies in a Pipe Manufacturing concern.
6. — : Relationship between W S P 05 contents.
7. — : Sorting Efficiency of the Electronic Testing Machines and other Allied Aspects.
8. Banerjee, K. K., Chatterjee, K. N. & Roychowdhury, S. : An Optimisation Problem in the Control of Quality of Packaged Commodities
9. Banerjee, K. K. : Optimal Steel Plant—Washery Linkage : A Study on Application of Linear Programming.