

INDIAN STATISTICAL INSTITUTE

THIRTIETH ANNUAL REPORT

April 1961—March 1962



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CALCUTTA-35

INDIAN STATISTICAL INSTITUTE

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INTRODUCTION : CONSTITUTION AND ACTIVITIES

GENESIS

Work on mathematical statistics had started nearly forty years ago, in the early twenties, in the room of P. C. Mahalanobis, then Professor of Physics in the Presidency College, Calcutta. In the course of the next ten years, a small group of young men gathered together in what came to be known as the Statistical Laboratory which by 1930 was receiving an annual research grant of about Re. 2,500 from the Imperial (now Indian) Council of Agricultural Research. This group conceived the idea of starting a statistical society in India and it was as a result of their initiative that the Indian Statistical Institute was brought into existence by a resolution passed at a public meeting held in December 1931 under the chairmanship of the late Sir R. N. Mookerjee who was elected the first President of the Institute and held that office for 5 years (1931-36). The Institute was registered on 28 April 1932 as a non-profit distributing learned society under the Societies Registration Act XXI of 1860. Against a single worker, a part-time computer and a total expenditure* of Rs. 238 in the first year, the Institute had, at the end of the thirtieth year (31 March 1962), a staff of about 2300 paid workers, the total expenditure (including capital expenditure) during the year being of the order of Rs. 122 lakhs. A notable event of the year was the adoption by the Institute of a crest (the banyan tree) and a motto (Unity in Diversity). The late Sir R. A. Fisher had compared the Institute to the banyan tree in reference to its activities which in spite of their diversity had an underlying unity of purpose—the promotion of research and of knowledge. The form of the crest was suggested by Sri C. D. Deshmukh, the President, who also suggested the Sanskrit equivalent of the motto.

CONSTITUTION

Object : The basic object of the Institute is the advancement of knowledge of statistics and allied subjects related to planning for national development and social welfare, and the collection of information and production.

Membership : The membership is open to all persons irrespective of sex, nationality, race, creed, or class. No part of the Institute funds can be distributed in any form among the members, though members who are also workers of the Institute are not debarred from receiving remuneration.

Control : The supreme control of the Institute is vested in the general body of members of the Institute which includes ordinary, life and honorary members, and honorary fellows. It is the body which has the authority to make and amend the rules of the Institute. The Annual Report and Audited Accounts are presented at the Annual General Meeting; other General Meetings are held whenever necessary. The number of members was 543 during the year.

Management : The management of the Institute is vested in the President, and a Council consisting of the Chairman, Vice-Chairmen, Treasurer, Secretary and other office-bearers, and 20 members, elected by the members of the Institute, besides

*Excluding the grant of Rs. 2,500 from the ICAR mentioned above.

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representatives of regional branches, three representatives of the Government of India and co-opted members. Subject to overall coordination by the Council, the management of the Research and Training School is vested in a Governing Body constituted with elected representatives of the Council of the Institute, of the Government of India, and of a number of public bodies. The International Statistical Education Centre is administered by a Board of Directors consisting of the representatives of the International Statistical Institute, the Government of India and the Indian Statistical Institute. There are two Finance Committees, one of the Governing Body and the other of the Council, an *ad hoc* committee for the allocation of expenditure, on which the Government of India is represented, a Journal Committee and an Examinations Committee; and several other committees, executive and technical, for day-to-day administration and coordination.

Sri C. D. Deshmukh has been functioning as the President of the Institute since 1945, Sir D. N. Mitra as the Chairman since 1955 and Sri S. C. Law as the Treasurer since 1936. Professor P. C. Mahalanobis has been the Secretary and Director from the inception of the Institute.

Audit: Chartered Accountants, qualified to audit accounts under the Indian Companies Act and appointed at the Annual General Meeting, have been auditing the Institute's accounts every year since its formation. In recent years the auditors have been selected with the approval of the Government of India.

Indian Statistical Institute Act: The Indian Statistical Institute Act (No. 57 of 1959) was passed by the Parliament in December 1959. The Act was presented by the Prime Minister Sri Jawaharlal Nehru, recognising the Institute as an "institution of national importance" and empowering it to confer degrees in statistics.

When the Indian Statistical Institute Act was brought into operation from April 1960, the Institute became a part of the public sector. The Institute was also left with a large measure of autonomy within limits prescribed in the ISI Act itself. The chief object was to make an experiment whether such autonomy would enable the Institute to function with greater efficiency than Government departments under the present patterns of administration.

DEVELOPMENT OF THE WORK OF THE INSTITUTE

Expansion: The expansion of the Institute's activities, both in volume and range, has taken place since its foundation, broadly speaking, in four stages, bearing in mind that there has always been considerable overlapping in the process so that no date-line can be fixed for the passage from one stage to another. During the first few years of its existence, the Institute functioned as a scientific society and also served more or less as a laboratory for analytical studies including the use of design of experiments in agricultural experiments on a fairly large scale. Even during this early tentative period, the Institute was commissioned by the Government as well as by some private concerns to carry out several economic enquiries on a small scale.

Professional training started in the very first year on a small scale and on an individual basis. To cope with the increasing demand, the Institute was obliged gradually to offer organised instructions at various levels, in theoretical and applied statistics and computational work. These activities developed later on into the Research and Training School with faci-

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ilities for advanced studies and research in many subjects. In 1938 the Institute started examinations for external students for the award of Statistician's Diploma and Computer's Certificate which are now held all over India. Since that year, the Institute has been receiving a research grant from the Government of India.

The Institute passed on to the second stage with an increase in the number as well as an enlargement of the scope of economic enquiries conducted by it, the most important among them being crop estimation surveys conducted on behalf of the Government of Bengal and later the Government of Bihar, which led to the development of specialized techniques necessary for large-scale sample surveys. During this period, the Institute prepared most of the tables for the 1941 census of population on the basis of two per cent *Y*-sample, at the instance of the Government of India.

A small workshop was started during the war through an associated non-profit-making organization for the repair and maintenance of calculating machines and other equipment. This made it possible for the Institute to design and construct in 1953 an electronic computer, the first in India, which led to the formation of an Electronic Computer Division.

The third stage followed as a logical consequence to the second, when the Institute was called upon by the Government of India in 1950 to take a leading part in organizing the National Sample Survey. The next big step was the inauguration by Prime Minister Nehru in 1954 of a section for studies relating to planning for national development. One of the first fruits of these studies was the formulation in 1955 of what came to be known as the "Draft Plan-Frame" which was accepted as the basis for the preparation of the Second Five Year Plan. Since then the Institute has been actively engaged in the work on planning in both Calcutta and New Delhi in close collaboration with the Planning Commission and the Central Statistical Organisation.

The enactment of the Indian Statistical Institute Act in December 1959 marked the beginning of the fourth and the present stage of the Institute's history. The Act declared the Institute to be an institution of national importance and conferred on it the right to hold such examinations and grant such degrees and diplomas as might be determined by the Institute from time to time. Facilities were already available at the Institute for training courses in statistics, and diplomas and certificates were being awarded on the results of examinations held periodically. But the Act gave the Institute the status of a University, and regular courses of study for the degrees of Bachelor of Statistics (B.Stat.) and Master of Statistics (M.Stat.) were started with effect from 1 July 1960. A feature of both these courses is the highly-integrated teaching of natural and social sciences as the foundation for the training of professional statisticians.

The courses leading to the B.Stat. or M.Stat. degrees have been formulated to cover a wide range of subjects, analogous to courses in medicine and engineering. Pure mathematics and the theory of probability have an important place. Theoretical and different branches of applied statistics, naturally, form a large part of the teaching programme. Because of the special needs of India, a great deal of attention is also given to the economics of planning. In these three groups of subjects, the courses include a good deal of the content of knowledge, besides theory and methodology.

Facilities are also provided for the students to become familiar with methods of observation, measurement and experimentation in a number of subjects in natural and

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social sciences. The emphasis is not so much on the content of knowledge but on methods, and stress is, therefore, given on practical courses which would give the students first-hand experience of making observations, measurements and experiments..

CURRENT ACTIVITIES

The more important among the current activities of the Institute, which cover a very wide field, are briefly outlined below :

1. *Learned Society* : As a learned society, the Institute publishes the internationally-known journal, *Sankhyā* : *The Indian Journal of Statistics*, as its official organ. It has society branches at Aligarh, Bangalore, Bombay, Madras and Poona.

2. *The Research and Training School (RTS)* has sections for mathematics, theoretical and applied statistics, biometry, haematology, psychometric research and service, demography, sociological studies, regional (geographical) surveys, geological studies, and flood research.

Several courses of professional training are given for candidates who have taken the Master's Degree, besides in-service training for statisticians in collaboration with the Central Statistical Organisation in New Delhi and technical training for computers, field investigators and operators of machine tabulation.

Since July 1960, the RTS has been conducting regular classes for Bachelor of Statistics (B.Stat.) and Master of Statistics (M.Stat.) degrees. The First Convocation was held on 12 February 1962 when five honorary degrees of D.Sc. were awarded to Sri Jawaharlal Nehru, Sir R. A. Fisher, Academician A. N. Kolmogorov, Dr. W. A. Shewhart and Professor S. N. Bose. Two Ph.D. and seven M.Stat. degrees were also awarded.

3. *The International Statistical Education Centre (ISEC)* is maintained jointly by the International Statistical Institute and the Indian Statistical Institute with the support of the Government of India and the UNESCO.

4. *Statistical Examinations* : The Institute is conducting examinations on a country-wide basis for the award of the Statistician's Diploma and Certificates for Computers and Field Investigators.

5. *The Planning Division* has units in Delhi and Calcutta. The Delhi Unit is working on economic planning in collaboration with the Perspective Planning Division of the Planning Commission and the Central Statistical Organization. The Calcutta Unit is working on various problems of economic development.

6. *The National Sample Survey (NSS)* : The Institute is in charge of the design of surveys, the technical work, and the tabulation and processing of the primary data collected by the Field Branch of the NSS which works under the direct control of the Cabinet Secretariat. The tabulation work is done at three centres, Calcutta, Giridih and Delhi.

7. *Electronic Computer Division* : An analogue computer was designed and constructed in the Institute in 1953; a digital computer of British make was purchased in 1956; and a Russian digital computer was installed in 1956. A project for the construction of two new digital computers (working on syllable instead of word structure) has been taken up in collaboration with the Jadavpur University. Computation service is being offered to many scientific institutions; and developmental research is also proceeding to construct electronic adjuncts and equipment.

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8. *The Development Workshop* services the machines and equipment in the Institute and is also engaged in developmental research. Fifteen high-speed electronic sorters were designed and constructed and have gone into batch production; and prototypes of desk calculating machines have also been constructed.

9. *Statistical Quality Control* : The Institute maintains eight units at Bangalore, Bombay, Baroda, Calcutta, Coimbatore, Delhi, Madras and Kerala (with offices at Ernakulam and Trivandrum) which work under the guidance of an SQC Policy Advisory Committee appointed by the Government of India.

10. *Publication* : In addition to *Sankhyā : The Indian Journal of Statistics*, the Institute publishes important scientific and statistical books in collaboration with the associated non-profit distributing Statistical Publishing Society which has a well-equipped press (the Eka Press) in Calcutta. Arrangements have also been made to publish another research journal, *Nizasha*.

Associate Organizations : In addition to the work done under the direct control of the Institute, the following associated organizations, located within or near the Institute premises, work in close cooperation with it:

The Statistical Publishing Society was established in 1935, on the initiative of the Institute, as a non-profit association, and registered under Act XXI of 1960, mainly for the publication of *Sankhyā : The Indian Journal of Statistics*, which is the official organ of the Indian Statistical Institute. The Society maintains the Eka Press, which is adequately equipped for undertaking the printing of scientific and technical work.

The Indian Calculating Machine and Scientific Instrument Research Society, which was established in 1934, on the initiative of the Institute, as a non-profit society registered under Act XXI of 1960 with the object of promoting research, production and use in India of calculating machines and statistical, mathematical, scientific and engineering instruments, apparatus and appliances, is now working in association with the Institute Workshop.

PART I: GENERAL REVIEW OF THE WORK DURING THE YEAR

1. RESEARCH AND TRAINING SCHOOL

The Research and Training School (RTS) may be described as the hard core of the Institute. Before the Institute came into existence, statistics, in its scientific sense, was practically unknown in the country, the widely prevalent notion being that statistics meant just the compilation of figures. From the very beginning therefore, the Institute had to train up its workers in methods of statistical analysis. As early as 1932, the Central and State Governments began to depute officers for training in the Institute. Such training in the earlier years was largely on an individual basis. In 1939 the Institute started organized courses of instruction which gradually led to the development of the present Research and Training School.

The activities of the Research and Training School during the year consisted of (i) research in advanced probability, statistical methods and scientific fields such as Biochemistry, Biology, Demography, Educational Test Construction, Geology, Haematology, Sociology, etc., (ii) conducting the two new degree courses, viz., B.Stat. (four-year) and M.Stat. (two-year), (iii) providing about fourteen training courses in statistics, at different levels and in different centres, (iv) conducting all-India professional examinations for statisticians, computers and field investigators, and (v) offering consultation and other technical services.

The Research and Training School carried out its work with C. E. Rao as the Head of the Division of Theoretical Research and Training. Research was carried out in several applied units and science laboratories attached to the Research and Training School under the following persons: N. K. Bose (*Flood Research*), S. Chatterjee (*Psychometric Research and Service*), S. Chaudhuri (*Haematology*), T. A. Davis (*Crop Science*), P. K. De (*Chemistry*), R. K. Mukherjee (*Sociology*), P. R. Pal (*Biochemistry*), S. J. Potl (*Demography*), V. L. S. Prakash Rao (*Regional Survey*), B. Roychoudhuri (*Geological Studies*), and S. K. Roy (*Botany*). A. Matthei was in charge of the International Statistical Education Centre, which provides courses for trainees deputed from South East Asian and other foreign countries.

A BRIEF SUMMARY OF RESEARCH

Research work was carried out during the year in many branches of theoretical statistics such as Probability, Estimation, Multivariate Analysis, Sampling Distributions, Design of Experiments, Sample Surveys, and Economic Planning. The units for applied research in Psychometry, Haematology, Sociology, Demography, Regional Surveys, Geology and Flood Research and science laboratories undertook a number of research projects, mainly of applied interest, besides some basic research. A brief outline of the activities and important contributions of the School are given below. The full details of research are given under "Research Summary"; and a complete list of 39 published papers, 50 papers submitted for publication and 13 working papers during the academic year is given in Appendix 5.1.

Theoretical Statistics: In theoretical statistics, the group of workers on advanced probability and applications made several important contributions specially on, information

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theory applied to communication problems, limit theorems and distributions on topological groups. An entirely new subject relating to probabilistic methods in number theory is developed and two papers laying the foundation have already been published.

Another active group has started work on error correcting codes, automation and combinatorial problems in the design of experiments.

Further advances have been made in the theory and application of Fractal Graphical Analysis introduced a few years ago, and the subject is receiving wide attention.

In multivariate analysis, work is continued on errors in discrimination. A significant contribution is procedures of selection under restriction, which involves quadratic programming.

The research on efficient estimates and optimum inference procedures has thrown further light on the properties of maximum likelihood estimates.

Biology and Crop Science : Experiments on interaction of rice varieties were continued and a new series of experiments on mixed cropping of wheat and gram was started. Some favourable interactions were observed in the case of rice varieties indicating that yield could be considerably increased by growing certain varieties of rice together on the same field. The results, if confirmed, will help in increasing the production of valuable food grains with little extra cost.

It has been found by extensive observation that coconuts having a left-handed leaf spiral give 21 per cent more yield than the right-handers. Apart from the economic importance of this finding, its explanation poses an extremely intriguing biological problem as this phenomenon is related to a character (asymmetry) established to be non-inherited and which is distributed with equal frequency in India and abroad.

Geological Studies : The Geological Studies Unit conducted explorations (November 1961-March 1962) in three localities in the Godavari valley. One party surveyed 500 square miles in the south-eastern part of the Godavari basin (the Archean and Purana rocks that frame and underlie the Gondwana sediments), and mapped in detail about 170 square miles. A second party worked on the undisturbed Pakhal and Sullavai sediments in the middle part of the valley and mapped in detail about 150 square miles, and a third party worked in detail on a pro-Cambrian inlier in the north-central part of the basin, mapping about six square miles of area.

The coordinated work of this expedition, reveals some important inadequacies in stratigraphic work by previous workers in the area and some revisions of the geology of the area by members of the Unit are under way.

Psychometric Research and Service : The Psychometric Research and Service Unit was engaged in activities concerning occupational and educational selection of which the more prominent were tests for the use of the Vellore Medical College and tests conducted on behalf of the Education Testing, Princeton, U.S.A. The Unit was also associated in the various selection tests conducted for the admission of trainees for the courses in the RTS at Calcutta, Bombay and Madras and for the NSS at Delhi.

Demographic Research : The Demographic Research and Service Unit studies, on the basis of considerable data obtained from maternity wards in hospitals, infant health

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conditions, mortality and development as also the relation between pre-natal conditions and post-natal complications. The seventh round data of the NSS were analysed for evolving suitable methods to determine the economic differentials of fertility.

Sociological Research : Studies in Sociology covered, among others, forces of integration in rural life, urbanisation and the consequential changes in family structure, and the growth of industrial townships.

Regional Planning : The Regional Planning Unit examined the data on natural and human resources in several regions, and these are primarily intended to aid economic planning. From a study of the distribution of natural and agricultural resources a tentative framework of regions for planning has been prepared to aid the breakdown of national targets and estimation in such a manner that the potentialities of every region are tapped to the full.

Flood Research : The Flood Research Unit was engaged in the study of problems entrusted to it by the Metropolitan Water Supply and Drainage Board, Government of West Bengal. These included the trend in the capacity of navigable sea-route of the river Hooghly since 1926, erection of a unit hydrograph for the catchment of the river Ajoy at a suitable site, and the regeneration of a river between two sites between January and April.

NEW PROJECTS, LABORATORIES AND EXPANSION OF EXISTING UNITS

Haematological Research : The Haematological Research Unit was opened in July 1961 with Dr. (Miss) S. Chaudhuri as its head. In the first few months efforts were made by the Unit to develop standardised techniques of collection of haematological data and of blood group study. A programme of research was worked out for a coordinated study of economic conditions, body build and haematological observations; and necessary forms for the collection of information were prepared in consultation with statisticians. A diagnostic laboratory was organized in the Medical Unit of the Institute, as it was expected to provide valuable material for research in the Haematological Unit.

The Unit has already carried out extensive work on blood groups and abnormal haemoglobins. A survey of blood groups included 349 Bengalees in Calcutta, 86 Anglo-Indians in Khargpur, 116 Totos in Jalpaiguri (West Bengal), 103 individuals belonging to 6 tribal groups in South India and 87 miscellaneous cases. In all these cases, frequencies of ABO, MN, Rh system and a few other rare blood groups were determined.

About 691 cases were investigated for abnormal haemoglobins. They include 385 samples from different castes in West Bengal, 101 of tribal people from South India, 116 of the Totos from Jalpaiguri, and 89 Anglo-Indians from Khargpur. The tribal groups in South India have a higher percentage of target cells than others. Among the South Indian tribal groups, the Todas have the lowest percentage of target cells. An interesting association between blood groups and frequency of target cells has been detected. The Unit is collecting data to study etiological factors and pathogenesis of target cell anaemia.

The Unit also led an expedition to Totopara to carry out combined anthropological, haematological (including study of blood groups and genetics), sociological and demographic surveys of the Totos, many of whom (51.73%) were found to be suffering from Yaws. The results of these surveys are summarized in three papers awaiting publication. A project on somatotyping and survey on growth and development of Bengali children has also been started.

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Geological Studies : An advisory committee for the Geological Studies Unit was formed in 1960 to advise the Institute on the geological research and the projects to be undertaken by the Unit. The Committee consists of Professor D. N. Wadia, F.R.S. (Geological Adviser, Department of Atomic Energy, Government of India, New Delhi), Dr. B. C. Roy (Director, Geological Survey of India, Calcutta), Professor N. N. Chatterjee (Head of the Department of Geology, Calcutta University) and Professor P. C. Mahalanobis, F.R.S., and Dr. C. R. Rao (Indian Statistical Institute). It met for the first time on 13 December 1960. Dr. Pamela L. Robinson who had earlier organized the Geological Unit at the Institute, and Dr. Alec Smith, University College, London, who was visiting the Institute, also attended this meeting on invitation. Since then the Committee is in constant touch with the progress of research in the Unit, and the external members of the Committee have given valuable help in formulating plans for expanding the activities of the Unit, laying special emphasis of the quantitative and interpretative aspects of Geology.

Through the efforts of the Director of the Institute, an arrangement has been made with the USSR Academy of Sciences for getting a number of geological samples analysed and dated in the laboratory of Academician Polkanov. The dating of some of the rocks found in the Godavari valley will be of great help in studying the geological problems of that area.

In view of the importance of the fossils discovered in the Godavari valley by the Geological Studies Unit, the organizing committee of the 22nd International Geological Congress to be held at New Delhi in December 1964, suggested that a geological excursion for the international delegates to the Godavari valley may be organised. The Institute has accepted this assignment and is making the necessary plans for arranging the excursion.

Dr. Pamela L. Robinson, University College, London, visited the Institute in April 1962 for a fortnight for discussions with the members of the Unit regarding the future work. On her recommendation and with the concurrence of the members of the Advisory Committee, two geologists were employed to conduct some new lines of work.

Biochemical Laboratory : A biochemical laboratory was set up with Dr. P. R. Pal as its head. During the course of one year, the laboratory was equipped for carrying out fundamental and applied research of economic importance. Several lines of investigation under progress include : (i) biosynthesis of amino acids by *E. Coli*, (ii) an enzymatic method of assay of pyridoxal phosphate, (iii) biosynthesis of a yellow fluorescent pigment produced by an unidentified strain of pseudomonas, (iv) free amino acid contents of green leaves and (v) microbiological assay of Vitamin B₁₂.

Anthropometric Project of Inter-racial Crosses : At the invitation of the Institute, Professor Buggles Gates, F.R.S., came to India for six months (September 1961-February 1962) to study the effect of inter-racial crosses on physical characteristics. He was assisted in this project by two Indian anthropologists, Dr. M. R. Chakravarty and Sri D. P. Mukherjee, of the Anthropological Survey of India, who were kindly made available by Professor N. K. Bose, Director, Anthropological Survey of India.

Professor Gates and party visited several parts of India and studied about 61 inter-racial pedigrees with a total of 284 individuals. The communities studied were Anglo-Indians of Calcutta, Khargpur and Madras, Franco-Indians of Chandernagur and Anglo-Khasis and Italo-Khasis of Shillong.

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An anthropological survey was also undertaken on a limited scale for studying the differences between tribes and castes in West Bengal and South India. The tribes and castes of West Bengal included Brahmias and Kayasthas, Vaikyas and other low castes in Calcutta, Lepchas, Bhutias, the Tibetan refugees at Darjeeling, the Totos of Jalpaiguri and the Khaals in Shillong. And those of South India included Todas, Kotos, Lambardis and the Chenchus of Hyderabad. The analysis of the data is under progress.

The "Crop Museum" started at the Institute in 1960 was expanded by planting 80 more species, making a total of 130 species, most of which are economically important in some way or the other. A beginning has been made to build up a Herbarium in the Biology laboratory and over 50 species or rare plants have been collected from in and around Darjeeling. The Herbarium has also a foundation stock of over 180 very rare specimens, mostly of medicinal plants and timber trees, which has been kindly donated by Sri S. C. Sen.

An electronic device useful in detecting certain harmful insects inside plants has been made and the palm climbing machine devised earlier is being improved.

Agricultural Chemistry : The chemistry department under the guidance of P. K. De is engaged in researches on : (i) Assimilation of elementary nitrogen by rice plants, (ii) fixation of nitrogen by algae at different depths of water-logged soils, and (iii) Chemistry of the decomposition of urea and ammonium sulphate in rice fields.

Indications have already been obtained that rice plants are able to assimilate elementary nitrogen at certain stages of growth. Experiments are now in progress to establish this fact beyond doubt.

Gerontology Project : The Gerontology Project was initiated by Dr. Alex Comfort, Nuffield Research Fellow in Gerontology, University College, London, who was invited to visit the Institute in the winter of 1961.

The aim of Gerontology is the study of ageing—the progressive fall in vigour which occurs in many organisms, leading ultimately to their death. This fall can be measured for the most part as the increase in the force of mortality, or the likelihood of dying, with increasing age. A study will be made, at first, of animal life spans with a view to secure information on the fundamental nature of age-changes. The aim of biological attack on the age-process is, in the long run, to slow down ageing as a whole.

Data Processing Unit : Data processing methods is a compulsory subject for study in the degree and training courses of the Institute. The training was being organised so far by the BTS in collaboration with NBS Operations ; but with the increase in the number of trainees and work-load of the NBS, a separate Data Processing Unit (DFU) was organised in the BTS from November 1961. The purpose of the DFU is to impart training and to organize research on large-scale data processing methods and also to undertake special tabulation or computation projects.

The DFU also handles projects on request from different sections of Institute. It has taken over the responsibility of processing data for the mechanised accounting system of the Institute.

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RESEARCH SEMINARS AND TECHNICAL PUBLICATIONS

Several research seminars were conducted by the members of the staff for the benefit of research scholars and staff members. The list of topics on which regular courses were held at an advanced level during the academic year is given in Appendix 5.1.7.

The Research and Training School also arranged from time to time lectures and seminars by eminent visiting scientists and experts. The School received considerable encouragement from two distinguished visitors—Sir Ronald A. Fisher and Academician A. N. Kolmogorov. Both of them gave a number of lectures on advanced topics to the students and staff and held numerous discussions with the research scholars. Sir Ronald Fisher who paid, during the year, his eighth visit to the Institute, had always taken till his death, a very great interest in the research work and the general scientific activities at the Institute. The School was fortunate in having as a visitor, during the year, Academician Kolmogorov who had never before visited any country outside Europe.

Six technical publications were issued during the year. A complete up-to-date list is given in Appendix 14.

Besides these publications, *Statistical and Mathematical Tables* for use by statisticians and research students has been edited, and is awaiting publication. This volume has some special features both in presentation and in coverage, and it is hoped that it will be of use in practical work.

DEGREE AND TRAINING COURSES

Training Courses : The Institute offers at present about fourteen courses of study and training, at different levels, in Calcutta, Bombay, Madras and Delhi, in cooperation with the Central Statistical Organization and the Institute of Agricultural Research Statistics. Some of these are degree courses, while others are courses designed to produce trained statisticians. The School also organizes the training of statistical computers at different levels. Up to 1961-62 organized training was given to nearly 4,100 persons including about 400 foreign trainees in theoretical and applied statistics and in addition, apprenticeship training was given to about 2,750 persons through participation in project work.

New Degree Courses : The Indian Statistical Institute Act passed by the Parliament in December 1959 empowered the Institute to confer degrees in statistics. The Institute has been conducting since 1 July 1960, courses of study for examinations leading to the degrees of Bachelor of Statistics (B.Stat.) and Master of Statistics (M.Stat.). The two higher degrees of Ph.D. and D.Sc. have also been introduced. With effect from the same session, the two-year advanced professional statistician's course has been discontinued. Almost all the other training courses and examinations that were being conducted up to 1960 are continuing with modifications in the syllabus, wherever necessary.

From its inception, the Institute realized the need for courses of training at different levels for turning out professional statisticians in a much larger number than theoretical statisticians who are competent to do only teaching or research work. It also realized, in organising the various courses conducted at the Institute, that a purely academic type of education imparted through lectures on theory and laboratory work was not sufficient for the making of competent professional statisticians, and that field-work on small and large-scale statistical investigations and actual in-service experience should form an essential

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part of their training. In other words, education and training in statistics should be similar to those in medicine or engineering. It was in accordance with these ideas that several professional courses in statistics were organized a few years ago.

Statistical methods as they are known today are a powerful tool in other branches of knowledge and in various fields of human activity, particularly in the natural and social sciences, including economics. For the correct and efficient use of statistical methods, it is therefore necessary that professional statisticians should be equipped with basic knowledge at least in the more important fields in which they are called upon to work. To impart this basic knowledge, exclusive specialisation in a few fields will not only fail to achieve necessary comprehensiveness, but also may not be feasible in a course which is primarily one in statistics. It has, therefore, been held that an integrated approach in this respect should be optimal. Incorporation of the professional elements in teaching, and an integrated education in the fields of application of statistics, are two important features of the new B.Stat. and M.Stat. degree courses.

With effect from 1 July 1960, the activities of the Institute relating to the courses of study and training and research facilities, and conducting of all-India examinations fall under the following categories. The intake capacity of each of the courses is given in brackets.

1. *Research Guidance*
 - Research leading to the Ph.D. degree of the Institute (15)
2. *Degree Courses*
 - 2.1 Four-Year Course leading to the B.Stat. degree of the Institute (class of 30 yearly)
 - 2.2 Two-Year Course leading to the M.Stat. degree of the Institute (class of 25 yearly)
3. *Training Courses* (for specialized studies, training of personnel, and for candidates preparing for Diploma and Certificate examinations)
 - 3.1 Research and Advanced Studies, general (8)
 - 3.2 Summer Course (Advanced) for Statisticians (30)
 - 3.3 One-Year Apprentice Course (15)
 - 3.4 Statistical Officer's Course (Jointly with CSO*, 8/9 months) (25)
 - 3.5 Special Short-duration individual training for officers on deputation (10)
 - 3.6 Occasional Courses on special subjects (short duration) —
 - 3.7 Evening Courses in Statistics
 - 3.7.1 One-Year Evening Course in Statistics at Delhi (in collaboration with CSO) (40)
 - 3.7.2 Advanced Course in Statistics at Delhi (in collaboration with CSO) (20)
 - 3.7.3 One-Year Evening Courses in Statistics at Bombay and Madras (30 at each centre)
 - 3.7.4 Three-month Course on Punched Card System (25)
 - 3.7.5 Computer's Training Courses at Calcutta (Junior and Senior) (75)
4. *Courses at the International Statistical Education Centres (9 months)* (30)
5. *Diploma and Certificate Examinations* (all-India examinations, open to external candidates)
 - 5.1 Statistical Field Survey, Junior Certificate

*Central Statistical Organisation, Government of India, New Delhi.

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- 5.2 Statistical Field Survey, Senior Certificate
- 5.3 Statistical Field Survey Diploma
- 5.4 Computer's Certificate
- 5.5 Statistician's Diploma
- 5.6 Associateship of the Indian Statistical Institute (A.I.S.I.) on the basis of report submitted, of professional work.
- 5.7 Associate Fellowship of the Indian Statistical Institute (A.F.I.S.I.) on the basis of report/thesis submitted, of professional work.
6. *Award for Outstanding Contributions*
- 6.1 D.Sc. degree of the Institute in recognition of outstanding published work in the field of Statistics.
- 6.2 Fellowship of the Indian Statistical Institute for fundamental contributions in the field of Statistics.

B.Stat. and M.Stat. Degree Courses : This was the second year since the two degree courses were started, after the enactment of the ISI Act (No. 57 of 1950) empowering the Institute to award degrees.

Admission of Students : The selection tests for admission of students were held in July 1961 at eight centres : Banaras, Bombay, Calcutta, Delhi, Hyderabad, Madras, Travandrum and Waltair. The selection of candidates to the courses was made by a Committee consisting of the representatives of the Indian Statistical Institute (ISI), invitees from the Central Statistical Organization (CSO) and the representative of the Institute of Agricultural Research Statistics (IARS). Those admitted to the M.Stat. course included candidates who would proceed, on satisfactory completion of the First Year M.Stat. course in the ISI, to the Professional Statistician's Certificate Course in agricultural research statistics at the IARS, New Delhi.

The number of candidates who sat for the tests and who attended the courses during the year are given in Appendix 10.16. The lists of students who attended the different degree courses together with their academic qualifications, are given in Appendices 10.1-10.4.

Statistical Officers' Course (Jointly with CSO) : The session was attended by twenty-two trainees, of whom ten came for a six month's general course on statistical theory and applications; twelve stayed for another three months to undergo training in machine tabulation or for special training in some branch of statistics or other. This course was started in 1955 to provide opportunities for the statisticians working in statistical departments of State and Central Governments to have refresher courses in current developments in statistical techniques. The list of officers who received their training in 1961-62 is given in Appendix 10.8.

Officers on Deputation : There were two officers on deputation during the year. Their names, subject of study and period of study are given in Appendix 10.2.

Evening Courses in Statistics : Besides the degree courses, thirteen different training courses were conducted by the Research and Training School in 1961-62, including the training given in the International Statistical Education Centre (ISEC) about which details are given in the next section. Most of these courses are conducted in the evening for the benefit of those already in employment and who wish to improve their qualifications in Statistics. Special selection tests were held for admissions to the

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evening courses in Bombay, Calcutta and Madras, while for the course in Delhi admissions were decided in consultation with the CSO, giving suitable representation to the various government departments.

Six Months' Advanced Course at Delhi : In addition to the regular one-year evening course, a special course was conducted at Delhi in collaboration with the CSO for the benefit of those who desire to have specialised training in statistical methods and applications. Twenty trainees attended.

Three Months' Evening Course on Punched Card Systems at Calcutta : This is a new course organized by the Data Processing Unit of the Research and Training School for imparting training in efficient programming and the operation of tabulating and computing machines. The first batch of 20 (Appendix 10.12) was admitted to this Course in March 1962.

Summer Course (Advanced) for Statisticians : This course was held during May-June 1961 in response to the desire expressed, from time to time, by a number of research workers and teachers in the statistical departments of universities and other educational or scientific institutions, to spend their summer vacation at the Indian Statistical Institute for advanced study and consultation. The Institute has been providing facilities for such participation for a long time to individual applications deputed from the universities, research institutions and government departments, who, however, are required to study on their own with some guidance from the staff of the Institute.

It is felt that an organized short course at an advanced level might serve a larger number of workers engaged in research, teaching and professional work. The participants of the course will have an opportunity to attend lectures given by the staff of the Institute, as also by a number of invited specialists, on various aspects of the theory and application of modern statistics. There will be a limited number of lectures on each subject covering only the salient points and current trends of research, together with the importance of the subject in relation to other subjects. Besides regular lectures, it is hoped that a number of seminars and group discussions on teaching and research in theoretical and applied statistics, will also be held.

The course which was held during the current academic year for a period of five weeks during May-June 1961 was attended by 30 participants from different universities and research institutions. The teaching at the Summer School was undertaken mainly by the staff of the Research and Training School. Professor S. S. Shrikhande, Banaras Hindu University, and Professor N. U. Prabhu, Karnatak University, also participated in teaching, on special invitation.

The details about the lectures delivered together with a list of participants are given in Appendix 10.13.

2. INTERNATIONAL STATISTICAL EDUCATION CENTRE, CALCUTTA

The International Statistical Education Centre (ISEC), was established in 1950 under the joint auspices of UNESCO and the International Statistical Institute in collaboration with the Indian Statistical Institute. It is being maintained with the support of the Government of India. The Centre has conducted fifteen terms up to April 1962 and has trained 404 candidates representing twentytwo Asian countries. Candidates trained in the ISEC have been statisticians in government departments, officials in other fields interested in statistics, or teachers of statistics.

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In the earlier terms the Centre used to conduct regular courses of six months, but the last eight terms have been each of nine months' duration. In view of a certain amount of difference in requirements by the candidates who came from different countries of Asia, it was decided in 1956 to provide training at least for three different categories: (i) teachers in statistics, (ii) persons engaged in statistical work, and (iii) persons working in other fields in which a knowledge of statistics is necessary. The present training caters to all the three groups, although the majority of the candidates belong to the second category.

In recent years there has been a demand for specialized training at the Centre on an individual basis. Provision has been made for such training for which some candidates have offered themselves.

Since 1959 the Centre has arrangements for accepting a limited number of senior student participants and visiting senior statisticians for specialization. Senior statisticians may also participate in the research and teaching work at the Institute.

With regard to the type of instruction provided, particularly for the regular nine months' course at the Centre, the training in governmental statistics had been extended to a period of six to eight weeks with effect from the Fourteenth Term.

The Centre conducts periodical examinations and a final examination for each candidate. Two categories of certificates are being awarded: (i) certificate of merit and (ii) certificate of attendance, depending upon the performance of the candidate at the examinations.

There are arrangements at present for training in each year about thirty students for the regular course and about six candidates for the different specialization courses including the senior course.

Participants : The Fifteenth Term, in which twentyfour participants from seven countries had attended, commenced on 1 August 1961. In all the fifteen terms together, training was imparted to 404 participants from the following twentytwo Asian countries: Afghanistan (2), Burma (34), Cambodia (2), Ceylon (16), India (113), Indonesia (27), Iran (11), Iraq (1), Japan (19), Laos (1), Malaysia (4), Nepal (7), New Zealand (1), Pakistan (64), Philippines (59), Sarawak (1), Singapore (4), South Africa (1), Syria (1), Thailand (28), United Arab Republic (2), and Viet Nam (8).

Joint Board of Directors : The Centre was being supervised by a Board of Directors composed as follows : *Chairman* : P. C. Mahalanobis; *Members* : M. Boldrini, G. M. Cox, E. Lunenberg (ex-officio members representing the International Statistical Institute), V. Sahay (Cabinet Secretary, representing the Government of India), S. Basu, C. R. Rao, and A. Matthai, Member-Secretary (representing the Indian Statistical Institute).

THE FIFTEENTH TERM

The announcement of the Fifteenth Term was issued early in 1961 from the Permanent Office of the International Statistical Institute at The Hague and the different countries in the region were invited to nominate candidates for training at the Centre.

Fellowships : The Government of India made available twenty fellowships for the term under the Technical Cooperation Scheme of the Colombo Plan. Three other fellowships of approximately the same value as the Colombo Plan fellowships were awarded to

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candidates from Iran with the help of funds provided by the Government of India for scholarships outside the Colombo Plan; while two other students from Japan received scholarships from the Indian Statistical Institute.

Selection of Trainees : Twenty-six applications from seven countries were received for admission to the Fifteenth Term. The candidates were selected by respective national selection committees and were approved by the Board of Directors for admission. All the twenty-four candidates who were selected, twenty-two for the regular course and two for special courses, joined. Twenty were statistical officials and four were teachers. The number of applications received, number of candidates selected, etc., from the different countries, are given in the Table below. The names, designations, fields of interest and the period of training are given in the list of trainees appearing in Appendix 10.14.

NUMBER OF APPLICANTS, NUMBER OF CANDIDATES SELECTED, AND
TRAINED AND NUMBER OF FELLOWSHIPS AWARDED (1961-62)

country	number of candidates		
	applicants	selected and trained	fellow- ships awarded
<i>Regular Course</i>			
1. Burma	2	2	2
2. Ceylon	1	1	1
3. India	7	5	—
4. Iran	3	3	3
5. Philippines	8	8	8
6. Thailand	3	3	3
<i>Special Course</i>			
7. Japan	2	2	2
	26	24	19

Instruction : The Fifteenth Term formally opened on 1 August 1961. It took about a week for all the students to arrive, and the training commenced on 7 August 1961. The training consisted of lectures, laboratory work, project training, assisted reading and field work. The first two months were mainly devoted to training at Calcutta in general statistical methods, including auxiliary mathematics, computational techniques, economic statistics, economic and statistical organization and procedures. As in the Fourteenth Term, a six-weeks' training in governmental statistics was also arranged at the Central Statistical Organization, New Delhi, during October-November 1961. Later, a one week's practical training programme was carried out at the experimental station of the Indian Statistical Institute at Giridih (Bihar). Further training in sampling theory and practice, advanced statistical techniques and different aspects of the National Sample Survey was given at Calcutta from December 1961 up to the middle of February 1962. From the end of February to the first week of April 1962, specialization courses on an individual basis were given in the following fields : agricultural surveys, vital and health statistics, educational and psychological statistics, national income estimation, planning statistics and

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mathematical statistics. While the specialisation courses were in progress, a few general lectures were also given on survey techniques, analysis of variance, elements of the theory of design of experiments and economic planning. Apart from the general lectures given, the students were further assigned project work for which reports were to be submitted before the final examination.

Examinations and Certificates: In all eleven periodical examinations were held on various topics. The final examination consisted of two parts: the subjects for the first examination were statistical measures and statistical principles and those for the second were economic statistics and economic planning, elements of sampling theory, design of experiments and sample surveys. The grants of Certificates of Merit to twentythree candidates and Certificate of Attendance to one candidate was recommended on the basis of the results of the examinations. These certificates were awarded at a function on 12 April 1962.

Educational Tours: The students were taken on educational tours to places of interest like Agra, Delhi, Dehra Dun, Mussoorie and Giridih. They also visited places of interest in and around Calcutta.

Teachers: A considerable part of the teaching at the Centre was undertaken by the staff of the Research and Training School and the Project Divisions of the Indian Statistical Institute. A number of government statisticians took part in the training at the Central Statistical Organisation, New Delhi, during October-November 1961.

Visiting Teachers: The United Nations arranged for Dr. A. G. Aulsebrook (Senior Statistician and Senior Operations Analyst, Stanford Research Institute, California) to work as Director of Studies at the Centre for the period July 1961-April 1962. Among other visiting teachers were: Dr. C. I. Bliss (USA), and Dr. Q. M. Hussain (Pakistan). The students of the Centre also benefited from the lectures and seminars by other distinguished scientists and statisticians like Professor R. C. Bose (USA), Professor S. Chandrasekhar (USA), and Sir Ronald A. Fisher (UK).

8. STATISTICAL EXAMINATIONS

An Examinations Committee, constituted by the Council of the Institute from among statisticians, economists and other specialists selected from all over the country, has been conducting external examinations known as Professional Examinations, since 1938. The diploma and certificates issued to successful candidates indicate professional competence at varying levels and are recognised as acceptable qualifications for employment by the Government as well as by non-Government institutions and commercial organisations. The external examinations are open to all who possess the requisite academic qualifications or professional experience prescribed for each examination. The examination centres are located in different places in India. The examinations which are ordinarily held twice during each year, in March and September, are widely advertised. The results are communicated to all candidates after the approval of the Council. The results are also published in the Gazette of India, Part IV. Up to March 1962, 3,791 candidates had passed in one part or another of these examinations, that is 30.7 per cent of 12,350 who had appeared out of 14,796 who had registered.

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The Institute has been instrumental in making available about 10,500 trained persons, of whom about 4,100 (including about 400 trainees from outside India) received organised courses of instruction, 2,750 received apprenticeship training, and nearly 3,650 became qualified through external examinations conducted by the Institute.

Statistician's Diploma: The Statistician's Diploma Examination was held in March and September 1961 at Bangalore, Bombay, Calcutta and New Delhi. It was also held in March 1961 at Poona and in September 1961 at Madras. In the examination held in March, 130 candidates registered, 117 appeared and 60 passed in one or more papers. In the examination held in September, 144 candidates registered, 121 appeared and 53 passed in one or more papers.

During the year 1961-62, the Statistician's Diploma was awarded to five candidates who passed completely in all the papers prescribed for the examination in March 1961 or earlier. Fourteen candidates also completely passed the Statistician's Diploma examination in September 1961. The total number of candidates who have completed the Statistician's Diploma examination upto the end of March 1962 are seventy-nine. The names with addresses and the months and years of passing are given in Appendix 11.2 and of those who were awarded the Associateship of the Indian Statistical Institute (A.I.S.I.) in Appendix 11.1.

Computer's Certificate: The Computer's Certificate examination—Part I was held in March and September 1961 at Bangalore, Bombay, Calcutta and New Delhi, and at Giridih only in September 1961. In the examination held in March, 67 candidates registered, 60 appeared and 17 passed in one or more papers. In the examination held in September, 73 candidates registered, 70 appeared and 36 passed in one or more papers. In March, one candidate registered and appeared for Part 2A (Sections I & II) but failed in both sections; while in September one candidate registered and appeared in Part 2A, Sections I & II and passed in Section I only.

Statistical Field Survey Certificate: This examination was not held during the year, as the Examinations Committee felt that it should be held only after the revision of the syllabus.

The names of successful candidates in the examinations held in March and September 1961, and also a summary of the results in each paper for all the examinations held from 1961-52 to 1961-62 are given in Appendix 11.4.

Bye-laws and Syllabi: The Bye-laws and Syllabi relating to the award of Professional Diplomas and Certificates in Statistics was finalised during the year. It was decided that the future examinations will be held in accordance with the revised Bye-laws and Syllabi.

4. PLANNING DIVISION

A small Central Statistical Unit was established in New Delhi in 1949. It was staffed by the Institute workers. This Unit looked after the statistical work of the Government of India for two years until the establishment of the Central Statistical Organisation. A small Institute office continued to be maintained in New Delhi for active collaboration in the statistical work of the Government. In 1953-54 an Operational Research Unit was established to undertake technical work on planning on a small scale.

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In September 1954, the Institute was asked by the Planning Commission to study, jointly with the Central Statistical Organisation and the Finance Ministry, the possibility of preparing the Second Five Year Plan in such a way as to ensure a continuing increase in national income and improvement in the level of living and also a solution of the problem of unemployment, if possible, within ten years.

On 3 November 1954, Prime Minister Jawaharlal Nehru inaugurated a section in the Indian Statistical Institute for studies relating to planning for national development. These studies led to the formulation of the "Draft Plan Frame" of March 1955 which was accepted as the basis for the preparation of the Second Five Year Plan.

In September 1955 it was decided that the technical work on planning in the Institute should be strengthened and greater attention paid to perspective planning. Since then work on planning is being done by the Institute in Delhi and Calcutta.

WORK IN DELHI

During 1961-62, the Planning Unit of the Indian Statistical Institute at New Delhi continued to carry on research work on economic planning under the general guidance of Sri Pitambar Pant, Honorary Joint Secretary, Indian Statistical Institute and Chief of the Perspective Planning Division, Planning Commission. The Unit worked in close collaboration with the Perspective Planning Division in its research activities and most of the studies were conducted jointly.

As in previous years, Indian and foreign economists and specialists in planning were associated with the research activities of the Unit. Six eminent geographers from the Soviet Union accepted the invitation of the Institute to work in the Unit on problems of regional survey and planning. Dr. A. T. A. Leermouth, Department of Geography, University of Liverpool, came for a short visit during which he held discussions with the workers of the Regional Survey Unit. Messrs. A. Harberger, R. S. Eckaus, Per Sevaldson, N. Andreatta, visiting professors at the Centre for International Studies, M.I.T., India Project, New Delhi, collaborated in studies relating to price policy, inter-industrial relations and the economics of education. Dr. Chao Kuo-chun, a visiting scholar from the Harvard University, completed a study on "Rural Manpower Utilization in India" during an assignment of one year at the Institute. Dr. A. K. Sen worked for some time on the concept of working capital.

Lectures and seminars are organized in the Unit from time to time. Members of the research staff took part during the year under report in various discussions with the Planning Commission, attended conferences and seminars organized by other organizations and delivered lectures both in India and abroad by invitation. The Unit also arranged for the practical training in economic planning of seven trainees of the Statistical Officers' Training Course, sponsored by the Central Statistical Organisation, for a period of six weeks.

The research work that is being carried on in the Unit comprises several types of studies. These may be grouped as follows : 1. Regional surveys and planning; 2. Growth Models for the Long-range Development of the Economy; 3. Studies on the Changing Structure of the National Economy; 4. Consumption Patterns; 5. Cost Benefit studies; 6. Studies on Price Policy; 7. Foreign Trade Problems from a Long-range point of view; 8. Problem of Effective Utilization of Manpower; 9. Education in Relation to Economic Development; 10. Techno-economic Coefficients; 11. Planning Experience of other countries; and 12. Other Studies. A list of reports and papers prepared by the Unit is given in Appendix 5.

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WORK IN CALCUTTA

The work in Calcutta included research, teaching, seminars and discussions and other studies.

Research: The main fields of research covered at Calcutta were inter-industry studies, studies relating to national income and allied subjects, studies on consumer behaviour, econometric studies and miscellaneous studies on planning. The lists of reports and papers prepared by the Unit are given in Appendix 5.2

As inter-industry studies have a direct bearing on planning, it was felt that the inter-industry study group of the Calcutta Unit might be more conveniently situated at Delhi. The group was transferred to the Delhi Unit in October 1961. A detailed report was prepared on the 1953-54 input-output table, and submitted to the Inter-Industry Committee set up by the Planning Commission.

The national income group continued its studies on the basis of original NSS records to ascertain the levels of output and employment in household enterprises. The studies on household trade and household transport of rural areas were completed; a study on household small-scale industries, professions and services, is under way. Also in progress are (i) a study of the growth of population and agricultural production in India in the second half of the nineteenth century, (ii) one on district-wide growth of population in the present century, and (iii) one on the relative prices of steel and foodgrains during historical periods in a few countries.

Eight workers of the Division attended the Third Indian Conference on Research in National Income held at Bombay during 1-5 November 1961. Seven of them presented papers at the Conference.

The studies on consumer expenditure related to the size distributions of consumer expenditure based on NSS data were embodied in a paper prepared for the Committee on the Distribution of Income and Wealth. Work was undertaken on the preparation of the cost of living indices by fractile groups and also by categories of commodities divided into groups—bare essentials, other essentials and non-essentials. This work was also mainly based on NSS data. Another study based on NSS data relates to the consumption of nutrients in various Indian diets.

Econometric studies related to the estimation of marginal propensities to consume; a complete econometric model for India; quality preference in relation to changes in the level of living; the effect of differentials in consumer price index on the Lorenz measure of inequality; and proximate relation between the distribution of income per capita and income per income-earner etc.

Eight papers were presented by Institute workers at the Econometric Conference held at Waltair in June 1961.

Other studies included the following: the economic bearing of the use of different techniques in the production of the same commodity; a field inquiry into the income of domestic servants in Calcutta city; another field inquiry concerning the manufacture of agricultural implements by artisans and blacksmiths; distribution of income as derived from a study of income-tax data, and factor share of labour in manufacturing industries. A comparative study of inventories in the United States and India was made in another paper.

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Cottage Industries : Certain studies on cottage industries were taken up in February 1956. A working centre, *Kalganore*, was started by the Institute for the purpose and it has been running more or less on a self-supporting basis; the workers engaged are being paid on a piece-rate basis out of the sale proceeds of articles manufactured in the Centre. Technical reports on the Centre are prepared from time to time.

Family Planning : Several investigations which were carried out by a small group of workers on family planning included the following :

(i) an exploratory programme to find out the efficiency of various agencies in transmitting family planning information and to discover the motives underlying both the acceptance and rejection of family planning, (ii) an attitude survey to determine primarily the factors affecting family size, and how many persons, if not already practising birth control are willing to postpone pregnancy by learning a method, and (iii) a study of the rhythm method in exploring the patterns of the sexual impulse in the human female.

The design and preparations for the action research programme is to be conducted shortly in Baranagar and Jodhpur.

Teaching : The Division organised, as in previous years, several courses in economics and econometrics under the auspices of the Research and Training School. Lectures and practical classes were also arranged for the International Statistical Education Centre and the Statistical Officer's Training Course, in accordance with the normal practice. A. Biswas, who had supervised these courses, was given lien to work with the Economic Commission of Asia and the Far East from August 1961; Dr. H. Mazumdar has accepted this responsibility since then.

Seminars : Several lectures and seminars were held at the Calcutta Unit. R. S. G. Butherford, Solomon Fabricant, Chao Kuo-shun, Allen Barry, S. C. Raman, V. B. Singh and Alexander Nove were among the visiting scholars who participated in the seminar work.

Publication : *Talks on Planning* by P. C. Mahalanobis was published during the year. The printing of another volume by P. C. Mahalanobis, *An Approach of Operational Research to Planning in India*, is also nearing completion.

A working paper of the Division by M. J. Solomon was in the final stage of printing under the title "Better Plant Utilization : A Blue Print for Action". The publication, *Statistics and Planning in Socialist Countries* by several foreign experts, was delayed; it is expected to be published during 1962-63.

Twenty-seven additions were made during the year to the series of mimeographed working papers prepared by the Division.

5. NATIONAL SAMPLE SURVEY

The absence of reliable statistics relating to production, consumption and other aspects of economic and social life in India has been known for a long time. Since 1947 the development of statistics has, therefore, been a continuing concern of the Government of India. In 1948, at the instance of Prime Minister Sri Jawaharlal Nehru, a review was made of the organization of statistics in the Central Ministries and a Standing Committee of Departmental Statisticians was established for the co-ordination of statistical work. A few months after the establishment of the Central Statistical Unit in January 1949, the National Income Committee was appointed with Professor P. C. Mahalanobis as Chairman and Professors D. R. Gadgil and V. K. R. V. Rao as members, to report on the national

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income and related estimates, to suggest measures for improving the quality of the available data and for the collection of further data and to recommend ways and means of promoting research in the field of national income.

The Standing Committee of Departmental Statisticians as well as the National Income Committee found large gaps in the available statistical information, and by the end of 1949 it became clear that there was an urgent need of improving the quantity as well as the quality of statistical information. On 18 December 1949, the Prime Minister desired that a sample survey should be organized covering the whole country to collect essential information. An abstract scheme for organising a National Sample Survey (NSS) was immediately prepared by Professor Mahalanobis and was handed over on 25 December 1949 to Sri C. D. Deshmukh on whose advice it was approved in principle by the Government of India in January 1950. A little later, on 10 March 1950, the National Income Committee recommended the use of sampling methods to fill the gaps in information required for national income estimation.

The National Sample Survey (NSS) was started in 1950 with the object of obtaining comprehensive and continuing information relating to socio-economic and demographic conditions on a countrywide basis. Since then it has been carrying out a continuous survey programme through which a wide variety of essential statistical information is collected to provide national and regional estimates of demographic characteristics, consumption patterns, employment features, and agricultural production, etc.

The NSS collects information simultaneously on a number of topics in a specified survey period of about a year at present, called a round. Different subjects are covered in different rounds, some subjects however are repeated over a number of rounds.

Information is collected by the NSS to meet the needs of various users including the Ministries of Government of India, the Planning Commission and the States. Owing to limited resources, it is not possible to meet the demands of all the users at the same time. Therefore in deciding on the subjects of enquiry and the items of information to be collected in a particular round and also in formulating the programme of tabulation and in drawing up the time-schedule for the completion of work, it is necessary to keep in view the available resources. The Central Statistical Organization (Government of India) co-ordinates the different aspects of the NSS enquiries including the drawing up of the survey design and tabulation programme, the fixation of priorities for tabulation work and other related matters. A Programme Committee consisting of the representatives of the various Central Ministries and other interested parties advises the Central Statistical Organization on various aspects of the survey.

The National Sample Survey is carried out in the following three stages, each of which is in charge of a branch of the NSS organisation: 1. Planning of the survey, 2. Field work, and 3. Processing and analysis of the data collected and the preparation of statistical reports. Since the very inception of the NSS, the branches for planning the survey and for processing and analysis of the data have been located in the Institute. The field work is mainly the charge of the Directorate of National Sample Survey, which is under the control of the Cabinet Secretary, Government of India. The field work in West Bengal and Bombay city is, however, the responsibility of the Institute.

Participation by States: The NSS was started solely as a central agency for the collection of statistics. But it was soon realised that it was necessary that the States also

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should participate in the NSS work. The States collect statistics for their own use. It was considered only natural that the same or similar data collected by both the Central and State agencies should be based on uniform concepts and definitions. The data collected by the Central and State agencies on the same concepts and definitions and according to the same survey plan could also be pooled together to obtain estimates for the different regions with increased precision. Moreover, if the States collect data according to the NSS programme, they would have to process their own data. This would mean the building up or strengthening of the tabulation units of the States, which participate in the NSS work. According to the present arrangement, both the Central and State agencies cover different interpenetrating network of samples according to the same survey plan. State agencies also process their own data, but the work relating to the planning of the survey including the drawing up of the sample design and the preparation of the schedules of enquiry is done at the Institute. The participation by the States in the NSS work started from the ninth round with the coming in of Bombay and Uttar Pradesh; Kerala joined in the tenth round, Bihar in the eleventh, Andhra Pradesh, Assam, Orissa and Punjab in the fourteenth, Madhya Pradesh in the fifteenth, and Rajasthan in the sixteenth round. From the seventeenth round, the Union territories of Manipur and Tripura started participating in the NSS. All the States of the Indian Union except three are participating in the NSS at present.

Use of Interpenetrating Network of Samples : A unique feature of the statistical operation in the NSS is the use of an interpenetrating network of sub-samples (IPNS). This technique, in its general form, consists in drawing a number of parallel samples, each of which is spread over the entire region under consideration. These samples which have the same sample size, are drawn under an identical process of selection from the same universe. Different sets of samples are generally surveyed and/or processed independently by different operational units. Each sample is thus capable of providing an equally valid estimate of the population characteristics under study. This technique helps in providing a broad check on the survey results and an idea of the total error involved in the survey estimates.

The normal practice in the NSS is to arrange interpenetration in field work by allotting different sets of samples to different parties of investigators. Until recently the data obtained from the different sub-samples of the central sample were largely processed by one operating unit. For the last two years, interpenetration has been extended to the processing work as well. Data collected in the recent rounds are being processed by three independent processing units of the Institute, located at Baranagar (Calcutta), New Delhi and Giridih.

Machine Tabulation : NSS data are processed with the help of machine equipment installed in the three operating units at Baranagar, New Delhi and Giridih. On 31 March 1962, there were thirty-one sorters, eighteen tabulators, four calculating punch, five collators and twenty-three reproducers and gang summary punches. In addition, one sorter was being used by the Bombay Branch. A feature deserving special mention was the creation in this period of a machine pool in the Research and Training School with the following machines, in addition to those mentioned above : 3 tabulators, 4 sorters, 1 collator, 1 electronic calculating punch, 2 reproducers and 1 electronic statistical machines.

Recent Rounds : Fifteen rounds of the NSS had been completed by June 1960. During the period under report the sixteenth round (July 1960-August 1961) was completed and the seventeenth round was started in September 1961. Immediately before the start of a round, a training conference is held at the Institute where the concepts and definitions

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adopted in the survey and methods of filling the schedules of enquiry are explained by the Institute's (NSS) technical staff to the supervisory field staff who in turn explain these to the inspecting and primary enumerating staff at the regional training conferences. Such a training conference was held in August 1961.

Reports and technical papers are also published for the information of the public. Ninetyeight reports have been prepared, out of which fiftyeight have been printed and the remaining reports are in the press.

During the latter part of the sixteenth round, the NSS carried out the post-census surveys relating to the 1961 Population Census and the 1961 Livestock Census.

After the seventeenth round had been in progress for five months, the Chief Director, NSS Field Branch, organized refresher training for the field staff in a number of centres. Some technicians from the Institute participated in these regional training conferences. During the year, the Programme Committee held a meeting in November 1961 under the chairmanship of the Director of the Central Statistical Organisation to settle the item coverage for the eighteenth round (NSS) as well as to decide on the tabulation plans and priorities.

Subjects covered in Different Rounds: The subjects covered in different rounds may be grouped into two categories—continuing and *ad hoc*. Information about consumer expenditure and conditions of household living is being collected from the first round. Other subjects of a broadly continuing nature are employment and unemployment; population, births and deaths; land utilization and crop production; retail prices, household enterprises, etc. Among the important *ad hoc* surveys conducted in the earlier rounds mention may be made of newspaper reading (sixth round), distribution of land holdings (eighth and sixteenth rounds), household indebtedness (eighth and sixteenth rounds), farming practices (eighth round), employment and unemployment and indebtedness of agricultural labour households (eleventh and twelfth rounds), production of milk and production and utilization of cowdung (twelfth round), middle class and working class family living surveys (fourteenth round), livestock products (fifteenth round), capital formation (fifteenth round), disposal of cereals (fifteenth round), and family planning (sixteenth round). Type studies and pilot enquiries were also undertaken from time to time.

Manufacturing Industries: The NSS has been carrying out since 1952 (reference year 1951) a survey of manufacturing industries in continuation of the survey which was started in 1951 by the Directorate of Industrial Statistics, Government of India. The Sample Survey of Manufacturing Industries (SSMI) brought within its purview establishments using power and employing 10 or more workers, and establishments not using power and employing 20 or more workers. From the fourth round (reference year 1954), the scope of the survey was extended to include industrial undertakings covered by the Industries (Development and Regulation) Act 1951. In this round an exploratory survey of thirty-six out of fifty five industrial undertakings registered/licensed under the above Act was undertaken side by side with the SSMI. In the fifth round (reference year 1955) all the industrial undertakings excepting coal mines were covered on the basis of complete enumeration. Coal mining undertakings are being included in the complete enumeration of undertakings since the sixth (reference year 1956) round. The work of the eighth round (reference year 1958) was practically completed in July 1960. The size of the sample factories (registered under the Indian Factories Act 1948) was 6090, and 7222 undertakings were covered.

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Till 1956 the Census of Manufacturing Industries (CMI) was being carried out under the Industrial Statistics Act 1942. In respect of establishments using power and employing twenty or more workers, twenty-nine industry types, out of a total of sixty-three, were covered by the Census. The State Statistical Bureaus were responsible for the collection of data. As the integration of CMI and SSMI was considered desirable, these two enquiries were merged together, and the Annual Survey of Industries (ASI) was started (reference year 1959) in August 1960. During the year, the work of the ASI-1959 was completed and the work of the ASI-1960 was taken up. The salient features of the survey are: 1. Collection of data on a statutory basis under the Collection of Statistics Act 1953, 2. Complete enumeration of all large establishments having 50 or more employees on an average and using power, and 100 or more employees on an average and not using power, 3. Coverage of all the remaining smaller establishments by a probability sample, 4. A common questionnaire for both the bigger and the smaller establishments on vital items with additional details for bigger establishments. 8,979 factories are being covered in the Census and 8,047 factories in the sample. Important items covered are input, output, labour employed, wages, capital inventory and transactions, etc.

Crop-cutting Experiments : A working group was set up by the Central Statistical Organization in October 1960 to examine the discrepancies between the "official" and NSS estimates of production of crops. One of the possible reasons for the discrepancies could be the different sizes and shapes of cuts used to determine the yield rates of crops. The NSS estimates are uniformly based on circular cuts of a radius of 4 ft. (with an area of about 50 sq.ft.; provision is also made to record separately yield rates of concentric circles of radius 2 ft. 3 in. and from the annular ring, to serve as checks). The "official" estimates are, on the other hand, generally based on rectangular cuts of 33 ft. by 16½ ft. (with an area of about 544 sq.ft.). The working group recommended that studies should be undertaken to compare the yield rates obtained by the two agencies, and that necessary experiments should be conducted under the joint supervision of the different agencies concerned.

As the first in such a series of joint studies, crop-cutting experiments were carried out on *jowar* grown in mixture in two adjoining villages of Bundi district in the State of Rajasthan in November 1960. This study was conducted under the joint supervision of the Directorate of National Sample Survey, Government of India, the Department of Agriculture, Government of Rajasthan and the Indian Statistical Institute. A preliminary report on this study was prepared in January 1961 and subsequently revised in September 1961, in the light of the comments received from the participating agencies (N 11).

In the second of the series, crop-cutting experiments on *rabi* wheat were carried out in Barh in the State of Bihar in March-April 1961 (with complete harvesting of a number of sample fields) under the supervision of the Directorate of National Sample Survey, Government of India; State Statistical Bureau, Government of Bihar and the Indian Statistical Institute. The preliminary results were submitted to the Government in September 1961 (N 12).

The results of these two studies indicate that under adequate supervision, the yield rates from the two types of cuts were not significantly different.

Special Enquiries and Type Studies : Crop Survey in West Bengal : As in previous years, experimental surveys to develop survey techniques were conducted during *jute-aw*, *aman* and *rabi* seasons of the year 1961 in West Bengal. 334 villages were surveyed during

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jute-cum, 768 during both *amon* and *robi* and 780 during the *robi* seasons. For estimating the yield more accurately, crop-cutting experiments were conducted with a modified circular apparatus having three concentric circles of radii 2'3", 3'3" and 4'0" respectively, instead of the previous apparatus having two circles with radii of 2'3" and 4'0" respectively. While the survey of average and crop yields was in progress, a study of fish cultivation based on household interviews was also made. Here, too, the estimates of yields per acre were studied.

Study on Village Cluster Sampling: A special study on village cluster sampling was conducted for a short period in two villages of West Bengal during the *jute-cum* season.

Land Utilization Survey: A land utilization survey was conducted in the *amon* season at the Daaghara Centre (Hooghly district, West Bengal).

Opinion Survey among NSS Investigators: An opinion survey was conducted among the NSS Investigators and Inspectors regarding the adaptability of sampling of a cluster of villages for the work of the National Sample Survey. A preliminary report of the findings has been prepared.

Transport Facilities: For a proper stratification, information was collected from the field staff on the transport facilities available between neighbouring tahsils.

Post Census Survey: The post-Census Survey was conducted in April-June 1961 to study the extent of 'coverage' and 'content' errors in the population census of 1961. About 1200 villages and 400 urban blocks (central sample) were completely enumerated by the NSS and IBI investigators.

Type Study on Morbidity: A type study on morbidity was carried out for one year in one village and in one urban block each in the three States—Maharashtra, Kerala and Rajasthan—and in two villages in West Bengal and in five urban blocks in Bombay city, to study the effect of different probes and definitions, recall periods and proxy interviews on the morbidity rates. This ended in December 1961. The data are now being processed.

Type Study on Consumption of Cereals: The field work of the type study on consumption of cereals by the method of interview (using different reference period of inquiry) and by actual weighing was started in October 1960, and completed in December 1961. The survey was conducted by the staff of the NSS Directorate in one village and one urban block in each of the States of Rajasthan, Maharashtra and Madras. The field staff of the Indian Statistical Institute, Bombay Branch, also conducted the survey in two urban blocks in Bombay city. They also took up later two villages at Bassein where the field work which was started in July 1961 is likely to continue till June 1962.

Commutation Survey: A type study was conducted in West Bengal during the year with a view to study the socio-economic implications of gradual increase in the number of commuters to Calcutta i.e., persons who make to and for movements from neighbouring areas daily or at short, regular intervals of a week or fortnight for economic and other reasons. The entire urban areas within an area around 75 miles from Calcutta on road and railway and the part of rural areas covered by the villages near all railway stations within 75 miles were under the geographical coverage of the study. The sample consisted of 624 households, from which information was collected by personal interview. The data are now being processed.

Type Study on Middle Class Indebtedness, Investment and Saving (1962-63): To explore the possibility of suggesting some methods for a better assessment of savings and

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indebtedness of the middle classes, a study was undertaken in two urban middle class centres, Madras (by two NBS investigators) and Calcutta (by two ISI investigators). The study which commenced in February 1962 in Calcutta and in March 1962 in Madras was to be conducted initially for a period of six months covering about 1,000 sample families in the two centres. The idea was that after the end of this period the same set of families would be canvassed for another six months. Each investigator has been assigned the same set of families belonging to one independent sub-sample of the Middle Class Family Living Survey (1958-59) in these two centres. This study is progressing satisfactorily.

6. ELECTRONICS DIVISION

Analogue Computer : A small workshop was started during the war through an associated non-profit organization for the repair and maintenance of calculating machines and scientific equipment. In 1950 a small section was started to promote the use of modern electronic computers. In 1953 a small analogue electronic computer was designed and constructed in the Institute for the solution of a linear equation in ten variables. This was the first electronic computer designed and built in India.

Digital Computers : A digital computer, HEC-2M, of British make was installed in 1956 by Institute engineers and it has been maintained since then by them. In 1958 a much bigger digital computer, URAL, which was received from the USSR through the United Nations, was installed by Soviet engineers, and it has been maintained by Institute engineers since then.

The most significant development which took place during the year was the launching of a joint project for the design and construction of two solid state electronic digital computers in collaboration with the Jadavpur University. The machines will be character-based, having a syllable structure instead of a word structure like the *HEC-2M* and the *Ural* installed in the Institute. A machine of this type will open up the possibility of investigation about mechanical translation from one language to another and will be adaptable to automatic programming using a universal programming language such as the "ALGOL". The machine will be capable of both binary and decimal operations, which will enable it to be used either as a general purpose scientific computer or as a data-processing machine. The logical design of the machine was started in October 1961 and it was almost completed by March 1962. Expert assistance was obtained through the UNTAA, which provided for five weeks the services of Professor N. C. Metropolis, Director, Institute for Computer Research, University of Chicago, and Dr. S. Y. Wong, Philco Corporation, U.S.A. The work on the design of the circuitry, which is in progress, is expected to be completed within the next three years.

The following joint executive committee has been set up for the project : The Registrar, the Dean of the Faculty of Engineering, and the Professor-in-Charge of Telecommunications Engineering of the Jadavpur University, and the Joint Director and the Head of the Electronics Division, Indian Statistical Institute.

Computation Service : The electronic computers are being used not only for the Institute's own work but also to solve computational problems sent by other scientific institutions among whom may be mentioned the Indian Institute of Science, Bangalore; the Tata Institute of Fundamental Research, Bombay; the Indian Institute of Technology, Kharagpur; and the Indian Association for the Cultivation of Science, Calcutta.

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A number of computation problems received from outside scientific institutions and from the Institute itself were programmed and solved on the computers *HECSM* and the *UruI*. These are listed in Appendix 6.

Research and Development: The investigation on the design and development of high-speed transistorised logical circuits for computers continued as before.

The work on the development of a correlation computer was also continued.

Progress was made on the designs and construction of a Random Number Generator using the random property of radioactive emission. The list of papers completed and published is included in Appendix 5.4.

Maintenance Service: The responsibility of maintaining punched card machines was transferred to the Development Workshop during the early part of the year.

Training: Seven graduate apprentices were given practical training for six months, viz., Sarvasri Baidyanath Biswas, M.Sc. (Tech.), Anutoah Chatterjee, M.Sc. (Tech.), Satyendra Pratin Dutta, M.Sc. (Tech.), Sankar Sen Gupta, M.Sc. (Tech.), Jayanta Sharma, B.E. (Telecom.), Nihar Ranjan Ganguly, B.E. (Telecom.), and Manoh Dutta, B.E. (Telecom.) from the Universities of Calcutta and Jadavpur.

A regular training course of two years' duration on computer science was started from February 1962. Eight science graduates from 230 applicants were admitted to this course on the basis of selection tests.

7. DEVELOPMENT WORKSHOP

The Institute has a well-equipped workshop which is responsible for the repair and maintenance of different types of calculators and other equipment in the Institute. It also assists other organizations for repair work; for example, the workshop has redesigned and fabricated successfully a vital part of the radar equipment at the Calcutta airport at the request of the Civil Aviation Directorate.

Apart from maintenance and repair work, the workshop carried out developmental research for the manufacture of precision scientific instruments such as desk calculators, punched card sorters and improved parts of calculating equipment, and it has already designed and constructed some high-speed sorters for punched cards. Work is in progress on transistorised electronic circuits for use in high-speed sorters.

It may be mentioned that in November 1960 the Ministry of Commerce and Industries, Government of India, issued a licence to the Indian Statistical Institute for the manufacture of calculating machines.

High Speed Electronic Sorters: The Workshop made four of these sorters during the period under report, making a total of seventeen, including two proto-types, produced so far. Of these six are being used in the Army Statistical Organization, New Delhi; five in the Institute at Baranagar and one at Giridih; the remaining three are ready for installation. The work on the third batch of twelve high-speed sorters was taken up and nearly eighty per cent of the parts were manufactured during the year.

Desk Calculators: Special tools required for the large-scale manufacture of these calculators are being made at the Workshop. Three desk calculators were produced during the year; if these are found to be satisfactory in their trial run, the final design will be approved for the manufacture of a batch of 200 calculators.

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Other Projects : Besides the two projects mentioned above, the workshop has undertaken the development of other punches and machines, such as manual key punches, manual verifiers and tabulators under the licence granted by the Government of India for the manufacture of desk calculators, sorters, key punches, verifiers and tabulators. Substantial progress was made in developing key punches and verifiers. An Electronic Unit has been added to the Workshop, mainly for the development of electronic parts for use in the tabulators.

Training Schemes : The Workshop started an Apprentices Training Scheme in the year under report for training personnel in different technical trades, with the aim of providing requisite technical staff for the Workshop from among its own trainees. The scheme was prepared in collaboration with the Directorate of Industries (Vocational Training), Government of West Bengal.

Service : Services were rendered to the different departments of the Institute by the Workshop as usual. One hundred and eighty-two jobs were executed for different departments and 200 crop survey instruments were manufactured and supplied to the NSR, along with 400 spare parts. Major repairs were carried out by Calculating Machine Repair and Maintenance Unit of the Workshop to 85 desk calculators; the unit also attended 199 service calls and was responsible for the routine maintenance of 312 calculating machines, both electrical and manual. The Workshop carried on maintenance of the 43 punched card machines of the Institute at Calcutta, Delhi and Giridih. Several intricate jobs were also executed for outside organizations.

8. STATISTICAL QUALITY CONTROL (SQC)

The Institute became interested in SQC as early as 1935 and started organizing training courses in SQC from 1945. In 1947-48, Dr. Walter A. Shewhart, who may be described as the "father" of SQC, paid a visit to this country and aroused considerable enthusiasm in the ideas of SQC both in statistical and industrial circles. Immediately after Dr. Shewhart's visit, the Indian Society for Quality Control was established in Calcutta, but the SQC idea did not really catch on till 1952 when a team of experts deputed by the United Nations Technical Assistance Administration conducted intensive training courses in SQC methods in different parts of the country. The programme in this connexion was organized by the Institute in collaboration with the Central Statistical Organization. SQC has made fairly steady progress since then and eight SQC Units are now functioning, one each at Bangalore, Baroda, Coimbatore, Bombay, Calcutta, Delhi, Madras and one for Kerala (with offices at Ernakulam and Trivandrum), with a coverage between them of eighty factories.

Three All-India Conferences, held in Calcutta in January 1948, January 1955 and December 1958 have helped the progress of SQC. Dr. Shewhart who presided over the first conference paid three more visits in 1954-55, 1958-59 and 1961-62. An Advisory Committee for the guidance of SQC policy was set up in 1953 with Dr. C. D. Deshmukh as Chairman and Sri Pitambar Pant as Secretary.

The SQC work has three aspects : 1. promotion, 2. application to industry and 3. training of specialists. The promotional activities are carried on by the organization of conferences, seminars and meetings.

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On the operational side, apart from a few large industrial units which have their own SQC organizations and some of which provide consultants who work on a limited scale, the SQC units of the Institute are engaged directly in the practice of Quality Control establishments. An idea of the wide scope of the advisory service given by these units will be apparent from the following list of industries which are covered by SQC work: textiles; metallurgy; foundry and light engineering; electrical; plastics, chemicals and pharmaceuticals; glass and ceramics and process and miscellaneous industries.

During the year 1961-62, the ninth year in the history of the SQC Units, the main functions continued to be consultative work in a number of industrial organizations, conducting of short-term training courses for industrial personnel and the practical training of scholars of the Institute under a system of apprenticeship, which consisted mainly of in-service training in the factories which were being served by the Units.

The number of factories serviced remained practically the same as in the previous year, namely, 80 in place of 77. While there were a number of new enrolments, a number of withdrawals from membership also took place.

The training courses for industrial personnel, sponsored by industry, remained popular, though in the older centres there was not the same keenness as in the early days. Although there was a reduction by only 2 courses in 1961-62 from a total of 12 courses in 1960-61, the number of trainees who attended was reduced to 177 from 293 of the previous year. The reason may be that other organizations like the Indian Society for Quality Control, Calcutta, the Quality Control Association, Bangalore and the National Productivity Council, also organised their own courses.

A more systematic procedure for apprenticeship training was adopted in the current year. The duration of apprenticeship was longer and the practical training more thorough. Orientation courses were arranged in various aspects of industrial engineering and industrial economics. The aim is to build up an institutional organisation for whole-time training of one to two years duration, with opportunities of assessment and a proficiency certificate.

During the current year also two senior members of the staff went under fellowship schemes on study-tours in the USA and Europe. Another senior member was selected for the NPC productivity team on SQC, which toured through Japan, the USA and the UK. A fourth member was selected for the NPC productivity team on textiles, which spent some weeks in the Soviet Union. A fifth member of the staff was sent to the Case Institute of Technology for study on Operations Research.

The nature of the technical work remained more or less the same, except that the Units were better prepared to take up special studies and pilot surveys. The variety and range of problems handled were also wider, so was the repertoire of statistical techniques that were brought into use under different circumstances.

Though promotional work, through lectures and talks, conferences and seminars and visits to factories, showed an increase of nearly 40 per cent over that of the previous year, the number of factories on the service-list did not increase appreciably. An intensive direct approach to top management was made in a number of cases in the Madras area, but with little result.

The finances of the Units continued to be on a subsidized basis, the subsidy being about 60 per cent of the total expenditure, which was about Rs. 6 lakhs per year.

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There was an important meeting of the Policy Advisory Committee in November last and it was decided to have bi-yearly meetings in future.

A number of tables containing quantitative details are given in Appendix 13.

B. LIBRARY

The Institute's Central Library at Baranagar has a service centre at the City Office, 9B Esplanade East, and branches at Giridih, Delhi, Bombay and Bangalore.

Owing to shortage of space, the purchase of reading material had to be restricted considerably during the year.

Resources : The Library's collection at the end of the year numbered 93,300 volumes in round numbers distributed subject-wise as follows :

Statistics (theoretical and applied)—22,960; *Mathematics*—4,960; *Physical and Biological Sciences*—8,800; *Economics* and its subsidiary branches—23,000; *Sociology, Cultural Anthropology and Demography*—10,400; *Engineering and Technology* (including *Agriculture, Medical Sciences and Management Sciences*)—10,000; *Humanities*—9,080; and *General Reference Works*—4,080. There is also a collection of about 22,500 reprints, monographs and specialised technical reports and documents, including a large collection of photo-prints and microfilms.

Books : 7,161 books were acquired, compared to 7,434 in the previous year. Of these 7,161, 1,234 were gifts, and 429 were received in exchange of *Sankhyā* and other occasional publications of the Institute. Books received as gifts and through exchange thus amount to 23 per cent of the total receipt.

Periodicals : 1,949 periodicals and serials were received, compared to 1,816 in the previous year and of these, 582 were subscribed for, 824 were received in exchange of *Sankhyā* and other occasional publications of the Institute and 543 were received on a complimentary basis. Twenty-two daily newspapers were subscribed to for the news-clipping files on planning and economic development in India.

Special Collection : As in previous years, scientific and technical publications in Russian, Chinese and Japanese were received from several friendly sources. These publications are being processed.

The collection of the photo duplicated material in the Library comprises 260 micro-film rolls and paper prints of 3,845 pages.

Bibliographic Services : The Library continued to issue the documentation lists of 1. *Weekly List of Selected Periodicals*, 2. *Monthly Bulletin of Acquisitions and Library News* and 3. *Index to Statistical Literature*, at regular intervals and these were received favourably by research workers in and outside the Institute. 3,585 articles from different scientific periodicals were indexed, out of which 1,484 were on theoretical statistics and 2,101 on applied statistics.

Lists and bibliographies were also issued on the following subjects : (i) *Indic names*; (ii) *Productivity and Labour—Management Relations*; (iii) *Blood Groups*; (iv) *Programming Techniques*; and (v) *Digital Computers*. *The Union List of Learned Periodicals : Calcutta Region* : (A selection from the periodicals received in certain libraries in Calcutta and its neighbourhood). The list, published in 1959, received favourable response from librarians

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and scientific workers in India and abroad. A revised edition of the list is under preparation and will be published soon.

Revision of Bibliography of Bibliographies : A revision of the bibliography has been completed. A full catalogue of periodicals held in the Library has also been prepared.

Translations : Forty-one documents in foreign languages were translated into English. Of these seventeen were in Russian, six in Chinese, twelve in Japanese, five in German and one in French.

The Translations Unit also rendered into English a large number of letters and other communications in foreign languages. A separate translation unit is working in Japan for the systematic translation of research material in Japanese.

Service and Circulation : 1,547 persons used the library during the year as against 1,419 in the previous year. Books, journals and other materials issued during the year numbered 62,007, as against 64,406 in the previous year. Of these, those issued from the Lending Section were 18,953 and 26,708 from the Reference Section and 16,346 from the periodicals counter. The issue of periodicals and vertical file materials numbered 15,656. Requests received numbered 70,534 of which about 12 per cent could not be fulfilled, against 9 per cent last year. 74 outsiders were given special permission to use the library, against 146 persons last year.

Inter-Library Loans : Transactions were made with the libraries of the following organizations : 1. Bose Institute, Calcutta; 2. Calcutta University; 3. Department of Applied Economics (Calcutta University); 4. Commercial Library, Calcutta; 5. University of Baroda; 6. Geological Survey of India; 7. University of Varanasi; 8. Imperial Chemical Industries, Calcutta; 9. Saha Institute of Nuclear Physics, Calcutta; 10. Viava-Bharati University; 11. Jadavpore University; 12. West Bengal Government, Health Department; 13. Joint Cipher Bureau, Ministry of Defence, New Delhi; 14. School of Tropical Medicine, Calcutta; 15. National Library, Calcutta; 16. Asiatic Society, Calcutta; 17. Calcutta Mathematical Society; 18. Sudhira Memorial Library, Calcutta; 19. Bengal Immunity Research Institute, Calcutta; and 20. Botanical Survey of India, Calcutta.

A complete up-to-date list of Library publications is given in Appendix 14.

10. PUBLICATIONS

From 1932 the Institute started organizing regular scientific meetings at which statistical papers were presented. It was naturally felt that the Institute should have a journal of its own and a special committee was set up by the Council to report on this matter. After a careful review, the committee recommended that a new journal should be started as the official organ of the Institute but its management and business arrangements should be made independent, so that no financial liabilities should fall on the Institute. This recommendation was accepted by the Council and it was decided to start a new journal *Sankhyā* : *The Indian Journal of Statistics* with P. C. Mahalanobis as Editor. The late Narendranath Mukherjee, the proprietor of the Art Press, very kindly offered to shoulder the responsibilities of management while the Editor made himself personally responsible for all financial liabilities. In this way the first number was issued in June 1933.

A little later, on the initiative and with the approval of the Council of the Institute, a separate, non-profit distributing association called the Statistical Publishing Society was

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registered under Act XXI of 1960 in September 1935 with Dharendra Nath Mitra, Girindra Sekhar Bose and P. C. Mahalanobis as trustees to take over the financial and business responsibility for *Sankhyā*. After the death of G. S. Bose, Satyendranath Bose was appointed the third trustee. This Society gradually built up the Eka Press which has modern typesetting and monotype equipment and which now prints a fairly large number of scientific publications.

Sankhyā, the official journal of the Institute, soon gained an international reputation and became self-supporting. Publication was partly interrupted during the war but twenty-three volumes had been published by 1961. To cope with the increasing volume of matter, the Council decided that *Sankhyā* should be published from 1960 in two separate series, one mainly for papers and notes on new methods and techniques and the other mainly for original data, records and applications of new methods.

During the year, Parts 2, 3 and 4 of Volume 23 of Series A, Part 1 of Volume 24 of Series A and all the four parts of Volume 24 of Series B containing fifty-five papers and two reports were published. There were papers on advanced probability, fractile graphical analysis, information theory, design and analysis of experiments, combinatorial problems, stochastic processes, estimation, multivariate analysis, sample surveys, demographic variable, selection tests, economic studies, etc., and also book reviews and reports of the National Sample Survey.

Indian Statistical Series: Over fifteen years ago the Institute considered the possibility of bringing out a series of statistical monographs. The first book, *Some Aspects of Multivariate Analysis*, by S. N. Roy (who had undertaken this assignment when he was in the Institute) was published jointly by the Indian Statistical Institute and John Wiley & Sons, Inc., New York, in 1957 for distribution outside India, and an Indian edition was published jointly with the Asia Publishing House, Bombay. Since then arrangements have been made for the publication of the monographs in this series jointly by the Statistical Publishing Society and the Asia Publishing House under the auspices of the Indian Statistical Institute.

In addition to eleven books already published in the series, the following three books were published during the year : 1. *Some Basic Planning Problems* by Charles Bettelheim; 2. *Mysore State (Volume I) : An Atlas of Resources* edited by A. T. A. Learmonth and L. S. Bhat; 3. *Talks on Planning* by P. C. Mahalanobis.

A complete up-to-date list of this series is given in Appendix 14.

During the year, the Publication Unit saw through the press 3,465 pages of the following categories of publications : (a) *Sankhyā* (Series A & B), (b) NSS Reports, and (c) other documents. There are 4468 pages under different stages of printing.

Samvadadhvam : The House Magazine of the Indian Statistical Institute : The magazine was first published in July 1956, during a period of rapid growth of the Institute, with the object of opening channels of communication between different sections of the Institute, fostering the growth of team spirit and helping the workers appreciate the purpose of the Institute. Prominent guests and scientists, rank and file workers as well as students are among its contributors. Each issue contains three different sections in English, Bengali and Hindi. During the year, the fourth issue of the fourth volume was published in July 1961 and the first issue of the fifth volume was published as a special number in December 1961. The second issue of the fifth volume was under preparation.

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11. GENERAL ADMINISTRATION

Membership : During the year, 152 new members of different categories were enrolled and 57 members discontinued (2 having died), bringing the total membership of the Institute to 543. This number includes 69 life (including 4 ordinary members who became life members during the year), 290 ordinary, 4 institutional, 49 sessional and 124 student members. The remaining seven are honorary members.

Annual General Meeting : The Annual General Meeting was held on 30 October 1961 to transact the business under the constitution, namely, the election of the President and Vice-Presidents, one of the Joint Secretaries and the members of the Council, and the adoption of the General Report and Statement of Accounts for 1960-61 audited by Messrs, Lovelock & Lewes, Chartered Accountants. The office-bearers who were elected on 29 October 1960 continued to function during 1961-62 also, as a fresh election of office-bearers is due only in October 1962. A list of the office-bearers and members of the Council is given in Appendix 2.

Meetings of the Council and the Joint Meetings of the Council and the Governing Body : The Council of the Institute met ten times during the period under review, on 22 April, 27 May, 8 July, 23 August, 10 October, 30 October and 30 December in 1961 and 13 January, 26 February and 24 March in 1962. Of these, four were joint meetings with the Governing Body of the Research and Training School, namely, those on 27 May and 30 October 1961, 13 January and 24 March 1962. Among important items considered and resolutions passed by the Council may be mentioned the approval to the formation of the Kerala Branch of the Institute (22 April 1961); arrangements for senior administrative changes (22 April 1961); amendment of P.F. rules (22 April 1961); purchases of lands and buildings at Giridih (22 April 1961); publication of the *Nikasa* (22 April 1961); arrangements for and participation in international meetings at technical and non-Governmental level for considering problems of economic development of less advanced countries (22 April, 27 May, 23 August 1961); revision of pay-structure for categories of workers other than those previously settled (27 May 1961); reorganisation of the Selection Committee for the recruitment of research staff (27 May 1961); settlement of procedure for incurring capital expenditure on lands, buildings, etc. (23 August 1961); constitution of a Standing Committee for the award of higher Doctorate and Honorary Degrees and Fellowships of the Institute (23 August 1961); participation in the Biennial Session of the International Statistical Institute in Paris (23 August 1961); revision of rules regarding maternity leave (10 October 1961); approval of revised budget estimate for 1961-62 and approval of budget proposals for 1962-63 and auditors' report and audited statement of accounts for 1960-61 (30 October 1961); adoption of Standing Committee's report for the award of higher degrees and arrangement for the award of honorary degrees (30 December 1961); adoption of bye-laws for professional examinations (30 December 1961); matters relating to house-rent and other compensatory allowances, NSS work, efficiency bar tests (30 December 1961); approval of recommendations of the Committee regarding the crest and motto, degree scroll, gowns and hoods (13 January 1962); exchange of scientific workers and scientific collaboration between the ISI and the Academy of Sciences, Bulgaria (26 February 1962); acceptance of a grant of \$ 10,000 from the Rockefeller Foundation (24 March 1962); matters relating to International Conference for Economic Cooperation in Austria, International non-Governmental Conference on Economic Development, proposed session of the Pugwash Conference in India in 1963 (24 March 1962); reorganisation of NSS

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work (24 March 1962); problems relating to ways and means position and reimbursement of expenditure by Government (23 April, 23 August, 10 October, 30 December 1961 and 24 March 1962).

Governing Body of the Research and Training School : The Governing Body met jointly with the Council of the Institute on 27 May 1961, 30 October 1961, 13 January 1962 and 24 March 1962 as reported above.

Finance Committees : The Finance Committee of the Council and the Finance Committee of the Governing Body of the Research and Training School met on 28 October 1961 to consider the audited statement of accounts, report of the *ad hoc* committee on the allocation of expenditure, the budget proposals and other matters.

The *ad hoc* Joint Committee of the Research and Training School and of the Council of the Institute examined the allocation of expenditure to different projects on 28 October 1961 and submitted its report to the Finance Committees of the Governing Body and of the Council.

A list of members of the Committees is given in Appendix 2.

Appraisal : The Appraisal Division which was formed in the middle of 1960-61 consisted of the staff from the Psychometry Unit and a few suitable workers from the NSS and the Administration. An Appraisal Advisory Committee was set up to consider proposals by the Appraisal Division before their adoption by the administration. The assignment of the Division was to evolve suitable schemes in connection with confidential rating forms, departmental examinations and output record forms for the appraisal of workers, as prescribed in the new terms and conditions of service introduced with effect from the beginning of that year. Before the close of 1960-61, confidential rating forms and objective work record forms for certain categories of staff were introduced by the Administration on the basis of schemes prepared by the Division.

During the year, technical work continued for effecting an improvement on the forms introduced on the basis of the data received since April 1961. The data on confidential reports showed a moderately high agreement between the pairs of supervisors. The analysis, however, indicated certain improvements on the rating procedure and plans were made for effecting them.

As the flow of output record forms was meagre, very little progress could be made. Schemes were being evolved for specific departmental examinations.

ESTATE AND TRANSPORT SECTIONS

The Estate Office designs and supervises all construction work in the Institute and looks after the repair and maintenance of its buildings, roads, grounds, furniture and other equipment. The electric installation and internal telephone system are maintained by a trained group of workers who also look after the refrigeration plants used for air-conditioning some of the laboratories and machine-rooms.

All buildings and hutments of the Institute at Baranagar and Giridih which have been designed and constructed so far by the Institute's own staff are also being maintained by them. The Institute was occupying in 1962 about 1,25,000 sq. ft. of pucca buildings and nearly 1,04,000 sq. ft. of hutments in its different premises at Baranagar. The Institute was also occupying 9,000 sq. ft. in rented premises in the city of Calcutta, and about 47,800 sq. ft. of buildings and 3,700 sq. ft. of hutments at Giridih.

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The Institute started a transport section in 1945-46, and since then a number of light cars have been maintained for official work and the use of Institute guests. The Institute has 19 vehicles of various types in its fleet. 5,089 out of 5,173 requests for transport were complied with during the year.

WELFARE AND GENERAL SERVICES

The Institute maintains hostels for students, canteen for supplying subsidised refreshments, mess for workers, a circulating library, medical units including a health home at Giridih, its own transport service, and a workers' club for sports, recreation and cultural activities. There is also a workers' cooperative credit society and a cooperative stores. The Institute provides a good deal of 'in-service' training and also publishes a house journal, *Samsadodhoom*.

The Guest House, arrangements for guests, medical units and certain residential units are in the charge of a Hospitality Committee under a Chairman elected by the Council.

Visitors: Over 600 visitors from India and abroad (from 25 countries) came to visit the Institute during the year under review. (See Appendix 3).

The Public Relations Unit was responsible for showing the visitors round the Institute and also for the house-journal *Samsadodhoom*.

International Guest Houses: Since 1938 distinguished foreign scientists began to come to the Institute as visiting professors and experts; and upto 1952 or 1953 most of them used to stay with Professor and Srimati Mahalanobis. The numbers of guests increased very considerably with the inauguration of the work on economic planning in 1954 and it became necessary to make some regular arrangements for them. A portion of the main building at 203, Barrackpore Trunk Road, Calcutta-35, was converted into a guest house, and several suites of rooms of *Amrapali* were also set apart for Institute guests.

In 1953 a House Committee was constituted with Srimati Nirmalkumar Mahalanobis as Honorary Chairman to look after the arrangements for the Institute guests, and the workers who reside at headquarters and in five rented houses in the neighbourhood, the grounds and gardens and sanitation.

In 1956 and 1956 new hutments (East Cottage and North Cottage) were constructed to provide additional accommodation for the trainees of the International Statistical Education Centre and some of the many foreign visitors who came to attend the Twenty-fifth Anniversary Celebrations of the Institute. In this way, by the end of 1956, thirtytwo single and double rooms, many of them with attached baths, became available for guests in these hutments.

The Institute maintains these Guest Houses mainly for foreign visitors, many of whom stay at the Institute for fairly long periods for lectures, research work and technical consultation. The number of such guests during 1961-62 was 216.

There is also a guest house at *Mabus*, Giridih.

Medical Welfare Unit: The Medical Welfare Unit which is now in its eighteenth year was set up on a modest scale in February 1945. The benefits of the Unit which are available to the workers, members of their families as well as students and guests include free consultation and service, visits to residences at subsidised rates and the supply of

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medicines on a cost basis. The number of workers seeking medical aid has been increasing steadily. About 24,000 patients were treated in the Unit and more than 900 home visits were paid. The cost of medicine supplied to workers increased from Rs. 38,162 in the previous year to Rs. 47,005 in the year under review. The present staff consists of Dr. B. Goewami as consultant till the end of 1961, Dr. R. Maitra, visiting physician, Dr. S. C. Sen (Resident Medical Officer), and Dr. A. Banerjee. The Medical Unit at Giridih is in charge of Dr. Sujit K. Maitra, Resident Medical Officer with Dr. N. K. Das as visiting physician. Further particulars are given in Appendix 9.

In collaboration with the Haematological Research Unit, a diagnostic laboratory was set up in the Unit at Baranagar.

Cultural and Other Activities : The ISI Workers' Club at Baranagar, the ISI Field Workers Club in Calcutta and the Balboni Club at Giridih organized annual sports meetings, recreations and varied cultural activities. A music club at Baranagar, *Sarodhusi*, was also given certain facilities.

The ISI Club participated in the Inter-office Table Tennis League under the B.T.T.A., Calcutta. Two teams of the ISI met in the final and ISI 'B' team became the champion, while ISI 'A' team was runners-up. The ISI team secured the third position in the Inter-office League Championships conducted by the West Bengal Volley Ball Federation. The Club also participated in foot-ball and cricket tournaments under the West Bengal Sports Federation, Calcutta. The Club magazine *Lekha* was published this year as a Special Rabindra Centenary Issue.

Cooperative Credit Society : The Indian Statistical Institute Cooperative Credit Society Ltd. which started functioning on 2 February 1966 as a registered society had 1004 members, Rs. 89,400 as paid-up share capital and Rs. 1,52,900 in deposit funds at the end of June 1962.

Co-operative Stores : The Indian Statistical Institute Co-operative Stores Ltd. which was registered under the Bengal Co-operative Societies Act in 1960 began to function as a consumer's stores in March 1961. The Institute provided it with free accommodation and a number of other facilities. The West Bengal State Government has extended financial assistance to the Society under a scheme for the development of consumer's co-operative stores under the Five Year Plan Programme.

OPERATING CENTRES

For the first ten years (1932-1941) the work of the Institute used to be done in the Presidency College, Calcutta, and in some rented rooms in the city. At the time of evacuation during the war in 1942, one part of the Institute was removed to *Amrapali* (Professor Mahalanobis' house) at 87, now 204 Barrackpore Trunk Road, Calcutta-35 in Baranagar, a suburb of Calcutta) and another part to *Makua* (Mrs. Mahalanobis' house) at Giridih, Bihar, about 200 miles from Calcutta, both of which were placed at the disposal of the Institute by the owners, free of rent, for the duration of the war and one year thereafter.

Headquarters at Baranagar (Calcutta-35) : From 1946 the Institute has also occupied rented premises at 206 B. T. Road, Calcutta-35 (near *Amrapali*) comprising about 8 acres of land. In 1950 the Institute acquired about 3 acres of land at 203 B. T. Road, Calcutta-35, and started constructing a building on it. Since 1954 the Institute was using about 8 acres of land and buildings at 202 B. T. Road, Calcutta-35 and the premises known as *Geoplineasia*

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in the same neighbourhood which were placed at its disposal by the Government of India. The Institute subsequently purchased some other pieces of land at Baranagar measuring about three and a half acres.

In this way Baranagar (Calcutta-35) gradually became the headquarters of the Institute. The Institute has constructed about 85,000 sq. ft. of buildings and 29,000 sq. ft. of hutments on its own land at 203 and 206 B. T. Road, Calcutta; and it also occupies about 80,000 sq. ft. of buildings and 75,000 sq. ft. of hutments in other premises. Over 1,25,000 sq. ft. of pucca buildings and 1,04,000 sq. ft. of hutments are thus in the occupation of the Institute at Baranagar.

The Research and Training School with its different laboratories, the International Statistical Education Centre, hostels for students, the bigger part of the National Sample Survey, the Calcutta wing of the Planning Division, the Library, the Electronic Computer Laboratory and Development Workshop, the Guest House, and Central Office and services are located at Baranagar.

The associated non-profit organizations, the Statistical Publishing Society and the Eka Press, occupy adjoining premises at 204/1 B. T. Road and the non-profit organization, the Indian Calculating Machine and Scientific Instrument Research Society (ICMSIRS), is associated with the Development Workshop.

Calcutta City Offices : The Institute occupies about 9,000 sq. ft. in rented premises in the city. The SQC Unit has its office at 9B Esplanade East which is also used for evening training courses and for meetings and lectures of the Institute. The Field Branch of the Institute has its offices at 204/2/1 Upper Circular Road, Calcutta-9 and at 210 Cornwallia Street, Calcutta-6; and also rooms in the Albert Hall near Presidency College.

Giridih : Since 1941 an operating centre has continued to be located at Giridih. In 1949, the Institute acquired 35 acres of open land adjoining *Mahua* and standing by the river Uri where an agricultural farm has been established. The Institute has put up some hutments on its own land and has also constructed a Health Home for convalescent workers on a piece of land at Pachamba which was received as a gift. The total space in the occupation of the Institute at Giridih in 1962 was about 47,800 sq. ft. of buildings and 3,700 sq. ft. of hutments. During the year, an additional plot of land covering 6.12 acres was purchased, with a building covering 3,000 sq. ft. of floor area.

The agricultural farm is used for various field experiments and biological studies by the Biometric Unit; and two field units are maintained at Giridih, one for the *ad hoc* crop and socio-economic surveys, and the other for sociological surveys. The National Sample Survey also has a branch at Giridih with a machine tabulation unit of four tabulators, seven sorters, one calculating punch, one collator, two reproducers, and three gang summary punches. During the year the Giridih Centre was assigned 20 per cent of the operation work of the NSS.

The students of the RTS and the ISEC trainees visit Giridih in batches every year for practical training in crop-cutting experiments and socio-economic surveys.

There are guest houses for visitors, a canteen with subsidized tiffin, a circulating library, a club for sports and social functions, a co-operative or dit society and a medical welfare unit with a Resident Medical Officer.

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Delhi : In 1949 when Professor Mahalanobis started working as Honorary Statistical Adviser to the Cabinet, the Institute opened a small office in New Delhi which functioned for two years as the Central Statistical Unit for the coordination of the statistical work for the Government of India until the Central Statistical Organisation was established in 1951.

The Institute staff was increased from 1954 to work on studies relating to planning and scientific and technical man-power in collaboration with the Planning Commission under the guidance of Sri Pitambar Pant who is the Chief of the Division of Prospective Planning and also helps the Institute as its Honorary Joint Secretary.

During the year, 30 per cent of the total work of the National Sample Survey was processed in the NSS Operations, Delhi. Due to the increase in work and in staff, new accommodation was arranged at 6 Link Road, Jangpura Extension, for housing the punching, pre-punching and post-machine processing sections.

Bombay : In addition to a society branch, the Institute maintains one operating centre in Bombay working under the guidance of Sri M. A. Telang, Honorary Secretary, with an office for the field work of the National Sample Survey in Bombay city and one SQC Unit. Various special surveys and studies were undertaken from time to time in cooperation with the society branch.

Bangalore : An SQC Unit is maintained at Bangalore under the guidance of Sri Srinagabhushana; the Mysore State Branch is also doing important work on pilot surveys and statistical studies.

Trivandrum : A new Kerala Branch commenced working from 8 April 1961 with its headquarters at Trivandrum.

Field Branch : The Institute has a field branch which is in charge of the field work of the National Sample Survey in West Bengal, and an office for similar field work in Bombay city, and two small field units at Giridih for pilot studies.

THE INSTITUTE STAFF

The office-bearers of the Institute are elected by the general members of the Institute and serve in an honorary capacity in accordance with the usual tradition of scientific societies in India. As the Institute began to undertake organised research and teaching, and also special enquiries and large-scale projects on a contract basis, it became necessary to appoint a large paid staff for research, teaching and operation work.

Professor P. C. Mahalanobis worked both as Secretary and Director of the Institute. Sri Saradindu Basu continued as Joint Director and Joint Secretary, functioning both in Delhi and Calcutta. Sarvasri Nihar Chandra Chakravarti and Tripti Kumar Roy Chaudhuri worked as Joint Secretaries and also as whole-time Special Officers in the administrative sector in Calcutta. Sri Pitambar Pant worked as Honorary Joint Secretary in charge of the Planning and administrative work in New Delhi. Sri Suresh Chandra Sen, who had previously retired from the office of the Joint Director and had kindly agreed to work as Joint Director from 2 April 1960 continued to function as such, at the request of the Director and the Council, upto 30 September 1961.

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Changes in Senior Staff: The staff of the Institute was strengthened during the year by the addition of the following persons. The date of joining is shown against each name:

Dr. B. P. Adhikari, M.Sc. (Stat), Dr. es. Sc. (Paris), 25 August 1961 (RTS); Sri Sudhir Basu Mallik, M.Sc. (Geology), 15 June 1961 (*Geological Studies Unit*); Sri Jagdish Natwarlal Bhagwati, M.A. (Econ), 3 January 1962 (*Planning Unit, Delhi*); Sri Dwarka N. Bhattacharjee, B.Sc. (Hons.), M.Sc. (Tech.), Maintenance Engineer, 1 June 1961 (*Electronics*); Sri Sudhir K. Chowdhuri, B.A., formerly Development Secretary, Life Insurance Corporation of India, Eastern Zone, 14 August 1961 (*Administration*); Dr. Sujata Choudhuri, M.B.B.S., D.C.H. (Lond.), F.R.C.P. (Edin.), M.R.C.P. (Lond.), 1 July 1961 (*Head, Haematological Research Unit*); Dr. Jharna Ghosh, M.Sc. (Physiology), D.Phil., 16 November 1961 (*Haematological Research Unit*); Sri S. John, M.A. (Math.), 1 April 1961 (RTS); Dr. Lillian Khan, M.A. (Industrial Psychology), Ph.D., 10 July 1961 (*Appraisal Division*); Dr. E. V. Krishna Murthy, M.Sc. (Statistical Mechanics), Post M.Sc. (Nuclear Physics), Ph.D., 28 October 1961 (*Electronics*); Sri R. V. Krishna Rao, Licentiate, Electrical Engineering, 6 February 1962 (*Electronics*); Dr. (Mrs.) M. Krishnan, M.A., M.Sc. (Stat.), Ph.D. (Stat.), was appointed Officer-in-charge, Evening Course in Statistics at Madras, 15 July 1961 (RTS); Dr. Arup K. Mitra, B.Sc., M.B.B.S., 1 December 1961 (*Haematological Research Unit*); Dr. Promode K. Pathak, M.Sc. (Stat.), Ph.D., 1 April 1961 (RTS); Sri K. Raja Gopal, Electrical Engineering with Electronics and Telecommunication, 12 October 1961 (*Electronics*); Sri D. K. Roy, B.Com., 1 October 1961 (*Administration*); Dr. D. K. Roy Choudhuri, M.Sc. (Stat.), rejoined on 18 September 1961 (RTS) after spending about four years in the University of North Carolina; Sri T. K. Roy Chaudhuri, B.Sc., LL.B. (Belfast), F.C.A. (Eng.) formerly Secretary and Chartered Accountant, Calcutta Improvement Trust and lately of the Howrah Improvement Trust, 1 May 1961 (*Administration*); Dr. Satyendra Nath Sen, M.B.B.S., Diploma in Dermatology, 1 September 1961 (*Haematological Research Unit*); Sri B. K. Sen Gupta, M.Sc. (Appl. Math.), D.I.I.Sc. (ECE), Maintenance Engineer, 1 July 1961 (*Electronics*); Sri J. Sethuraman, B.Sc. (Hons.), 1 April (RTS), Sri K. R. Shah, M.A. (Stat.), 1 April 1961 (RTS).

The following left the Institute on the dates mentioned:

Sri Soumyendra M. Bose, 26 December 1961 (*Electronics*); Professor J. B. S. Haldane, M.A. (Double), D.Sc., F.R.S., F.N.I., Research Professor (RTS), October 1961; Dr. (Mrs.) Helen Spurway Haldane, B.Sc., Ph.D., October 1961 (RTS); Dr. Sujit K. Mitra, M.Sc. (Stat.), Ph.D., 16 April 1961 (RTS); Sri K. G. C. Nair, M.Sc. (Stat.), 12 September 1961 (RTS); Sri Ajay K. Sen, B.E., Electrical Engineer, 1 September 1961 (*Electronics*); Sri Ashis K. Sen, M.Sc. (Tech.), Engineer, 14 September 1961 (*Electronics*).

Sri S. J. Poti was granted leave for six months from March 1962 to accept a WHO assignment in Ceylon.

Honours and Awards: Professor P. C. Mahalanobis was awarded the degree of Doctor of Science (*Honoris Causa*) by the Sofia State University, Bulgaria, in December 1961. He was awarded the degree of Doskottama (D.Litt. *Honoris Causa*) by the Visva-Bharati University at a Special Convocation held in May 1961 on the occasion of the Tagore Centenary Celebrations in Santiniketan.

Dr. C. E. Rao was appointed Treasurer of the International Statistical Institute.

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Sri T. A. Davis, (RTS) was awarded a cash prize of Rs. 250 by the Inventions Promotions Board, Government of India, for his invention of certain instruments for agricultural research. He was elected a Fellow of the Royal Microscopical and Royal Horticultural Societies, London.

Sri B. K. Verma, (RTS) was appointed editor of the Applied Physical Anthropology Number of the Journal of Research published by the Council of Social and Cultural Research, Bihar.

Sri S. Chatterjee, Psychometric Research and Service Unit (RTS), was awarded the degree of Doctor of Philosophy (D.Phil.) by the Calcutta University in July 1961.

Sri K. N. Sharma, (Appraisal Division), was awarded the degree of Doctor of Philosophy (D.Phil.) by the Calcutta University in July 1961.

Sarvasri R. K. Som and Saibal Banerji (National Sample Survey), were admitted to the D.Phil. (Statistics) degree of the Calcutta University in 1961, on the basis of theses prepared under the direction and guidance of Professor P. C. Mahalanobis.

12. SOCIETY BRANCHES

BOMBAY BRANCH

The Annual General Body meeting and the Council meeting of the Bombay Branch were held on 26 July 1961. Office-bearers were elected for the year 1961-62 (see Appendix 2). Another meeting was held on 16 February 1962 to consider the working of the training course and the Library.

Membership : At the close of the year there were 17 ordinary, 3 life and 39 associate members. One person joined as an associate member during the year 1961-62.

Sample Surveys : During the period, the second sub-round of the sixteenth round was completed. The field work of the seventeenth round (NSS) was started in September 1961. The seventeenth round consists of 6 sub-rounds divided into two visits. The first visit was completed and the second is now in progress.

The Branch also undertook, during this period, the Post Census Survey with an additional 48 sample blocks and livestock survey.

Joint Training of Post Census Survey : The Central, State and NSS unit of the ISI (Bombay Branch) participated in a joint training conference for Post Census Survey arranged by the Indian Statistical Institute, Bombay Branch. Fifty trainees took part in the training which lasted from 22 to 27 March.

Type Studies : The type studies on morbidity and consumption of cereals were continued in 1961-62.

(1) *Type Study on Morbidity* : The type study on morbidity is designed to estimate morbidity rates in Bombay City as also to study the suitability of the different probes and definitions and proxy interview for conducting future morbidity surveys. After the completion of these pilot studies, a suitable methodology is expected to be evolved for large-scale surveys of this type. Six investigators and one inspector were employed for the pilot survey. An interesting feature of this survey is that during the first visit of the investigation, information relating to the preceding two months was collected. Subsequently,

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the investigators visited the household every alternate day for one month and collected information. The survey is expected to be completed within one year from its commencement. Ten sample blocks were selected at random and the necessary number of households were selected from each block by a systematic sample.

(4) *Type Study on Consumption of Cereals*: The main object of the type study on the Consumption of Cereals is to find out the difference between monthly consumption of cereals estimated by (a) the investigators' interviewing and questioning the household and (b) by actual weighing of the purchases of cereals during the reference period as also stocks in the beginning and at the end of the period. For the purpose of weighing, the investigator visited each household as many number of times as the household purchased cereals, and the minimum period of the visit being alternate days. The study was confined to the consumption of cereals only. The survey which was originally started at one centre, Sion-Koliwada, was extended later to a cluster of villages in Beassein (Thana District). The first is already complete and the latter will be continued till July.

Tabulation: The Branch received 2 punch machines, 1 verifier and 1 counter sorter. The type study on morbidity was taken for machine tabulation.

Visitors: Dr. P. V. Sukhatme, Director, FAO, who visited the Branch in January 1961, gave a talk on "Food Problem in India". Sri G. V. Bedekar, ICS, Secretary, Maharashtra Government, presided. Sir Ronald A. Fisher, FRS, who visited the Branch in February 1961 had discussions with the members of the Bombay Branch and the students of the training class. Dr. W. A. Shewhart, visiting SQC expert from the USA, who visited the Branch in December 1961 had a discussion with the members of the staff of the Indian Statistical Institute and SQC and of the training course on Statistical Quality Control. Dr. G. N. Wilkinson, Senior Research Officer, Commonwealth Scientific & Industrial Research Organisation, Australia, who visited the Branch during July-August 1961 gave a lecture on "A formula for the expected value of the interblock sum of squares in the analysis of incomplete block designs with recovery of interblock information". Dr. C. I. Bliss, Professor, Yale University, delivered a lecture on "General models in Biology in relation to statistical inference." Academician A. N. Kolmogorov, Professor of Mathematics, University of Moscow, had a discussion with the staff and members of the Bombay Branch and students of the training class.

Among other distinguished visitors may be mentioned I. V. Komar, and K. M. Popov, both from the Institute of Geography, USSR; L. E. Rodin, V. L. Komarov Botanical Institute, Academy of Sciences, USSR; Alexander M. Riabchikov, Dean, Geographical Faculty, Moscow University; V. A. Nikolaev, Senior Scientific Worker, Moscow University; N. C. Metropolis, Professor of Physics, Institute of Computer Research, Chicago University; and Ruggles Gates, Professor of Biology, University of London.

Diploma Examination: The Statisticians' Diploma Examination was held in March and September. In the March examination 7 candidates passed in one or more papers and in the September examination 11 students passed in one or more papers.

An admission test was held in Bombay in August for the various degree courses.

Training Course: The Branch started the second batch of training course in April 1961 for which an admission test was held on 26 March. Out of the 84 candidates who applied for admission, 53 appeared for the test. Thirty students were selected in order of merit and 4 students were kept in the waiting list. Dr. S. Chatterjee, RTS, helped in

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conducting the test. The second batch completed its training by the end of April and the third batch of the training course started from May 1962.

Library : The Branch was in a position to increase the stock of books with the help of the grant of Rs. 10,000 from the Head Office. Library books at present number nearly 800. Books worth Rs. 6,000 were added during the period.

Conference : The Third Annual Conference of Research Workers on National Income was held in Bombay during 1-5 November 1961. Sri Wankhede, Finance Minister, Government of Maharashtra, inaugurated the Conference and Sri H. V. R. Iyengar, Governor, Research Bank, presided. Dr. N. S. R. Sastry, Chairman, Steering Committee, welcomed the delegates.

MYSORE STATE BRANCH

Membership : The membership of the Branch at the end of the year stood as follows: Ordinary-27, Institutional-1, Life-3, Sessional-1, Total-32.

Office Bearers : The office-bearers for 1961-62 were elected at the 8th Annual General Body Meeting of the Branch held on 13 May 1961 (See Appendix 2).

Accounts : The Statement of Accounts for the year 1961-62 was audited by certified auditors.

Examinations : The Statistician's Diploma and Computer's Certificate Examinations of the Indian Statistical Institute were held at the Bangalore Centre during September 1961.

Pilot Surveys : Two sub-committees were constituted during the year, one to draw up proposals and also to formulate suitable programmes about the activities of the Branch, and the other to draw up proposals about a pilot survey that the Branch might undertake in one or two important industries (for the nature and distribution of dust, its vertical density and other particulars) to determine how far they would affect the health, efficiency and productivity etc. of workers. The sub-committees will continue their work during 1962-63.

The sub-committee constituted for the Pilot Survey on Industrial Estates which has already furnished its report regarding the Industrial Estate in Madras, continued its studies during the year and members of the Committee visited the Industrial Estates in Bangalore and Mysore.

The Director of Industries and Commerce, Madras, made appreciative remarks about the first report furnished by the Committee regarding the Industrial Estate, Gundy.

Visits Abroad : The following members of the Branch visited the countries mentioned against their names.

Sarvasri G. V. S. Desikan, Officer-in-charge, SQC Unit, Coimbatore, (USA, UK and the Continent); S. M. Sundara Raju, Officer-in-charge, SQC Unit, Madras, (USA and UK); M. V. Venkataraman, Deputy Regional Director, National Productivity Council, Bangalore and Member of the Productivity Team on Quality Control (USA, UK, Japan and the Continent); Srinagabhushna, Principal, SKSJ Technological Institute, Bangalore and Director, SQC Unit, Southern Regional Centre, Bangalore, (USSR and Czechoslovakia as a member of the Productivity Team on Textiles).

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Lectures : Under the auspices of the Mysore State Branch, Professor Alexander M. Riabohikov, Dean, Geographical Faculty, Moscow University and Chairman, Scientific Council of the Faculty, delivered a lecture, 'Natural Resources and National Economy', on 30 November, 1961.

Professor Chester I. Bliss, Biometrician, The Connecticut Agricultural Experiment Station, USA, delivered a lecture, 'Some Principles of Bioassay', on 13 January 1962.

Sri A. Ananthapadmanabha Rau, Ex-President of the Branch, who was in Bangalore from his UNO assignment in Ghana, spoke on the role of statistical investigations on cocoa cultivation being carried out in Ghana, when he met Branch members on 23 November 1961.

MADRAS CENTRE

The Madras Centre of the Indian Statistical Institute was inaugurated by Sri C. Subramanian, Minister for Education and Sri M. Bakhavatsalam, Home Minister, Government of Madras, on 13 September 1961.

Training : There were 164 applicants for the one-year Evening Course in Statistics. Ninetyfour persons took the entrance selection test and 24 were admitted to the course (22 according to merit and 2 deputed by the Government).

The regular classes for the first term (Part A) commenced on 13 September at the Presidency College where the Government of Madras had kindly lent two rooms to the Institute. The classes were held for 6 days in the week. The second term (Part B) commenced on 12 March 1962.

Lectures : Special lectures which were also held during the first term were attended by the trainees as well as a number of invitees. Professor C. I. Bliss, Connecticut Agricultural Experiment Station, USA, gave a lecture on 'General Models in Biology in relation to Statistical Inference' on 17 January 1962. Professor K. B. Madhava, Vice-President, Indian Statistical Institute, presided.

Sri K. C. Cheriyan, Agricultural Credit Department, Reserve Bank of India, gave a lecture on 'Rural Credit Surveys in India—Sampling Procedure', on 29 January 1962. Sri V. K. Narasimhan, Deputy Editor, *The Hindu*, presided.

Dr. A. Narasinga Rao, Honorary Professor, Massachusetts Institute of Technology, spoke on 'Galois Fields and Finite Geometries' on 7 February 1962. Dr. V. S. Krishnan, Professor of Mathematics, Madras University, presided.

Dr. Walter Shewhart, Bell Telephone Laboratories., USA, spoke on 'Quality Control' on 14 February 1962. Professor K. B. Madhava presided.

Professor K. B. Madhava, Vice-President, Indian Statistical Institute, spoke on 'Index Numbers' on 21 February 1962. Professor K. B. Vaudevan, Professor of Economics, Vivekananda College, presided.

All the meetings were well attended and were also followed by interesting discussions.

The trainees inspected the punching, verifying, sorting and tabulating machines at work in the machine room for the Southern Railway.

The trainees did well in all the five periodical tests held during the first term, and in the examination for all the subjects in Part A held from 26 February to 4 March 1962. Practical examinations were held in different batches due to the non-availability of an adequate number of calculating machines.

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A Committee of Management consisting of the following was formed to conduct the affairs of the Madras Centre : Professor K. B. Madhava, (President), Sri S. Guhan, IAS, (Deputy Secretary, Education and Public Health Department); Sri V. K. Narasimhan, Editor, 'The Hindu', Sri D. S. Rajabhushanam, Director of Statistics, Madras State; and Dr. (Mrs.) M. Krishnan, Secretary.

Four meetings of the Committee were held on the following dates : 4 and 28 August 1961, 28 December 1961 and 17 March 1962.

Kumari S. Satyabhama, IAS, Deputy Secretary, Education and Public Health Department, took Sri S. Guhan's place as a member of the Committee of Management for the last meeting, on Mr. S. Guhan's transfer to Delhi.

Dr. (Mrs.) Marakatha Krishnan, officer-in-charge, was engaged in research, in addition to her normal work.

A research fellowship was awarded to Sri T. Krishnan who joined duty on 2 April. Sri K. Natarajan, Office Assistant, helped in looking after the accounts, issue of library books and the office correspondence.

KERALA

The Kerala Branch of the Indian Statistical Institute was started on 8 April 1961 with its headquarters at Trivandrum.

Membership : The membership of the Branch rose to 20 from 12 at the end of 1961-62.

The Branch plans to conduct surveys as well as evening classes for the Computer's Certificate Examinations of the ISI. The University of Kerala has agreed to help the Branch in its activities.

13. VISITING SCIENTISTS

Since 1958 the Indian Statistical Institute has been inviting distinguished scientists from abroad to come to the Institute as visiting professors. Such visits have not only been of considerable benefit to the Institute and its workers but have also contributed to a wider knowledge and an appreciation of the work of the Institute and of Indian conditions and problems in other countries.

Foreign Scientists : During the year, a number of distinguished foreign scientists participated in the research, training and other activities of the Institute. Some of them stayed for fairly long periods and assisted in the regular work of the Institute, while others came for short periods and participated in lectures and seminars. Most of them were available for consultation by research workers and teachers of the Institute. A list of the visiting scientists is given below. The dates in parentheses indicate the period of their work in the Institute.

AUREL, A. G., Senior Statistician and Operations Analyst, Stanford Research Institute, California, USA; assigned by the United Nations to work as Director of Studies, International Statistical Education Centre, Calcutta (18 July 1961-13 April 1962).

BLISS, C. I., Connecticut Agricultural Experiment Station, New Haven, USA.
Lectures : (i) General Models in Biology in relation to Statistical Inference, (ii) Comparison of Plant Genetics and Human Genetics, (iii) Regression Analysis of Biological Cycles.

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Dr. Bliss also participated in the teaching activities of the RTS and IBEC (14 December 1961-8 March 1962).

BOBE, E. C., University of North Carolina, USA. *A course of three lectures: Error Correcting Codes. (10-12 October 1961).*

BOURBON, D. G., Professor of Mathematics, University of Illinois, USA. *Lecture: Mapping Theorems. (31-29 March 1962).*

BRODY, E. J., Professor of Mathematics, formerly of University of Malaya, Singapore, came to the Institute on 28 February 1962. Since then he has given a series of lectures/seminars on Algebraic Topology.

CHANDRASEKHAR, S., F.R.S., Morton D. Hall Distinguished Service Professor of Theoretical Astrophysics, Yerkes Observatory, University of Chicago, USA, *Lecture: The Statistical Theory of Turbulence (17-22 September 1961).*

COLLATE, LOTHAR, Director, Institut für Angewandte Mathematik (Institute for Applied Mathematics), University of Hamburg, Federal Republic of Germany. *Three lectures: (i) Upper and Lower Bounds of Approximate Solution of a Given Problem with Monotonic Operators, (ii) Different Types of Topological Spaces and their Application to Numerical Mathematics, (iii) Numerical Example Illustrating the Methods. (26-30 December 1961).*

COMFORT, ALEX, Nuffield Research Fellow in Gerontology, Department of Zoology, University College, London, UK. He came to India to initiate the setting up of a Gerontology Unit and was of considerable help in organising the Unit. (22 December 1961-14 February 1962).

ERWIN, P. D., Pro-Rector, People's Friendship University, Moscow, USSR. *Lecture: Education in the Soviet Union with Special Reference to Friendship University (3 April 1962).*

FABRICANT, SOLOMON, Director, National Bureau of Economic Research, New York, USA. *Lectures: (i) Industrial Structure and Economic Growth, (ii) Measurement of Productivity. (11-18 November 1961).*

FISHER, SIR RONALD A., F.R.S., Division of Mathematical Statistics, Commonwealth Scientific and Industrial Research Organization, University of Adelaide, S. Australia. *A course of four lectures on Scientific Inference. Topics discussed: Connectivity and Mutual Dependence of Experimental Designs, Statistical Analysis, Logical Examination of Disputed Questions which cannot be adequately studied in isolation. (5 December 1961-14 February 1962).*

GATTS, R. RUGGLES, F.R.S., Honorary Research Fellow in Biology, University of Harvard, USA. *Lecture: "Comparison of Plant Genetics and Human Genetics". (30 September 1961-1 March 1962).*

Hsia, DAVID YI-YUNG, Professor of Pediatrics, Northwestern University Medical School; Director, Genetics Clinic, Children's Memorial Hospital, Chicago, USA. *Lecture: Galactosemia, its Clinical, Genetical and Biochemical Aspects (14 December 1961).*

HUSSAIN, Q. M., Director, Statistical Survey Research Unit; Professor of Statistics, University of Dacca, Pakistan. *Lecture: Idios Behind Correlation (20-28 January 1962).*

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KATZ-SUCHY, J., Ambassador Extraordinary and Plenipotentiary in India, People's Republic of Poland. *Lecture* : Some of the Problems of Economic Growth on Example of Poland. (27 March 1962).

KAUFMAN, ARNOLD, Professor, Institut Polytechnique de Grenoble Ecole Nationale Supérieure des Mines de Paris, France. *Lecture* : Automation and its Social Consequences (6 November 1961).

KOLMOGOROV, ACADEMICIAN A. N., Professor of Mathematics, University of Moscow, USSR. *Lectures* on the following topics (i) Tables of Random Numbers, (ii) Some Trends in Modern Mathematics, (iii) On the Estimation of Parameters of a Complex Stationary Gaussian Markov Process and (iv) On the Approximation of the Distributions of Sums of Independent Summands by Infinitely Divisible Distributions. He held a number of seminar discussions on different problems in cybernetics, ergodic theory and limit theorem in Probability Theory. He also gave a course of lectures at the Seminar School organized by the Institute at Bangalore in May-June 1962. (14 April-12 May 1962).

KOMAR, I. V., and POPOV, K. M., Institute of Geography, USSR Academy of Sciences, were invited by the Institute to study problems of regionalisation for planning. They met and exchanged ideas on problems of regionalisation and development of natural resources, with the leading geographers at Calcutta, Bombay and Madras. They also studied the work of the Regional Survey Unit of the Institute and made valuable suggestions regarding the future programme of work. (18 April-31 May 1961).

KONJUN, H. S., Professor of Mathematics and Economic Statistics, University of Sydney, Australia; Cowles Foundation, Yale University, USA. *Lecture* : Problems in the Estimation and Use of Production Functions. (25-28 December 1961).

LEARMONTH, A. T. A., Department of Geography, University of Liverpool, UK., who assisted in setting up the Regional Survey Unit in 1956 returned on a brief visit to India in March 1962. He visited Delhi, Calcutta and Bangalore and delivered some lectures. (20 March-11 May 1962).

MASUYAMA, M., Institute of Physical Therapy and Internal Medicine, Faculty of Medicine, University of Tokyo, Japan. Two lectures on "Graphical Methods in Tests of Significance". (22 September 1961-14 January 1962).

METROPOLIS, NICHOLAS C., Professor of Physics, Institute of Computer Research, University of Chicago, USA. (3 October-3 November 1961).

MONROY, ALBERTO, Principal, Department of Zoology, Palermo University, Italy. *Lecture* : Protein Synthesis during the Early Embryonic Development. (16-26 August 1961).

MORIGUTI, SHIGEMI, Professor of Applied Physics, Faculty of Engineering, University of Tokyo, Japan. *Lecture* : A Bayes Test of $P \frac{1}{2}$ Versus $P^1 > \frac{1}{2}$. (2-7 April 1962).

PHILLIPS, J. G., Deputy Governor, Reserve Bank of Australia. *Lecture* : Role of the Reserve Bank in the Fiscal Economy of the Country. (3-5 July 1961).

RIASHCHIKOV, A. M., Dean, Faculty of Geography, Moscow University and NIKOLAEV, V. A., senior scientific worker, Chair of Physical Geography, Faculty of Geography, Moscow University, were invited by the Institute to participate in studies of regionalisation in collaboration with the Perspective Planning Division of the Planning Commission, Government

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of India. They visited different States to become acquainted with (a) problem of land improvement, (b) character of the terrain, and (c) facilities for geographical training. (11 October 1961-13 February 1962).

RODIN, L. E., V. L. Komarov Botanical Institute, USSR Academy of Sciences, Leningrad, was invited by the Institute for consultation on problems of regionalisation in India, particularly in arid and semi-arid regions, as part of the work of the Regional Survey Unit. He toured the arid parts of Rajasthan, the Bhal reclamation area of Saurashtra and the saline areas of Cutch along with a research worker of the Institute. He held discussions with the working group of the Central Arid Zone Research Institute, Jodhpur, agricultural experts of the Dutch firm 'NEDCO' in Vallabhipur, and the Irrigation Department, Gujarat State, on the problems of reclamation of sandy and saline areas, afforestation schemes, measures to check migration of sand dunes, etc. Dr. Rodin submitted a technical note on the basis of the reconnaissance study tour. (16 April-12 July 1961).

RUTHERFORD, R. S. G., Associate Professor, Economic Statistics, University of Sydney, Australia. *Lecture*: "Some Notes on the Possible Errors Involved by Using 'Income per Capita' Information to Measure the Concentration of 'Income per Career' Distributions". (11 October-5 December 1961).

SCHARENBAUGH, F. H., Swiss Foundation for Alpine Research, Zurich, Switzerland. *A course of six lectures*: (i) History, Development and the Scope of a Germination Test in Biology and Statistics, (ii) A Quick Assay Method for the Detection of Biologically Active Principles. (3 November-2 December 1961).

SHEWHART, WALTER A., Bell Telephone Laboratories, USA. (17 December 1961-14 February 1962).

WILKINSON, G. N., Senior Research Officer, Division of Mathematical Statistics, Commonwealth Scientific and Industrial Research Organization, University of Adelaide, S. Australia. *Four lectures*: (i) Some Remarks on Fiducial Probability, (ii) A Formula for the Expected Value of the Interblock Sum of Squares in the Analysis of Incomplete Block Designs arranged in Replications, (iii) Experimental Design Solution by Inversion within Quadratic Forms (in lieu of solving normal equations), and (iv) Nutrient Response Laws in Plant Nutrition. (16 July-7 August 1961).

WINKELBAUER, KARL, Assistant Director, Institute of Information Theory and Automation, Czechoslovak Academy of Sciences. Two lectures on "Some New Problems on Information Theory". He participated in several discussions and gave a series of lectures at the Summer School, Bangalore, on Information Theory and Automation. (19 March-8 September 1961).

LECTURES BY INDIAN GUEST SCIENTISTS

A list of lectures given by guest scientists from other Indian institutions and Government departments is given below:

BHATTACHARYYA, P. K., National Chemical Laboratory, Poona. *Lecture*: Microbiological Transformation of Terpeni. (9 February 1962).

LALITHI, S. K., National Productivity Council, Calcutta. *Lecture*: Work Studies (1 November 1961).

MENON, P. K., Joint Cipher Bureau, Ministry of Defence, Government of India, New Delhi. *A course of six lectures* on (i) Combinatorial Problems, and a popular lecture on (ii) Artistic Designs. (4 October 1961).

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PRASAD, TRIBHUVAN, Bihar Institute of Technology. *Lecture : Automation and Computations. (11 December 1961).*

SHEKHANDE, S. S., Professor of Statistics, Banaras Hindu University, Banaras. *Lecture : New Methods on Construction of Designs (10-11 October 1961).*

14. VISITORS

Among other visitors may be mentioned :

VLADIS BALANT, Director, Institute of Chemical Process Fundamentals, Prague, Czechoslovakia. (9-12 January 1962).

J. D. BERNAL, F.R.S., UK. (2 April 1961).

P. M. S. BLACKETT, Nobel Laureate, UK. (6-8 January 1962).

B. G. BANTROUT, Regional Statistician for Asia and Far East, Regional Office of Food & Agricultural Organisation, Bangkok, Thailand. (20-25 February 1962).

G. EYMOV, Member, State Committee, USSR, Council of Ministers for Cultural Relations with Foreign Countries, USSR. (3 February 1962).

SHIOBU FUJI, Dean, Faculty of Economics, Professor, International Economics, Kobe University, Japan. (16 December 1961).

H. HANANI, Department of Mathematics, Israel Institute of Technology, Israel. (28-29 September 1961).

SYED HOSSAIN, Vice-Chairman, Planning Commission, Pakistan. (20 November 1961).

J. N. KHOSLA, Indian Ambassador to Indonesia. (8 April 1961).

KIYOSHI KOJIMA, Professor of International Economics, Hitotsubashi University, Kunitachi, Tokyo, Japan. (16 December 1961).

HENRY A. KISSINGER, Consultant to President Kennedy; Professor, Harvard University, USA. (19 January 1961).

DAME CATHERINE LOWSDALE, Vice-President, Royal Society, UK. (9 January 1962).

FIKRET NARTER, Professor of Mechanical Engineering; Rector, Technical University of Istanbul, Turkey. (4-12 January 1962).

B. L. RAJNA, Director of Forestry Planning, Directorate-General of Health Services, Government of India. (24 January 1962).

HANNA RIZK, Vice-President, American University of Cairo, Head of the Division of Public Service, UAR. (13 January 1962).

GEORGE SEIBYI, Director, Institute for Technical Physics, Budapest; Member, Hungarian Academy of Sciences. (9-12 January 1962).

SOMARMAN, Senior Officer, Department of Home Affairs and Regional Autonomy, Republic of Indonesia. (28 February 1962).

RT. HON. JOHN SYMAOLEY, M.P., UK. (18 March-2 April 1962).

WILLIAM C. SHERLTON, Chief, Division of Foreign Labour Conditions, Bureau of Labour Statistics, U.S. Department of Labour, USA. (11 December 1961).

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E. I. VASSILYEV, Professor, Bulgarian Academy of Sciences, Sofia, Bulgaria. (*9-12 January 1962*).

G. A. ZUKOV, Chairman, State Committee, USSR Council of Ministers for Cultural Relations with Foreign Countries, USSR (*3 February 1962*).

15. VISITS ABROAD

Sri S. Banerjee, National Sample Survey, attended as a member of the Indian delegation, the Fourth Session of the Conference of Asian Statisticians at Tokyo in November-December 1961. He visited the Bureau of Statistics, Prime Minister's office, Government of Japan.

Sri N. C. Ghosh, National Sample Survey, served as the Discussion Leader of the Seminar on Industrial Statistics of the Economic Commission for Asia and the Far East (ECAFE) held in September 1961 at Bangkok under the joint auspices of the Statistical Office of the United Nations and the ECAFE. He also served as a consultant to the ECAFE.

Dr. S. L. Jain, Geological Studies Unit, went to the U.K. for one year in August 1961 for training in vertebrate palaeontology. He has been working at the British Museum (National History Section) in collaboration with the Museum Curator and Dr. P. L. Robinson of the University College, London, on the vertebrate collection of the Museum as well as on a collection he took with him from India. He is also undergoing training in the techniques of fossil preparation and the organisation of museums.

Sri T. S. Kutty, Geological Studies Unit, was sent by the Institute in August 1961 for three years' basic training and study in geology at the University College, London.

Sri D. B. Lahiri, National Sample Survey, attended as an Adviser the meeting of the United Nations Working Group on Sampling at Geneva in September 1961. In September-October 1961 he visited, among others, the following research institutions and agencies where he held discussions on methodology of sampling survey and other topics: International Labour Office and World Health Organisation (Geneva); Office of the International Statistical Institute and Statistical Office of the Netherlands (The Hague); Social Survey (London); Rothamsted Experimental Station (U.K.); Federal Institute of Statistics (Belgrade); and the Academy of Sciences (Sofia). He delivered addresses in Belgrade and Sofia on methods of sampling as developed in India.

Professor P. C. Mahalanobis went abroad five times during the year to attend international conferences, to arrange for the exchange of scientific personnel and to give lectures. He paid a short visit to Moscow at the invitation of the USSR Academy of Sciences from 28 March to 3 April 1961. During his second trip (8 June-25 July 1961), he visited Switzerland, Yugoslavia, the U.K. and the USSR. On his third visit (28 August-23 September 1961), he went to France and Czechoslovakia. On his fourth trip (5 October-11 December 1961), he visited the USSR, Czechoslovakia, Switzerland, the U.K., Yugoslavia, Bulgaria, Istanbul and Bahrain. On his fifth trip (3 March-14 March 1962), he visited Austria and the U.K. (For details see Appendix 4).

Sri M. Majumdar, National Sample Survey, attended, as a member of the International Union for the Scientific Study of Population, the International Population Conference in New York in September 1961. He read a paper at the Conference.

Dr. A. Matthal, Research and Training School, went to Geneva in June 1961 to assist in conducting the International Non-Governmental Conference in Economic Develop-

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ment of Less Developed Countries (6-9 June 1961), organized by the Indian Statistical Institute. He also visited several industries and SQC centres in Switzerland, the Netherlands and the U.K.; and also attended the Statisticians' Annual Conference at Oxford. He also visited the important statistical offices and research institutions in the Netherlands and the U.K. He had some discussions at the International Statistical Institute at The Hague relating to the International Statistical Education Centre attached to the Indian Statistical Institute. He was deputed by the Institute as a consultant to the Economic Commission for Asia and the Far East (ECAFE), Bangkok, for two months, November 1961-January 1962, for the preparation of a manual on the training of statistical personnel.

Sri K. G. K. Murthy, Statistical Quality Control Unit, Calcutta, was sent by the Institute to the USA for studies in Operations Research. He left on 6 July 1961.

Sri B. K. Raja Rao, Statistical Quality Control Unit, Kerala, was selected by the National Productivity Council as a member of the Productivity Team on Quality Control to go abroad under the TCM Programme. He left with the team on 27 July 1961 and spent about eight weeks in Japan, the USA and the U.K. He visited different organizations, held discussions and studied the system of Quality Control. He also spent a further period of eight weeks in the U.K., Holland and France to study recent developments of Statistical Quality Control in those countries. He returned in October 1961.

Dr. C. R. Rao, Head, Research and Training School, attended the 33rd session of the International Statistical Conference held in Paris from 29 August to 7 September 1961. He went to the U.K. in November 1961 at the invitation of the Royal Statistical Society, London, to deliver a course of special lectures at the University of London. Of the three lectures he delivered, the first was on 'Some New Tests in Large Sample Theory' and the two others on 'Problems of Discrimination with Multiple Characters'. He attended a joint seminar under the auspices of the Imperial College, Birkbeck College and University College, London, where he lectured on 'A Generalised Inverse of Matrix and its Application to Problems of Mathematical Statistics' and 'Some New Problems on Multivariate Analysis'. At the University of Birmingham, he delivered lectures on the 'Use of Discriminant and Allied Functions in Multivariate Analysis'; at a research meeting of the Royal Statistical Society, London, on 'Efficient Estimates and Optimum Inference Problems'; at the University of Aberdeen, Scotland, on 'Second Order Efficiency in Estimation'; and at the University of Zurich, Switzerland, on 'Testing Prior to the Application of Discriminant Functions'.

Sri S. P. Sen, Development Workshop, was sent for training to Czechoslovakia for six months in May 1961 on a Productivity Fellowship arranged by the National Productivity Council with the aid of the Czechoslovak Government. His training programme comprised a course of lectures on engineering and allied subjects, working in factories for practical training and visiting a number of workshops. He returned in December 1961.

Sri C. A. Sotty, Statistical Quality Control Unit, Bangalore, left for the U.K. on 19 September 1961, under the Colombo Plan Programme. He attended a course of lectures on Methodology of Operations Research at the Royal Statistical Society at Birmingham. He visited and worked in some important industrial organizations where SQC methods are practised. He returned on 17 April 1962.

Sri R. K. Som, National Sample Survey, presided over the session on 'New Methods of obtaining Vital Statistics in Under-developed Countries' at the International Population

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Conference, New York, in September 1961. He also presented a paper at this Conference. In September-October 1961, he visited centres of demographic research in the USA and Europe, among which may be mentioned : U.S. Bureau of Census and the U.S. National Centre for Health Statistics (Washington); Population Research Centre, Department of Sociology, and Population Research Centre (Chicago); United Nations Population Branch (New York); Department of Sociology and Survey Research Centre (Ann Arbor); Office of the Registrar-General (London); International Labour Office and the World Health Organisation (Geneva); Food and Agriculture Organisation (Rome); and the Federal Institute of Statistics (Belgrade). In Belgrade he delivered a lecture on the organization and methods of the National Sample Survey in India.

Sri Srinagabhushana, Executive Director, Statistical Quality Control Unit, Southern Regional Centre, was selected by the National Productivity Council as a member of the Productivity Team on Textile Industry to visit the USSR and Czechoslovakia. He left India as a member of the team on 6 July 1961 and spent about seven weeks in those countries. He visited some textile mills and textile machine manufacturing concerns. He returned on 28 August 1961.

Sri S. M. Sundara Raju, Statistical Quality Control Unit, Madras, left India for the USA on 5 September 1961, under the UNTAA training programme. He attended SQC courses at the Rutgers Statistics Centre and participated in conferences and seminars organized by the American Society for Quality Control. He visited industrial plants in the USA. He went to the U.K. for a short period and visited some plants operating SQC programmes and held discussions with experts in SQC. He returned on 7 March 1962.

16. EXTERNAL ACTIVITIES

As in previous years, the workers of the Institute participated in conferences, served on various committees and gave lectures at many places in India. An account of these activities is given in Appendix 12 but mention may be made here of some of the more important of these activities.

Sri D. B. Lahiri, National Sample Survey, attended as a representative of the Institute, the First Conference of the Central Technical Advisory Council of Statistics in New Delhi in December 1961.

Dr. A. Matthai, Research and Training School, attended a symposium on Statistical Quality Control organized by the Jamshedpur Productivity Council and delivered a lecture on "Organising for Statistical Quality Control".

Sri Monimohan Mukherjee, Head, Planning Division, attended the Second Indian Econometric Conference at Waltair in June 1961 and presented a paper on 'The Derivation of Size Distribution of Personal Household Income from a given size Distribution of Consumer Expenditure'.

Dr. Ramkrishna Mukherjee, Head, Sociological Research Unit, participated in the Decennial Symposium of the Indian Sociological Society at Mysore in October 1961.

Sri Jibananda Saha, Chief Librarian, attended the Indian Standards Convention held in Kanpur from 25 to 30 December 1961 and presented a paper.

PART 2 : RESEARCH SUMMARY

A brief account is given in this section of the progress of research in the different divisions and sections of the Institute. Lists of scientific and technical papers published or read at conferences or submitted for publication and working papers and notes are given in Appendix 5. References are also given in this section to relevant papers in Appendix 5.

RESEARCH AND TRAINING SCHOOL

1.1. THEORETICAL STATISTICS

1. *Probability Theory* (E. M. Paul, S6) : Let $p_1 = 2, p_2, p_3, \dots$ be the prime numbers in ascending order. Let $\{X_n\}$ be a sequence of measure spaces, each X_n consisting of the points $0, 1, 2, 3, \dots$. In X_n we place mass $\left(1 - \frac{1}{p_n}\right) \frac{1}{r_n}$ at the point $(r = 0, 1, 2, \dots)$. We take the product space $X_1 \times X_2 \times X_3 \dots$ and the product measure P in it. Each point of this space is an 'infinite vector' (x_1, x_2, \dots) , the co-ordinates being non-negative integers.

Now let S be any set of positive integers. By the *upper magnification* $M^u(S)$ of S , we mean the set of vectors (x_1, x_2, \dots) such that $2^{x_1} p_2^{x_2} \dots p_n^{x_n} \in S$ for infinitely many values of n . By the *lower magnification* $M_l(S)$ of S , we mean the set of vectors (x_1, x_2, \dots) such that $2^{x_1} p_2^{x_2} \dots p_n^{x_n} \in S$ for all sufficiently large n . In this paper, we prove that $P[M_l(S)] < \partial_l(S) < \partial^u(S) < P[M^u(S)]$, where $\partial_l(S)$ and $\partial^u(S)$ represent the lower and upper logarithmic densities of S , respectively.

Also, let f be a real valued function defined on the set of positive integers. We prove that if the sequence of random variables $f(2^{x_1} p_2^{x_2} \dots p_n^{x_n})$, defined on the probability space $X_1 \times X_2 \times X_3 \dots$ converges with probability one to a random variable g , then f has a distribution, namely, that of g ; in defining the distribution of f , we employ logarithmic density. The whole theory is formulated in an abstract framework.

2. *Probability Distributions on Groups* (K. R. Parthasarathy, R. Ranga Rao and S. R. S. Varadhan, S7) : Let X be a locally compact abelian group which is separable metric and let Y be its character group. For $x \in X$ and $ye Y$ let (x, y) denote the value of the character y at the point x . A measure μ on the Borel field of X is said to be infinitely divisible, if, for every positive integer n , there exists an element x_n and a measure μ_n such that the translate of μ by x_n is the n -th power of μ_n in the sense of convolution. The main result of this paper can be stated as follows : in order that a measure μ may be infinitely divisible and without idempotent factors it is necessary and sufficient that its characteristic functional be of the form $(x_0, y) \exp \int [(x, y) - 1 - iy(x, y)] d\mu(x) - \phi(y)$, where x_0 is a fixed element of X ; m is a σ -finite measure on X having finite mass outside every neighbourhood of the identity and integrating $(1 - \text{Real}(x, y))$ for each $ye Y$; $g(x, y)$ is a fixed real valued function independent of μ and ϕ is a continuous function on Y with the property $\phi(y_1 + y_2) + \phi(y_1 - y_2) = 2\phi(y_1) + \phi(y_2)$. However, the representation is not always unique.

3. *Estimation in Large Samples* (C. R. Rao, S12) : The following theorems are proved under certain regularity conditions.

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Theorem 1. If $r_n(\theta)$ is the power function of any test criterion based on a sample of size n for testing the null hypothesis $\theta = \theta_0$ at a level of significance α , then

$$\lim_{n \rightarrow \infty} n^{-1} r'_n(\theta_0) < \frac{1}{2\pi} e^{-\alpha^2/2}$$

where $r'_n(\theta_0)$ is the derivative of $r_n(\theta)$ at θ_0 and α is the 100 α % point of the standard normal deviate.

Theorem 2. If $\beta_n(\theta) = 1 - r_n(\theta)$, then

$$\lim_{\theta \rightarrow \theta_0} \lim_{n \rightarrow \infty} \frac{n^{-1} \log \beta_n(\theta)}{(\theta - \theta_0)^2} > \frac{-i(\theta_0)}{2}$$

It is shown that for tests based on efficient estimates (in the sense of first order efficiency defined in earlier papers of the author) the upper and lower limits of Theorems 1 and 2 are actually attained. These results establish optimum properties of efficient estimates in relation to their use in statistical inference.

4. *Higher Algebra* (C. R. Rao, S13) : The literature on attempts to define a generalised inverse of a singular or a rectangular matrix including that of the author in 1955 is briefly reviewed. It is shown that a generalised inverse (g -inverse) of a matrix can be constructed in such a way that it can be used to test the consistency of linear equations involving the matrix. The computation of such an inverse is demonstrated. The use of a g -inverse in the solution of some problems in mathematical statistics is demonstrated.

5. *Multivariate Analysis* (C. R. Rao, S14) : It is well known that the best selection function (in plant and animal breeding) for a desired characteristic (y) in terms of concomitant measurements (x_1, \dots, x_p) is the regression of y on x_1, \dots, x_p . In practical problems it sometimes happens that such a selection function which is best for y may bring in a deterioration in some other characteristic z_i , $i = 1, 2, \dots$, which may be considered undesirable. The problem is then that of constructing a selection function in terms of x_1, \dots, x_p so as to maximise the expected value of y in the selected individuals subject to the condition that the expected values of z_i are not below the values in the population from which the individuals are selected. The solution of the problem ultimately depends on quadratic programming. An elegant solution is provided for $i = 1$ or 2.

6. *Design of Experiments, Combinatorial Problems* (D. K. Roychoudhuri, S10) : Let $X = x_1, x_2, \dots, x_n$ be a finite set of n points and $A = A_1, A_2, \dots, A_n$ be a class of n subsets of X . Such a system of points and sets is called a complex (X, A) . If every set of the class A contains two points the complex is a graph with n points x_1, x_2, \dots, x_n and n edges A_1, A_2, \dots, A_n . For any subclass A_1 of A , $A_1(x)$ denotes the class consisting of the sets of A_1 which contain x . $|A_1|$ denotes the number of sets in the subclass A_1 . Let $c = (c(x_1), c(x_2), \dots, c(x_n))$ be a vector of n positive integers. A subclass A_1 is called a c -cover if for every point x , $|A_1(x)| \geq c(x)$. A subclass A_1 is a c -matching if $|A_1(x)| \leq c(x)$ for every point. Covers with minimum number of sets and matchings with maximum number of sets are respectively called minimum covers and maximum matching. Berge and Norman and Robin proved a number of theorems for minimum covers and maximum matchings of graphs and also gave algorithms for finding minimum covers of graphs. In the present paper similar results are proved for general complexes. An algorithm is developed for minimum covers of complexes. Many combinatorial problems of interest in statistics can be formulated as a minimum cover problem.

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D. K. Roychaudhuri (P16) : A quadric Q in $PG(n, s)$, the finite projective geometry of n dimensions based on $GF(s)$, is the set of points $\frac{x}{(1 \times n + 1)}$ such that $xAx = 0$ where A is a triangular matrix of order $(n+1) \times (n+1)$ with elements from $GF(s)$. The matrix A is taken to be triangular so as to enable us to develop the theory for the case of characteristic 2 also. The quadric Q is called degenerate if by a non-singular transformation the number of variables in the equation of Q can be reduced. A point $\frac{\alpha}{(1 \times (n+1))}$ is defined to be conjugate to a point $\frac{\beta}{(1 \times n + 1)}$ if $\alpha(A+A')\beta' = 0$. The polar of α is the $(n-1)$ -flat determined by the equation $\alpha(A+A')x' = 0$. Primrose developed methods for counting points in a non-degenerate quadric. In the present paper, we obtain formulae for the number of p -flats in a non-degenerate quadric. By applying the principles of projection, properties of linear spaces contained in a quadric are studied. It is shown that every non-degenerate quadric Q in $PG(m, 2^k)$ contains a point S , called nucleus of polarity, such that every tangent space of Q passes through S .

D. K. Roychaudhuri (S11) : A systematic method of studying the properties of linear spaces contained in quadric surfaces in finite projective spaces has been developed by Roychaudhuri (P12). The incidence properties of intersection of linear spaces contained in a quadric are studied. The results of this paper are applied for constructing several new series of Partially Balanced Incomplete Block Designs.

C. R. Rao (P11) : Several years ago C. R. Rao introduced new combinatorial arrangements called orthogonal arrays which were found useful in solving many combinatorial problems. In the present paper some other combinatorial arrangements called orthogonal arrays of Type II, useful in the construction of dicyclic solutions to balanced incomplete blocks, have been defined. Consider a set S of s symbols and a $t \times N$ matrix of elements of S . Such a matrix is called an *orthogonal array of Type II*, strength d , constraints t and index λ if in every set of d rows, the N columns contain each of the $s!/d!(s-d)!$ combinations of s elements taken d at a time with order ignored and without repetitions, λ times. It has been proved that when $d = 2$, and s is a prime or prime power such arrays exist with the minimum possible N and maximum possible t .

7. *Sampling Distributions* (J. Roy and M. L. Tikku, S8) : The sampling distribution of the variance in a sample from a non-normal population has been worked out in Laguerre series form and the coefficients of the first few terms obtained explicitly in terms of the population cumulants. This can be regarded as an extension of Gaven's expansion. This distribution is used in investigating the robustness of the Analysis of Variance tests.

8. *Sample Surveys* (P. K. Pathak, S3) : In simple random sampling with replacement authors like Basu and Des Raj and Khamis have shown that for estimating the mean, the average of distinct units is more efficient than the overall sample mean. This problem is considered in greater detail and the variance of the above estimator is worked to be

$$v(\bar{y}) = \frac{1^{n-1} + 2^{n-1} + \dots + (N-1)^{n-1}}{N^n} S^2$$

where \bar{y} is the average of distinct units in the sample, S^2 is the population variance and n and N are sample and population sizes respectively. Several other estimators of the population mean are suggested and their relative efficiencies compared. This estimator is found to

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be of smaller variance than the well-known Horvitz-Thompson estimator only when the coefficient of variation in the population is less than a specified quantity. Unbiased estimators of $s(y)$ are given and their relative performance is studied with the help of a numerical example. An improved estimator of the population variance is also derived. A comparison is made between the two simple random sampling schemes (with and without replacement) for the purpose of estimating the population mean.

9. *P. K. Pathak (S4)* : The problem of deriving improved estimators in sampling with unequal probabilities of selection is considered. An improved estimator \hat{y} of the population mean based upon the distinct sample units in the sample is suggested and it is shown to be having a uniformly smaller risk function than the usual estimator \bar{z} for any convex loss function. For large sample sizes, a simpler improved estimator which is less efficient than \hat{y} but simpler to compute is suggested. Two improved estimators of the square of the population total are also presented; one of them is simple to compute while the other is unwieldy. A remark on the Rao-Blackwell theorem is made and is utilised in deriving some further simpler improved estimators.

10. *P. K. Pathak (S5)* : In the case of sampling with unequal probabilities, two-stage sampling (first stage with unequal probabilities and second stage by simple random sampling) and stratified sampling with unequal probabilities, unbiased ratio estimators of the ratios of population totals of two characteristics, more efficient than the one given by Murthy, Nanjamma and Seth are presented. The results derived indicate that the improved estimators in these modified sampling schemes are obtained simply by taking the ratio of the improved estimators of the numerator and denominator respectively under the original sampling scheme (without modification). The method of improvement is essentially based on Rao-Blackwell theorem.

11. *J. Roy and G. Kalyaneundaram (S9)* : When sampling is with unequal probabilities, unbiased estimates of population totals are obtained as weighted sums of sample observations, weights being reciprocals of the probabilities of selection. This makes data processing on punched card machines somewhat laborious since a calculator has to be used in computing the product of the weight and the sample observation. Two methods of rounding of the weights in a randomized way without introducing any bias into the estimate are described and under certain conditions one is shown to be superior to the other in respect of the variance. The use of standard punched card machines in randomly rounding off the weights and the use of Electronic Statistical Machine in enumerating type of data with randomized rounded off weights are appended.

12. *T. V. Hanumantha Rao (S16)* : The well-known problem of estimating the total of a variable Y defined over a finite population of size N , say, is considered in this paper. Interest is focussed on the practical cases when auxiliary information such as the values of a variable X highly correlated with the variable Y are known for all the units of the population. In such cases it can be supposed that the realised (but unknown) values y_i are realisations of random variables Z_i whose expectations and variances for given values x_i of the auxiliary variable X , are known (partly or fully) in terms of x_i 's. This concept of super population has been introduced by Cochran and since then has been in use as a successful one. In many cases that we come across in practice we can assume that

$$E(Z_i/x_i) = ax_i \quad i = 1, 2, \dots, N$$

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where a is an unknown constant. It is to be noted that we tacitly make such an assumption when we use pps estimators and ratio estimators. If then we take the probabilities of including the i -th unit in the sample to be proportional to x_i and use the well-known Horwitz and Thompson's estimator, the question arises as to what further restriction should be put on the sampling design to make it optimum (in the sense of minimising the expected variance). The author proves that the class of sampling designs which, while resulting in the prescribed values of the inclusion probabilities, minimise the variance of the sample size (where we ignore repetitions of units in a sample) have this optimum property, and none else. The only further assumption involved is that the random variables Z_1, \dots, Z_N are pair-wise-independent.

Further, regarding the conditional variances $V(Z_i/x_i)$ in many cases we can assume that these variances are proportional to x_i^2 's (i.e., constancy of conditional coefficients of variations). Under this assumption it is proved that for designs having average sample size 2, the Horwitz and Thompson's estimator in the corresponding optimal class of designs is uniformly superior to the un-ordered Des Raj's estimator. It seems plausible that the result holds for any (average) sample size.

13. *Design of Experiments, Analysis of Data* (K. R. Shah, S17): In a previous paper J. Roy and K. R. Shah had shown that the combined inter and intra block estimates of treatment contrasts are unbiased and that they have finite variance. The expression for variance obtained there has been evaluated here for the designs which are duals of BIB designs and this variance has been compared with that of the intra-block estimate.

14. *Genetics* (T. V. Hanumantha Rao, S15): When a stock of species has to be maintained from an initial stock and when we want to keep the same number of mating pairs in each generation, and at the same time to minimise inbreeding it is felt that a system of mating which we call cyclic mating systems (borrowing Professor Haldane's terminology) will suit the purpose.

In this system, we start with a fixed number say ' s ' of mating pairs and number them. We then mate a random offspring of the first pair with one of the second pair, a random offspring of second pair with one of the third pair and so on. A random offspring of the s -th pair will be mated with one of the first pair. We continue the same process for the further generations and will always have " s " mated pairs in each generation. The problem is to find the expression for inbreeding coefficient of n -th generation.

Only autosomal genes have been considered in this paper. The difference equations that will result have two suffixes. These equations have been solved by an entirely new method using matrix algebra. Explicit expression for the required coefficient of inbreeding was then found out in terms of the latent roots of certain matrices. Due to the asymmetry in the difference equations for even and odd values of ' s ', these cases have been separately dealt with. It was felt necessary to tabulate the latent roots and latent vectors of the corresponding matrices, at least for the range of values of s from 10 to 12, but could not be undertaken as yet. It is to be noted that three of the commonly known mating systems—the sibmating, first-cousin mating and double-first cousin mating are special cases of our general set-up.

15. *Random Permutations* (C. R. Rao, P13): A general method for generating random permutations of any number n of integers using a table of random sampling numbers and without wasting the random numbers read, is given. The method consists in drawing

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a random numbers of suitable digits and arranging them in increasing order. The relation between the *order* in which the numbers were drawn and the manner in which they are arranged in increasing order gives in a natural way a random permutation of the integers $1, 2, \dots, n$. However, if the same number is drawn more than once, further random permutations of these sets of equal random sampling numbers are needed to determine the order. A simple scheme which provides the random permutations as soon as the requisite number of random numbers are read, without having to arrange the numbers in increasing order, is given. The method suggested is convenient in practice especially when permutations of a large number of elements are needed. Even for permutations of small numbers the method outlined offers greater scope than consulting a table of a limited number of random permutations.

1.2. RESEARCH IN APPLIED UNITS AND SCIENCE LABORATORIES

1.2.1. GEOLOGICAL STUDIES UNIT

1. *A New Vertebrate Fauna from the Early Jurassic of the Deccan, India* (Jain, S. L. with Robinson, P. L. and Roy Chowdhury, T. K., P 39) : A literature survey of the fossil terrestrial vertebrates reveals the records of practically three good specimens and some fragments which comprise our entire knowledge of early Jurassic land faunas. But the evolution of the dinosaurs in particular during this early Jurassic time must be phenomenal as evident from the excellent fossil records of dinosaurs in the upper Jurassic and Cretaceous time. So, the paucity of a good land fauna in the lower Jurassic time is a serious gap in our knowledge of the evolution of Mesozoic terrestrial vertebrates of the world.

The Geological Studies Unit of the Indian Statistical Institute, in collaboration with University College, London, first by surface finds in 1958-59 and then by systematic palaeontological mining made a good haul of fossil dinosaur bones (about 10 tons) from the Kotas, at the junction of a sandstone with a clay lens and lying about 20' below a fish bearing limestone band (the fish and crocodile fauna date these limestones to be early Jurassic). This discovery of dinosaurs in early Jurassic rocks provides the 'missing link' as discussed above.

The bone bed is reminiscent of a log jam in a river as large fossil woods measuring up to 10' ϕ , occur along with the bones. As regards the fauna, these dinosaurs are provisionally known mostly to be sauropods. A carnivore is also found to be present in the fauna.

2. *Shear emplacement of thin limestone bands along granite contact, east of Kharua* (28°11' : 74°26'). *Rajasthan* (Sugata Sen Gupta, C15) : In this area, Dr. Heron mapped a group of Delhi metasediments in contact with Pre-Aravalli Granite. Here two thin (30'-100') linear belts of marble are found to intervene between them. All the contacts are sharp and straight. The bands trend N40°E on average, showing a tendency to merge with the main belt of 'Ajabgarh Marble' towards SW from which they are separated by a thin horizon of micaceous quartzite.

The marbles are vertically foliated. The foliation plane is parallel to its lithologic boundary and is extensively developed in all the adjoining rocks as a very good shear cleavage. Very often, the quartzites are mylonised and the granite is changed to augen-gneiss or even to ultra mylonites. The thinner quartzite lenses within the marble bands are only fractured and slightly granulated, but where the quartzites dominate, it is converted to an extremely sheared quartzschist.

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The 'Ajabgarh Marbles' to the west of the shear zone of ten have thin long tongue-like projections into the associated micaceous quartzites mainly along these shear cleavages.

The main marble horizon and the linear marble bands are lithologically identical. There is no visible effect of the granite on the marbles though they occur in close contact. These features besides the structures lead to the presumption that the marbles were possibly emplaced as 'cold intrusions' by shear gliding from the 'Ajabgarh' marble. The physical discontinuity between them may be due to the still later shearing along a N-S shear plane which is well-developed within the intervening quartzites.

3. *A note on thin section mechanical analysis* (S. Basumallik, S36): The purpose of this note is to suggest a method for obtaining sphericity distribution in sandstone by thin section measurement of both long and short diameters of each grain and by optical examination of a plot of long-diameter vs. short-diameter.

4. *Crystal-optic study of secondary overgrowth in quartz* (S. Basumallik, S37): A conspicuous tendency shown by sandstones having a considerable proportion of silica cement is the formation of idiomorphic facets in the reconstituted grains. These facets are not only planar surfaces, but they appear to concentrate, when their orientation with respect to the c-axis of the reconstituted grain is plotted on a stereogram, near rational crystallographic face-poles. The forms which appear to be developed include commonly $r(10\bar{1}1)$ and $m(10\bar{1}0)$, and less commonly $z(01\bar{1}1)$, $s(11\bar{1}1)$ and $x(51\bar{8}1)$.

5. *Cross ripples in Jodhpur sandstone, Rajasthan, India* (S. Basumallik, S38): Cross ripples have been reported from the Jodhpur sandstone of Rajasthan, India. The wave length of the smaller set, which has affected the crests and in some cases the troughs too of the larger set, is one-third to one-fourth of that of the latter. A secondary current with a 'drag' in the lower part of the optimum range is thought to produce the second set, intersecting but not destroying the larger set.

6. *A suggested revision of the pre-cambrian stratigraphy of the lower Godavari basin* (B. Raychaudhuri, S43): The existence of a sedimentary sequence older than the so-called Pakhals of the Godavari Valley is reported for the first time. This sequence was erroneously counted as a part of the Pakhals by previous workers. The significance of this stratigraphic revision on the correlation of the Pakhals of the Godavari Valley is discussed.

7. *The primary source of the iron-ores in the Pakhal formation of the Godavari Valley* (B. Raychaudhuri, S44): The workable iron ores in the Pakhals and the associated iron-rich rocks of various kinds in the Pakhals follow a marked stratigraphic horizon. In areas of less elastic dilution, the iron is often concentrated enough to be used as workable ore. The significant association of finely banded hematite jasper, fine tuffaceous shale, typical pyroclastics and flows (association typical of Naomundi iron-ores) etc. with the Fe-horizon at certain areas suggest that the primary source of the iron is possibly volcanic.

8. *Occurrence of glauconite in the Purana formations of the Godavari Valley* (B. Raychaudhuri, S45): The presence of glauconite in the Pakhals and Sullavai is reported for the first time. The mode of its occurrence and association is described and its significance in palaeo-environmental and palaeogeographic reconstruction as well as in the correlation of the Pakhals is pointed out.

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1.2.2. BOTANY AND CROP SCIENCE

1. *Interaction in Crop Plants* : S. K. Roy continued experiments on interaction effects using different varieties of rice and also extended the study to mixed cropping of wheat and gram. The co-operating interaction of two rice varieties (36 BK BR7 and 499-2A BR8) in the fourth year of field trial was also positive. The root development of these varieties in water culture is currently under investigation and the results show that their root systems, e.g., length and the nature of branching differ. It was discovered that a lodging of a co-operating pair is provided with mechanical support by the non-lodging one when they are mixed and thereby loss due to lodging is avoided. A few other favourable interactions have been found in rice this year.

The second crop from *cus* (autumn) rice harvested by cutting half way up the stem varied greatly in different varieties. The yield of the best regenerating variety this year was of the same order as obtained during the previous season.

The discovery of the existence of a water soluble substance in clover seeds, which stimulates the growth of a grass in small concentration but inhibits it in higher ones, and also a water-soluble substance in old rice which inhibits the germination of the new seeds, was followed up and confirmed by a suitable bioassay method. This work was done in collaboration with Dr. F. H. Schwarzenbach (Director, Swiss Foundation for Alpine Research, Zurich, Switzerland), during his stay as a guest scientist in the Institute.

2. *Asymmetry of Coconut Palms* (T. A. Davis, P27, S21) : Out of the 11,688 coconut palms of the tall variety personally observed by Davis in India as well as 2,213 examined through others, the frequency of left-handers is 51.24. Similar data from 27 other coconut-growing countries were obtained on 25,921 palms, of which the left-handers account for 48.88%. Data on palms of the dwarf variety of coconut as well as 'vegetative shoots' were also collected. The fact that this character is not inherited was confirmed from further data. But the important but inexplicable point is that the left-handers yield 21% more nuts than their counterpart. This fact was revealed while analysing the yield data of 384 trees used at the Coconut Research Station, Kayangulam (Kerala) for trials of micronutrients, of which 177 were left-spiralled. The yield figures for healthy coconut palms showed significant difference between the two types. The figures for the diseased palms, though not quite significantly different, strongly reinforce the significance of those for healthy trees.

It was discovered that in a plant of the family Malvaceae the petals of some flowers are twisted clockwise and the others in the opposite direction. About 49,000 flowers were examined from 26 species comprising ten genera of Malvaceae and it was found that both the types of flowers are distributed, almost in equal proportion. Similar phenomenon was also observed in the silk cotton tree (*Salmalia malabaricum*) and 33,689 flowers were examined from three trees of this species.

3. *Study on Root Pressure* (T. A. Davis, P 22) : Work was continued on two more palm species and five other monocotyledonous species, and all of them showed positive root pressure while their negative pressures were consistently small. Further success in clonal propagation in the coconut, including two suckers from one seedling, has been achieved.

1.2.3. SOCIOLOGY

1. *Studies on Rural Integration and the Process of Urbanisation* : The objective of this study is to obtain some primary information relating to different integrational forces that are working in the day-to-day life and living of rural folk. For this purpose, 18 villages

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from all those falling within a walking distance of 10 miles from Giridih town in Hazaribagh, Bihar, were selected at random on the basis of relevant sociological considerations. Information on levels of integration of local inhabitants was collected, among others, through the 'life-cycle' method in Social Anthropology. The first round of survey of these villages is already completed and preliminary tabulation work is in progress. A paper based on the findings to date is being prepared for publication.

2. *Urbanization of Villages around Giridih Township* : This study, reported earlier, is in progress. The investigators have covered all the villages within 10 miles of Giridih town. At present they are investigating the villages falling between 10-20 miles radial distance from that town.

3. *Caste as a Factor in Rural Economy* : An investigation was carried out in this respect in six villages sampled at random as well as one village selected purposively from the 120 inhabited villages falling within a radial distance of 5 miles from Giridih town. In the light of the analysis of data collected from 1316 households inhabiting the largest three of these 7 villages (and covering 10 per cent of the total in the circle of 5-mile radius from Giridih town), a paper was prepared and read at the Tagore Centenary Seminar on 'Human Factor in the Growth of Rural Economy', held at Vava-Bharati, Santiniketan.

4. *Enquiry into Cohort-children Composition of Family Units* : The enquiry was made to get bench-mark data on variations in the cohort-children ratio between different types of family organization and within different cultural groups. For this purpose, a survey was conducted in the town of Giridih in Bihar, and data already available from Calcutta and other places in West Bengal were made use of. A working paper was prepared in the light of the analysis of the above data which may be useful for launching an action programme for family planning research.

5. *Survey of the Toto families* : A pilot survey of the Toto families inhabiting the village of Totopara in Jalpaiguri district was completed. Its main objective was to collect some basic data on the social and economic stratification of the Totos which would be useful for the formulation of hypotheses for future studies concerning this 'closed group' comprising only 85 families.

6. *Changes in Family Structure-Urban/Rural in West Bengal* : The first phase of work on the above scheme, sponsored by the Research Programme Committee of the Planning Commission, Government of India, was completed. On the basis of the data collected from 3528 family-units and 736 single member units in the rural and urban areas of West Bengal, an introductory report dealing with sampling method, coverage, precision, etc., has been submitted. Subsequent reports are being prepared. A longitudinal analysis of available data has also been undertaken.

7. *Study of Family Structures of Displaced Persons from Pakistan to West Bengal* : Work is in progress with respect to 17,436 households surveyed by the Indian Statistical Institute in 1948.

8. *Structural Analysis of the Growth of Durgapur Townships* : A draft report was prepared on the basis of survey data. Further analysis on the social and settlement problems of the 'Refugee Groups' working in the townships is in progress.

Research workers have also been entrusted with pilot studies on different aspects of social life in the areas under study, which are likely to result in the formulation of research schemes at a future date.

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1.2.4. DEMOGRAPHY

Follow-up Study of In-patients in Maternity Wards (S27) : About 500 women who were delivered at the maternity wards were followed up for studying (i) infant health conditions in terms of morbidity, mortality and development and their association with factors like birth-weight, social status, housing condition, etc., and (ii) the association between the post-natal complications and the conditions during ante-natal and labour periods.

1.2.5. REGIONAL SURVEY

The Regional Survey Unit was engaged in studies relating to regional approach to planning problems at macro-regional (South India) and national levels. The first phase of the work on South India relating to the studies on regional patterns of distribution of natural, agricultural and human resources and regional variations in economic development has been completed. The Unit also conducted some theoretical and applied studies oriented to planning and tried to test the concept of 'core' areas in crop planning, the concept of a region and the type of region suitable for planning, the concept of regional hierarchy and its implications as applied to urban studies in Mysore State, measurement of index of concentration of resources and criteria in the delimitation of under-developed areas. These studies will provide a basis for the preparation of long-term regional sectoral plans for South India. A detailed programme of work is being drawn up in consultation with economists.

During the course of the year, the workers of the Unit prepared a series of notes indicating the lines of work which facilitate the preparation of perspective plan for India as a whole and its sub-regions.

Based on a study of the distribution of natural and agricultural resources, a tentative framework of regions for planning has been prepared to facilitate the regional breakdown of national targets and estimates and to set up regional *norms* of development taking into consideration the region's intrinsic conditions and potentialities for development. Developments in irrigation, power and industries are being mapped to study the spatial patterns of development.

Six Soviet scientists were invited to collaborate in the studies relating to regionalisation for planning and the workers of the Unit are now studying their reports on economic regionalisation in the U.S.S.R. and the role of natural regions in economic development with a view to formulate the concept of a planning region suitable for Indian conditions.

A study has been undertaken with the aim of building up a frame-work for long-range policy of regional allocation of resources and of transportation, on the basis of the current and planned pattern of development.

1.2.6. PSYCHOMETRY

1. (Chatterjee, S. and Mukherjee, Manjula, S33) : In view of the importance of the stability of measured interests in a guidance situation, this study was undertaken for investigating the stability of measured interest under the influence of training imparted and the passage of time. The Kuder Preference Record (Vocational) and a Non-Verbal Interest Inventory (CPR-1158) was administered to a group of freshmen. After one year, when these students were in second year of their training, the testing was repeated. Correlations between the initial and the final scores for the different fields of interest ranged between

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.35 to .74 for the KPR and from .24 to .86 for the CPR. Generally speaking it could be said that stability is quite high in those fields which are directly connected with the training during the intervening period.

2. (Chatterji, S. and Mukherjee, Manjula, S34): This study investigated the relation between the scores obtained on the Kuder Preference Record (Vocational and a Non-Verbal Interest Inventory) developed in the Unit. The product moment correlation between the comparable scales ranged from .21 to .73. In short it might be sufficient to say that mainly these are the two factors operating in determining the observed relationships between the two instruments: a) the diagnostic significance and hence the resulting cluster of the KPR items might be different here in India, b) difficulty of expressing several types of behaviours as expressed through the KPR items, through the non-verbal medium.

3. (Mukherjee, Manjula, S35): The object of this investigation was to test whether previous experience of a similar test had any effect on the scores of the test taken afterwards. The scores of these pairs of tests conducted over three different groups of persons were analysed. It was found, in all the three samples studied, that practice had some effect on test scores and this effect was significant statistically.

1.2.7. FLOOD RESEARCH

The Flood Research Unit was engaged during the period 1961-62 in the work entrusted with the Institute by the Metropolitan Water Supply and Drainage Board, Government of West Bengal. The following studies were taken up:

i) '*Regeneration*' Study: A similar study was made by the Unit last year. While the previous study was based on the analysis of daily discharge records, the present one is more difficult because of the availability of only daily river level records and a few discharge observations. The available data relate to the months January to April of the years 1949 to 1960, both years inclusive.

The study requires firstly estimation of daily discharges and then estimation of the regeneration values. For the former estimation, the knowledge of regression of 'discharge' on 'river level' is essential. Two types of regression have been tried for each year and based on each regression model, estimates of daily discharge values at both sites have also been obtained. The way how the 'regeneration' values vary with the river-level at the upstream site, is now being studied.

ii) *Trend in the capacity of the navigable sea-route of the river*: This study aims at locating the gradually deteriorating sections of the river Hooghly. The available data are the 21 years' river cross-section records observed at successive distance of 1000 feet starting from Cossipore, during the last three and a half decades. Both 'pre-freshet' and 'post-freshet' cross-section records were analysed to determine the trend.

iii) *Unit Hydrograph (Ajoy)*: The problem was first taken up in 1960-61 to develop a procedure for the estimation of daily run-off at a suitable site on the river, from a knowledge of the rainfall over its catchment, upstream of the site. Accordingly, analysis was first started with the available discharge observations at Natunhat.

All the major 1959 and 1960 storm-rainfall and corresponding run-off data were analysed to estimate the 'rainfall'-'run-off' relationship on the knowledge of which we could further proceed to build up the 'Unit hydrograph'. Owing to glaring inconsistencies in the

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values of the 'run-off fraction' for individual storms, all efforts proved abortive. This failure is thought to be due to the following reasons :

a) The river 'Ajoy' is joined by another stream 'Kunoor' at a point upstream of Natunhat, thus affecting the discharge at Natunhat. No information on 'Kunoor' discharge is available.

b) Spilling of the river over its banks after heavy rainfall.

However, an alternative upstream site has been chosen at 'Jamtara' and the study is being continued on the same lines using the information available on the river discharge there.

iv) *Salinity of the River Hooghly* : Seventeen years' records (1944-60) of salinity were collected, scrutinized and necessary charts were made.

v) *Average Daily Rainfall over 'Ajoy' Catchment* : Sixty-nine years' daily rainfall recorded during the monsoon months at the rain-gauge sites in the 'Ajoy' catchment were collected, scrutinized and daily average rainfall over the said region was computed.

1.2.8. BIOLOGY AND BIOCHEMISTRY

1. R. L. Brahmachary (P21) found by using the technique of chromatography that the earthworms do not enrich the soil by amino nitrogen. This supports a part of the famous recent findings by Barley and Jennings in Australia.

2. R. L. Brahmachary (S10) also studied the evolution of free amino-acid pattern from the egg stage onwards. Apart from supplying information on descriptive chemical embryology, the investigation also points out certain interesting features of gene-determined biochemical individuality.

PLANNING DIVISION

A. WORK IN DELHI

Growth Models for the Long-range Development of the Economy : The programme of work consists of working out the structure of the economy, as it is expected to be in 1975-76, in terms of the structure of production, income distribution, national account flows and capital formation, etc. The first part of the work, which consisted of the production structure, has already been completed. The problem has been set as follows : what should be the production structure if certain broad macro-economic targets are to be realized by 1975-76. The target is set in relation to a certain minimum level of living to be provided to the poorest section of the people. From this is worked out the minimum level of overall consumption. Certain assumptions are also made about the rate of savings, gross investment, government consumption, imports and exports.

The work consisted of four stages. Firstly, the pattern of consumer demand in 1975-76 was calculated and two alternative approaches were adopted. One alternative considers the pattern as it would be if the consumption habits of the consumers remained unchanged. The other alternative considers the demand pattern that would arise after steps were taken to bring about certain rational changes in the existing consumption habits. The export pattern has been projected on the basis of the best information and/or judgement regarding the possibilities of expanding exports. On the basis of the pattern of consumption

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of households, exports and imports, capital formation and government expenditure, the entire production structure and the input-output structure has been calculated by solving a set of equations involving the technological co-efficients, characterising the different sectors. Having obtained the levels of output and inputs in each sector finally, the value added by sectors has been calculated.

Changing Structure of the National Economy : The report on the Structure of the Indian Economy, 1953-54, completed during the year, is ready for publication. A pilot Inter-industry Model on the Growth of the Indian Economy was undertaken in collaboration with Messrs. R. S. Eekaus, Per Sevoldson and N. Andreatta. In a closed multi-sectoral frame-work, employment and income relationships are tagged on to different patterns of consumption behaviour at different levels of income. The investment demands are studied in a mutually interconnected system depending on the changes in levels of activities. Production targets will be solved subject to the consistency and balance relations in a dynamic equilibrium process. The collection of the data for the model has almost been completed and the solution of the system will be carried out with the help of electronic computers.

Cost-benefit Studies : The cost-benefit analysis was applied to a number of project reports on the manufacture of phosphorus, diesel locomotives, alloy steel etc. The work was done in collaboration with the Perspective Planning Division of the Planning Commission.

Price Policy : The studies relating to price policy aim at discovering, at theoretical and empirical levels, the rational principles which should govern the determination of prices for some of the major industries. Work has been completed on railways, irrigation, and electricity. The study on railways was carried out in collaboration with Dr. Louis Lefebvre and on electricity in collaboration with Professor A. Harberger and Professor N. Andreatta. Another research project on the price policy for coal is in hand.

Foreign Trade Problems from long-range point of view : Export projections which can be used in a perspective plan for 1975 are being worked out for the major commodities. An attempt is also being made to study the trends in foreign trade in major areas of the world and its implications for the foreign trade of India. A survey to quantify the benefits received by exporters under the various export promotion schemes is also being conducted. The relationship between benefits and quantitative restrictions are being analysed.

Problem of Effective Utilization of Manpower : The Unit collaborated closely with the Perspective Planning Division of the Planning Commission in the preparation of the studies on manpower. Dr. Chao Kuo-chun's study on "Utilization of Rural Manpower", completed during the year, is expected to be published.

Plan for Educational Development : A comprehensive study which is in hand aims at elaborating a 15-year plan of educational development related closely to the needs of the growing economy. It will cover education at all levels from the primary to the university stage, requirements of school teachers, assistance to students, current and investment expenditures, educational levels of the labour force and other related aspects.

Economics of Scale and Location : A study was begun on the economics of scale and location, the aluminium industry in India, being the first industry taken up for the study.

Techno-economic Co-efficients : A study was completed on the detailed requirements of material input per unit of output of manufacturing industries. The information obtained from this study is valuable not only for inter-industry studies but also for an assessment of the import requirements of the developing economy.

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Planning Experience of other Countries : There are two ways in which the planning experience in other countries is being studied (a) by studying the techniques, methods and data of other countries as available in documents received from time to time through arrangements made by the Institute with other countries (the Unit has its own translators to translate and summarise documents as required); and (b) to invite experts from other countries to write and lecture on experience of planning and economic management in other countries.

Under the first category, a number of books and articles in Russian and Polish languages were translated into English. Under the second category may be mentioned the lectures of (1) Dr. V. M. Kollontai (USSR) on Some Problems of Planning in the Soviet Union (2) Dr. Kiyoshi Kojima (Japan) on The Pattern of Triangular Trade between Japan, USA and South Asia (3) Professor I. V. Komar and Professor K. M. Popov (USSR) on Economic Regionalisation Principles and Methods (4) Dr. A. T. A. Learmonth (UK) on From Regional Survey to Regional Planning and (5) Professor A. M. Riabchikov and Dr. V. A. Nikolaev (USSR) on the Role of Natural Regionalisation in Economic Development.

Other Studies : In a study on the estimation of the current consumer demand, a preliminary estimate was made of the total consumption expenditure during 1957-58 to 1960-61. In another study, an attempt was made to define the concept of non-monetized investment. A bibliography with brief notes on the work done on consumption studies in India was also prepared. A simple macro-economic exercise on savings and efficiency of investments for a 15-year planning model for India is in hand.

B. WORK IN CALCUTTA

Studies on Consumer Behaviour : Elasticities of consumer expenditure on 46 selected items were estimated from NSS 10th round data, for both the urban and the rural sectors of India. These estimates were utilized for estimating the increase in demand during the Third Five Year Plan.

Analysis of variance of sub-sample estimates showed that expenditure elasticities for different commodities were more or less constant over NSS rounds.

'Quality elasticities' were computed for selected commodities on the basis of NSS data. Quality preferences were found to be stronger in the urban than in rural areas. The calculations were done by using concentration curves and also directly by regression methods.

The marginal propensity to consume in India was estimated by using different econometric methods. The most plausible estimate came out as 0.81, and was confirmed by the estimate given later by the NCAER. Data collected in a pilot enquiry in Baranagar was also analysed to study the marginal effect of increased income on consumer expenditure.

The pattern of consumer expenditure in India depends on the degree of urbanization in addition to the per capita household expenditure. This was observed from the 2nd to 7th Round data of the NSS relating to the consumption pattern in villages and towns of various sizes.

Studies on Income and Allied Distributions : For the use of the Committee on the Distribution of Income and Wealth, set up by the Government of India, a study of the changes in income distribution was made on the basis of material available from the second to the fourteenth rounds of the NSS. It was found that, broadly speaking, the inequality in the

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distribution of income remained constant during the period covered in both the rural and urban-sectors. A paper on the availability of NSS data for studies on levels of living was also prepared for use of this Committee.

Professor R. S. G. Rutherford, a visiting economist from Australia, studied the possible errors involved in using distribution of income per capita to measure income per earner. The effects of changes occurring in the family structure were also studied.

When the consumer price index increases (or decreases) monotonically with total consumer expenditure, the expenditure distribution at current prices shows greater (or less) inequality than the corresponding current price distributions. Similar results were proved for specific concentration curves also. The difference, however, seemed to be of little significance.

Some earlier work on deriving distributions of households by size classes of personal income was revised, and improved estimates were prepared for the years 1962-63, 63-64 and 64-65. These estimates were based on NSS distributions of household expenditure and the RBI estimates of personal savings. These distributions were also used for studying the changes in equality occurring during 1962-67.

An alternative method of obtaining size distributions of personal income from given distributions of consumer expenditure was studied and illustrated in another paper.

Lognormality of the NSS distribution of persons by per capita monthly expenditure was studied and established by graphical methods. The adequacy of this fit was later examined by vigorous methods, and the fit was found to be remarkably good.

Analysis of variance of sub-sample estimates of lognormal parameters showed no significant reduction in inequality of consumer expenditure in either rural or urban India between the 8th and the 14th Rounds of the NSS.

National Income and related fields : A part of NSS 9th Round data on household trade was analysed in great detail from the point of view of national income estimation. In particular, gross earnings, current costs and gross value added were estimated by types of trading establishments. By combining NSS and other data, the contribution of the trade sector to national income was estimated at Rs. 1,173 crore for the year 1955-56 as against the corresponding official estimates of Rs. 1,331 crore.

An estimate of national income originating from rural transport enterprise in India in 1955-56 was prepared from the NSS 10th Round material on household transport activities. Some interesting information about different forms of transport was also obtained from the study.

A sample survey was conducted in September-October 1959 to enquire into the earnings from domestic services in the city of Calcutta. The findings were discussed in a detailed report dealing with some general characteristics, besides earnings, of the domestic employees in Calcutta.

Miscellaneous studies on planning : The ratio of raw material inventory-holding to monthly usage (as well as the month's supply of finished goods) is generally much higher in Indian industries than in comparable industries in the USA. The corresponding ratios of inventory to annual value added are also much higher in India. These were revealed in a comparative study of inventory holdings in India and the USA covering most of the industries included in the Indian Census of Manufacturers.

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The localization of and the productivity in some major Indian industries formed the subject of another study. Some new measures of localization were used for this purpose.

Estimates of marginal capital-output ratios were obtained for some important manufacturing industries on the basis of time-series data for 1948-56; for the manufacturing sector as a whole, a cross-section study was also possible. The estimates were based on simple econometric models.

In another study, a paradox relating to the agrarian set-up in India was demonstrated by statistical methods. It was shown that the progress of structural preconditions of development had not been accompanied by a corresponding fruition of the technical potential in the agrarian set-up.

A study was made to assess, on the basis of scientific standards and prevailing prices, costs of maintenance and milk production of animals with body weights ranging from 300 to 1200 lbs., and having different milk-yields (annual) from 1000 to 2400 lbs. In another study, the size and composition of India's cattle population were examined in relation to the supply of milk and of work animals.

Linkage coefficient for 32 sectors of the Indian economy were calculated from the input-output table for India (1953-54). The usefulness of these coefficients was discussed and some international comparisons made.

The impact of growth of population on economic development of India was studied in another paper.

A comparative study was made of the changes during 1951-57 in civil police strength and in the number of crimes in the different districts of West Bengal.

Other Econometric Work: Some attempts were made to build an aggregative econometric model for the Indian economy during 1948-56. Only two sectors were distinguished, viz., household and enterprise, and apart from a production function, the consumption function and the labour demand equations were the only equations in the model, all other equations being mere identities. Even so, and in spite of the deficiencies of the statistical series employed, the model threw considerable light on the effects of various factors on the economy.

A nonparametric method of comparing the regressions in two populations, based on the concept of "interval-regression", was studied both theoretically and through model sampling experiments.

A test for the mean of a discrete linear stochastic process was proposed and studied in another paper.

NATIONAL SAMPLE SURVEY

Fractile Graphical Analysis: Mahalanobis's technique of fractile graphical analysis was applied to NSS consumption data on an extensive scale. The results of this analysis were presented by Professor P. O. Mahalanobis in a paper, 'A Preliminary Note on the Consumption of Cereals in India', at the International Statistical Conference at Paris in 1961.

Sampling Studies: Unbiased estimators in a sample design have so far been estimated on an *a priori* basis and not on a systematic generating technique. M. N. Murthy developed a technique of generating unbiased estimators for the class of parameters which can be expressed as a sum of single-valued set functions defined over a class of sets belonging to a finite population. He has also studied a technique for estimating unbiasedly (or almost unbiasedly) parametric functions which can be expressed as non-linear functions of parameters

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belonging to the class considered above. This technique consists in fixing the bias of the estimator by using estimates based on interpenetrating sub-samples, and in correcting the estimator for its bias. He has also introduced a new method of estimation which may be called "the product method". If y and z are unbiased estimators of population totals Y and Z of the variate under consideration and of the supplementary variate, respectively, the product estimator is of the form $\frac{yz}{\bar{y}\bar{z}}$. He showed that this estimator is more efficient than the unbiased estimator Y in large samples provided $P(\frac{z}{y}) - \frac{1}{2} \frac{bz}{by}$ where bz and by are the relative standard errors of the estimators z and y , respectively, and P is the correlation coefficient between z and y .

Recent developments in the methodology of sampling from finite populations were reviewed by M. N. Murthy, who covered (i) general techniques for improving estimators, (ii) varying probability sampling, (iii) method of ratio estimation, (iv) optimum stratification and (v) theory of survey numbers. He gave a comprehensive treatment of the theory of errors in censuses and surveys incorporating the work of previous writers on the subject.

M. N. Murthy has considered the question of determining the sample size in such a way as to ensure a given probability for the confidence interval at a specified level of confidence to be less than a specified value when the variance is estimated on the basis of interpenetrating sub-sample estimates. A specimen table has been prepared, giving the sample sizes for different specified situations.

G. Parthasarathy and J. Sethuraman have given a mathematical analysis of the method of comparing the regressions over fixed intervals, designated here as Fixed Interval Analysis. Many asymptotic results have been established under no assumption on the parent population. One of these results states that in large samples, the strata means (the strata being formed after the sample has been drawn) are independently normally distributed.

G. Parthasarathy has proposed a criterion for fixing the proportion of common units to be retained for the second period to the total sample size for a survey conducted in two successive periods of time when the rate of change, as also the total value, are to be estimated. According to this criterion the proportion is to be fixed as to have the same efficiency for the estimates of the two parameters. It is seen that generally the optimum proportion is near about half, provided the rate of change is small.

G. Parthasarathy has developed three criteria for determining a common multiplier in the case of a stratified two-stage design where the number of units to be selected at the first stage is fixed. Under criterion one, the common multiplier is chosen so that the required precision is attained, while under criterion two the expected value of the cost is equated to the desired value, in criterion three the mean square error of the cost to the desired value is minimised. It is shown that the common multiplier and the variance under criterion two are less than those under criterion three.

For the stratified two-stage sampling design where the units are selected with equal probability at both the stages and a single multiplier is desired, G. Parthasarathy has suggested a modified sampling procedure whereby the variance in the number of second stage units to be sampled is decreased.

Fractile Graphical and other Analysis of NSS Consumption Data: The following studies were taken up under the research project during 1961-62: 1. Distribution of persons consuming selected items by fractile groups from NSS data; 2. Estimates of per capita consumer expenditure by fractile groups by interpolation of NSS data; 3. Construction of National

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Expenditure series over the years from NSS data on consumer expenditure; and 4. Quantitative estimates of consumption of cereals over the years from NSS data.

The data on marginal spending collected during the pilot study on employment conducted in Baranagar in December 1954, were analysed by R. K. Som. It appeared that there was an under-rating of the important necessities of life, like food and clothing. At the other end of the scale there was also seen an exaggeration of expenditure on capital goods, and on savings.

Population Studies: Studies on non-sampling errors and biases (including recall lapse) has been studied in a paper on the basis of NSS data of two consecutive rounds. Information on vital events occurring in the same calendar period was collected in the fourteenth and fifteenth rounds in the same set of villages, and vital rates thus obtained were compared to evaluate the extent of recall lapse.

R. K. Som has proposed a new approximation to the true infant mortality rate. The condition under which this gives better approximation is the constancy of the ratio of the number of infant deaths in the next calendar year to that in the same calendar year as that of birth. On the criteria of 1. number of closest values, 2. average deviation and 3. root mean square deviation, this gave better approximation than the other available approximations when applied to the Swedish data of 1914-45.

Detailed studies on age-specific fertility rates, age specific mortality rates, by sex, infant mortality by sex, and age-sex composition of rural population were made on the basis of NSS fourteenth round (July 1958-July 1959) data and the results were presented in a report. In rural India, the general fertility rate was almost negligible in the ages 10-14, but began to rise rapidly in the age group 15-19 to attain the maximum in the age-group 20-24 (263.6 per 1000 females), to decline slowly in the age-group 25-29 and to record a sharp fall in the age-group 40-44 and finally to become negligible beyond the age of 45. The mortality pattern over the ages was found to be similar for males and females. Female mortality was higher than that of the males over the age range 15-34. Abridged life tables have been prepared by A. K. De and R. K. Som on the basis of the above data: the expectation of life at birth in rural India during 1957-58 has been estimated at 46 years.

Crop-cutting Experiments: The methodological studies conducted in the previous year under the auspices of the Central Statistical Organization in a group of villages in Rajasthan and Bihar, to test the differences in the estimates of crop yields by the use of rectangular cuts of size 33' x 16½' and circular cuts of 4' radius, respectively, were also continued in the current year. The conclusion reached by experiments in the previous year, namely, that, under adequate supervision, the rates from the two types of cuts were not significantly different, was further strengthened by the experiments in the current year.

Other Studies: D. K. Dutta Majumdar made a study of the estimates of increase in demand for services and specified miscellaneous items during the Third and Fourth Plan periods, based on NSS tenth round data. The estimates of aggregate and per capita demands have been worked out, as also percentage increases. He also worked out, in another study, elasticities for cereals, using fractile variate data (Mahalanobis, 1958), based on NSS thirteenth round data. He projected the percentage increase in the per capita consumption of cereals for successive years in the Third and Fourth Plan periods, by two independent interpenetrating samples (IPNS). The aggregate total demand for cereals in these years was also projected.

PART 3 : APPENDICES

Appendix I : First Convocation : 12 February 1962.

The Indian Statistical Institute was recognised as an institution of national importance and empowered to confer degrees in Statistics by the Indian Statistical Institute Act which was sponsored by Prime Minister Jawaharlal Nehru in the Parliament in December 1959. This Act came into operation in April 1960, and the First Convocation was held in the mango-grove of the Indian Statistical Institute on 12 February 1962.

The Prime Minister had sent the following message which was read by Sri Vishnu Sahay, Secretary to the Cabinet, Government of India :

"I send my greetings and good wishes to the Indian Statistical Institute on the occasion of its Foundation Day and Convocation ceremony. The Institute was declared by Parliament as one of national importance. Long before this declaration, it had by virtue of its own work assumed that position and, indeed, had received international recognition. I have watched its activities from a distance, and sometimes visited it also during the last 22 years. I have watched its growth under the distinguished guidance of Professor Mahalanobis with great interest and pleasure. It has developed a high status and reputation for creative work. To us, who are devoted to planning for the future growth of India, it is of essential importance.

"Statistical science has grown greatly during recent years and the Indian Statistical Institute has participated in and helped in this growth. The part that this Institute has played in India is one of which we may legitimately be proud. I have every hope that the Institute will carry on its work in the future with efficiency and originality, applying it especially to the conditions in India. To Professor P. C. Mahalanobis specially I send my congratulations."

OPENING OF THE CONVOCATION

In the absence of the President, Professor K. B. Madhava, Vice-President of the Institute, took the chair. The function started with the singing of a Vedic hymn after which Professor Madhava declared the Convocation open, and read the following message from Sri Chintaman D. Deshmukh, the President of the Institute, who was out of India at that time.

MESSAGE FROM SRI C. D. DESHMUKH, PRESIDENT OF THE INSTITUTE

"I regret that on account of the combination of unfavourable circumstances I am unable to attend the Convocation ceremony. Though there was some possibility of my being able to attend on the date originally fixed, viz., 13 January, on the date now fixed, 12 February, I shall be out of the country on some work connected with the UNESCO.

"The occasion is one which ought to be a source of legitimate pride to everyone concerned with the growth and progress of the Indian Statistical Institute. It is also an opportunity for us to remember the whole-hearted assistance that we have received from experts from all over the world in building up the institution, in the shaping of its policies and the direction of its operations from time to time. It is in the fitness of things that the Institute

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should honour itself by conferring Honorary Degrees on some of the outstanding personalities from among these friends, sympathisers and supporters of the Institute, and although I shall be absent from the ceremony in the physical sense, I shall in spirit participate in thus paying our tribute and showing our gratitude to these very distinguished, eminent and highly esteemed men.

"The fact that there has recently been a great deal of reference in the press, some of it testifying to anxiety or solicitude, in regard to the smoothness of operations and management of the Institute, is perhaps testimony to the importance which the Institute has in its chosen field in relation to the planned national effort for economic development. Since all the facts of the situation are not known to those who have in all sincerity and with all goodwill been critical, be they inside or outside of the Institute, it is only natural that an impression might have been created in the minds of the public tending to cast doubt on the stability of the institution or the general efficiency of its management or the harmoniousness of its relations with the Government departments concerned. The fact of the matter is that whatever lapses have come to notice have been the result largely of misunderstanding and that essentially the situation is sound, although it is evident that the management staff of the institution is to be strengthened at one or two points. The misunderstandings have been removed and the necessary rectification is in train, so that there need be no more reason to doubt the capacity of the Institute to fulfil its academic objectives as well as to deliver goods in regard to certain tasks of national importance assigned to it on a contractual basis.

"I have every hope that the Convocation will be celebrated in a befitting manner."

SPEECH BY SRI VISHNU SAHAY, SECRETARY TO THE CABINET, GOVERNMENT OF INDIA.

Sri Vishnu Sahay delivered the following speech after he had read the message from the Prime Minister :

"In being the vehicle for this message from the Prime Minister, Mr. Chairman, I hope you will permit me to express my own personal pleasure at being present on this occasion, when the Institute is having its Convocation for conferment of degrees for the first time. My personal pleasure arises for two reasons—one, because I am a member of the Governing Body and the Council and also because, under the instructions of the Prime Minister, I myself had some connection with the drafting and preparation of the Bill which became an Act of Parliament and which conferred a unique status on this Institute.

Some reference was made in Mr. Deshmukh's message to misunderstandings and things of that kind. The relationship between science and administration, and scientific workers and orthodox administrators is not an easy one to determine. The coming in of science into the administrative field is a matter of comparatively recent growth in this country. The Act which set up this Institute represents a new line in defining the relationship between scientific institutions of this kind and government. There will occasionally be difference of opinion but the concept behind this legislation is one of joint endeavour between scientists and the administrators, a joint endeavour in which the autonomy and independence of the one will be preserved while the legitimate interest of public administration will be safeguarded. There will be growing pains in a new system of administration but I am perfectly certain that we shall justify the faith which the Parliament has put in us."

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GENERAL REVIEW OF EDUCATIONAL ACTIVITIES BY P. C. MAHALANOBIS

Professor P. C. Mahalanobis delivered the following speech at the First Convocation: The Council of the Institute decided to mark this occasion of the first convocation of the Indian Statistical Institute by the award of the degree of honorary Doctor of Science to five eminent persons who have made great contributions, each in his own way, to the advancement of statistics. It is a great honour that they have kindly agreed to be associated with the Institute by accepting these degrees.

In addition, the degree of Master of Statistics would be awarded to seven students and the degree of Doctor of Philosophy to two students on the merit of their advanced studies and research. We wish them all success in life and in their professional work.

Review of Educational Activities: Early History

On this occasion it would be of interest to review the development of educational activities of the Institute. It would be recalled that at a meeting held in Calcutta on 17 December 1931, it was decided to establish a society for the advancement of statistics. A little earlier, during informal discussions, K. B. Madhava had suggested provision being made for training and education. This was included in the aims and objects of the Indian Statistical Institute which was registered as a non-profit distributing society under Act XXI of 1930 in April 1932.

Advanced studies and research in statistics had however started much earlier; and a small group of statistical workers had gathered, in an informal way, in what came to be known as the Statistical Laboratory in the decade before the formal foundation of the Institute itself which used to be located in, but was not a part of, the Presidency College, Calcutta. A tradition of research with an orientation towards the application of statistical methods to practical problems had been already established. During this period, Harish Chandra Sinha and Subhendu Sekhar Bose had taken a leading part in the research activities of the Institute.

First Training Course: July 1932

Ad hoc grants were being received from the Government at this time for special enquiries and reports. The first regular grant of Rs. 2,500 per year was sanctioned for three years from July 1931 by the Imperial (now Indian) Council of Agricultural Research. Besides theoretical research on the design of experiments, the programme included giving advice to persons working in government departments and scientific institutions. In the course of dealing with such enquiries, three agricultural officers asked for permission to receive some training in the Statistical Laboratory. With much hesitation, we accepted them in July 1932. This is how the training programme started almost exactly thirty years ago. One of our oldest workers, Jitendra Mohan Son Gupta joined the staff in 1932; and then came Raj Chandra Bose in April 1932, Samarendra Nath Roy in July 1933, both of whom are now working in the USA, and K. Raghavan Nair in 1936. The Government of India sanctioned an annual grant of Rs. 5,000 from April 1935 for research and advanced studies which made it possible to expand the training programme to some extent.

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External Examinations in Statistics : 1938

Apart from the individual training mentioned above, the Institute had also taken early action in connexion with the training and examination of technical personnel at various levels. In 1935, the Institute had set up a committee to review the likely future demand for statisticians in India and the need of establishing recognized technical qualifications. On the recommendations of this Committee, various examinations were started in 1938 for the award of certificates of proficiency in computation, field survey, machine tabulation, etc., and also for the award of diplomas in statistics practically at the university level. Up to the end of 1961, 11,572 candidates had appeared in these examinations and 3,539 had passed.

First Professional Courses : 1939

Between July 1932 and July 1939 more than 150 officers from government departments, universities and scientific institutions came to the Institute for individual training and studies. As the demand was increasing steadily it was decided to start in 1939 an organized professional course for one year which was thrown open to persons who had already taken their master's degree.

Another expansion of the training programme took place a little later, on the initiative of the Institute, with the opening of post-graduate classes leading to the M.A. and M.Sc. degrees in statistics in the Calcutta University in 1941. For about five years the entire work of this new department used to be done by the staff members of the Statistical Laboratory and the Indian Statistical Institute; and the university department was located in the room occupied by the Institute in the Presidency College in Calcutta. C. R. Rao had joined the one-year training class in the Institute in early 1941, and was also among the first batch of students who joined the post-graduate M.Sc. course in statistics of the Calcutta University in August 1941.

International Statistical Education Centre (ISEC) : August 1950

In 1950, the Institute again took the initiative in starting, with the support of the UNESCO and the active cooperation of the International Statistical Institute, the International Statistical Education Centre which has been maintained since then with the support of the Government of India mainly for students from the Asian countries. In eleven years since its inception, over 400 students from seventeen countries have attended the courses given in this centre.

In the Institute itself a two-year course was started in 1951, which was restricted to persons who had already taken the master's degree in statistics or in some associated subject. About twenty-five students used to be admitted at that time, and the teaching staff of eighteen were also heavily engaged in both theoretical and applied research. Between 1939 and 1959, about 550 students attended the whole-time professional courses in the Institute.

Technical Training

The Institute had also started long ago training classes for junior technical personnel (computers, punchers, machine operators, etc.) and has been conducting, for some considerable time, evening courses in statistics at a higher level in Calcutta, Delhi, Bombay and Madras. In addition to the regular whole-time students, the Research and Training School is at present

offering twice part-time, evening and special training courses to nearly 400 students in different parts of India. Also, a good deal of training has always been given, and is still being given, in the form of apprenticeship and short intensive courses in technical subjects outside the Research and Training School, for example, in the National Sample Survey, in Statistical Quality Control, in the Computer Division, etc. Up to 1961, training had been given to over 3,500 persons in organised courses and to over 2,500 persons in apprenticeship courses. The educational and training responsibilities of the Institute have been thus quite large.

Emphasis on Project Work

So far I have spoken about the educational activities of the Institute. I should also emphasise that from the very beginning, even in the decade before the formal establishment of the Institute, the Statistical Laboratory was accepting enquiries and projects mostly from government departments and occasionally also from private firms. A big scheme was started in 1937 to develop sampling methods for estimating the output of the jute crop in Bengal. This survey was extended very soon to all important crops in the two provinces of (undivided) Bengal and Bihar covering a total area of nearly 150,000 square miles. Various other projects were also being taken up at that time. Some of the most important were in connexion with the control of floods in Bengal, Bihar and Orissa. One report on rainfall and flood had pointed out in 1931 the possibility of building dams in the Orissa river system to hold up water for purposes of flood control and also to use the same water to generate electrical power. This proposal was implemented after a long time in the Hirakud hydro-electric project which came into operation twentyfive years later. There was also a steady expansion of large-scale sample surveys. The National Sample Survey was started in 1950 with a programme of collecting information every year on the growth of population, production of food crops, level of living, industrial production, employment and various other socio-economic conditions covering the whole of India. The Institute has been intimately connected with these development and has continued to do a very large volume of project work on sample surveys on behalf of the Government.

Integration of Research, Projects, and Training

I have been referring to the early history to bring out an important point. Scientific activities in the form of both theoretical and applied research, directed specially to Indian problems, had become established before the educational programme was started. Also, both theoretical research and applications of statistical methods to special enquiries and projects have always continued to form an important part of the activities of the Institute. The educational and training programme had originally developed, partly as a by-product of research and project work, and partly in order to train technical and professional workers for the Institute's own activities. In fact, a very high proportion of the Institute staff at all levels have always come from among persons who had received their statistical and technical training in the Institute itself. Also, it is worth noting, although the Institute could not award degrees, the students who completed the Institute course satisfactorily did not usually find any difficulty in obtaining suitable employment. That is, the training given by the Institute was being generally appreciated on its own merits.

Difficulties of Integrated Teaching in Professional Courses

In the professional courses attempts were being made continually to stress on teaching theoretical statistics in close relation to practical applications. Considerable difficulties were, however, being experienced in this connexion. The Institute had deliberately restricted

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admissions to the professional courses to persons who had already taken their master's degree usually in mathematics or statistics, from other universities. Although the Institute had maintained a very high standard for admissions, experience showed that many of the students, while possessing skill in dealing with the abstract mathematical portions of statistical theory, had difficulty in using statistical methods in practice. This was mainly due to a lack of sufficient acquaintance with the natural sciences on the part of the post-graduate students who were coming to the Institute.

Conferment of Powers to Award Degrees and Opening of Undergraduate Classes : 1960

It was felt that it might be advisable to admit younger students at an undergraduate level and give them opportunities for acquiring some direct experience of methods of observation, measurement and experimentation in science. From 1953 various suggestions were considered for converting the Institute into some kind of a university, but this did not seem to be entirely suitable for higher education and training in an essentially technological subject like statistics. Finally, the Institute was empowered to give degrees in statistics by a Central Act in 1959; and first admission at an undergraduate level started in 1960. The award of degrees of Master of Statistics (M.Stat.), Ph.D. (in statistics) is starting at this First Convocation in 1962.

New Type of Technological Institute

It is worth pointing out that, because of the close integration of research, project work and teaching the Institute had been obliged from the very beginning to develop educational and training programmes which deviated considerably from accepted models for teaching statistics in universities not only in India but also in the advanced countries of the world. This created great difficulties. For example, in 1945 when the Government of India wanted to develop the Institute as a higher educational institution it was proposed by the Government that the London School of Economics should be accepted as a model and it was seriously suggested that there was scarcely any need for practical classes or of any involvement in project work. Similar difficulties still have to be faced in giving expression to our ideas of a new type of technological institute.

The Dual Character of Statistics

The difficulties which were being experienced in developing an integrated programme of education and training in statistics were due in a good measure, to the dual character of statistics. It requires stressing that statistics has two aspects, one which is utilitarian or economic and the other which is scientific, mathematical and logical.

The utilitarian or economic phase of statistics had its origin in time immemorial, in the collection of information relating to social and economic conditions of a country to help in making administrative and policy decisions. The English word "statistics" is connected with statecraft, the business of the State or of Government or Administration. In India and in other countries, during periods of social and economic growth, there has also been a rapid advance of statistics.

The concept of random events came much later, in connexion with games of chance, the theory of probability was developed at the time of emergence of modern science in

the sixteenth and seventeenth centuries.* This had a motivation which was both economic (in estimating the chance of winning a stake or a game) and mathematical or logical.

This dual aspect of statistics led to a dichotomy in teaching and research in statistics, one part being usually associated with economics and the other part with mathematics. This has had some unfortunate consequences. The attempt to teach statistics as a branch of pure mathematics has led to sterile exercises in abstract theorems without any relation to the real world.

Statistics as a New Technology

The fact is that statistics is concerned essentially with the world of reality rather than with the world of abstract mathematics. All natural and social sciences (whether pure or applied) are based on observations, measurements, and experimentation, where feasible. Also, all such sets of observations, measurements and experimental results are, in principle, a 'sample of the universe' to which they belong. All generalisations based on observations, measurements, and experimentation, that is, all inductive inferences in science must be, in principle, identified with or involve statistical inference. There is also a tendency or at least an attempt to make decisions in technology, engineering, medicine and in every-day affairs, more and more, on the basis of an objective appreciation of relevant facts which, again, involve the collection and analysis of data of all kinds. This is the reason why the use of statistical methods is spreading rapidly in all the sciences—both natural and social, in technology, engineering and medicine, in commerce and industry, and in business and administration.

Statistics is thus very much concerned with devising efficient methods of collection of facts, observations and experimental data of all kinds and of extracting the maximum amount of information from such data in a valid manner and at a minimum cost. Logic and mathematics must be used for such purposes as tools and as the language of science, to the fullest possible extent. Modern statistics is thus intimately connected with mathematics, with economics, and with science and technology.

The time has come to recognize statistics as a new and practically universal technology of the present age. In statistics, teaching and research must, therefore, have an intimate relation to mathematics, economics, and all the sciences, natural and social. Teaching in statistics must be viewed as something analogous to teaching in engineering or medical sciences. In statistics, teaching, research and applied work must, therefore, be closely integrated.

* Although games of chance were known and were widely prevalent in ancient times in China, India and other countries, it is important to note that the concept of probability did not arise until the 16th and the 17th centuries, that is, not until the emergence of modern science. This is easy to understand. Before the emergence of the modern scientific view of an objective world of physical reality, all chance events would have to be necessarily ascribed to the whims of gods, demons, or supernatural forces. After the emergence of the scientific view of an objective world of physical reality, it became necessary, both logically and psychologically, for the human mind to accommodate the occurrence of chance events as an integral part of the uniformity of nature. This could be accomplished only on the basis of the theory of probability, or rather, as I should prefer to put it, only through a statistical view of the world. It seems to me, therefore, that the concept of probability or the statistical view of the world did arise at the same time as the emergence of modern science only because it could not possibly have arisen earlier.

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The Pioneering Role of the Indian Statistical Institute

Ten years ago, on the occasion of the formal opening of the main building of the Institute on 28 December 1951, Sir Ronald Fisher had pointed out the pioneering role of the Institute in this connexion with prophetic vision. I cannot do better than reproduce extracts from his speech on that occasion.

"During the twenty years of its existence the Indian Statistical Institute has developed several activities of national, and even to some extent, of international importance. It has in several aspects the character of

- (a) a learned society devoted to the increase of national knowledge in statistical science;
- (b) a professional organization extending recognition to professional statisticians in various employments;
- (c) a commercial non-profit distributing corporation capable of carrying out on economic terms projects of fact-finding and analysis for State and Central Governments, and for commercial and industrial organisations;
- (d) a teaching centre for pure and applied statistics at under-graduate and post-graduate levels; and
- (e) a publishing house analogous with the university press of many Western universities.

"It is, I believe, principally of the fourth of these aspects that national planning should take account and make use, for with the great extension, in recent years, both of abstract or mathematical statistics, and of its applications in the economic, administrative and scientific life of modern nations, there has grown up as never before the need of centres for the concurrent study of mathematical statistics, and of its several specific applications. A similar need, which I believe to be rather closely analogous, has been felt in Western nations for technological institutes, in which the most advanced methods of applied physics may be studied concurrently with the facilities offered by modern engineering. This dual need has created great institutes, of which many examples might be given, but of which the Massachusetts Institute of Technology is typical, which differ in structure and organization from the traditional university, being particularly charged with the task of bridging the gulf which separates purely academic studies from effective execution and in which consultant work for industry is a duty required of the professors.

"The history of the Indian Statistical Institute shows it to have been progressively shaping its organisation towards the fulfilment of such a task in relation to the constantly expanding applications of statistical methods. In particular, it has taken the lead in the original development of the techniques of sample surveys, the most potent fact-finding process available to modern administrations, while at the same time it has harboured a series of brilliant mathematicians of world reputation in mathematical statistics. What is most striking is that the mathematical work has been constantly linked with work on the projects, so that practitioners in the applied fields can learn incessantly the uses of mathematical analysis, and the mathematicians can receive the vivifying stimulus of seeing their devices applied in practice. It is the organic unity of theory and practice that has given the Institute its unique status at the present time.

"In the course of National Planning such an institution may be either used or wasted. It will be wasted if planning consists of a dull conformity to a blue-print of ready-made and foreign conception. It can only be used if planning can recognize the aptitude of this spontaneous growth as a national resource peculiarly fitted to the current changes of the modern world. Difficulties of organizations may well require its segregation in the future into several economically autonomous, yet closely-linked organisations, with different specified tasks. Nevertheless, an organic unity of personnel should be preserved as the only guarantee of harmonious development. In this way it can become a model for similar institutions badly needed by all forward-looking communities."

Sir Ronald Fisher's speech ten years ago, was prophetic not only because it saw what was coming in future but also because it pointed the way to future progress. All the implications have not yet been fully appreciated. He had not only emphasized the importance of the Institute having many facets of activities but had also pointed out the need of future "segregation into several economically autonomous, yet closely-linked organizations, with different specified tasks". At the same time, he had stressed the need of preserving an organic unity of personnel as the only guarantee of harmonious development. The logic of events is rapidly moving the Institute in the direction indicated by him.

The Educational Policy of the Institute

In the course of its integrated activities and partly as a matter of deliberate policy, the Institute has steadily persisted in its efforts to develop a type of statistical education which would best serve the needs of India. The aim is to give students the opportunity not only to acquire knowledge of statistical theory but also to become proficient in the use of statistical methods in economic planning, science and technology, and in solving practical problems of various kinds.

It is intended to adopt a teaching programme with a very broad base which would include mathematics, which supplies a common language for science, up to a fairly high level; mathematical statistics and application of statistical methods in various fields with actual participation in the collection and processing of statistical data; sample surveys and project work of various kinds; economic planning and the use of statistical methods in social sciences.

It is also intended to give the students adequate opportunities for acquiring experience of making observations, measurements, and experiments in the natural sciences. The Institute has, therefore, adopted a policy of establishing a number of small research units in different scientific fields. Each such unit should concentrate on intensive research of high quality on carefully selected themes without any idea, however, of developing into big faculties or big centres for undertaking extensive programmes of work which would require a large staff or a large financial outlay. The number of workers in each unit should be fairly small to ensure fruitful team work.

The Institute should have the freedom to choose any field of science in which such units would be established provided research workers of sufficient ability happen to be available. The number of units would be necessarily determined by the limits of availability of financial and other resources. The greatest importance must, therefore, be given to the quality of work with an austere limitation of the volume of work. Also, if the research leaders in any particular unit leave the Institute, there should be no responsibility to continue it. That is, the research units should be organized round research personnel and not on the basis of a selection of subject fields.

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These research units must have close connexions with statistics and will offer facilities firstly for the development and application of statistical methods, and secondly, for the training of professional statisticians in the selected subject fields.

The Institute has deliberately adopted a policy of attracting a small number of candidates of exceptional ability and giving them a comprehensive background of experience of scientific methods to supply a concrete basis for professional training in theoretical and applied statistics. The aim of the Institute would be fulfilled if it succeeds in turning out every year even a small number of graduates of ability with adequate knowledge of the theory and application of statistical methods which now constitute a new and most versatile technology of the modern age.

Professor P. C. Mahalanobis then read the following citations for the conferment of Doctor of Science (*honoris causa*) as the degrees were awarded.

Professor Satyendranath Bose

Satyendranath Bose, National Professor of India, and Fellow of the Royal Society, is an eminent theoretical physicist who introduced a new concept in quantum statistics which, with the collaboration of Albert Einstein, was later developed into a basic principle of quantum mechanics known as the Bose-Einstein statistics; and elementary particles conforming to this principle were given the name 'bosons'.

In recent years he has made important contributions to the unified field theory in relativity.

He has been an inspiring teacher and has helped successive generations of students with fertile ideas not only in theoretical physics but also in chemistry, biology and other sciences.

He has been taking a leading role in the dissemination of scientific knowledge through the medium of his own Bengali language.

He has been deeply interested in cultural developments and in literature and music, and served for some time as Upadhyaya (Vice-Chancellor) of Visva-Bharati, the international university founded by Rabindranath Tagore.

He has been actively helping in the work of the Indian Statistical Institute since its foundation, and for a considerable time, immediately after the war, shouldered heavy administrative responsibilities as the Honorary Secretary of the Institute.

Sir Ronald Aylmer Fisher

Sir Ronald Aylmer Fisher, Fellow of the Royal Society, is the most outstanding personality of the present age in the field of statistics. He has laid the foundation of modern statistical theory by his pioneering contributions to the theory of estimation and exact sampling distributions, and has supplied most powerful and versatile tools for scientific and technological research in the form of the statistical design of experiments and the analysis of variance.

His genetical theories of natural selection and inbreeding and his work on the inheritance of blood groups have opened new fields of biological research.

He has introduced fiducial probability as a fundamental concept in statistical inference and in recent years has been vigorously exploring the statistical basis of scientific induction.

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By continually stressing the need of using statistical methods in science and technology he has promoted the rapid advance of statistics in every direction and has helped in winning recognition for statistics as a new technology in the fullest sense.

He has taken a keen interest in the development of statistics in India, has come to the Indian Statistical Institute as a guest scientist on seven occasions during the last quarter of a century, and has helped in formulating the policy and programme of work of this Institute in a most significant way.

Sri Jawaharlal Nehru

Jawaharlal Nehru, a great leader, wise statesman, humanist, and a patron of science, has full appreciation of the role of statistics in planning and economic development long before he became the Prime Minister of India.

After assuming this great office, he has given unwavering support to the expansion of statistical services and the advancement of statistical education and research in India.

He has been taking active interest in the work of the Institute for about twenty years, has visited the Institute on many occasions and has given it continuing encouragement and support. He took the initiative in securing recognition for the Institute as an institution of national importance and empowering it to award degrees by sponsoring the Indian Statistical Institute Act in the Parliament in 1959.

Academician Andrei Nikolayevich Kolmogorov

Academician Andrei Nikolayevich Kolmogorov, Member of the Academy of Sciences of the USSR, and Professor of Mathematics, University of Moscow, is one of the great mathematicians of the world and has made fundamental contributions to pure and applied mathematics.

His work on the foundations of probability has given a rigorous basis for mathematical statistics and has supplied a framework for the development of stochastic processes associated with physical and biological phenomena and limit theorems which form the basis for a study of statistical regularities in physical sciences.

In recent years, he has made outstanding contributions to information theory and its applications in the field of dynamical systems and in the solution of a famous problem of Hilbert in constructive function theory. He has also made significant contributions to cybernetics and studies on automation.

He is an inspiring teacher and has combined the creative power to develop completely original ideas of great depth with an unusual capacity to take interest in and encourage the achievements of other mathematicians and statisticians, and has in this way exercised a great influence in the advancement of research in mathematical statistics and its applications.

He has also shown a friendly interest in the work of the Indian Statistical Institute, and in the economic development of India.

Dr. Walter Andrew Shewhart

Walter Andrew Shewhart, while working as a research physicist in the Bell Telephone Laboratories, developed Statistical Quality Control as a powerful method for improving and maintaining the quality of manufactured products at a sufficiently high level consistent with economic costs.

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He showed great skill in evolving methods which were simple in principle and which could be adopted under widely varying conditions. This made it possible to adopt Statistical Quality Control on a very extensive scale in the USA and the UK for purposes of war production during the Second World War.

SQC methods are being used on an increasingly large scale in many advanced countries not only in manufacturing industries of all kinds but also in systems of distribution and services and the regulation of organized human activities. The use of these methods is, in one sense, of even greater value in the less advanced countries for the maximum utilization of resources during the period of industrialization and rapid economic growth.

Walter Andrew Shewhart has taken an active interest in the promotion of Statistical Quality Control in India by personal visits as a guest scientist of the Indian Statistical Institute on four occasions since 1947.

SPEROR BY DR. C. R. RAO

Dr. C. R. Rao, Head of the Research and Training School, before presenting two candidates for the Ph.D. degree and seven candidates for the M.Stat. degree, made a short introductory speech in which he recalled that he himself had joined the professional course in the Institute in 1941 although he knew he would not be awarded a degree. His relations and friends thought this most inadvisable. But he had heard of the new subject and of the statistical group which had already come together in the Institute. He, therefore, decided to join the Institute as a great adventure and he has never regretted this.

He recalled that although the trainees in the professional courses of the Institute did not receive any degrees, they usually succeeded in obtaining suitable posts; still there was some discrimination and disadvantages in their not having a formal degree conferred on them. This defect would be now remedied as the Institute will now be able to confer degrees on successful students.

AWARD OF PH.D. AND M. STAT. DEGREES

Dr. C. R. Rao then presented the following candidates and gave a citation in each case for the award of Ph.D. and M.Stat. degrees. The subject of the thesis is mentioned after the name of each candidate.

Doctor of Philosophy

1. Kalyanasuram Ranga Parthasarathy : *Some Problems in Ergodic Theory and Information Theory.*
2. Jayaram Sethuraman : *Some Results concerning Asymptotic Distributions and their Applications.*

Master of Statistics

1. Narasimha Sreenivasa Iyengar : *Some Econometric Models for India,*
2. Vasant Tukaram Konde : *Errors in Medical Diagnosis with special reference to X-ray Readings,*
3. Taree Maitra : *A Study of Trade in India.*
4. Manjula Mukhopadhyay : *Problems of Educational and Vocational Measurement.*
5. Ganesean Parthasarathy : *Sampling on Successive Occasions and Self-weighting Designs.*
6. Kadiyala Koteswara Rao : *Size Distribution of Personal Income and Allied Problems.*
7. Paras Nath Singh : *Some Econometric Studies related to Indian Economy.*

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CONVOCAATION ADDRESS BY SIR RONALD A. FISHER

Sir Ronald A. Fisher delivered the following Convocation Address :

It is now just about 25 years, since I first had the pleasure and privilege of meeting in India both Professor Mahalanobis and the very able group of friends and students whom he had gathered to form the Indian Statistical Institute. I had, indeed, before that known something of Mahalanobis's work, for I was much concerned to view if necessary only from a distance, the movements of thought in different parts of the world associated with the rapid development of statistical understanding in my own country; and I had recognized the appearance in the East of a new movement which was putting India not far from the centre of the statistical map. A movement comparable in importance, for example, with that of *Yates* in the extension and elaboration of Experimental Design, or of that which under the impulse of *Walter Shewhart* was soon to storm through the United States under the banner of Quality Control. I need hardly say that I refer to the emergence of a statistically competent technique of Sample Survey, with which I believe Professor Mahalanobis's name will always be associated.

What at first most strongly attracted my admiration was that the Professor's work was not imitative. That is a fault which has been ascribed to Indians, but as every statistician knows, nations are composed of very many, and very different individuals. They do not share the same list of faults, and at the present time you have only to look at any bunch of newly published books, on statistics for example, to see that this fault is by no means a monopoly of any one people. Imitative books are as common as dirt; and work of striking originality is as rare now, as it was when I first read of the surveys of the jute crop of Bengal in which the Professor was trying out his new ideas.

During the inter-war period and indeed before, there had been some discussions at the International Statistical Institute on sampling for the ascertainment of demographic and economic data. The conditions imagined were very different from those of practical work in India, and, indeed the theoretical principles also had been very imperfectly appreciated. Even so elementary a requirement as randomisation was at first ignored.

What was striking therefore in the Indian contribution to the problems of Sample Survey, was that it combined a clear realization of statistical principles with a down-to-earth experience of the practical difficulties, in a country in which education was, on the whole, backward, of getting such work done, on a large scale, and yet with the primary scientific requirement of ascertainable and demonstrable precision. From that point the standard set has never gone back, and publicly organized censuses and surveys in all parts of the world look to the Indian Sample Survey as a basis for comparison. Difficulties of course there are, in India, and also elsewhere, but the speed and economy, as well as the accuracy of sample surveys when competently organised, have now been put beyond question.

The needs of India, which are always I fancy at the heart of the Professor's thinking, show themselves again in the utilization of those aptitudes in which Indians have shown themselves to be especially gifted. From time to time as new editions of *Statistical Tables* are required, I go over those contributions of sufficient importance to be noticed in the preface, especially to the combinatorial problems arising from *Yate's* work on experimental design and his invention of balanced incomplete blocks. Mathematicians of many nations have contributed to our knowledge of this very intriguing field, but I do not think I exaggerate if I say that the Indian names are as numerous as all others together, and this must particularly

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be ascribed to the fact that early in the Institute's history several of the young mathematicians brought into intellectual contact by the Institute's activity, found in this subject a type of problem ideally suited to their gifts. Again the important work in multifactorial analysis in which I have been glad to see extensions and amplifications of my own early work, has been chiefly, if not wholly taken up by past and present members of the Institute such as Bose and Roy in North Carolina, and especially by Rao here in Calcutta.

Every time I see the Institute it is bigger, and I hope better. On this visit I am sure I have not seen it all. It certainly shows no sign of narrowness or standardization. New facets are always appearing—a paleontological museum, or a garden of Indian cultivated plants. I take these bold excursions to mean that the Director believes, as I most certainly do myself, that teaching, instruction, or training in statistics, at whatever level is bound to gravitate to an exhibitionism in useless mathematics, unless it is linked as intimately as may be, on the one side with fact-finding projects in the traditional statistical fields of demography and economics, and on the other side with opportunities to gain first-hand familiarity with at least some field in the natural sciences. Moreover, the science with which the student is to become acquainted must be genuine research in its own right, not what is eloquently called a "mock-up" for the use of students only. Visitors are often surprised, when they learn that Miss Robinson and her colleagues are actually digging up some of the early inhabitants of India, and writing a new chapter in Indian megalithic history. They ask what has that to do with statistics. That sort of question reveals well how comparatively narrow and trivial a subject statistics was in the nineteenth century. It has grown since then, almost explosively; and it is certainly proper, some would say it is a prime requirement, if the Statistical Institute also widens its range of interests. The answer to the question, therefore, of what the sciences have to do with statistics lies in the part they must play in the education of any competent statistician. And that the Institute's future stands or falls by the *quality* of the education it offers.

The implementation of this broad educational policy seems to me extremely difficult. For its educational programme the Institute needs not only leaders in mathematical thought like Professor Rao, who can uphold and maintain the high place in world opinion that Indians have already won, but they need also that patient and obstinate class of scientific workers, who alone can transmit the feel and know-how of the natural sciences. There is very little of the aggressive and self-advertising about such men; though they may be among the most gifted of teachers, for whom even the best text books are no substitute at all. I do not suggest that they are easy to find, only that, here as elsewhere, they are fitted to play the most important part in scientific, technological and technical education.

These, may I insist, are not *casus*. Though literary men and journalists have often shown their aptitude for getting hold of the wrong end of the stick, by suggesting that technologists in particular are less than highly educated, nothing could be further from the truth. Scientists indeed may, at their own risk, narrow their interests in order to gain special proficiency in one line. Technicians also may develop by ample practice very special aptitudes. The technologist must talk the language both of the scientist and of the technician. His education must be broader than theirs, though at points less intensive. He has to see both sides of the fence, and is the channel through which alone the skills of the others can be made

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effective. It is, I believe, in recognizing Statistics as the key technology of our century, that we can appreciate the special features of the Indian Statistical Institute.

The Convocation was then declared closed and the function terminated with the National Anthem.

SPECIAL CONVOCATION : 28 APRIL 1962

A Special Convocation, presided over by Professor S. N. Bose, Vice-President of the Institute, was held in the mango-grove of the Indian Statistical Institute on 28 April 1962 to confer the honorary degree of Doctor of Science on Academician Andrei Nikolayevich Kolmogorov.

SPEECH BY PROFESSOR P. C. MAHALANOBIS

Speaking on the occasion, Professor P. C. Mahalanobis said :

I welcome Academician Kolmogorov on behalf of the Indian Statistical Institute and I should like to greet him in the Indian way. At our First Convocation in last February, we announced the award of the honorary degree to two persons who could not be present—our Prime Minister Jawaharlal Nehru, and Academician Kolmogorov. We are very happy that Academician Kolmogorov could come here, although somewhat behind schedule, and we are glad to have this opportunity to welcome him.

Respected Chairman, on this occasion of the Special Convocation of the Indian Statistical Institute, I have the honour to present before you the name of Academician Andrei Nikolayevich Kolmogorov, Member of the Academy of Sciences of the USSR and Professor of Mathematics, University of Moscow. I will now request Dr. C. R. Rao, Head of the Research and Training School, to read out the citation.

Dr. C. R. Rao then read the citation.

REMARKS BY THE CHAIRMAN

Professor S. N. Bose, the Chairman, then said :

In recognition of your great achievements and contributions to the advancement of statistics, on behalf of the President of the Indian Statistical Institute, I confer on you, Academician Andrei Nikolayevich Kolmogorov, the degree of Doctor of Science.

It gives me great pleasure to be able to be present at this Special Convocation, though I regret that our President and the Chairman are unavoidably absent. Professor Kolmogorov has been with us for a number of days and he has delivered several lectures at the Indian Statistical Institute. We are all very glad that, in spite of many difficulties particularly indifferent health, he could come over to India and stay with us for a few days and by his presence and lectures inspire the workers of the Indian Statistical Institute. I had a talk with him recently and he showed great appreciation of the work that is being done at the Indian Statistical Institute. Personally, I regret very much that he cannot stay in Calcutta longer; if he could the University of Calcutta would have been glad to have him. I hope, Professor Kolmogorov, you will be able to come over and, I can assure you, you will always find a warm welcome here. People here would like you to be among them, as you have solved many problems in the mathematical world which others were afraid to grapple with. I hope your presence here will encourage our young workers of whom you have already shown your appreciation and whom you have inspired to fresh efforts. This Institute had been in

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contemplation in the mind of our Director for many years. Recently, it has been promoted to the rank of a university. Your name will remain inscribed in our books for ever.

SPROUCH BY ACADEMICIAN KOLMOGOROV

Academician Kolmogorov said in his reply :

The Indian Statistical Institute is very well-known in my country as one of the greatest world centres of scientific thought in the field of statistics and relative branches of mathematics. We have especially welcomed the energy with which Professor Mahalanobis has devoted himself to the task of planning, using scientific theory for the greatest possible benefit of the Indian people. Thus you can understand how glad I was to learn that the Institute had decided to award me an honorary degree. I thank the Indian Statistical Institute, Professor Mahalanobis and all my colleagues gathered here for the honour which they have bestowed on me.

I may be a mathematician; thus I saw my tasks here in Calcutta, as being mainly one of doing concrete work with a group of Institute mathematicians under the leadership of Dr. Rao. I was extremely glad to observe that the young mathematicians of his group are working with great energy on a series of interesting and difficult problems. The scientific potential, as it is sometimes said, of this group is very high. I sincerely congratulate Dr. Rao for having been able to assemble in Calcutta such a remarkable group of young mathematicians. My acquaintance with the applied work of the Institute has been unavoidably too cursory. The Institute is too big for one to be able to become acquainted with all its work in a period of two weeks. But the impression which I have received has been an extremely good one and it has been of great value to me. It has been a great pleasure for me to become acquainted with your country of which all of my compatriots are very fond. We all believe in a great future for India and we are sure that your country can contribute to peace and enlighten the existence for all humanity.

Academician Kolmogorov then added a few words in French :

I want to add a few other words of thanks for which I had not prepared in advance. I should like to add my personal thanks to Professor Mahalanobis and to Mrs. Mahalanobis. I have been staying in *Amrapali*, where one comes across Indian culture at its best. These were two very delicious weeks of which I will have very fond memories in future. I should like to thank all the young colleagues who were around me always and also Dr. Adhikari who has been my guide.

I should like to thank the Institute once again for the honour which they have bestowed upon me and for the cordial welcome which they have accorded me.

CONCLUDING REMARKS BY PROFESSOR P. C. MAHALANOBIS

Professor P. C. Mahalanobis said in his concluding remarks :

Friends, I and my colleagues feel proud now to have Academician Kolmogorov as a member of the Institute, as one of its Doctors of Science. I may also answer one question about the invitation which our Chairman has given to Academician Kolmogorov. I spoke to Academician Kolmogorov only this morning about his coming to India again and I was assured that possibly in about a year's time he does intend very seriously to come and make a long stay here (applause). We shall look forward to that day again. As a token of our esteem and respect we should now like to offer him something of our Indian handiwork made in the Institute and also some photographs taken when he was here.

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Appendix 2: List of Office-Bearers and Members of the Committees of the Council

President : Sri Chintaman D. Deshmukh.

Vice-Presidents : Professor S. N. Bose, F.R.S.; Professor D. R. Gadgil, M.A., M. Litt.; Dr. Q. M. Hussain, M.A., Ph.D.; Dr. Zakir Hussain, Ph.D.; Professor K. B. Madhava, M.A., A.I.A.; Dr. K. C. K. E. Raja, L.R.C.P. and S., D.P.H., D.T.M. and H.; Sir Shri Ram.

THE COUNCIL : 1961-62

Chairman : Sir D. N. Mitra.

Vice-Chairmen : Sri K. P. Goenka; Sri K. C. Mahindra, M.A. (Cantab); Sri D. N. Mukherjee, M.L.A.; Sri S. C. Ray, M.A., B.L.; Professor N. R. Sen, M.A., D.Sc.

Treasurer : Dr. S. C. Law, M.A., B.L., Ph.D., F.Z.S., M.B.O.U., F.N.I.

Secretary : Professor P. C. Mahalanobis, F.R.S., D.Sc.

Joint-Secretaries : Sri S. Basu, M.Sc.; Sri N. C. Chakravarti, M.A.; Sri Pitambar Pant, M.Sc.; Sri T. K. Roy Chaudhuri, B.Sc. (Cal.), LL.B. (Belfast) F.C.A.(Eng.).

Members : Sri S. K. Acharyya, Bar-at-Law; Sri R. Banerjee, I.A.S.; Srimati Chameli Bose, B.Sc. (Lond.); Sri V. M. Dandekar, M.A.; Sri A. Mitra, ICS; Professor H. C. Ghosh, M.A., P.R.S.; Sri N. C. Ghosh, M.A.; Sri S. Gupta, B.Sc. (Lond.), F.I. Consult E. I.S.E. (Retd.); Sri D. B. Lahiri, M.Sc.; Srimati Nirmalkumari Mahalanobis; Sri N. T. Mathew, M.A., M.Sc.; Sri S. C. Maulik; Sri M. M. Mehta; Sri M. Mukherjee, M.A.; Sri J. K. Pande, M.A.; Dr. C. R. Rao, M.A., M.Sc., Ph.D. (Cantab), F.N.I.; Dr. N. S. R. Sastry, M.A., M.Sc., Ph.D. (Lond); Sri S. C. Sen, M.A., LL.B.; Sri S. C. Sen, B. A. (Cantab); Sri S. Sengupta M.Sc. (Dacca), B.Sc. (London).

Government Nominees to the Council : (i) Cabinet Secretary—Sri Vishnu Sahay, ICS (upto April, 1962); Sri S. S. Khara, ICS, upto August 1962; Additional Secretary, Department of Statistics, Government of India—Sri P. C. Mathew, ICS, from August 1962). (ii) Joint Secretary, Ministry of Finance (Food and Agriculture)—Sri A. C. Bose. (iii) Chief Director, National Sample Survey—Sri R. Prasad.

GOVERNING BODY OF THE RESEARCH AND TRAINING SCHOOL : 1961-62

Sir D. N. Mitra, Chairman (*ex-officio*); Professor P. C. Mahalanobis, Director-Secretary (*ex-officio*); Mr. George Barrell, (upto March 1962, Sri Dinesh Bahl from May 1962) (*Associated Chambers of Commerce of India*); Dr. S. N. Sen, M.A., Ph.D. (*Indian Economic Association*); Sri G. Basu, B.A., F.C.A., F.S.A., F.C.I.S., F.I.C., W. A. M.L.C., J.F. (*Federation of Indian Chambers of Commerce and Industry*); Dr. K. R. Nair, M.A., Ph.D., Joint Director, *Central Statistical Organisation*; Sri A. C. Bose, I.A.S., Joint Secretary, Finance (Food and Agriculture), Government of India; Professor B. N. Prasad, D.Sc. (Paris), Ph.D. (London) Head, Department of Mathematics, Allahabad University (*National Institute of Sciences of India*); Dr. N. S. R. Sastry, M. A., M.Sc., Ph.D. (*Reserve Bank of India*); Dr. Ram Behari, M.A., Ph.D., Sc.D. (Cantab), Professor and Head of the Department of Mathematics, Delhi University (*Inter-University Board*); Sir Shri Ram; Sri Pitambar Pant, M.Sc.; Professor K. B. Madhava, M.A., A.I.A., F.N.I.; Dr. C. R. Rao, M.A., M.Sc., Ph.D. (Cantab.), F.N.I.; Sri S. Basu, M.Sc., Professor S. N. Bose, F.R.S. and Sri N. C. Chakravarti, M.A. (*Council of the Indian Statistical Institute*).

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FINANCE COMMITTEE OF THE GOVERNING BODY

Sir D. N. Mitra (ex-officio); Professor P. C. Mahalanobis (ex-officio); Sri N. C. Chakravarti; Dr. N. S. R. Sastry; Sri Vishnu Sahay, ICS (upto April 1962); Dr. K. R. Nair, Joint Director, Central Statistical Organisation (from July 1962); Sri A. C. Bose, Joint Secretary, Ministry of Finance; Mr. George Barrell (upto March 1962) and Sri Dinosh Bahl (from August 1962).

COMMITTEES OF THE COUNCIL

FINANCE COMMITTEE

Sir D. N. Mitra, Chairman (ex-officio); Dr. S. C. Law, Treasurer (ex-officio); Professor P. C. Mahalanobis, Honorary Secretary (ex-officio); Sri Snehangshu Kanta Acharyya; Sri R. Banerjee; Sri S. Basu; Sri S. C. Roy; Sri T. K. Roy Chaudhuri; Sri S. K. Sen (Financial Adviser); Sri N. C. Chakravarti, Joint Secretary (Member-Secretary) and two representatives of the Government of India. (i) Cabinet Secretary or his representative—Sri Vishnu Sahay, ICS, (upto April 1962); Additional Secretary, Department of Statistics, Government of India.—Sri P. C. Mathew, ICS, (from July 1962). (ii) Joint Secretary, Ministry of Finance (Food and Agriculture).—Sri A. C. Bose.

EXAMINATIONS COMMITTEE

Dr. D. Basu; Dr. Ram Behari (representative of the Governing Body); Srimati Chameli Bose; Sri N. C. Chakravarti; Sri V. M. Dandekar; Sri N. C. Ghosh; Professor K. B. Madhava; Professor P. C. Mahalanobis; Sri N. T. Mathew, Dr. A. Matthal, Sri M. Mukherjee, Sri M. N. Murthy; Dr. K. R. Nair; Sri B. G. Narasimhan; Dr. C. R. Rao; Dr. J. Roy; Dr. N. S. R. Sastry (representative of the Governing Body); Sri J. M. Sengupta; Sri Sarasw Sengupta; Sri M. A. Telang and Sri S. Raja Rao (Member-Secretary).

JOURNAL COMMITTEE

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JOINT AD HOC COMMITTEE FOR ALLOCATION OF EXPENDITURE

Professor P. C. Mahalanobis; Sri N. C. Chakravarti; Dr. C. R. Rao; Professor K. B. Madhava; Sri Vishnu Sahay, I.C.S. (upto June 1962); Additional Secretary, Department of Statistics, Government of India—Sri P. C. Mathew, ICS, (from July 1962).

BOMBAY BRANCH: 1961-62

President: Sri Sheshrao Wankhede.

Vice-Presidents: Dr. N. S. R. Sastry; Sri R. G. Saraiya; Sri M. C. Kutibhaskar; Dr. C. Nanjundiah.

Hon. Secretary: Sri M. A. Telang.

Joint Secretary: Sri K. A. Antony.

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Members of the Executive Council: Dr. R. L. M. Iyengar; Dr. S. A. Palekar; Sri P. K. Bhaumik; Dr. V. N. Patankar; Professor V. B. Kamath; Sri P. N. Phutane; Sri K. S. Narayanan.

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MYSORE STATE BRANCH

President : Sir R. Natarajan.

Vice-President : Sri P. S. Narayana.

Treasurer : M. C. Satyanarayana.

Secretary : Sri Srinagabhushana.

Joint Secretary : Sri H. S. Narayana Rao.

Members of the Executive Committee : Sarvaari R. Ramaswami; Ravi L. Kirloskar;
C. A. Setty; M. V. Venkataraman; S. R. Subramanian; M. V. Jambunathan.

KERALA BRANCH

President : Dr. K. C. K. E. Raja.

Vice-President : Dr. U. S. Nair.

Hon. Secretary : Dr. (Miss) A. George.

Members of the Executive Council : Professor S. Janardhana Iyer; Sri J. Christopher.

Appendix 3 : Visitors to the Institute

Australia

- EWING, MAURICE : Professor of Surgery, University of Melbourne. 26-29 November 1961.
- FISHER, SIR RONALD A. : Division of Mathematical Statistics, Commonwealth Scientific and Industrial Organisation, University of Adelaide. 6 December 1961—14 February 1962.
- GODDING, JAMES R. : Physiology Department, Melbourne University. 7-10 October 1961.
- KOENIG, H. S. : Professor of Mathematics and Economic Statistics, University of Sydney, NSW. 25-28 December.
- PHILLIPS, J. G. : Deputy Governor, Reserve Bank of Australia. 3-5 July 1961.
- RUTHERFORD, R. S. G. : Associate Professor, Department of Economic Statistics, University of Sydney. 11 October-5 December 1961.
- TURNER, H. NEWTON : Senior Research Officer, Commonwealth Scientific and Industrial Organisation, Division of Animal Genetics, Glebe, NSW. 2-4 May 1961.
- WILKINSON, G. N. : Senior Research Officer, Division of Mathematical Statistics, Commonwealth Scientific and Industrial Research Organisation, University of Adelaide. 15 July-7 August 1961.

Bulgaria

- VASSILYEV, I. I. : Professor, Bulgarian Academy of Sciences, Sofia. 9-12 January 1962.

Burma

- WELLS, W. A. : Manager, Rangoon, Office, Imperial Chemical Industries (I). 4 August 1961.

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Czechoslovakia

- BASANT, VLADISLAV : Director, Institute for Chemical Process Fundamentals, Prague. 9-12 January 1962.
- HABAN, LADISLAV : Consul-General in Calcutta. 11 January 1962.
- KROBEK, J. : Department of Development Physiology and Pathophysiology, Czechoslovak Academy of Sciences, Prague. 9-12 January 1962.
- LEBLER, GUYRAY : First Secretary, Embassy, People's Republic of Czechoslovakia, New Delhi. 12 April 1961.
- MERHAUTOVA, ELISKA : Indologist, Oriental Institute, Prague. 19 March-23 June 1962.
- SIMOVIC, LADISLAV : Ambassador of the People's Republic of Czechoslovakia in India, New Delhi. 12 April 1961.
- WINKELBAUER, KARL : Assistant Director, Institute of Information Theory and Automation, Czechoslovak Academy of Sciences. 19 March-8 September 1962.

France

- FLOY, MARCEL : Cultural Counsellor, Embassy of France, New Delhi. 12 December 1961.
- KAUFMANN, ARNOLD : Professor, Institut Polytechnique de Grenoble Ecole Nationale Supérieure des Mines de Paris; Scientific Adviser, Campagne des Machines Bull, Paris. 6 November, 1961.
- POULQUEN, JACQUES : Centre Culturel Français de Calcutta, Calcutta. 12 December 1961.

Germany (Federal Republic)

- BROCK, DIETEV : Research Fellow, German Research Council. 3 October 1961.
- COLLATE, LOTHAR : Institut für Angewandte Mathematik (Institute for Applied Mathematics), University of Hamburg. 28-30 December 1961.

Ghana

- EVANS, EVELYN : Director of Library Services, Ghana. November 1961.

Hong Kong

- BARRY, ALLAN J. : Professor of Economics, University of Hong Kong. 12-14 October 1961.

Hungary

- SEADRECKY-KARDOS, F. : Professor of Geochemistry, University of Budapest. 9-12 January 1962.
- SEIONTI, GEORGE : Director, Institute for Technical Physics, Budapest; member, Hungarian Academy of Sciences. 4-12 January 1962.
- VANHAUTE, G. : Secretary-General, Trade Union International of Chemical, Oil & Allied Workers, (W.F.T.U.), Budapest. 5 July 1961.

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India

- BRATTACHARYYA, P. K. : National Chemical Laboratory, Poona. 9 January 1961.
- CENTRAL BOARD OF IRRIGATION & POWER RESEARCH STATION : 80 delegates to Annual Session to Calcutta. 8 June 1961.
- CHAKRAVARTI, N. K. : Defence Research Laboratory, Kanpur. 21 December 1961.
- DASGUPTA, D. K. : Employment Officer, Directorate of National Employment Service, Calcutta. 3 October 1961.
- DEMOGRAPHIC RESEARCH & TRAINING CENTRE, BOMBAY : 23 students. 29 December 1961.
- GUNE, H. S. : Lecturer in Mathematics, University of Boorkee, Uttar Pradesh. 2 February 1962.
- HABIBULLAH, E. : Major-General, Director, Heavy Engineering Corporation Ltd. (a Government of India Undertaking), Ranchi. 26 December 1961.
- INSTITUTE OF ENGINEERS (INDIA) : 42nd Annual Convention in Calcutta. 36 delegates. 6 February 1962.
- KHANNA, K. L. : Ex-Director, Sugarcane Research Development, Bihar. 25-26 August 1961.
- KHOSLA, J. N. : Indian Ambassador to Indonesia; accompanied by Mrs. Khosla. 8 April 1961.
- KULKARNI, G. A. : Statistician, Institute of Agricultural Research Statistics, New Delhi. 29 December 1961.
- KING, PETER S. : Professor, Indian Institute of Management, Calcutta. 8 February 1962.
- LAWRIE, S. K. : National Productivity Council, Calcutta. 1 November 1961.
- MATHUR, K. K. : Professor of Statistics, All-India Institute of Hygiene & Public Health, Calcutta. 24 January 1962.
- MENON, P. K. : Joint Cipher Bureau, Ministry of Defence, Government of India, New Delhi. 4 October 1961.
- MUNAVALLI, R. S. : Lecturer in Statistics, Karnatak College, Dharwar, Mysore State. 29 May 1961.
- NAIR, RAVINDRAN G. : Lecturer, Engineering College, Trivandrum, Kerala. 11 December 1961.
- NATH, S. N. : Statistical Assistant, Institute of Agricultural Research Statistics, New Delhi. 29 December 1961.
- PANDE, J. W. : Statistician, Public Works Department, Government of Maharashtra. 23 December 1961.
- PAPPU, V. : Chief Engineer, Andhra Pradesh Electricity Board, Kairabad, Hyderabad. 8 June 1961.
- PHATAK, A. G. : Lecturer in Statistics, University of Baroda. 20 May 1961.
- PRASAD, TRIBHUVAN : Assistant Professor of Mathematics, Bihar Institute of Technology. 4 December 1961.
- PRATAP, MAHENDRA : Professor of Statistics, J. V. College, Baraut. 29 May 1961.

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- RAIYA, B. L. :** Director of Forestry Planning, Directorate-General of Health Services, Government of India. *24 January 1963.*
- RAMDORAI :** Deputy Financial Adviser, Ministry of Health, Government of India. *24 January 1963.*
- RAMASWAMY, P. :** Marketing Officer, Regional Office, Directorate of Marketing & Inspection, Government of India. *8 June 1961.*
- RAMAN C. B. :** Department of Economics, University of Madras. *29 May 1961.*
- ROY, B. :** General Secretary, Burma Shell Employees Association, Calcutta. *5 July 1961.*
- SARKAR, K. C. :** Professor of Law, Rajshahi University. *24 October 1961.*
- SHAH, K. S. :** Foundry Superintendent, Machanite Foundry, Premier Automobiles Ltd., Bombay. *8 December 1961.*
- SHRIKHANDR, S. S. :** Professor of Statistics, Banaras Hindu University. *10-11 October 1961.*
- SINGH, RAMKISHOR :** Statistical Officer, Community Development Department, Patna. *1 August 1961.*
- SINHA, REEBOOA :** Research Scholar, Banaras Hindu University. *15 January 1962.*
- STEVENS, F. W. :** Deputy Controller of Purchase, Heavy Engineering Corporation Ltd. (a Government of India Undertaking), Ranchi. *26 December 1961.*
- SUNDARAM, G. :** General Secretary, All-India Petroleum Workers' Union, Bombay. *5 July 1961.*
- TETJA, D. :** businessman; former Professor of Nuclear Physics, University of Chicago, U.S.A. *3 February 1963.*
- TIKHAR, V. G. :** Department of Applied Mathematics, Indian Institute of Science, Bangalore. *29 May 1961.*
- VYAS, V. S. :** Officer-in-charge, Agro-Economic Research Centre, Sardar Vallabhbhai Vidyapeeth, Vallabh Vidyanagar, Gujarat. *15 March 1962.*

Indonesia

- SOEMARMAN :** Senior Officer, Department of Home Affairs & Regional Autonomy, Republic of Indonesia. *26 February 1962.*

Iran

- MINOU, FOROUGH :** Iran Public Library, Tehran. *23 December 1961.*

Israel

- HANANI, H. :** Department of Mathematics, Institute of Technology. *28-29 September 1961.*

Italy

- MARABO, C. :** *Swam Projects* (Italian Government firm). *17 January 1962.*
- MONROY, ALBERTO :** Principal, Department of Zoology, Palermo University. *16-26 August 1961.*

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Japan

- AKATSU, M.: Research Section, Economic Bureau, Ministry of Foreign Affairs. 16-20 October 1961.
- FUJI, SHIGERU: Dean, Faculty of Economics, Professor of International Economics, Kobe University. 16 December 1961.
- FUJITA, F.: Director, Affiliates Relations, Asahi Glass Co. Ltd., Tokyo. 19 June 1961.
- ISHII, IORIBO: Research Staff, Institute of Asian Economic Affairs, Tokyo. 20 December 1961.
- KATANO, HIKOJI: Assistant Professor, Research Institute for Economics & Business Administration, Kobe University. Arrived 31 March 1962.
- KAWATA, TADASHI: Associate Professor of International Relations, University of Tokyo. 20 December 1961.
- KITAGAWA, KAZUO: Professor, Department of Economics, Nagoya University. 8 January 1962.
- KOJIMA, KIYOSHI: Professor of International Economics, Hitotsubashi University, Kunitachi, Tokyo. 16 December 1961 & 8 January 1962.
- MASUYAMA, M.: Institute of Physical Therapy & Internal Medicine, Faculty of Medicine, University of Tokyo. 22 September 1961-14 January 1962.
- MATSUTANI, KENJIRO: Research Scholar, Institute of Asian Economic Affairs, Tokyo. 31 May 1961-31 May 1962.
- MORIGUTI, SHIGEHITO: Professor of Applied Physics, Faculty of Engineering, University of Tokyo. 2-7 April 1962.
- OSURO, T.: Mitsui & Co., Calcutta Branch. 16 December 1961.
- OGURA, HIROKATSU: Dean, Faculty of Economics, Ritsumeikan University, Kyoto; Member, Science Council of Japan. 9 January 1962.
- OHNUMA, ETSURO: Research Division, Institute of Asian Economic Affairs, Tokyo. 24 & 26 February 1962.
- SURUGAWA, HIROSHI: Statistical Standards Bureau, Administrative Management Agency, Tokyo. 24-26 February 1962.
- TAKAGI, KENJIRO: Counsellor, Office of General Secretary, Asian Productivity Organisation. 16 October 1961.
- YAMAQUCHI, HIROSHI: Research Officer, Institute of Asian Economic Affairs, Tokyo. 31 March 1962.
- YONAKURA, JIRO: Professor of Geography, Hiroshima University. 6 June 1961.

Malaya

- FABREY, DAVID B.: Director, Agronomic Research, Pineapple Research Station, Alor Bukit, Johore Bahru. 28 July 1961.

Pakistan

- HOSSEIN, SYED: Vice-Chairman, Planning Commission, Pakistan. 20 November 1961.
- HUSSAIN, Q. M.: Director, Statistical Survey Research Unit; Professor of Statistics, Dacca University, Dacca. 20-28 January 1962.

INDIAN STATISTICAL INSTITUTE

Poland

- KATS-SUCHY, J.: Ambassador Extraordinary & Plenipotentiary in India, New Delhi. 27 March 1962.
- KAWINSKI, ROMAN: Consul-General in Calcutta. 9 March 1962.
- SMOLENSKI, D.: Professor of Chemistry, Polytechnika, Warsaw. 10 January 1962.
- STEVANSKY, W.: Professor of Parasitology, Polish Academy of Sciences. 10 January 1962.

Switzerland

- BELINOU: Sandos Ltd., Basle. 7 November 1961.
- DREULEUX, E. J.: Consulate-General in Calcutta. 2 December 1961.
- SCHWARZENBACH, F. H.: Swiss Foundation for Alpine Research, Zurich. 3 November-2 December 1961.

Turkey

- ERGEN, KAZIM: Professor of Mining Engineering, Faculty of Geophysics, Technical University of Istanbul. 4-12 January 1962.
- INAN, MUSTAFA: Professor of Civil Engineering, Faculty of Applied Mechanics; Former Director, Technical University of Istanbul. 4-12 January 1962.
- NARTER, FERHAT: Professor of Mechanical Engineering, Faculty of Heat Engine; Rector, Technical University of Istanbul. 4-12 January 1962.
- REED, H. B.: Professor of Psychology, University of Istanbul. 11-15 August 1961.

United Kingdom

- BERNAL, J. D., F.R.S.: 2 April 1961.
- BLACKETT, P. M. S.: Physicist, Nobel Laureate. 6-8 January 1962.
- CHANDA, AMIT: Secretary, London Brahma Samaj. 27 December 1961.
- COMFORT, ALEX: Nuffield Research Fellow in Gerontology, Department of Zoology, University College, London. 22 December 1961-14 February 1962.
- GALLAGHER, JOHN ANDREW: Dean, Trinity College, Cambridge. 2 September & 23 December 1961.
- GATES, RUGGLES: Professor of Biology, University of London. 30 September 1961-1 March 1962.
- INGHAM, W. G.: Assistant Regional Representative, Eastern India, The British Council. 15 January 1962.
- KIDD, H.: Secretary, London School of Economics. 15 January 1962.
- LEARMONTH, A. T. A.: Department of Geography, University of Liverpool. 20 March 1962-11 May 1962.
- LONSDALE, CATHERINE, DAME: Vice-President, Royal Society of London. 9 January 1962.
- MARTIN, D. C.: Assistant Secretary, Royal Society of London. 6-7 January 1962.
- ROBINSON, PAMELA: University College, London. 10 November 1960-9 April 1961.