PRASANTA CHANDRA MAHALANOBIS  
(1893-1972)  
Foundation Fellow 1935  

MAHALANOBIS ERA IN STATISTICS

The Professor, as Prasanta Chandra Mahalanobis was known in India, passed away on 28 June 1972 in a nursing home in South Calcutta three weeks after an abdominal operation. Born on 29 June 1893 he would have completed 79 years on the next day; his last rites were performed on his 79th birthday. At the time of his death he was actively engaged in research, in guiding the work of the Indian Statistical Institute as its Chief Executive, Secretary and Director, and in advising the Government of India on statistical problems as Honorary Statistical Adviser.

In India, statistics was practically unknown in the first quarter of this century. There was no teaching or research in statistics at the Universities, no statistical society and no journal of statistics. Official statistics were collected only as a by-product of the administration. A sudden spurt of statistical activity occurred about 40 years ago, which was to put India, in the course of a few years, in the centre of the statistical map of the world.

The Indian Statistical Institute was founded by Mahalanobis in 1931, with facilities for high level research, training and execution of large-scale project work. Sankhyā, the Indian Journal of Statistics, was started in 1933. The new technique of estimating acreage and crop yield by random sampling was worked out and applied to jute in Bengal in 1937. The first Indian Statistical Conference was held in 1938. Post-graduate studies in statistics were opened for the first time in India at the Calcutta University in 1941 under the guidance of Mahalanobis. The Indian Science Congress, which had not recognised Statistics as separate discipline for a long time, included it in the section of mathematics in 1942 and created a separate Section for Statistics in 1945. A Central Statistical Unit was established by the Government of India in 1949 with Mahalanobis as Honorary Statistical Adviser to the Cabinet; two years later, the Central Statistical Organisation (CSO) was formed for coordinating all statistical activities of the Government, and soon after, the Department of Statistics was created. Based on the experience gained in Bengal, the National Sample Survey (NSS) was established in 1950 for the collection of socio-economic data through sample surveys covering the entire country, to provide information needed for government policy decisions and for the computation of national income. In 1954, the Prime Minister and the Planning Commission called upon Mahalanobis to initiate studies in planning at the Institute to find ways and means of increasing national income and solving the unemployment problem.
The Indian Statistical Institute was recognised as an institute of national importance and permitted to award degrees in Statistics by a Central Act in 1959.

Training of technicians for statistical quality control started in 1945 at the Indian Statistical Institute. A conference on standardization and quality control was held in 1948, which gave a start to the quality control movement in India. These significant achievements within a short span of time would not have been possible without the indefatigable energy of Mahalanobis.

With his death, the Mahalanobis era in statistics which started in the early twenties ended. Indeed, it will be remembered as the golden period of statistics in India, marked by intensive development of a new technology and its applications for the welfare of mankind.

EARLY LIFE AND EDUCATION

Prasanta Chandra Mahalanobis was born in Calcutta on 29 June 1893 in a well-known family of Brahmos (a protestant theist movement within the fold of Hinduism, founded in 1828 by Raja Ram Mohan Roy). He was the eldest of six children, two sons and four daughters. His father, Probodh Chandra was a businessman, and his mother Nirodbashini was a sister of Sir Nilratan Sarkar, the famous physician, educationist and industrialist. Prasanta had his early education in Brahma Boys' School. Later, he went to the Presidency College and obtained his B.Sc. degree with honours in Physics in 1912. Soon after, he left for Cambridge, U.K. for higher studies, where he took Part I of the Mathematics Tripos in 1914 and Part II of Physics Tripos in 1915. He was awarded a senior scholarship by the King's College, Cambridge; his intention was to work with the famous experimental physicist, C.T.R. Wilson, at the Cavendish Laboratory after spending a short vacation in India. But this did not materialise.

Mahalanobis married Nirmal Kumari on 27th February 1923. Rani, as Nirmal Kumari came to be known to friends of Mahalanobis, was a devoted wife. In the true Indian tradition she took up all the responsibilities of running the household, looked after the continuous stream of guests they had, relieved him of all the worries associated with his busy life, and made his life complete. She was constantly with the Professor throughout his life, and accompanied him on his frequent tours abroad and within the country.

PHENOMENAL ACTIVITY

Mahalanobis was offered a teaching position in the Physics Department of the Presidency College in Calcutta soon after his return from Cambridge. He joined the Indian Educational Service (IES) in 1915, held the post of Professor of Physics and later became Principal, Presidency College, from which he retired in 1948. During his life time he held several distinguished positions, several of them simultaneously. He was the chief executive of the Indian Statistical Institute, Calcutta, continuously since the founding of the Institute in 1931, Honorary Statistical Adviser to the Government of India since 1949; and was associated with the Plan-
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He served as a Meteorologist in Calcutta (1922-26), General Secretary of Vishva Bharati (1921-31), the University founded by Rabindranath Tagore, Head of the Department of Statistics of the Calcutta University (1941-45) and Statistical Adviser to the Government of Bengal (1945-48). He was Member of U.N. Statistical Commission since 1946 and its Chairman (1954-58), General Secretary of the Indian Science Congress (1945-48) and Treasurer (1952-55), President of the Indian National Science Academy (1957-58) and Editor of Sankhya, the Indian Journal of Statistics, since its founding in 1933.

His work apart, the Professor was in the mainstream of Bengal's social, cultural and intellectual movements. He tried to reform the Brahmo Samaj by arguing against some of its rigid tenets. He wrote a number of literary and Philosophical articles in Bengali and English. He was associated with Rabindranath Tagore and edited the 'Quarterly of Vishva Bharati'; he was acknowledged as an authority on the literary works of Tagore.

With all these activities, he could spend long hours arguing or discussing with his colleagues giving instructions to engineers and administrators, examining legal matters connected with the ISI, working out programmes for numerous foreign visitors to the ISI, and in between, giving time to his pet cat with whom he appeared to be able to communicate.

He was mentally alert and physically active throughout his life. Even after he was admitted to the nursing home in Calcutta he was constantly thinking of the new statistical tool he was developing, 'Fractile Graphical Analysis', and discussing with the present author some theories he had developed. He baffled the doctors by putting up a valiant battle for three long weeks after an operation before death overtook him.

Contributions to Statistics

While in Cambridge, Mahalanobis accidentally came across Biometrika, edited by Karl Pearson, in the King's College Library. He got so interested in the Journal that he bought a complete set of volumes and brought them to India. He soon discovered that statistics was a new discipline capable of wide application. In India, he tried to look for problems where he could apply statistics. Fortunately, he found some extremely interesting ones in Meteorology and Anthropology, and this marked a turning point in his career from a physicist to a statistician.

The Indian Statistical Institute

Genesis—The idea of starting the Indian Statistical Institute was conceived by Professor Mahalanobis and a group of young men who had gathered round him in the twenties (1920-31). There was already a workshop, in what came to be known as the Statistical Laboratory, located in the room of Mahalanobis, then Professor of Physics at the Presidency College, Calcutta. A public meeting, called over the signatures of Pramatha Nath Banerji (Minto Professor of Economics), Nikhil Ranjan Sen (Khaira Professor of Applied Mathematics) and Prasanta Chandra Mahalanobis was held on 17 December 1931, with the late Sir R.N. Mukherji in
the Chair. This meeting adopted a resolution which led to the establishment of the Indian Statistical Institute which was registered on 28 April 1932 as a non-profit distributing learned society under the Societies Registration Act XXI of 1860.

Phenomenal Growth—In the beginning, the Institute was located in the Physics Department of the Presidency College. During the fifties the present premises of the Institute on Barrackpore Trunk Road was built. At the time of the Professor’s death, the Institute at Calcutta and its branches at Bangalore, Baroda, Bombay, Delhi, Ernakulam, Giridih, Madras and Trivandrum had a total staff of over 2000, and an annual budget of about twenty million rupees. The phenomenal development of the Institute was mainly due to the individual efforts and imaginative planning by Mahalanobis. Other factors contributing towards his success were the great encouragement and support he received from two men of vision, Jawaharlal Nehru (as Prime Minister) and Chintaman Dwarkanath Deshmukh (as Finance Minister and President of the Indian Statistical Institute), and the band of talented statisticians who gathered around him and who themselves made significant contributions to statistics. Among those who came under the influence of the Professor include such outstanding statisticians as the late S. S. Bose, J. M. Sengupta, R. C. Bose, the late S. N. Roy, K. R. Nair, R. R. Bahadur, G. Kallianpur and D. B. Lahiri.

A significant role in the development of the Institute was played by the late Shri Pitambar Pant. Pant was Secretary to Jawaharlal Nehru during the Independence Movement in India. He was deputed by Nehru to the Institute to learn statistics in 1946. He was associated with the Professor since then and constantly helped him in all negotiations with the government, which often turned out to be delicate and difficult. Although Pant was never an employee of the Institute, he took considerable interest in it and gave much of his valuable time to the Institute’s work. He held the honorary positions of Joint Secretary and Vice-President of the Institute, and for a long time directed the activities of the Delhi Branch of the Institute.

Thirties and Forties—The present author was associated with the Professor for over thirty years, having joined the Institute in 1941 as a student in what was called the Training Section of the Institute. As there were no regular courses in statistics anywhere else in India at that time, the Institute attracted talented students from all parts of India. In addition, there were trainees deputed by government organizations and universities to take courses in statistics or to learn specific statistical techniques applicable to their problems. There used to be about ten students in the class and the duration of the training course was one academic year. The teaching was somewhat disorganized. Mahalanobis himself was too busy with the affairs of the Institute and his duties as Professor of Physics, and he never gave any regular lectures. There were others at the Institute (R. C. Bose, S. N. Roy, K. R. Nair, K. Kishen and A. Bhattacharya) doing research work and making fundamental contributions in specific areas of statistics, such as design of experiments and multivariate analysis. They discussed the students’ problems in the classes but did not attempt to give any systematic treatment of statistics, as they themselves were engaged in learning the subject. There were two staff members, S. Sengupta and Chameli Bose who had degrees in Statistics from the London University, who
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tried to cover the general area of statistics as developed by Karl Pearson. After completing training at the Institute and obtaining the Master’s degree in statistics from Calcutta University, the present author was appointed to the staff in 1943.

Working in the Institute was an exciting experience. One had the freedom to pursue one’s own ideas, to participate in the projects of the Institute, to accept administrative responsibilities or to devote time to research.

The Institute was engaged in conducting several sample surveys, consumer expenditure, public opinion, forecasts of acreage and yield of crops. Under the leadership of Mahalanobis, much pioneering work was done in the design of sample surveys, organization of field work and tabulation of results, for which the Institute received wide recognition. Some of the mathematicians in the Institute concentrated more on theoretical problems based on the research work initiated by Sir Ronald Fisher and Professor Mahalanobis in field experimentation, anthropometry and meteorology. Significant contributions were made in the areas of multivariate analysis, design of experiments, combinatorial mathematics and estimation by the workers of the Institute.

There was also the training section already referred to, which started in July 1938 where courses were given in theoretical and applied statistics spread over an academic year leading to a ‘Certificate of Training.’ A scheme of external professional examinations was started in 1938 for the award of the Computer’s Certificate and Statistician’s Diploma of the Institute on the same lines as the external examinations leading to the Fellowship of the Institute of Actuaries in England.

Fifties and Sixties—There were fresh developments in the fifties and sixties which were to give the Institute its special character. In 1950, the Institute undertook the responsibility of technical direction and tabulation of the National Sample Survey data, which meant considerable expansion in the staff of the Institute at both technical and non-technical levels. A new division of Statistical Quality Control was started in 1953 to provide consultation service to industry and this meant the establishment of a number of branches of the Institute in different parts of India. The Institute’s planning units in Calcutta and Delhi were expanded in 1954 to undertake studies in economic planning on behalf of the Government of India. A few years earlier, two research units, one for Sociology and another for Demography, started functioning. The fifties also saw the establishment of an Electronics Division and Workshop for the development of computers.

The Institute was declared as an Institute of national importance and empowered to award degrees by an Act of Parliament in 1959. The Institute immediately introduced undergraduate and post-graduate programmes leading to B.Stat., M.Stat., and Ph.D. degrees. The Institute continued to attract brilliant students. Some of them, D. Basu, G. P. Patil, T. N. Srinivasan, V. S. Varadharajan, K. R. Parthasarathy, R. Ranga Rao, S. R. Vardhan, and D. K. Roychoudhury have achieved international recognition.

Earlier a research unit in Biometry was started with a few workers, which considerably expanded when Prof. and Mrs. J.B.S. Haldane joined the staff of the Institute and branched off into a number of independent units, anthropometry, botany, agriculture, human genetics, embryology and biochemistry. About the same time,
Psychometry (under the leadership of Dr. Edwin Harper) and Linguistic research units were established. At the suggestion of Professor Haldane, Dr. Pamela Robinson of the London University was invited to start a geological research unit. With the introduction of the B. Stat. course, the departments of physics and chemistry were opened. Two research units, one for immuno-chemistry and another for leaf protein work, were established recently.

Thus the I.S.I. as it exists today, is a many-faceted organization. It functions as a university in its educational programmes and degree-awarding activity, as a corporation in undertaking large-scale projects, as a firm of consultants for industry to improve productivity and as a meeting place of scientists, economists and literary figures from all parts of the world.

Visitors are often intrigued to find such diverse and unrelated activities in the I.S.I., some of which may appear to be far removed from statistics, and also a Geological Museum with a rich collection of palaeontological material including dinosaur fossils. But to Prof. Mahalanobis, such diversification was a necessity. Though Statistics has its origin in gambling and demography, it grew in importance as a principal tool in scientific investigations, and statistical methodology has today been applied to the study of many problems.

**Mahalanobis Distance**

The first opportunity to use statistical methods came to Mahalanobis when N. Annadale (then Director of Zoological Survey of India) asked him, during a chance meeting at the Nagpur session of the Indian Science Congress in 1920, to analyse the anthropometric measurements taken on Anglo-Indians (of mixed British and Indian parentage) in Calcutta. This study led to Mahalanobis’s first scientific paper published in 1922 in the records of the Indian Museum under the title ‘Anthropological observations on the Anglo-Indians of Calcutta.’ This was a remarkable contribution. Among other things, it established Mahalanobis’s skill in applying statistical methods for extracting information from given data and drawing inferences. This study was followed by a number of other investigations, based on anthropometric measurements, which led to the formulation of the statistic, known in statistical literature as ‘Mahalanobis Distance’ and widely used in problems of taxonomical classification.

Mahalanobis was not satisfied with just providing a tool for cluster analysis based on a specified set of measurements. His logical mind had led him to raise fundamental issues connected with the application of the $D^2$ statistic. He argued that inferences drawn on affinities between populations might depend on particular measurements chosen for study, in which case the conclusion would not have the desired practical significance. The configuration may change, and even the order relations between distancees may be disturbed, if one set of measurements is replaced by another. Mahalanobis was, therefore, led to lay down an important axiom for the validity of cluster analysis called dimensional convergence of $D^2$.

Mahalanobis also pleaded for the standardization of anthropometric measurements so that data obtained by different investigators are comparable. In a paper
published in 1928 in ‘Biometrika,’ he examined the anthropometric data available from different sources and showed how a comparative study was not possible because of differences in the definitions of measurements in different investigations. He also emphasized the need for scrutiny of field records and devised systematic methods for detecting recording errors and making adjustments.

Mahalanobis’s early work on statistical analysis of anthropometric data and the theoretical problems it raised opened up a rich field of research in multivariate analysis to which several of his colleagues at the Institute have made valuable contributions.

In addition to his duties as Professor of Physics at the Presidency College, Mahalanobis also worked as a Meteorologist in Calcutta, in charge of the Eastern Region, from 1922 to 1926. During this period, he carried out a number of statistical studies on meteorological data, some of which were published in 1937.

Early Examples of Operations Research

In 1922, a disastrous flood occurred in North Bengal. An Expert Committee of engineers appointed by the Government was about to recommend the construction of expensive retarding basins to hold up the flood waters, when the question was referred to Mahalanobis for examination. A statistical study of rainfall and floods extending over a period of 50 years showed that the proposed retarding basins would be of no value in controlling floods in North Bengal. The real need was improvement of rapid drainage and not holding up the flood water. Specific remedies were recommended, many of which were implemented and proved effective.

A similar question of flood control in Orissa was referred to Mahalanobis, after a severe flood in the river ‘Brahmini’ in 1926. An Expert Committee of engineers were of the opinion that the bed of the ‘Brahmini’ had risen, and they recommended increasing the height of river embankments by several feet. The statistical study covering a period of about sixty years showed that no change had occurred in the river bed, and the construction of dams for holding up of excessive flood water in the upper reaches of the river would provide an effective control. Mahalanobis also pointed out that dams could be used for the generation of electric power needed for the economic development of the region. He also gave the first calculations for a multipurpose (flood control, irrigation and power) scheme for the ‘Mahanadi System’ in Orissa, which formed the basis of the Hirakud Hydroelectric Project inaugurated about thirty years later in 1957.

In retrospect, one finds that Mahalanobis’s early work on river floods is in the nature of operations research (O.R.) introduced as a separate discipline after the Second World War. Another example of such an approach is the study he made, in a note submitted to the Government of Bengal in 1937, on the Hooghly-Howrah Flushing and Irrigation Scheme. He had estimated the expected increase in the yield of paddy by the introduction of an irrigation scheme by which high floods in the Damodar river were intended to be used to supplement the rainfall. This report
was of some help in developing in later years the Damodar Valley Multipurpose Hydroelectric Project.

**Education Tests**

Mahalanobis developed an interest in the construction and performance of educational tests in his early days of statistical research. Group tests in the medium of the Bengali language were constructed and used in the Institute. Studies were also made of the correlation between intelligence or aptitude tests and success in school-leaving certificate and other examinations, and of standardization of tests.

The Institute has now a separate division for the development of educational and vocational tests. It offers a regular service to educational institutions for the admission of students and to industrial establishment for the recruitment of skilled personnel.

**Errors in Field Experimentation**

In 1925, Mahalanobis had occasion to study the probable errors of results of agricultural experiments in which six varieties of paddy had been sown in a systematic manner in ten replicated blocks. In this study, the variation in soil heterogeneity was sought to be eliminated by fitting non-linear graduating curves (a method which was used independently by J. Neyman several years later). Mahalanobis was not aware of experiments introduced a few years earlier by R.A. Fisher, and suggested that each strip or plot should be divided into a number of sub-plots with a view to securing replicated observations for the computation of error. This paper placed him in touch with R. A. Fisher, and Mahalanobis immediately began to study seriously Fisherian methods of field experimentation. During a visit to England in 1926, he met Fisher, and a close personal relationship was established which was strengthened by Fisher’s frequent visits to the Indian Statistical Institute. The two had common views on the foundations and methodological aspects of statistics, and also on the role of statistics as a new technology. Fisher’s death in 1962 removed a very close friend of Mahalanobis.

**Large-Scale Sample Surveys**

Large-scale sample survey techniques as practised today owe much to the pioneering work of Mahalanobis in the forties and fifties. He recognised the need for sample surveys in collecting information, especially in the developing countries, where official statistical systems are poor and ‘data are treated as an integral part of the administrative system regulated by the principle of authority.’ A sample survey, properly conducted, would provide a wealth of data, useful for planning and policy purposes, ‘expeditiously, economically and with a reasonable degree of accuracy,’ and at the same time ‘ensuring objectivity of data.’

The methodology of large-scale sample surveys was developed during 1937-44 in connection with the numerous surveys planned and executed by the Institute. Some
were on consumer expenditure, tea-drinking habits, public opinion and public preference, acreage under a crop, incidence of plant diseases' rupee census and so on. The basic results on large-scale sample surveys were published in 1944 in the 'Philosophical Transactions of the Royal Society' and also presented at a Meeting of the Royal Statistical Society, London.

Mahalanobis made three notable contributions to sample survey techniques, namely, pilot surveys, concept of optimum survey design, and interpenetrating network of samples.

The concept of pilot surveys as developed by Mahalanobis was the forerunner of sequential analysis developed ten years later by the late Abraham Wald. A pilot survey serves many purposes. It provides basic information on operational costs and the variability of characters, which are two important factors in designing an optimum survey. It gives an opportunity to test the suitability of certain schedules or questionnaires to be used in the survey. A pilot survey can also be used to construct a suitable 'frame' for sampling of units.

From the beginning, Mahalanobis was very clear about the principles involved in drawing up a good sample design. A method proposed in this connection by Mahalanobis sparked off a controversy in India, some supporting small-sized cuts and others advocating larger ones. The controversy still exists although it has been repeatedly demonstrated that small circular cuts are more economical, operationally more convenient, and free from bias when the procedure is properly standardized.

Besides the variance function, the optimization problem involves the knowledge of cost function for field operations as well as for statistical analysis.

One of the greatest achievements of Mahalanobis is the establishment of the National Sample Survey (N.S.S.) in 1950. It is a continuing exercise employing a large number of field investigators spread over the entire country for collection of information on socio-economic and demographic aspects of the population, periodically, on a sampling basis. During the last twenty-two years the N.S.S. has provided valuable information needed by the government in the formulation of the five-year economic plans and for taking policy decisions from time to time. The N.S.S. is recognized as an integral part of the official statistical system in India for the collection of data. But it took years to convince the government and the users of the data that sample surveys, when properly organized, can provide reasonably accurate estimates of a wide variety of economic variables expeditiously and at low cost, and periodically at desired points of time. The task proved to be extremely difficult especially because there was no parallel anywhere in the world in the use of a continuing sample survey covering an entire country for collecting official statistics.

Mahalanobis was concerned more with the practical aspects of sample surveys, rather than with mathematical research on survey sampling. As Chairman of the United Nations Sub-Commission on Sampling (1947-51), he advocated the use of sample survey methods in less developed countries for the collection of socio-economic and demographic data and laid down specifications for conducting large-scale sample surveys.
Fractile Graphical Analysis

It is said that a scientist's best work is done when he is young; as he grows older he can only elaborate on his earlier ideas. But Mahalanobis was an exception. Throughout his long years of research he had been continually providing new ideas and new tools for statistical analysis. During the last ten years of his life he developed a semi-non-parametric method for comparison of two samples, which he called fractile graphical analysis. This method was first developed for comparison of socio-economic conditions of a group of people at different points of time or of two groups of people at two different places. Applications have been found in other fields such as demography, psychology, biometry, etc.

CONTRIBUTIONS TO PERSPECTIVE PLANNING

Mahalanobis’s acquaintance with economics was neither systematic nor complete. The economics he learnt was connected with the problems he had to solve, and these came intermingled with problems in other fields. In his studies on rainfall and floods in the Damodar valley and Hirakud project areas conducted in 1931, he mentioned the need for regional planning and made some suggestions. He had even given a plan for development of roads.

Mahalanobis initiated a number of family budget surveys in rural and urban areas during the forties. He also undertook a number of studies on consumer preferences. He even tried his hand on rupees census, estimating the life of a rupee coin. A survey of the after-effects of the great Bengal famine in 1943 made him acutely aware of the poverty of the country.

In 1949, Mahalanobis became the Chairman of the Indian National Income Committee, when he began to think about the macro-economic problems of India. There were gaps in information of computing national income. To fill this, he established the National Sample Survey (N.S.S.) in 1950, and also organized a statistical unit devoted to the study of national income. When Mahalanobis was called upon to help in the planning work of the Government, he took up the study of planning models. He realized that the models suitable for advanced countries might not be applicable for underdeveloped countries. Setting himself the twin objectives of doubling the national income and reducing unemployment considerably over a period of twenty years, he produced what are now known as Mahalanobis two- and four-sector models for economic development.

Mahalanobis’s association with the Planning Commission and his involvement in the formulation of the Second Five Year Plan brought him into contact with problems of wider national and international importance. He wrote extensively on subjects like (i) priority of basic industries, (ii) role of scientific research, technical man-power and education in economic development, (iii) industrialization of poorer countries and world peace and (iv) labour problems, unemployment and demographic problems.

Mahalanobis considered scientific advance as a prerequisite of sustained economic development. Economic progress entails technological change that could be
brought about only by engineers and technologists. Sustained technological research could only prosper in an atmosphere in which science in general is flourishing.

In his writings on scientific research, technical manpower education, etc., one could discover beginnings of a theory of economic growth. While the role of innovations in economic development has been stressed by Schumpeter and others, Mahalanobis emphasized the connection between scientific advance and technological innovations and the role of decision making at the appropriate time.

Mahalanobis discussed labour problems in India with particular reference to unemployment. The notion of unemployment had to be different in India in view of the existence of a large body of self-employed persons. ‘As they do not have jobs, they cannot lose jobs, and cannot, therefore, be unemployed in the sense of industrial countries’. On the other hand, manpower is grossly under-utilized in the country, and this applies to both self-employed and workers and employers. In addition, Mahalanobis thought that the conditions of living had not improved materially for the working class in comparison with the Prewar Period and labour productivity probably remained stagnant over the time. The solution according to him has to be simultaneous improvement in productivity, efficiency and remuneration.

In this context, Mahalanobis’s idea of Labour Reserve Service (L.R.S.) run by government assumes considerable importance. When a particular worker is thrown out of a job, the enterprise should make a payment of L.R.S. Under the circumstances, a person will be thrown out only when the anticipated benefit is more than the payment to be made. All such workers will be maintained by the L.R.S., financed by the government and payments received from enterprises. The workers in L.R.S. will receive training and be engaged in productive work, the average wage in L.R.S. being slightly lower than the industrial wage. With industrial expansion, the enterprise will provide employment to members of L.R.S. at nominal wage rates, the L.R.S. thus serving as a buffer against unemployment. Since enterprises will be able to fire a worker on grounds of economy and efficiency, it will be possible for them to attain high productivity. On the other hand, the workers will find a regime free from any apprehension of unemployment.

**HONOURS AND AWARDS**

Mahalanobis received numerous awards from academic societies all over the world for his contributions to statistics and economic planning. He was elected Fellow of the Royal Society of London (1945), Fellow of the Econometric Society, U.S.A. (1951), of the Pakistan Statistical Association (1952), Honorary Fellow of the Royal Statistical Society, U.K. (1954), of King’s College, Cambridge (1959), Honorary President of the International Statistical Institute (1957), Foreign Member of the U.S.S.R. Academy of Sciences (1958), Fellow of the American Statistical Association (1961), and Fellow Member of the World Academy of Arts and Science (1963). He received the ‘Weldon Medal’ from Oxford University (1944), ‘Gold Medal of the Czechoslovak Academy of Sciences (1963)’ on his seventieth birthday, the ‘Sir Deviprasad Sarvadhikari Gold Medal (1957)’, ‘Durgaprasad
Khaitan Gold Medal (1961)’ and the ‘Srinivasa Ramanujan Gold Medal (1968),’ all for contributions to science.

He was a Founder Fellow of the Indian National Science Academy (1935), and its President (1957-58). He was President of the Indian Science Congress in 1950. He received Honorary Doctorates from Calcutta (1956), Delhi (1964), Stockholm and Sofia Universities.

He received one of the highest civilian awards, ‘Padma Vibhushan’, from the Government of India in 1968 for his contributions to science and services to the country.

LIFE WITH A MISSION

The seventy-nine years of the Professor’s life were full of activity. His contributions were massive, on the academic side, as the builder of the Indian Statistical Institute, Founder and Editor of Sankhya, organizer of the Indian Statistical Systems, pioneer in the applications of statistical techniques to practical problems, promoter of the statistical quality control movement for improvement of industrial products, and as the architect of the Indian Second Five Year Plan.

Statistical science was a virgin field and practically unknown in India before the twenties. Developing statistics was like exploring a new territory. It needed a pioneer like Mahalanobis, with his indomitable courage and tenacity to fight all opposition, clear all obstacles and throw open wide pastures of new knowledge for the advancement of science and society.

With the passing away of Professor Mahalanobis, India has lost an outstanding personality, the like of whom is born perhaps once in several generations.

C. R. RAO

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