A partial History of the Indian Statistical Institute

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November 27, 2012

1 Introduction

The Indian Statistical Institute (ISI) was founded as a learned society in the year 1931 with the stated objects (i) 'To promote the study of Statistics both pure and applied and allied subjects' and (ii) 'To provide for research and instruction for the advancement of the study and dissemination of knowledge of Statistics and allied subjects'. The founder was P.C.Mahalanobis (1893 -1972). He was trained as a Physicist at Cambridge, England, where his tutor had drawn his attention to the well-known statistics journal Biometrika. When he came back to India he brought with him some volumes of this journal; from the pages of which, he came to learn about the work of the English statisticians and was attracted by the potential that he could foresee of the body of methods, especially in the context of India. At the time of the founding of the Institute, he was a professor of Physics at the Presidency College, Calcutta. He had by then gone through more than a decade of long preparatory work, carrying out statistical studies alongside of his work as a teacher of Physics - studies that included a number of innovative statistical analyses of a variety of data, anthropometrical, meteorological and from agricultural experiments. Some of these brought him local recognition, particularly the analysis of rainfall data for the purpose of flood-control, first in North Bengal and later in the Mahanadi basin in Orissa. His work on the agricultural data, when published, had attracted the attention of the English statistician R.A. Fisher, whom he had subsequently met during a visit to England, and whose backing was to be crucial in the early phase of the

Institute. Mahalanobis had been doing the data analysis almost single-handedly until his setting up, in 1926, of a small outfit to help him in his studies, named the Statistical Laboratory and housed in the Presidency College.

Here we present an historical account of the activities of the institute during (and limited to) the first fifty years of the Institute, namely the period upto about 1980; while the developments in the early years are discussed in a broader context and framework, for the sixties and seventies of the century, the focus will be on the developments related to Mathematics. It may be borne in mind that at ISI mathematics research did not have a formal beginning or planned development, and its growth has been intricately connected with the fascinating story of the beginning and growth of the Institute; though the latter has been recounted in many excellent accounts (for instance, [3],[10],[4]) it nevertheless bears retelling in the context of the theme here.

2 The Early Years

The Institute began as a continuation of the tiny Statistical Laboratory (in the words of Mahalanobis, the Laboratory and the Institute acted as a 'single operating unit' [8]) at the Presidency College, which had only recently hired S.S. Bose who, until his untimely death in 1938, was to be a close associate and collaborator of Mahalanobis. J.M. Sengupta was another important person in the setup, the man for all odd jobs, who joined soon after and who also developed, in course of time, an excellent feel for statistics. The transition from Statistical Laboratory to the Institute, still a one-man show, signalled the taking up of a whole range of activities within the next two or three years which was, as far as can be ascertained, without any sense of tentativeness. Statistical analysis of data that had brought quite some recognition in the previous decade continued as before. A report favouring the construction of a dam (and opposing other engineering solutions that had been proposed) to control the flood of Mahanadi after painstaking analysis of the rainfall data from the region had only recently been given to the Orissa Government. It is to be noted that work of this kind, once the statistical framework is decided upon, needed an enormous amount of 'dirty work' of computation by hand, done not by assistants alone. A different kind of work, again very painstaking, that Mahalanobis took up soon after was that of editing a data, collected by H.H. Risley, in 1891 of measurements on

various anthropometric characters from north India. The data had been found to be unreliable and Mahalanobis considered it important enough to attempt a retrieval from internal evidence and cross-checking, and he was splendidly successful in showing that the defect the data suffered from was of recording error, most of which could be rectified.

No account of Mahalnobis's early work in the Institute would be complete without adequately stressing his penchant for accuracy and reliability of data, his constant attention to all forms of error and even his insistence on proper presentation of numerical matter. He was said to have the knack of locating, say, a recording error, on a cursory glance at an entire page of data. Typists would later recall how he would use a ruler on the typescript to check for correct alignment of figures presented in tables. Later-day students at the Institute, learning of this passionate attachment of his, were to coin the sobriquet "Professor of Counting and Measurement" to go with the initials of his name. Coming back to our theme, work also started in preparing the statistical tables needed for drawing inference after processing of data. It would seem that preparations were being made for the Institute to take up the large-scale Sample Surveys that were still a few years into the future. Most remarkably, the international journal of Statistics 'Sankhyā' was launched before the second anniversary of the institute. All this time the Institute was also engaged in agricultural experiments employing the techniques of design of experiments introduced by R.A. Fisher. In fact, it is on account of the statistical work in the field of Agriculture that the Institute obtained an annual grant of Rs. 2500 for three years from the ICAR (the Imperial Council of Agricultural Research, Government Of India), the only assured income for the Institute at the time.

A very important development around this time was the addition of R.C. Bose and S.N. Roy who were to play crucial roles in the Institute gaining wider acceptance and who, later on, became celebrities in their respective fields. After these two came in, the Institute started regular seminars and, soon, a training programme for people engaged in Statistical work. There was also scope for theoretical research now. In connection with his statistical analysis of anthropometric data, Mahalanobis introduced a measure to discriminate between different groups. This is often regarded the most important contribution of Mahalanobis to Statistics. The notion went through a series of modifications, evolving into what is now called the Mahalanobis Distance. It was on Mahalanobis Distance

that both R.C. Bose and S.N. Roy started their theoretical work. Bose took to design of experiments later, after hearing a lecture by Fisher in Calcutta.

Soon the sample survey assignments were arriving: from the provincial Governments of Bengal and Bihar as also from some private concerns. It gladdens the heart of a statistician to be able to direct the collection of data that has to be analysed – keeping in mind the needs of the enquiry. When sample survey is employed, intrinsically there is an error involved, as the figures obtained from the sample are to be treated to stand for the whole population. If sampling is done properly, it is possible to control this error. But there are other worries. Errors in measurements or counting, or in recording, as with Risley's data, and even risks of a delinquent worker on the field cooking up data, have to be kept in mind. The highest standards that Mahalanobis held for the quality of data, needed all this to be taken care of, particularly the issue of the data being faked.

There was no ready help available from the statistics literature, as nothing of the scale of, say, the Bengal Jute survey (1937) had ever been tried anywhere. A simple check that Mahalanobis devised was to have the investigators toss a coin a number of times on the field and record the results of the toss along with the findings; the records of the toss could be tested for randomness which, if found doubtful, would cast doubts on the actual survey figures returned. But this method has obvious limitations. In 1936 he devised what was called interpenetrating subsamples, wherein two or more independent groups of investigators, who would not meet, would take measurements on two subsamples of the same sample. This method had the advantage of assessing sampling error, as also of controlling the other kind of error, though was liable to push up the cost. However, he was able to convincingly argue that the benefits outweighed the marginal cost increase. The question of cost minimisation by this time had become paramount. The Institute was slowly expanding, there were financial commitments in the form of salary of the workers. The ISI still functioned from the Presidency college, but soon it became necessary to find additional space at other locations; there was also the expense of Sankhyā. The only assured income still was the annual grant from the ICAR, which was doubled to Rs. 5000 per year by this time. Thus there was the great necessity to save as much as possible from the project earnings, to economise in the conduct of the survey works in all possible ways, without compromising on the quality of the findings. Two heads of cost were particularly important: the cost of making the actual measurement

on the sampling unit which, for instance, involved crop cutting for some surveys, and the logistics of the team of investigators reaching the sampling units, which, for the crop surveys, were distributed all over a province. The compulsion for cost-cutting strengthened another avenue of statistical research: field studies on various optimisation problems related to sampling, what were called statistical experiments. There were theoretical studies on these problems as well. It is no wonder that William J. Cook, the author of a recently published book [2] traces one of the first published works on the traveling Salesman problem in a paper of Mahalanobis in Sankhyā in 1940[1].

The journal Sankhyā was started in 1933 as there was, it was said, an 'accumulation of research material for publication'. For the first few years Sankhyā published mainly empirical studies from within the country; it gradually expanded its horizons, keeping up with the fast developing expertise in the Institute, when it could attract contributions to methodology, mathematical theory as well as applied statistical work from within the country (mainly, the Institute) as well as from outside. An interesting feature in the early volumes is the occasional editorial note, as a footnote, saying, for instance, that the statistical analysis in the paper concerned is untenable. Casting aside the big question of finances, even the physical efforts needed were daunting: a small hand operated type-casting machine had to be imported and hand-cut dice locally made to make the mathematical symbols possible. As the frequency of the journal increased better machines were needed. Later, on at least one occasion, Mahalanobis was to describe the starting of Sankhyā as "an adventure, even foolhardie, to have started a statistical journal in India thirty years ago when our resources in research and in material equipment were meagre" [7]. Whatever be the assessment on this count, *Sankhyā* succeeded as an international journal of Statistics, and by general consensus it was of invaluable help in projecting the work done at the Institute. In the backdrop of desperation for finances it is interesting to note that the Institute entered into an arrangement with the State of the Holkars in 1936 for receiving an annual grant of Rs. 1000/- earmarked for Sankhyā, in exchange for which the Institute agreed to 'prepare and publish in Sankhyā an annual statistical review of the Holkar state on the basis of material to be supplied by the State' [9].

[1]Known from private communication to M.K. Kundu

3 Coming of Age

It is important to realise that what Mahalanobis was striving to achieve was a double goal, recognition for his Institute and, no less important than that, recognition for the discipline of Statistics. In academia as much as in the echelons of power, few had a clear idea of what Statistics meant. In the mid-thirties Mahalanobis lobbied with the Indian Science Congress Association for a section on Statistics in the annual Indian Science Congress. It was unsuccessful, and story goes that he even faced ridicule. Not one to give up, he organised the Indian Statistical Conference to be held every year at the same venue as the Science Congress and immediately after the Congress. The First conference, in 1938 at Calcutta, was chaired by none other than R.A. Fisher, the greatest Statistician that ever was, according to many. There were five meetings of the Indian Statistical conference in all, after which, Statistics was accommodated in a joint session on Statistics and mathematics in the Science Congress, and a couple of years later as an independent session.

If that is about recognition in the academic circles, recognition from the government was not far behind. Thanks to the good offices of Fisher, some of the senior British civil servants in India took note of Mahalanobis' work, and it culminated in a visit of the Viceroy to the Institute in 1937. The early strategy that Mahalanobis adopted to get the Institute going was to take up projects, important from the point of view of social and economic life of the nation, had some salutary effect. Flood control studies in North Bengal, in the Damodar valley and in the Mahanadi valley, especially in that the Statistical work was important for the construction of the dams on the two rivers later on, seemed to catch public imagination to some extent. The Bengal Jute survey was a big success; a fall-out of this massive survey was that it unquestionably established the superiority of sample survey estimation, at least in Indian conditions. As most of the jute crop in those days used to be exported, confirmation of the survey findings on the expected yield were available from fairly accurate trade data within a year or so. And they showed the conventional crop-estimation figures to be off by large margins. The Bengal jute survey was followed by other big surveys among which was the Bihar Crop-survey: rabi season 1943-44. Projects brought money from the sponsors which made many scientific activities of the institute possible, and they also strengthened the credibility of what Mahalanobis or the ISI was upto.

As noted earlier, some of these surveys have since become classics in the statistical literature. The appreciation of the surveys was not limited to the contemporaries. There have been reappraisals even recently and people have also discovered precursors of some of the influential methods of modern-day Statistics in the sampling experiments of Mahalanobis (see [5]). The only negative impact of the surveys was that they, particularly the Bengal Jute Survey, triggered a conflict of egos with the ICAR, which was not well disposed to the 'circular crop-cutting' employed here. An immediate response of the ICAR was to stop the grant. A point to be noted here is that the financial difficulties for the Institute continued; things became somewhat easier with the help of C.D. Deshmukh, who became Governor of the Reserve Bank in 1945, and with the patronage of Jawaharlal Nehru after independence. Still it was only as late as in 1959 that the Government of India took over the financial responsibility for the Institute.

During the forties, apart from his own work, research findings of Mahalanobis' younger colleagues, particularly the reports on the surveys, started to come out in journals in a big way, a good many times in Sankhyā. The principal names are R.C. Bose, S.N. Roy, K.R. Nair, K. Kishen and, from the mid-forties, C.R. Rao. A later addition was D.B. Lahiri who came to the institute in the mid-forties and is regarded as one of this band. Together with Mahalanobis, they made path-breaking contributions to the fledgling Statistical Science of the time, especially in the areas of Design of experiments, Multivariate Analysis and Sample Surveys, making the institute one among the two or three leading centres for Statistics around the world. The group of people named above have been referred to as the 'Calcutta School of Statistics'. Unfortunately however, by the late forties this School nearly disintegrated, as some members left the Institute, especially, R.C. Bose in 1949 and S.N. Roy in 1950, and Mahalanobis himself turned towards economic planning.

Feeling the need of Statistical training at an advanced level, Mahalanobis founded the first postgraduate department of Statistics in the country at the Calcutta University in 1941, paving the way for the growth of the Indian Statistical Institute as also of Statistics in India. In the initial years the course was taught by ISI statisticians. This course produced many of the people the Institute employed and who made sure that Statistics flourished in the Institute in the post Calcutta school period. C.R. Rao was a student of the first batch of this course. He came to early prominence, already in 1945, with a paper that

has the Cramer-Rao inequality and the Rao-Blackwell Theorem, two of the basic theorems in Statistical Inference that now any student of Statistics at the bachelor level is taught. Unlike Bose, whose refusal to get drawn into the field work has been a legend at the Institute, Rao was interested and involved himself in all the activities of the Institute including teaching activities. After R.C. Bose and S.N. Roy left the Institute in 1949 and 1950, and Mahalanobis got busy with national planning process, Rao was the natural successor to the academic leadership of the Institute, a role that he fulfilled eminently until his retirement from the Institute in 1980. Along with that he has been steadily contributing to Statistics Literature with an ever widening range of interests for the last seven decades making him one of the most prolific scientists ever.

4 Mathematics at ISI

Research activity in the Institute in Mathematics, up to the fifties, can at best be described as sporadic. But the mathematical machinery involved in much of the research, and the mathematical content of some were quite sophisticated in combinatorial Mathematics, linear and abstract Algebra. One has to especially remember R.C. Bose whose later career in the United States made him a leading combinatorial mathematician. He was to be one of the trio of 'Euler foilers'; Bose along with S. Shrikhande and Parker disproved a conjecture of Euler about non-existence of what are called orthogonal Latin squares of orders $4n + 2$. He was also one of the three who invented the error correcting code 'BCH', named after Bose, ... Many of his results related to Design of experiments can as well be counted as mathematics. Bose and C.R. Rao had several collaborations with the well-known number theorist and combinatorial mathematician S. Chowla who was based in Lahore during the nineteen forties. Thus there was considerable general involvement with mathematical research since the early times. In terms of the institutional profile of the Institute it would however be more relevant to consider the scholastic tradition in mathematics that developed a little later.

The fifties saw a major shift in emphasis in America towards what was being called mathematical statistics and also towards the modern probability theory. The *Annals of Statistics* gradually came to be accepted as the most prestigious journal in theoretical Statistics. Though Mahalanobis was, from various accounts, quite sceptical about mathematical statistics, the influence spread to

the Institute. D. Basu, an ISI-trained statistician seems to be the first one to have moved in that direction in the early fifties. Basu [4] records the excitement created at the Institute by the visit of the American mathematical Statistician Abraham Wald. A strong visitors' programme was now firmly in place at the Institute. The nineteen-fifties also saw a number of ISI statisticians visiting American Universities for varying durations, facilitated perhaps by the presence in the US of the two senior statisticians, old hands from the ISI, Bose and Roy. D. Basu went to the university of California, Berkeley on a Fulbright scholarship. Many among the younger recruits like S.K. Mitra, R.G. Laha, J. Roy, went to the US for their Ph.D. work or for shorter visits. A reverse traffic also started trickling in, of young people obtaining a Ph.D. in the US coming to work at the ISI, which also strengthened the development of mathematical statistics and probability theory at the ISI. G. Kallianpur who had been trained in America, and who was at the ISI for a couple of years in the mid-fifties, would have influenced a growing culture in probability theory at the Institute. More certainly, the influence of R.R. Bahadur who was trained in the USA in mathematical statistics and probability theory, and who was at the Institute from 1955 to 1961, would have been considerable in bringing the tradition more firmly to the Institute. Support came also from the longish visits of Norbert Wiener in the mid-fifties, whose interest had by then shifted to statistical prediction theory. The well known collaboration between Wiener and Pesi Masani took place at the ISI.

Mahalanobis also established contacts with the flourishing academic world of the then Soviet Union which both he and C.R. Rao visited. From the Soviet side there were many visitors in the fifties and the sixties, and in the present context we must mention here the brief visit of Y. Linnik, one among the earliest of them, who wrote a paper with C.R. Rao, and later a book. Another important development was the institution of the regular three-year ISI training programme (a precursor of the later-day M. Stat.) in the early fifties through which seven or eight batches of students obtained excellent training in statistical theory and practice of the day. Many students of this programme were to become very successful mathematical statisticians and probabilists later. Thus, by the mid-fifties, ISI had an excellent faculty doing research in many branches of Statistics, including mathematical Statistics. But research in probability theory and stochastic processes was not quite catching up yet.

It was a courageous move when a young student, V.S. Varadarajan, joining the Institute in 1956 as a research fellow, decided to work in probability theory, rather than in Statistics, and started learning modern probability theory and the necessary mathematics by himself. Varadarajan was joined, in a little over a year, by two others, R. Ranga Rao, and after him, K.R. Parthasarathy. Like Varadarajan, they also joined the Institute after completing B. Sc. Honours from the University of Madras. Beyond what they could learn from the mathematical statisticians around, they charted out an ambitious learning programme for themselves, which they could execute with uncanny thoroughness, taking them to some of the frontier areas of probability theory. They would at times be helped by R.R. Bahadur. It was a small, but extra-ordinarily vigorous group. It was not long before they could get started on their research career, beginning with Varadarajan, who was able to write his Ph.D. thesis in 1959 on convergence of probability measures on metric spaces. Varadarajan temporarily left the Institute in 1959 for a three year Postdoctoral fellowship. S.R.S. Varadhan joined the Institute the same year. Varadhan, who later went on to receive the Abel prize of the Norwegian Academy of Sciences (considered as an equivalent to the Nobel prize, there being no Nobel prize for Mathematics), was initially desirous of working in applied Statistics, Statistical Quality Control, to be precise. Like each of the three we are talking about, he did a B. Sc. Honours from Madras before coming to Calcutta. ISI legend credits him with the incredible feat that before joining the probability group, he was given the well-known book on measure theory by Halmos as a prerequisite. And in less than two weeks' time he came back to say that he had learned the subject.

The activities of the probability group continued as before. The group of four (though they were rarely all together), made a singular impression over a period of several years, not only by their research but also by their regular seminars, lecture notes, and incessant discussions, something like which the Institute has not witnessed either before or after. If not many understood their work, the intensity of the efforts were for all to see. For a long time to come, people around remembered their perennial discussion on mathematics, mostly conducted in Tamil. A regular visitor to the Institute at that time, who often overheard their conversation claimed to have learnt a Tamil word, "ergodic", which actually is a keyword of one of the subjects they delved into! As their work and interest went through a variety of topics: topological and functional analytic aspects of probability theory, probability theory on groups, ergodic theory, information

theory, mathematics of quantum theory, and representation theory of groups, their research and their seminars seemed to overshadow for a time everything else that was going on at the Institute. When the great Russian probabilist A.N. Kolmogorov visited the Institute in 1962, the work of this group and, in particular, the Ph.D. thesis of Varadhan, of which he was one of the examiners, made a great impression on him. A crowning glory of this group came when they went into a field far away from probability theory, the theory of representations of semisimple Lie groups that was being worked out by Harish-Chandra, a theory which till then very few had understood. Following Harish-Chandra's work for real Lie groups, Parthasarathy, Ranga Rao and Varadarajan were able to do the construction of representations in the special case of complex semisimple Lie groups in a very satisfactory way; this work was published in the Annals of Mathematics.

In connection with Kolmogorov's visit, mention must be made of another piece of interaction that Kolmogorov had in Calcutta; it was with Mahalanobis. Mahalanobis posed to him the problem of how to decide if a sample drawn from a population is random (above, we have indicated one context for Mahalanobis' interest in the question). It was in response to this question that Kolmogorov started working on what is now called Kolmogorov complexity and his first paper was published in *Sankhyā* [6]; (however, in the paper there is no mention of the question of Mahalanobis).

Alongside the probability group, one other small group started working on combinatorial mathematics at the same time or a little later. They probably were inspired by a longish visit to the Institute of the French mathematician, Claude Berge in the early sixties. An atmosphere was created inspiring new research fellows to do mathematics.

The Institute looked upon the teaching activities with great seriousness. Three year ISI programme, came in the fifties and the formal B. Stat., M. Stat. and Research course in Statistics in 1960. There was difference of opinion, though, as to whether the Institute should get into undergraduate teaching before the B. Stat was launched. The renowned English biologist, J.B.S. Haldane, who was at the ISI during the years 1955-61 had a big say in formulating the curriculum. He conceived the idea of the B. Stat. course as a very broad based liberal science education in addition to its Statistics content. However, very soon the B. Stat. programme came to acquire a much more serious math-

ematical component than what was originally intended. The mathematics was limited to a few areas like analysis, probability, linear algebra and combinatorics, those relevant to Statistics, but went farther than any mathematics programme in the country. It is difficult to say how this shift of emphasis came about rather early, but it came to stay. As has been seen above at no point so far was research in mathematics any part of the "official" agenda of the Institute. This intrusion of Mathematics in the B. Stat. and M. Stat. provided the first openings where competent Mathematicians were needed. It is our contention that this had a role in the continuation of research in mathematics at the Institute. Another curious aspect about the courses in the Institute is the fact that it took time for the ISI courses of studies to attain the prestige they have now, even in West Bengal. It was very fortunate for the Institute, in those early years, that a large number of good students from (what now are) Andhra Pradesh and Tamilnadu came to study and work here.

5 Expansion of Activities

Major developments were taking place at the Institute in other areas during the fifties. The Institute established a separate wing for survey work, named the National Sample Survey (NSS), which was looked after by D.B. Lahiri, a number theorist turned Statistician who made important contribution to sampling theory as well as the organisational aspects of the NSS. He also continued to work in number theory, in Ramanujan partition functions, away from the mainstream of work at the ISI. The Institute also took upon the gigantic task of formulating the nation's second five year plan. In this exercise assistance was sought from noted economists and social scientists from all over the world, many of whom visited the Institute. The Institute also took up the statistical quality control work in an organised manner. The Institute was a pioneer in India in realising the importance of electronic Computers, it started using electronic computers from the late forties and took upon training activities in computer programming. Somewhat later, ISI also embarked on a project for developing computers which, however, had to be given up before it got far enough. Another major boost to the ISI activities came from the presence of J.B.S. Haldane. A good many small science units were added to the Institute during his stay (1956-61) for establishing live interaction between statistics and user sciences. Among the

eye-catching successes of the science units is the excavation of a nearly complete skeleton of a dinosaur in the Godavari valley by the geological science unit of the Institute in 1961. This dinosaur lived about 160 million years ago and is an evidence in favour of the present day view of how the subcontinent was formed as a result of continental drift.

Even though the work on computer hardware stopped, research in computer science continued. It would be from the nineteen seventies that research in computer science would get a new impetus making it one of the main research areas at the Institute in due course. Economics and other disciplines in social sciences remained very active since the days of the second five year plan. Several small units worked in different areas of biology, and ISI would later be counted as an important centre for Human Genetics. In 1959, the Institute was given the status of an Institute of National Importance by an act of parliament, which gave full financial support of the Central Government to the Institute and also empowered the Institute to award degrees. Following this regular undergraduate and post graduate programmes in Statistics (B. Stat. and M. Stat.) were begun from the year 1960. These programmes soon acquired a big reputation.

In many ways, the ISI in the period under consideration was very unorthodox; this was a point of strength as well as weakness. The greatest asset of the Institute during this period can unhesitatingly be named as the academic atmosphere, the unrestrained freedom of enquiry and a general friendliness. Some of the people who were a part of the Institute and even some who visited the Institute at that time have gone on record in appreciation of the academic atmosphere [12]. Another strong point was that ISI also had a brisk visitors programme from the late thirties in spite of the financial difficulties. Mahalanobis did not invite statisticians or scientists alone to the Institute. The list of visitors to the Institute included even Ho Chi Minh and Che Guevara! For an unmixed appreciation of what ISI has always stood for see [11].

During the 1950's and 1960's, as noted above, the Institute transformed itself into a major organisation with diverse academic activities and many commitments for statistical service. To accommodate the expansion, in the mid-fifties the Institute moved to its own campus in the northern suburb of Calcutta, where some very plain constructions came up and some pre-existing old buildings were put to use. Most of the disciplines cultivated at the Institute involved only modest equipments and the library of the institute was very well equipped to cater

to the diverse needs in the Institute. In consonance with a prevailing philosophy of "plain living and high thinking" ISI of the late nineteen-fifties and sixties was idyllic. However, on the negative side, there were a whole range of infrastructural inadequacies, arising partly from the financial difficulties and uncertainties and, also, the lack of clear direction about the future. Indeed, the Institute took upon many activities around the nineteen fifties, some of a very unorthodox nature and others too ambitious for its resources. For example, there had always been the plan of having a publishing house of the kind that some of the universities have in the west [8]; at the onset of the the cold war Mahalanobis had the idea of using India's good relations with the Soviet Union to take up a programme of speedily translating scientific literature from Russian to English for marketing in the western world. This was too good a plan to be able to execute with the resources at hand, especially in the face of the competition from the publishing houses in the west. The building activities lagged behind the needs, especially for residential purposes. Many of the old buildings in the campus that remained in use were in bad condition, the newer constructions at times of inferior quality. The nearly rural neighbourhood in which the campus came up had little to contribute to the lives of the campus residents. Even though Calcutta still held on to some of the glamour from her past, the difficulties of commuting between the city and a not very near suburb were quite acute. There were also complaints at times about the administrative set-up not being very responsive to the needs of the researchers and teachers. Finally, the workers' organisation which gradually came to have a say in most matters also posed problems, for instance, by obstructing any meaningful use of electronic computers in statistical research which even C.R. Rao could do little about [1]. The pioneering role that the Institute had taken in introducing the use of electronic computers was not reflected in its statisticians making any real use of the computer revolution.

6 A Setback for Mathematics and Revival

As far as mathematics and probability theory are concerned, ISI ran out of luck by the mid-sixties when the four stalwarts left the Institute. U.S.R. Murthy who led the combinatorics group also left around the same time. Statistics, though not unaffected by the so-called brain-drain, was able to hold on fairly well. C.R. Rao was by this time a world leader in Statistics and he with some colleagues and

students in the late sixties worked on a wide variety of topics including aspects of linear algebra, mathematical genetics, characterisation problems for probability distributions. D. Basu whose interest had by then shifted to foundational questions in statistical inference and J. Sethuraman, among the mathematical statisticians named above who stayed on through most of the sixties. There were important additions in the later part of the sixties, S. Dasgupta and J.K. Ghosh; the latter was to assume academic leadership of the Institute at Kolkata within the next few years when C.R. Rao shifted to Delhi in 1971. The joining of Ashok Maitra in 1965 turned out to be very important for mathematics at ISI. Maitra worked in dynamic programming at Berkeley for his Ph.D, but soon after joining the ISI decided to shift to mathematics, to Descriptive Set Theory. It was through his efforts that mathematics was rehabilitated at the ISI; he was later joined by M.G. Nadkarni, who joined the Institute in 1969 and the two were helped in their efforts by J.K. Ghosh. By the early-seventies the Institute had a prosperous group working in descriptive set theory. And by the mid-seventies the Institute had a number of mathematicians active in a variety of subject areas in mathematics like harmonic analysis, ergodic theory, functional analysis, and combinatorial mathematics at Calcutta (by this time the Delhi centre of the Institute had started functioning). Seeds for a revival of probability theory had been thrown with the visit in 1968 of J.L. Doob to the Institute during which he had given a series of lectures on Potential Theory, and it was in the later seventies when G. Kallianpur came back to Calcutta as Director of the ISI, that research interest in probability theory picked up again.

7 Epilogue

Mahalanobis passed away in 1972. C.R. Rao, who was the obvious choice for Secretary and Director of the Institute then, had shifted to Delhi a year earlier, signalling the beginning of the Delhi centre of the Institute. Delhi already had the Planning Unit of the Institute and to begin a Statistics unit, Rao was able to get his past colleagues and students in Statistics, B. Ramachandran and S.K. Mitra to join the new centre. Research in aspects of Theoretical Statistics as also the M. Stat. programme began in Delhi and the construction of a campus was soon taken up. Towards the mid-seventies K.R. Parthasarathy also came back to the ISI at the Delhi centre. Parthasarathy, soon after joining the Institute,

started on the research programme in Non-commutative probability theory which arguably has become the most enduring and successful research programme at the Institute, at least in the recent past. A third centre of the Institute opened in Bangalore in 1978 and by the mid-eighties it evolved in to a full-fledged academic centre.

Acknowledgement: The author is thankful to Amartya Dutta, K.K. Roy, B.V. Rao and S.G. Dani for many useful suggestions.

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