BACKGROUND INFLUENCES ON THE DEVELOPMENT OF STATISTICAL EDUCATION

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This paper makes an attempt to indicate some of the additional dimensions which distinguish the history of education in a science - statistics specifically - from the history of the science as such. The three aspects touched on are the influence of national educational systems, the influence of local research "schools", and the influence of individual great figures. The first is illustrated by an examination of the origins of the differing treatments of statistics in British and Continental Universities, the second by reference to the development of the Russian school in probability after the first world war, and the third by a brief account of the role of P. C. Mahalanobis in the development of statistics in India.

INTRODUCTION

No-one involved with the struggle to promote statistical education internationally can fail to be struck by the remarkable differences in the character of this struggle in different countries. Summary figures - of programmes and numbers of students and so forth - do not fully capture these differences. During the years that I was working with the ISI Education Committee, and later the IASE Executive, I began to formulate a number of specific questions which I felt would throw light on the general issues. Why were some of my French colleagues - especially the women - so frustrated with the situation in their country? Why did their problems seem so different in character to those of my colleagues in Australia and New Zealand? Why did the German-speakers talk about "stochastics" and not about "statistics"? How was it possible that one Asian country, India, could supply staff to half of the statistics departments throughout the English-speaking world, whereas another, Japan, did not have a single university department of statistics? What led to the extraordinary flowering of probability theory in the Soviet Union before and after the second world war?

I put forward some initial thoughts about these issues in my ISI paper (Vere-Jones(1995), and more recently in Vere-Jones(1996). When I was asked to give this lecture, it seemed a good opportunity to examine some of those initial thoughts more seriously. For example, in the ISI paper I suggested that the large divergence between the treatments of statistics in the continental European and British universities could be traced to the influence of the Napoleonic reforms in France. But does this stand up to more careful scrutiny? What other factors were at work behind the scenes?

Needless to say, the limited time which I have been able to devote to these issues has been sufficient only to persuade me, what anyone sensible could have told me at the outset, that these are complex historical questions which would challenge a professional historian, let alone an amateur with only limited time to hand. But the questions still seem to me worth answering, and I shall be happy enough if I do no more than to provoke others into challenging these current efforts.

It was John Bibby (I believe) who was the first to clearly remind us that the history of statistical education is not the same thing as the history of statistics. The history of some scientific field is concerned primarily with the evolution and transmission of ideas; the history of education in that science cannot ignore such additional factors as the evolution of educational systems and the institutions they embrace. Both are hugely influenced by dominating personalities, and the groups that grow up around them. Both are affected by the social and political currents of the time, but whereas for the development of the science these currents may remain in the background, in any study of educational systems they become part of the foreground. This is all the more true of statistics, in that it deals directly with the social, scientific and organisational problems of the day.

To try and illustrate the influence of these additional factors on statistical education, I have taken just three instances. I shall try to tackle again the problem of the differences between the European and the British approaches to Statistics; I shall try to give a bit of the background to the evolution of probability theory in the former Soviet Union; and I shall try to indicate the huge influence of one man, Professor P. C. Mahalanobis, on the development of statistics and statistical education in India.

CONTRASTING ORIGINS: STATISTICAL EDUCATION IN FRANCE, GERMANY AND BRITAIN

Whether or not the Napoleonic reforms were decisive in determining the fate of statistical education, they were certainly a major watershed in the history of education in Europe. In France, the reforms overthrew the Church’s control of the schools, and set up a new bureaucracy, “l’Université Impériale”, to control all aspects of education, not just the universities. For the rest of the 19th century, and beyond, the history of education in France is dominated by a tussle between the Catholic Church and the State to control the education system. As in every other country in Europe, this tussle was also part of the struggle of the rising classes - first the middle class, later the workers themselves - to gain full access to education. Within Napoleon's framework, the Universities proper continued to provide a classical education for the mainly upper class graduates of the lyces, while a new class of institutions, "les Grandes Ecoles Spécialisées", such as the Ecole Polytechnique (founded in 1897 with Laplace as its first full professor), the Ecole d'Administration Centrale, the Ecole des Mines, and numerous others, trained the offspring of the rising middle class for the professions created by the Industrial Revolution. Both types of institution set high standards and established strong traditions.

Despite the many changes wrought by the last 180 years, the organization of the French universities retains (at least insofar as a novice can penetrate its complexities) at least two of its early features - a degree of central direction, and its division into universities, with a general academic character, and institutions with a more explicit professional role. Recruitment of statisticians into the ranks of the French Government, and especially into the Statistical Office - the INSEE - is through a dedicated institute, the Ecole Nationale de Statistique et de l'Administration Economique. Social statistics, agricultural statistics, medical statistics etc are catered for by specialised departments in larger professional institutions. Probability, and to a lesser extent mathematical statistics, finds a natural and well-accepted role in the University mathematics departments. In general, however, statistics groups tend to be specialised, living in or on the boundaries of the established professional fields such as economics or medicine, and lacking the sense of an integrating discipline.

There are parallels with the development of education in Germany. In the 19th century there was the same tussle between the Churches and the State, between classical and professional education, between the upper classes and the rising middle class. "Technische Hochschüle" were developed with aims similar to those of the Grandes Ecoles. Once again the mathematical aspects of probability and statistics fitted easily enough into the university framework, while the applied aspects were closely linked into the discipline they served and scattered over a range of disciplines and institutions. Although Germany was not directly affected by the French reforms, the French defeat of the Prussian armies at Jena and Auerstädt in 1805 had a galvanising effect on the German states, reminiscent of that of Russian space successes on the USA a century and a half later. The education system was deemed to be an underlying source of weakness, and major reforms were initiated at all levels.

As well as the parallels there were also some important differences. The German university system did not adopt the centralised structure imposed by Napoleon. Alexander von Humbold, director of the Prussian education administration for a brief but influential period from 1809-1811, was the leading exponent of a new and enlightened view of the role of the universities.

“The State” he said, “should not treat the universities as if they were higher classical schools or schools of special sciences. On the whole the State should not look to them at all for anything that directly concerns its own interests, but should rather cherish a conviction that, in fulfilling their real destination, they will not only serve its own purposes, but serve them on an infinitely higher plane, commanding a much wider field of operation, and affording room to set in motion much more efficient springs and forces than are at the disposal of the State itself” (von Humboldt, 1810).

The University of Berlin, which he founded, was ``the earliest representative of a new type, the leading idea of its foundation being that the University should be, above all, the workshop of free scientific research” (Paulsen, 1908). From such a launching pad, the German universities reached a position of unrivalled scientific eminence, which they occupied from the middle of the 19th century right through to the beginnings of the second World War. They were taken as a model for the development of university education in Russia, and later in Japan and China.

The economic and political aspects of statistics have a particularly strong tradition in Germany. It should not be forgotten that the *stat* in *statistics* is of German origin, not Latin, and that in Germany the subject grew up alongside the very concept of a nation-state. Thus one can see a natural distinction developing between *statistics*, the quantitative study of nation-states, and *stochastics*, the science of random phenomena. As in France, if for slightly different reasons, the ground was not propitious for the development of a unified discipline, and the high-ground was taken by the proponents of the mathematical side of the discipline.

Now let us turn to the educational scene in Britain. Here again, the same basic forces were at work, but they followed a different time pattern and had different outcomes for statistical education. The industrial revolution came early to Britain, and with it the urge to reform the educational system. In Britain, however, the struggle to liberalise the education system did not lead to a revolution. Nor did it lead even to a revitalisation of the university system, but rather to a sluggish process of reconciliation and reform. As late as the middle of the 19th century, the dons at Oxford and Cambridge were still required to take orders for the Anglican church, and the traditional undergraduate syllabus was little influenced by subjects such as engineering or the experimental sciences. The nearest counterparts to the rising universities in Germany were the University of London, and the universities in Scotland, especially Edinburgh. The red-brick universities, such as Manchester and Birmingham, came somewhat later. Engineering and science faculties grew up within these universities, and a few more specialised institutions developed, such as the London School of Economics, but there was never such a clear separation of educational function as occurred on the continent.

Within the university mathematics departments, however, probability and statistics had a difficult time. If statistical education in France and Germany suffered from an undue emphasis on the mathematical aspects, its problem in Great Britain was almost the reverse. A critical factor may have been attitude of the mathematical establishment in Britain during the 19th and early 20th centuries. Britain had no great mathematicians, no Laplace or Poisson, working on probability theory in the early years of the 19th century. By the 1840's, probability and statistics were at a low ebb in all three countries.

But in continental Europe, mathematical scholars such as Bienaymé and Cournot in France, and Ostrogradski and Chebyshev in Russia, provided a link between the first great flowering of probability in the early part of the 19th century, and the work of Lebesgue and Borel, which paved the way for functional analysis and the modern theory of probability, at its end. 19th century mathematics in Britain, by contrast, focussed on algebraic and geometrical themes, and on mathematical physics, while the developments in analysis on the continent passed largely unappreciated.

For these or other reasons, probability and statistics were locked out by the British mathematical establishment in the late nineteenth century, and, once out, found it exceedingly hard to get back in. Not one of the three great pioneers of statistical methods in Britain, Francis Galton, Karl Pearson, and R. A. Fisher, worked within the mathematical establishment. Galton would not have described himself as a mathematician at all; Pearson started his career as a philosopher and ended as holder of a specially created chair of Eugenics; Fisher worked for the critical period of his professional life from an Agricultural Station at Rothamstead. Not until the appointment of M. S. Bartlett to a chair in Manchester in the late 1940's did the situation begin to improve. Even then, it was only in the early 1960's, with the appointment of D. G. Kendall to a chair in

Cambridge, that probability in Britain obtained the final seal of mathematical respectability.

The effects of this neglect on statistical education were not all bad, however. It meant that when, finally, probability and statistics made their entry into the mathematics programme, they did so as mature subjects, with a better understanding of their links. Staff appointed to teach statistics in the British universities in the 1950's and 1960's could feel that they belonged to a substantial discipline, with a strong theoretical core, eminent leaders, and a wide range of applications. The Royal Statistical Society provided a unifying and strengthening influence, as well as living evidence of the discipline's maturity. The emphasis in its meetings on topics with a practical slant helped to preserve the British empirical tradition in statistics, and to prevent the subject from becoming too far removed from its practical roots.

The effects of these different historical backgrounds on statistical education are rather dramatically illustrated in a UNESCO survey of statistics teaching in the Social Sciences, compiled and edited by P. C. Mahalanobis in 1957. It drew similar complaints from both French and German contributors. In France, ``One of the most striking features of statistical education ...is the mathematical emphasis surrounding it ..... Statistics has not attained its true status in any university. There is no faculty of statistics, work in statistics is not independently organized, nor is staff separately appointed for teaching statistics." The report from Germany indicated a somewhat similar situation: "The extremely small numbers of chairs of statistics (professors) and the shortage of first class young statisticians almost necessarily resulting are the chief drawbacks from which statistical education suffers in the Federal Republic of Germany" .

The reports from the English-speaking countries were more optimistic. In the United States, the subject was expanding rapidly, stimulated by a series of Committee reports, which recommended, for example, that "..institutions proceed as rapidly as is feasible .. to integrate and coordinate teaching, research and consulting services in statistics in order to attain the following objectives: to make the most efficient use of available equipment; to make the most constructive use of personnel; to avoid unnecessary duplication or multiplication of courses; to support a more adequate programme of statistical research; to permit the pooling of staff for consulting services" (Mahalanobis , 1957). In Britain at that time there were seven universities with separate departments of statistics, and in India ten. Australia was just starting degree programmes in statistics, while in New Zealand they were not much more than a gleam in the back of one or two professors' eyes.

If, as Mahalanobis suggested in his introduction to the Survey, statistics was a fusion of two streams, one concerned with the collection and analysis of data for government and planning purposes, the other with the modelling of, and inference from, variable data, then in France and Germany the ingredients were present, but the fusion had not occured. In the English-speaking countries, greater weight was given to applied aspects, and the subject tended to be treated more as a unified discipline. These differences in treatment were not accidental, but had deep roots in the countries' different institutional and educational histories.

RUSSIA: "SCHOOLS" AND FAMILY TREES

At the creative end of the educational spectrum, a matter of key importance is the way in which mathematical insight is passed on from one generation of scholars to the next. In retrospect one can trace such academic geneologies relatively easily. For example, one can draw up such a "family tree" for the British statisticians referred to in the previous section, while in a recent lecture to the New Zealand Statistical Association, (Vere-Jones, 1996) I was immodest enough to trace my own statistical descent from A.C.Aitken. Most often this is an orderly process, with one or two offspring per ancestor, but from time to time, perhaps under the influence of a particular leader or teacher, the single-offspring family blossoms into a fully-fledged "school". This tendency is nowhere more pronounced than in Russia, so let me take the development of the Russian probability school as an example. Here I can draw both on my own experience as an exchange student in the 1960's, and on a recent publication by Gnedenko(1991), which brings together several accounts of the famous mathematical "schools" associated with Moscow University.

At the time I went to study at Moscow University, Russia had the reputation for leading the world in probability theory. How did this come to be?

The history of probability in Russia goes back to the middle of the 19th century, when the first text in Russian appeared (by Bunyakovskii, in 1846). The founding figure of the Russian school, however, was P. L Chebyshev (1821-1894), an outstanding scientist, mathematician, and teacher. The school he founded was centred in St Petersburg, and included A. A. Markov and A. M. Lyapounov among its most famous members. It is most famous for its work in giving a precise formulation to the classical limit theorems of probability theory (the law of large numbers and the central limit theorem), thereby helping probability theory to emerge from the ”19th century fog” which shrouded it in the West.

However, the 20th century pre-eminence of Russian probability theory did not stem directly from this school, but rather from a marriage with another great school, that led by the analysts D. F. Egorov and N. N. Lusin.

From the time of Peter the Great, in the early 18th century, Russia made strenuous efforts to develop intellectual links with Western Europe, regularly importing leading scholars to its universities (Euler was the best-known mathematical example), and maintaining close links with France and Germany. This tradition continued even up to the Revolution. In analysis, in particular, there were close links between Egorov and Lusin in Moscow and the French mathematicians, such as Lebesgue and Borel, who founded the modern theory of real analysis, and first realized the close links between probability and measure theory. Both Egorov and Lusin were excellent teachers, albeit with very different styles. Lusin, in particular, was a charismatic figure who built around himself a group of enthusiastic young researchers. One of these, the topologist P.S.Aleksandrov, recalls this melting-pot of mathematical ideas as follows.

“As early as 1914-1916, Lusin’s senior students included D. E. Men’shov, A. Ya. Khinchin, M. Ya Suslin and myself. Around 1919-1920 the group was reinforced by a series of young mathematicians - P. S. Uryson, L. A. Lyusternik, M. A .Lavrent’ev, N. K. Bari and others. A very friendly collective was formed, which was shortly joined by such outstanding young mathematicians as A. N. Kolmogorov and L. G. Shniderman. So grew up the famous “Lusitania”, a society of young mathematicians held together, not only by their very friendly personal relations, but by their strong, enthusiastic, unselfish devotion to the science of mathematics.” Their activities included regular seminars, at which current research problems were debated in depth, small group discussions with their teacher, and weekly evening meetings at Lusin’s house. These, Aleksandrov notes, “consisted of two parts. First came the mathematical part, in Nikolai Nikolaevich’s study, a very comfortable room, which (at the host’s request, and in common with all other rooms in the house) was lit by a kerosene lamp. I shall never forget the discussions, filled with the most lively mathematics, which took place on those occasions. Sometimes they carried on till midnight, but no matter when they finished, they were followed by tea with the same invariably tasty nut cake. Over tea - and this was not in the study but in Lusin’s dining room - the conversations took on a different character, no longer mathematical, but touching on the most varied social and cultural themes."

In this environment, outstanding young mathematicians such as Khinchin and Kolmogorov were able to think deeply about both real analysis and probability, and then in their own work to achieve a synthesis of the two. In time they set up their own seminars. The Moscow school of probability grew up in the mid-1920's, first out of courses given by Khinchin, then a seminar run by Khinchin and Kolmogorov together. Gnedenko, who was one of their first graduate students, recalls that "a very important part was played by physicists and biologists, who not only gave their views on how the topic under discussion might be used in their own work, but suggested alternative approaches based on physical considerations."

When I arrived in Moscow, I was lucky enough to enter Gnedenko's seminar on queueing theory and reliability, where something of the same tradition was preserved. . His example - especially his hospitality, and the idea that making mathematics was an exciting and rewarding human function, with social as well as purely intellectual aspects - made a profound impression on me at the time, and served as a model which I have tried to follow, however inadequately, in my own environment (see further in Vere-Jones, 1997). In something of this way, a mathematical tradition can be kept alive over a time scale of decades if not centuries.

There are two codicils that I feel obliged to add to this story. The first is that there was no chair in statistics in the Faulty of Mathematics and Mechanics at the time I studied there. A statistical laboratory was set up some time later, but in general statistics and probability lived in entirely non-communicating compartments. Here it is necessary to bear in mind that, Revolution notwithstanding, the basic structure of higher educational institutes were still closely modeled on the German pattern. Statistics was regarded as a professional subject, closely linked to economics, useful primarily for the planning functions of a centralized economy. The Soviet contributor to Mahalanobis's Survey makes no mention whatsoever of the achievements of Russian probabilists. As in France and Germany, statistics as a unified discipline did not exist in the sense that it acquired in Britain and the United States.

The second codicil regards the Revolution. Its influence on statistical education in Russia is too large and difficult a topic to tackle here, but let me briefly mention three points. First, in both France and Russia, the revolutions were accompanied by a great upsurge in intellectual activity, and from this probability and statistics were not excluded. Second, in Russia, again to some extent as in France before it, science and technology were supposed to lead the revolution, and leading scientists, if they escaped immediate persecution, could play a distinguished role. One of the minor consequences of this creed was that university professors were supposed to devote a part of their time to public education, giving free public lectures (already a tradition in pre-revolutionary times) and writing pamphlets accessible, if not quite for the general public, at least for the university undergraduate. (Khinchin's many excellent short monographs, and Gnedenko's pamphlet from which I quoted earlier, may be examples). Third, both revolutions were followed by periods of reaction and repression, in the Soviet case by the Stalin period in particular. That the Moscow probability school survived this period without loss of integrity is a tribute to the strength of its members.

THE INFLUENCE OF GREAT INDIVIDUALS: MAHALANOBIS IN INDIA

Some have contributed to statistics as mathematicians, others, through their energy in promoting or popularising the subject, others again in developing new applications. Some very few have combined in one person all of these characteristics, and of these I know of no more remarkable example than P. C. Mahalonobis. All statistical paths in India lead back to Mahalonobis. If, by the 1960's, India, underdeveloped and crisis-ridden, was exporting top class statisticians to leading universities in the US, it was through the cumulative influence of his vision, and his unremitting personal efforts. What did he do, and how?

A brief account of his life, taken largely from the biographical articles published in Sankhya after his death, especially Sanyal (1973) and Rao (1973), is as follows.

He was born in 1893 near Calcutta, into a family closely associated with the Brahmo Samaj, a nationalistic, Bengali-based movement which aimed to regenerate and purify the Hindu religion. The Tagore family was one of its pillars, and in his youth Mahalanobis became very close to this family, and especially to the writer Rabindranath Tagore. Even as a child, Mahalanobis' gifts for logical argument were noted, and after finishing secondary school he was sent by his family to study science at London University.

Once in England, however, he decided to study at Cambridge. Here he took an active part in student life (the record notes that he even played tennis, "though not of championship class") and met many young English intellectuals, including Bertrand Russell and his circle. In 1915 he obtained a first-class degree in physics in the Cambridge tripos, then returned to India. In a remarkably far-sighted gesture, his supervisor, shortly before Mahalanobis left, drew his attention to the journal Biometrika and to Pearson's Statistical Tables. Digesting this material on the long voyage back to India (one wonders how different the result might have been had he returned by jet), he began to conceive of its potential for application in his country.

On his return, he again became closely involved with the Brahmo Samaj, acting virtually as a private secretary to Rabindranath Tagore, and helping him to found the Visva-Bharati, an educational and humanistic foundation. Shortly after his return, he was asked to fill a temporary vacancy in the Physics Department at Presidency College, a small university in Calcutta. Later, he was offered a permanent position, and decided to remain in India, instead taking up the scholarship he had been offered to King's College, Cambridge. He remained at Presidency College for many years, teaching physics, but devoting his main efforts to statistics. His office became a ``statistical laboratory", from which he made pioneering studies in O. R., meteorology, crop development, trying out methods, evaluating their potential for application in India, attracting local students to the new discipline.

In 1926 he accompanied Tagore on a trip to Europe, meeting many cultural, scientific and political leaders. After the trip he worked for some months in Karl Pearson's Statistical Laboratory in London, meeting also R. A. Fisher, and studying the latter's ideas about randomisation.

By the late 1920's his work in anthropometric measurements (Mahalanobis D^2), meteorology and field experiments had gained international recognition, and he had built around him a strong group of younger co-workers. Through his efforts, the Indian Statistical Institute was set up in 1931-1932 (as a non-profit-making learned society). Sankhya was founded a couple of years later. A major breakthrough came in 1937, when the Institute was contracted by the Government to estimate the size of the forthcoming jute harvest. The sampling methods developed by Mahalanobis and his colleagues enabled them to produce a quite accurate forecast, and the survey became a regular event. The sampling principles used, summarized in Mahalonobis (1944), attracted attention world-wide, and to this day Mahalanobis's name is associated primarily with developments in survey techniques.

From the 1940's onwards, Mahalonobis became increasingly involved in aspects of official statistics and government planning. After Independence, he was invited by Nehru to become honorary statistical advisor to the Cabinet. At his instigation, a Central Statistical Unit was started up, subsequently to become the Central Statistical Organization. From 1950, the Government initiated a National Sample Survey, the Institute taking a key responsibility for guiding the design and executing the statistical analyses. Also in 1949 he became chairman of the National Income Committee. During this period he wrote many papers on economic and planning themes, for example in the area of models for the economy. He became the principal architect and author of India's Second National 5-year Plan (1956/7-1961/2). His account of the thinking and modelling behind this plan, entitled "The Operational Research Approach to Planning in India", is set out in Mahalonobis (1963).

In the meanwhile, the Indian Statistical Institute had grown from a small group operating out of Mahalanobis' Office, to an organisation with important national responsibilities, a main campus in Calcutta, and branches in Delhi and many other cities. It attracted a whole stream of distinguished visitors, both statisticians and politicians, including Fisher, J.B.S. Haldane (who became a staff member, despite misgivings over Mahalonobis' strict insistence that all staff sign on when they arrive each day), Wiener, Kolmogorov, and many others. Its educational functions included not only professional courses, but the right to grant both undergraduate and graduate degrees. Following its leadership, and that of Calcutta University (where Mahalanobis was also the head of the Statistics Department), other Indian universities introduced programmes in statistics, and, by the time of the 1957 Survey quoted earlier, India could boast 13 universities at which statistics was a major subject for BA/BSc, and 8 in which it was a subject for the commerce degree. 10 universities had separate departments of statistics.
Mahalanobis was almost equally active on the international front, as doyen of the U.N Statistical Commission, within UNESCO, as a founding member of the "Pugwash" group, etc. We should honour him particularly as an early chairman of the I (international)SI Education Committee.

Although Mahalanobis was clearly a product of the British school of statistics, it seems to me that he was the inheritor of the mantle, not so much of figures like Pearson or Fisher, as of Florence Nightingale. For him, statistics was not the end, but the means to the end, the most potent available weapon for achieving ardently desired social, national and humanitarian goals. In the introduction to the second five-year plan (Mahalanobis, 1963), he wrote,

"It has always been my view that statistics is an applied science and its chief object is to help in solving practical problems. Poverty is the most basic problem of the country, and statistics must help in solving this problem."

In his eulogy at the time of his death, C. R. Rao, his closest associate and successor as director of the Indian Statistical Institute, wrote,

"Everyone knows him as the founder of the Indian Statistical Institute, the architect of the second 5-year plan, a close associate of Rabindranth Tagore, and as one who has richly contributed to the social, cultural and professional life in Bengal. All those in the statistical profession are aware of his fundamental contributions to statistical theory, his efforts in providing a sound data-base for the Indian economy, and the part he played in placing India not far from the centre of the Statistical Map of the World. Those who have been closely associated with him have witnessed his indomitable courage and tenacity in fighting opposition for a good cause and clearing obstacles for propagating right principles."

CONCLUSION

In this paper I have touched on three background factors influencing the development of statistical education in different environments: the influence of the institutional framework; the influence of schools or groups of enthusiastic researchers; and the influence of single great men. There are many others. For example I have not mentioned explicitly the importance of the general intellectual climate in setting the scene for new developments, although it underlies all of the examples I have used. In 19th century Britain, probability may have been at a low ebb, but there was other, more vital currents. The London (later Royal) Statistical Society was founded in 1833, Galton himself was a cousin of Darwin's and a noted explorer in his own right; it may not be altogether surprising that he should devote the major part of his life to statistical investigations associated with the study of "hereditary genius". Kolmogorov arrived as a student in Moscow University in a time of intense intellectual activity. Mahalanobis was born into a social class with a tradition of intellectual leadership, already actively involved in national and humanistic causes, and this environment patterned the rest of his life.

As for the present time, it may seem as if the statistical profession is under siege in some of the Western countries. The rapid advances in computing, and some kind of down-grading of the quantitative sciences in general, seem to be shrinking the enrolments in statistics courses. We should not despair, but hold rather to the basic tenets of the subject. The need for proper use of statistical methods has never been stronger.

It is, however, very important for the subject to retain its links with real problems, and to remain outward-looking. If mathematics is the “queen and servant” of science, statistics definitely comes down on the service side. It is notable how many of those who may made the profoundest contributions to the subject were motivated by the desire to achieve improvements in other scientific, social or economic fields. Mahalanobis suggests that to live and to develop, statistics must actively seek out the problems requiring solution in today’s world. Even the most mathematical of the groups I have considered, the Moscow school in probability, was notable in its early days for its close links with scientists from other disciplines, and for its contributions to fields such as statistical physics and queueing theory. Likewise the most successful of the departments of statistics that have developed in the United States are precisely the ones in which the applied aspects, including both consulting and service teaching, have been grasped most energetically.

No single approach to such problems is likely to be universally successful, and we should welcome diversity as much as unity. One of the great successes of the ICOTS Conferences, I believe, is that, by focussing on the problems of actually teaching the subject, they bring together those concerned with statistical applications in the widest possible variety of disciplines and contexts, so that all can gain insights from the others. This is a tradition that we should foster and cherish.

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