



Professor Valerie Isham



The evolving Society: united we stand

Valerie Isham

University College London, UK

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Summary. In recent years, the breadth of the Royal Statistical Society's activities has increased very dramatically. Considerable time and energy have been devoted to 'outreach' to the lay public and the media, to decision makers in government and industry and to those involved in all levels in education. The Society is both a Professional Society, developing and expanding services to members, and a Learned Society nurturing the discipline. There is much more to do but it is appropriate now to reflect on current challenges, to consolidate the progress that has been made and to consider future strategies to support the discipline. Statistics is a discipline whose time has come—there is great strength in its diversity as long as statisticians are united.

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1. Introduction

Preparing a Presidential address is a daunting prospect. In September 2010, soon after my election and several months before taking office, I had a briefing meeting with the then Executive Director, Martin Dougherty. High on Martin's agenda for my first meeting as President-Elect was my Presidential address: had I thought what its topic would be? When would I like to give it? I opted for 2011, and in consequence an awareness of this deadline has hovered over me for most of my first year as President.

It appears that I am the 100th President, although mine is the 107th Presidency, some—like my immediate predecessor—having served twice. I am not sure how many Presidential addresses there have been. It seems that the tradition of giving an address and having it published in the journal started with William Newmarch in 1869, i.e. just after Gladstone's presidency. I wondered about looking to see what my predecessors had talked about. There are distinct dangers in this—of becoming ever more daunted by their profound insights and wise words perhaps, or incapable of independent thought. As an academic, the latter phenomenon is all too familiar. Those setting examination papers know that looking at past papers is a disaster if one aims to construct properly original questions. Nevertheless, I was curious to see how the roles of the Royal Statistical Society (RSS) and the challenges that it faces have changed as the Society has evolved.

I have chosen not to go back to 1869, but just 16 years to 1995 when I was first elected to Council. At that time I also became an Honorary Officer of the Society, serving as a Vice-President first with Adrian Smith, and then with Robert Curnow, and I had the opportunity to learn in detail about the workings of the Society. I returned to Council as an Honorary Officer

Address for correspondence: Valerie Isham, Department of Statistical Science, University College London, Gower Street, London, WC1E 6BT, UK.
E-mail: valerie@stats.ucl.ac.uk

in 2008, after a gap of 8 years, and was very struck by how much the Society had changed. I suspect that many Fellows are equally ignorant of the sheer breadth of activities with which the Society is involved. Thus, one of the things that I want to address in this paper is the way in which the interests and activities of the Society have developed in recent years, and the directions in which we are moving. The past Presidential addresses give good insights into this.

In 1995, the Society was just starting to settle into its broader role as a Professional as well as a Learned Society. The merger with the Institute of Statisticians had taken place 2 years earlier, after a difficult and very protracted period of negotiations running over more than a decade. In 1989, in his Presidential address, Sir John Kingman (1989) had urged

‘the Councils of the Institute and of the Society to have the courage, the imagination and the generosity to look again at the possibility of creating a single body’.

The challenge was picked up by a new working party, chaired jointly by Peter Moore, Sir John’s successor as RSS President, and his Institute of Statisticians counterpart Tony Haws and, finally, in 1993 the two Societies had merged. Two years later, the Society moved from Enford Street to its current premises in Errol Street. Thus in many ways 1995 marks the beginning of the Society as we know it today.

There were many challenges for the newly merged Society, not only in services to members—both Learned and Professional—but also in reaching outwards to the wider society, and this can be seen very clearly in the topics that were chosen for their Presidential addresses by those who followed. It is natural to take the opportunity of such an address to take stock of the current position and future directions of the Society, and the question of promoting the role of statistics in the wider world is a common theme. Of course this did not start with the merger but goes back right throughout our history to the origins of the Society. There are two broad types of outreach: there are very many aspects of this wider world on which statistics impacts, but also there is the question of reaching out to other statisticians outside the Society, and of supporting the discipline itself. Both types are exemplified in recent addresses.

Thus, in 1996, Adrian Smith discussed a wide range of key issues relating to such ‘outreach’ on the part of the Society. In particular (Smith, 1996), he noted that

‘from the point of view of the general public, for the most part statistics impacts on day-to-day life not directly through its methodology but through the “evidence” which results from its application’.

Robert Curnow developed this theme much further in his own address in 1999, in which he discussed the assessment and communication of risk, concentrating on the specific context of public policies in the presence of biological uncertainties, using examples from his experiences on the advisory committee looking at transmission of bovine spongiform encephalopathy and variant Creutzfeldt–Jakob disease. However, continued development of core statistical methodology is also vital to enable support for the ever-increasing range of applications and evidence-based policy in science and society, and the Society’s role in this was the subject of Peter Green’s address in 2003.

In 2001, Denise Lievesley was concerned with outreach of the Society, not to the general public or to experts in other disciplines, however, but to the international statistics community and especially to those working in official national statistics, whereas, in 2005, Andy Grieve focused on statisticians working in the pharmaceutical industry and issues to do with the professionalization of statisticians. Tim Holt’s theme in 2007 was again official statistics, but in the UK this time, and concentrating on issues like building public confidence in the light of the Statistics and Registration Service Act of 2007. Finally, in 2009, David Hand discussed the mismatch between the exciting reality of statistics and its poor public perception.

The topics of these addresses reflect and in some cases are precursors for many of the activities of the Society today. Inevitably there will be common threads with this address, which has a strong educational theme. In what follows, I want to touch first on some of the current activities of the Society, emphasizing the breadth of the RSS as it is today. The range of these activities has expanded substantially since 1995, and is now very broad indeed. This breadth may come as a surprise to many Fellows who are familiar perhaps only with the programme of meetings and some of the Society's publications. I shall then attempt, not to define, but at least to try to describe the discipline to which the Society relates, and to argue that the interests that bind us together are very much stronger than the divisions between us. Here, and throughout, I shall assume a broad view of the term 'statistics', encompassing at least the applied end of probability, although there are no sharp boundaries. Finally I want to look at some of the challenges that face the discipline today, especially in these financially straitened times, and to consider how best it can be nurtured and supported. In some ways it may seem to be a rather inward looking address. As a Society we have enjoyed a period of considerable expansion in our activities, and there is much more that we would like to do and many exciting challenges to meet. Nevertheless a period of reflection is appropriate. We need to consolidate the progress that we have made and to ensure that further developments are on a firm foundation.

2. Outreach and the breadth of current activities of the Society

Many Past Presidents have stressed the need for outreach and indeed objective (v) of the 2006 Charter lists

'promoting the public understanding of statistics and competent use and interpretation of statistics'.

The perceived need over very many years, to encourage the use of quantitative reasoning to inform decision making both at a personal level and in government, the manufacturing and financial services industries, and in the health services, has led directly to the RSS's 10-year 'getstats' campaign. This was launched last year on the first World Statistics Day (20.10.2010) with the aim of improving general statistical literacy; its mission is

'working towards a society in which our lives and choices are enriched by statistics'.

The campaign is being targeted at the media, education (primarily in schools), elected representatives (Members of Parliament) and employers, and through these means the wider public. In today's world, ever-increasing amounts of highly complex high dimensional data needing analysis and interpretation are being routinely collected, e.g. continuously evolving spatial-temporal satellite images, whole genome sequences and multivariate financial time series. Individuals need to be able to make decisions about their pensions, to understand the risks of different types of behaviour and critically to assess competing claims in the media. As John Pullinger commented at the getstats launch, it is now time to add a fourth 'R' (statistical Reasoning) to the three 'Rs' ('Reading', 'Riting' and 'Rithmetic') as a vital life skill. This highly ambitious campaign is not something that we can do single handed, and many other bodies are collaborating with us to raise awareness of statistical issues. These include the Actuarial Profession, the British Academy, the Institute of Physics, the Nuffield Foundation, the Office for National Statistics, the Royal Academy of Engineering, the Royal Society, the UK Statistics Authority (UKSA) and many others. In particular, funding from the Nuffield Foundation has enabled the Society to appoint a getstats Director in 2011, giving a real impetus to the campaign.

The three series of the RSS journal are themselves a major form of outreach, although they target the worldwide statistical community rather than the lay public. In 2010, Series B of the

journal was ranked first out of 110 statistics and probability journals in terms of its impact by the *ISI Journal Citation Reports*. In 2004, a fourth publication was launched—the magazine *Significance*. Like membership of the Society itself, *Significance* is targeted at anyone who is interested in the analysis and interpretation of data and the non-technical articles on a myriad of topics are easily accessible to non-specialists. *Significance* has been a huge success. Its articles are interesting and entertaining not only to the RSS membership but also much more widely, and it provides an excellent means of promoting the discipline. In 2010, an agreement with the American Statistical Association for joint publication of *Significance* resulted in an immediate fourfold increase in the readership as well as plans for more frequent issues. In an ideal world, it would be possible to make *Significance* magazine freely available to all teachers of statistics in secondary schools, but funding is an obvious issue. However, the Society's Education Strategy Group has initiated a pilot scheme, 'Bringing *Significance* to the classroom' in which workshops and classroom materials are being developed based on articles published in *Significance*. The year 2010 also saw the launch of the *Significance* Web site where rapidly changing short articles and news stories can be found. The *Significance* Web site is updated daily, and was quickly recognized by the Google News aggregator as a reputable news source, providing another valuable means of outreach. More generally, the Society's Web site is the first point of contact with the Society for many. It provides excellent opportunities for outreach, but further work is needed to ensure that we maximize the benefits that it can give.

The Education Theme and the RSS Centre for Statistical Education (RSSCSE) in Plymouth are playing a vital role in improving statistics education in schools, not only through 'Bringing *Significance* to the classroom' but in a whole raft of other ways, by providing resources and ideas for teachers. Their outreach is world wide: the international 'CensusAtSchool' project, which aims to raise statistical literacy in schools, has been running since 2000 and in October 2011 Namibia became the 10th country to join the project. A 'SportAtSchool' activity has also been launched in 2011, inspired by the 2012 London summer Olympic Games, and in 2010 there was a 1-day conference for teachers 'Planet Earth: over the limit?' showing how climate change and ecological footprints could be used to teach schoolchildren data-based problem solving and decision making. There are interactive experiments in a range of subjects including science, geography and psychology and many other activities to engage students' interest and attention. If you have never looked at the RSSCSE Web site I recommend it as an example of what modern education can be like. But the RSSCSE does not neglect higher education. Again it has developed teaching materials for use in universities and also runs programmes leading to Certificates in Teaching Statistics, both for higher education and at schools level.

In 2010 many of us will remember seeing the BBC documentary on data visualization *The Joy of Stats* with Hans Rösling, for which the Open University and the RSS contributed to the production. This is available on YouTube and has now been downloaded more than 4.7 million times—a rather successful exercise in outreach! In 2011, some of us will have heard the *Tribes of Science* programme on statisticians, which was broadcast on Radio 4, for which the presenter, Peter Curran, conducted his interviews at our summer reception and concluded that, contrary to his preconceptions, statisticians turned out to be 'well-rounded human beings'.

More generally, the media (television, radio and the press) have a big role to play in improving the nation's statistical understanding and ability to hold decision makers to account, through accessible reporting of complex numerical information. There is some really excellent reporting, but also some rather less so. The Society runs very successful workshops for journalists on understanding and interpreting data, and in 2007 the Society inaugurated awards for 'Statistical excellence in journalism', to promote the highest standards. It has also just obtained funding from the Department of Business, Industry and Skills to co-ordinate science training for

non-specialist journalists for a second year. In the first year, a member of staff was seconded from the Parliamentary Office of Science and Technology to act as National Co-ordinator, whereas in the second year his replacement is himself a science writer. The statistical excellence awards have now been extended in two new areas: awards for ‘Excellence in official statistics’ (which are sponsored by the Office for National Statistics) were launched in 2010 and for ‘Excellence in pharmaceutical statistics’ (sponsored jointly with PSI—Statisticians in the Pharmaceutical Industry) in 2011. Beyond the pharmaceutical industry, the Society’s interactions with industry are not as strong as they could be. This is an area where we should do much more in outreach. Data analysis and use of advanced statistical methods feature strongly in the manufacturing industries, and we need to work more closely with industrialists and the engineering societies to promote awareness of statistics. Given the current emphasis of government on the effect of science on national economic prosperity, better links would be extremely timely.

Another form of outreach for the Society is that of policy development and communication, engaging with politicians and government, the media, education funding and regulatory bodies among others. We have an excellent position from which to influence national policy decisions and I shall try to illustrate the breadth of our activity by listing just a few of the actions over 2011 (further details can be found on the Web site, where Fellows’ attention is drawn to breaking news items of interest). News releases have included topics as varied as more effective use of prisons’ drug-testing data, the 2011 census and the report of the Independent Mathematics Taskforce (the ‘Vorderman report’). Statements have related to best practice in reporting and publishing scientific research, and the appointment of a new Chair of the UKSA; as I write, the announcement of the new Chair is expected imminently. There has been correspondence with the current chair of the UKSA on the use of consumer and retail price indices, and letters sent to the Chancellor of the Exchequer on pre-release access to official statistics, to the Public Administration Select Committee on the appointment of the new UKSA Chair and to Sir David Normington, who is overseeing the current appointment of a new Head of the Civil Service. Responses have been submitted to consultations and invitations to comment from many official bodies including the Welsh Government consultation on pre-release access, the House of Lords inquiry into the role and functions of Departmental Chief Scientific Advisers, the Royal Society inquiry on science as a public enterprise, the Department of Education’s consultation on the national curriculum and the Cabinet Office review of the post-legislative workings of the Statistics and Registration Service Act 2007, in which the UKSA was created. The Society’s strong interest in official and national statistics is focused through the National Statistics Working Party, which is a very active group of experts who provide many of the responses mentioned above, and through the Statistics User Forum. Regular meetings are held with the National Statistician, and the RSS is currently involved in the consultations on the whole ‘open data’ agenda.

For members and non-members alike, the programme of meetings and conferences, together with the journal, is very much the public face of the Society. Again, a brief look at the RSS Web site makes it clear just how extensive and broad this is. For example, in October 2011, there were 24 meetings spread over 16 of the 21 weekdays that month. Topics ranged from questionnaire design, through international standards for six sigma, sports statistics, and data visualization, to pharmacoepidemiology and cocaine on banknotes. By no means all these meetings are for statisticians alone—for example one was a study day on hypertension for nurses and pharmacists. I wonder whether the Society could do more to ensure that all our meetings are sufficiently widely publicized both within and outside the Society to guarantee that we properly capitalize on the outreach opportunities that they offer. On a related issue, there has been substantial discussion in recent years about recording Ordinary Meetings. This is an on-going project and would enable further outreach as well as providing a service to Fellows living outside London, and

especially those overseas. Various pilot studies have been conducted and many of the sessions at recent Society conferences have been recorded. There is no doubt that this is a worthwhile future project; the only limitations are financial resources and staff time.

The continuing difficult economic climate has inevitably had a marked effect on the Society's finances, although the team at Errol Street has been very effective in reducing expenses wherever possible so that the Society can continue to raise its profile and activities across a range of areas, some of which have been described. However, there are constraints on what we can do. The current financial position means that, like everyone else, Fellows must make hard choices: perhaps by cutting down the number of journal series to which they subscribe. It may be more difficult to justify to an employer the time and financial cost of attending meetings and conferences, or to fund them oneself. It is harder for the Society to recruit new members, there is less demand for hire of the premises for external functions and it is more difficult to raise funds from commercial companies and charities to support RSS projects. This does not mean that these things are not being done but more time and effort must be devoted to them. Against this backdrop, choices must be made on where to devote our efforts to greatest effect and how widely we can spread ourselves. There is far more that we want to do than current resources will allow. One way to enable the Society to do more is to raise funds by getting other bodies involved, as for example in the way that the Nuffield Foundation is supporting getstats. The Society already receives considerable support from external sources and we aim to extend this in spite of the difficulties involved. Another option is to work more closely with other groups with whom we have common aims. Given the breadth of RSS interests, there are many possibilities. For example, as mentioned earlier, many other bodies with educational interests are involved in the getstats campaign, and other examples will be given later. Naturally, the RSS has close contacts with the other Learned Societies in the mathematical sciences, but it could do more to develop its links with Societies in other subjects, particularly in science and engineering. But a third way to enable us to expand our activities and to achieve more than we do at present is to mobilize more of the membership to play an active role.

A striking feature of the annual report of the Society each year is the incredible number of names that appear on its pages. Very many people give their services to the Society, as committee members, organizers and speakers, as editors and referees, and in other capacities. They contribute enormous energy, enthusiasm and commitment, complementing that of the Society's permanent staff. The Society owes all these volunteers a great debt of gratitude for all that they enable it to achieve. Nevertheless, these people are a small portion of the entire membership (of well over 6000) and, if more were willing to share their experience and expertise, we could do more. This is one of the reasons for describing some of the many activities of the RSS in this address, and it is a plea for members to come forward and to volunteer to help to achieve more of our aims by becoming involved in Sections and Local Groups, and serving on committees and working groups. For example, the Local Groups are a vital resource in terms of outreach and have a big role to play in the getstats campaign which perhaps we do not properly exploit. More generally, taking part takes time as well as energy, but geography is becoming less of a problem than it used to be. Much of the work of the Society is conducted by e-mail, teleconferencing or videoconferencing is used increasingly, and committees often have one or two people phoning in remotely. As a Society we need to do all that we can to ensure that we exploit the use of modern technologies wherever possible.

Sometimes the President, on behalf of the Society, is asked to support a particular position, taken by another individual or Society. Almost always this requires us to tread carefully and to make sure that we are in possession of all the facts before jumping into the debate—there is not always time to do this—but it is vital that we do not harm our credibility by comments

that have not been properly thought through. Official consultations tend to be broader and without the same, possibly loaded, agenda. Nevertheless, preparation of a careful and rounded response usually involves substantial work. Examples of responses to consultations were given above, but there are many more official consultations and requests for comment to which the Society responds when it can. Inevitably there are problems in sending in an official view from a Society that is such a broad church. Usually a relatively rapid response is required, precluding consultation with more than a few members. Often the enquiry will be handled by a particular group; for example the National Statistics Working Party respond to matters pertaining to national and official statistics, whereas members of the Education Strategy Group combine to respond to educational consultations, and the Statistics and the Law Working Party considers legal matters. On other occasions, a single individual, perhaps a Vice-President or other Honorary Officer of the Society, will agree to take on the responsibility of leading the drafting of a response. Where time permits, such views can be endorsed by Council. Volunteers to help in researching and drafting responses to consultations are extremely welcome.

While looking at Adrian Smith's address (Smith, 1996), I noted with interest his reference to an article in *The Times* (The Times, 1996) in which the judgement in a Court of Appeal (Criminal Division) was reported as saying that

'The Bayes Theorem might be an appropriate and useful tool for statisticians, but it was not appropriate for use in jury trials or as a means to assist the jury in its task'.

We have moved on from there; this has been a busy area of outreach for the RSS, and the Statistics and the Law Working Party has been active in discussing appropriate use of statistics in legal cases with colleagues working in forensic sciences, nationally and internationally, and with the judiciary. The judgement (EWCA Crim2439; <http://www.bailii.org/ew/cases/EWCA/Crim/2010/2439.pdf>), again in the Court of Appeal (Criminal Division) relating to the case of *R. versus T.* (2010), has received much comment. Paragraph 90 states that

'it is quite clear therefore that outside the field of DNA... this court has made it clear that Bayes theorem and likelihood ratios should not be used'.

Redmayne *et al.* (2011) note that

'the Court of Appeal in *R. v T.* condemned the expert's methodology and served notice that it should not be repeated in future, a ruling which rapidly reverberated around the forensic science community causing consternation, and even dismay, amongst many seasoned practitioners'.

However, as Redmayne *et al.* (2011) go on to point out, it is highly misleading to take this paragraph out of context. In fact, the Appeal Court judgement gives a very careful discussion of the use of Bayes's theorem and likelihood ratios (of the evidence given the null hypothesis relative to that given the alternative) in the particular case of evidence based on shoe prints, emphasizing the role of relevant background information used in determining each likelihood. In particular, paragraph 78(c) of the judgement concludes that

'The robustness of the statistics and the use of mathematical formulae should not be considered on the present state of the data'.

It is clear that, in fact it is not the mathematical expressions for Bayes's theorem or likelihood ratios that are the issue, but the assumptions about databases and probability distributions of observations that are used in their implementation. It would have been better if the final judgement had more clearly separated these but nevertheless, within the judicial system at least, considerable progress has been made. However, there is more to do in relation to the use of evidence and getstats will have achieved a great success when the distinction between $P(A|B)$ and $P(B|A)$ is widely appreciated in the media and elsewhere outside the statistical community.

3. What is statistics as a discipline?

I referred earlier to the Radio 4 *Tribes of Science* programme on statisticians. At the end of this, Peter Curran summed up by saying that he had come into the programme

‘groaning with clichés about statisticians as number obsessives locked in their own field, but these are *well-rounded human beings with a passion for statistics, not in themselves but how these numbers, theories and models explain the world we live in* and give us the truth to work with’.

Perhaps some of us might worry about the certainty implicit in that final phrase, but nevertheless we are probably all happy to agree with the underlying sentiment. The italics here are mine, and this central portion seems to me a good starting point for a description of a statistician. It is clear that the phrase ‘these... theories and models’ relates to statistical theories and models; otherwise it would apply broadly across the sciences. I would also want to qualify it slightly by changing it to ‘help to explain’ in order better to encompass all the theoretical work that provides the generic tools on which the explanations rely. It is vital to recognize that there are two aspects to the discipline: the part that explores the mathematical and philosophical foundations of the subject, and develops generic methodology, and the part that is concerned with applications and the careful interpretation of data. Applied statisticians work in areas including central and local government, medicine and healthcare, administration, economics, business and commerce, industry, social studies, survey research and the sciences (physical, environmental and life), as well as in education. So what is it that we need to add, to come up with a description of statistics that brings together the common core of the huge diversity of topics that we think of as making up the discipline?

I believe that we need to emphasize the thing that Peter Curran missed in his summing up: the role of uncertainty. We are concerned with modelling phenomena and with analysing and interpreting data where randomness plays an important role. It may be that a process is intrinsically random, or that it is appropriate to subsume large amounts of complexity by assuming that this is so. For example, contacts between individuals in infectious disease transmission may not be truly random, but considerable insights for practical application can be obtained from models that assume that they are; global climate models are huge systems of differential equations that seek to replicate meteorological processes but weather variables can often be adequately represented by stochastic or statistical models in which complex deterministic behaviour is replaced by a simpler random representation. Furthermore, obtaining observations on a system will involve uncertainty from various sources, e.g. intrinsic random error in making measurements, errors in reporting or recording, or errors due to sampling a population of interest.

When, with the start of this millennium, my department at University College London moved from the Pearson Building which it had occupied since its founding in 1911, an old painted board came to light. This found its way to my office, where it has been ever since. It bears the quote

‘The true Logic for this world is the Calculus of Probabilities. . . . the only Mathematics for Practical Men’.

This quote is attributed to the Scottish physicist and mathematician James Clerk Maxwell (1831–1879) and, I assume, it had appealed to Karl Pearson, who had the board painted. I discovered that the quote comes in a letter (Maxwell and Harman, 1990) that Maxwell wrote to the Scottish classical scholar Lewis Campbell (1830–1908) around July 1850. It runs to 5.5 printed pages—which Maxwell noted is a short letter because it was written on Saturday night. The main concern of the letter was ‘Moral Philosophy’, but the part from which Pearson’s extract comes concerns the ‘duties of [the] cognitive faculty’. The full quote is

‘The actual science of Logic is conversant at present only with things either certain, impossible, or entirely doubtful, none of which (fortunately) we have to reason on. Therefore the true Logic for this world is the Calculus of Probabilities, which takes account of the magnitude of the probability (which is, or which ought to be, in a reasonable man’s mind). This branch of Math., which is generally thought to favour gambling, dicing and wagering, and therefore highly immoral, is the only “Mathematics for Practical Men” as we ought to be.’

It seems to me, as presumably it did to Karl Pearson, that statisticians are quintessentially Maxwell’s ‘practical men’ (and women).

When we think of the discipline of statistics, it does not seem helpful to try to draw boundaries. We might think rather of a spatial map. There is a core of central theory and generic methodology that probably we would all acknowledge lies at the heart of the subject, whether or not that is where we work. Outside this lies the methodology that is developed for particular application areas: clinical trials, chemometrics, epidemics, geostatistics or sample surveys to name but a few. Further out from the core there is the whole gamut of specific applications: testing a clinical treatment, estimating the chemical content of a sample, looking at the effect of a vaccination strategy, estimating the pollution levels at a location for which there are no observations, estimating the demand for social services and so on. Our subject is an interdisciplinary one *par excellence*. As listed earlier, we ply our trade in a whole range of areas and there are no clear boundaries. Not only are vast quantities of data routinely collected that pose questions to be answered and exciting challenges in doing so, but also the rapid computational advances provide the means to do so.

Computational statistics merges imperceptibly with the machine learning of computer science. The state space models of econometrics lie at the interface of statistics and economics; bioinformatics brings together statistics and genetics; the list is endless. Nevertheless at the heart there is random variation and uncertainty—without that we would probably be classed as applied mathematicians. We need to acknowledge and promote the essential unity of probability and statistics, without worrying too much about the boundaries and about whether other fields are ‘encroaching on our territory’.

Almost 30 years ago, in his Presidential address (Armitage, 1983), Peter Armitage talked of ‘the unity in diversity which characterizes our activities’ to which, in seconding the vote of thanks, Claus Moser responded that

‘We still suffer from too much diversity and inadequate bridges between the various parts of our subjects’.

Peter Green raised similar issues in his address (Green, 2003) 20 years later, and I make no apologies for returning to this theme here. Do we as statisticians, or as the RSS, still suffer from that diversity today? Does the discipline of statistics suffer from its own diversity? Probably the answer to each of these questions is yes. If the discipline suffers, then it is not its intrinsic diversity that is the problem, but our reactions to it. Indeed, that diversity is increasing as new subject areas emerge. I believe that it is essential that we are united in celebrating the diversity that statistics encompasses, taking a wholly positive view of its benefits. In addition to the diversity of the discipline, there is also the geographical diversity of practising statisticians, many of whom are employed in small expert groups within much larger numbers of those in other professions. There is great potential strength in all the diversity, through the influence that statistics has right across science and society, but the unity of the discipline and of its practitioners needs to be strengthened. More bridges are still needed between the various areas and those working in them. We need to seek out and to develop connections, benefiting from each other’s expertise and experience rather than reinventing the wheel. Above all, we need to avoid a silo mentality which separates theory from applications, and the many specific application areas from each other.

The Society has a major part to play here, but it needs the involvement of its members and of all statisticians. We can do much to help ourselves by being better informed about what our colleagues do—there is an important role for Sections and Local Groups as well as for the conference—but people need to take part! For all of us, life is ever more busy and pressured. 30 years ago, London University held intercollegiate seminars every Friday to which virtually all academic statisticians went routinely, from graduate students to senior professors. People attended talks on topics right across the discipline and learnt about each other's fields, they went to RSS Ordinary Meetings regularly regardless of the subject matter, and so on. It has been said that some Ordinary Meetings have become too technical for anyone but a specialist in the area to understand, so the pre-Ordinary-Meetings that have been initiated and organized by the Young Statisticians Section are a major step forward. These are a great success and many of the attendees are not the 'early career' statisticians that perhaps the Young Statisticians Section envisaged as their audience. The Society provides many opportunities for us all to learn more about modern developments in our discipline. As a matter of priority, we all need to try to find the time to take more part in these, if we are to build a stronger sense of unity. We also need to develop our international links with other Statistical Societies. Increasingly, these Societies are realizing that we can gain strength for the discipline by co-operation and sharing expertise. The RSS already collaborates with the American Statistical Association through the joint publication of *Significance* and in other ways, and it is actively involved in discussions with other European Societies and the International Statistical Institute, among others. Tele-conference meetings are held regularly on professional affairs, involving the RSS, the American Statistical Association and the Australian and Canadian Statistics Societies. Links in other parts of the world are gradually being built up, particularly through educational outreach activities and the Society's examinations, which are taken in centres in many countries throughout the world.

To be able to speak with authority, in some fields it is important to have a professional qualification as well as an academic one. Since the merger with the Institute of Statisticians, the RSS has been a professional body as well as a Learned Society. Chartered Statisticians, who hold the CStat professional award, now comprise about 20% of the membership (with a further 7% holding GradStat status). In addition, since 2009, the Society has been recognized by the Science Council as a licensed body for the award of Chartered Scientist status for which Chartered Statisticians are eligible to apply, and which may appeal particularly to those working in an interdisciplinary environment. The RSS is continually striving to improve its services to its professional members and, for example, now runs a mentoring scheme to assist GradStat holders with their professional development as they work towards acquiring CStat status. The Professional Development Centre provides large numbers of courses and training workshops, and additionally the Society runs an extensive programme of meetings including a strong thread of sessions during the RSS conference. It has also recently introduced an on-line system for individuals to record their continuing professional development activities and this facility will soon be made available to all RSS members.

4. Nurturing the discipline

How do we nurture the discipline? In current 'research-council-speak', a key issue is the 'people pipeline'—bringing people into the field and ensuring that support is there at all career stages. For statistics, which has suffered from negative perceptions for so long, an important starting point is to reverse those views and to improve public awareness. We need first to get people to be interested in the subject and then to see that it has all the characteristics to enable a whole range

of exciting and challenging careers. Changing our image is slow work, but something that many recent RSS initiatives, and especially *getstats*, aim to address. One difficulty is that, beyond the simplest examples, we can only explain what statistics is through applications. In some cases, in assessing behavioural risk or comparing drug treatments for example, the statistical result is essentially the end point of the work, and the principles of the underlying methodology can be explained, at least in qualitative terms, in a way that can be appreciated by an informed layperson. In other examples this is not so. Understanding the origins of the universe or how thought and perception are related to brain activity are often subjects of television documentaries or articles in the press. These fields attract considerable public interest. They are underpinned by substantial amounts of highly complex statistical modelling and analysis in astrostatistics or neuroimaging. Such media exposure may attract students to study astrophysics or neuroscience, but probably rather rarely to study statistics.

Even the very fact that we use the same term for both the discipline and numerical summaries of observed data is not helpful. Too many people still assume that statistics is little more than adding up numbers. Data visualization, as in the *Joy of Stats*, catches the attention, but perhaps helps to confirm this view even while illustrating the great value and importance of exploratory data analysis. Somehow we must do more to convey the message that becoming a statistician offers the opportunity to develop and apply methodology in a whole range of diverse and exciting areas. Other scientists are certainly convinced of the need for collaboration with statisticians: academic statisticians are in short supply to meet the demand especially from those in life, medical and environmental science departments. Outside universities, there is a shortage of statisticians across all sectors. The demand is there, but more outreach is needed both in education and among the lay public if the supply is to be sufficient to meet it.

4.1. Education in schools

As recognized by several of my Presidential predecessors, education is the key. We need to start from the youngest children and to move upwards. There are so many opportunities for incorporating simple data analysis and interpretation in coursework right across the schools curriculum from an early age, enabling understanding to be built up gradually, and leading as appropriate to the formulation of simple basic theory. The RSS takes the view that the best place for this is centrally within the mathematics curriculum; see the Society's response (Royal Statistical Society, 2005) to Adrian Smith's report 'Making mathematics count' (Smith, 2004). I had the pleasure of visiting Wells Cathedral School recently. Wells is internationally recognized for its specialist music programme for gifted young musicians, which is run in parallel with a regular independent school, so that musical training takes place within a full normal curriculum. It is noteworthy that at this school mathematics is a very popular subject; regularly around two-thirds of the sixth form take mathematics at A level, and roughly half of these take double mathematics. On the day that I visited, I heard a fascinating master-class on numbers being given by Professor John Berry from the University of Plymouth. On the basis of the successful music programme, the school has just launched a specialist scheme for gifted mathematicians (bursaries should enable a wide pool of potential participants, and the first intake started in the September 2011 term). Their mathematics studies will be enriched, both broadened and deepened, and statistics will form a strong part of their education. One of the stated objectives is

'To encourage gifted young mathematicians to remain within the field of mathematics and mathematics rich fields on graduation'.

Schemes such as this need to be commended and encouraged, and the example and good practice spread more widely.

As touched on earlier, the RSSCSE is doing sterling work in providing training for teachers and developing stimulating material for them to use in their classrooms, and the Education Strategy Group is very active in encouraging educational initiatives. Schools and colleges are invited to become associate members of the RSS, giving access to reports, publications and teaching materials. There is an RSS Guy (Schools) Lecturer, appointed each year, who visits schools to lecture on some aspect of statistics to sixth forms and General Certificate of Secondary Education (GCSE) students. The RSSCSE is not alone in the work that it does, and other organizations like the British Science Association and the Nuffield Foundation have substantial schools programmes and provide teaching materials. Universities have schemes to encourage their students to go out into classrooms to help pupils with mathematics and statistics and to provide role models. But perhaps between us we could do more to help with statistics in schools. For example, perhaps the RSS could have not just the current and some of the past Guy Lecturers, but a much longer list of members willing to go out into schools to give lectures and master-classes. If enough people were willing to find the time to prepare a single talk that could be repeated a small number of times, we could achieve much greater coverage. Perhaps we could provide mentors for teachers, or links between schools and statisticians. Can Local Groups help to run activities for schools? These are not original ideas; the issue is always the lack of volunteer manpower to make them happen. But, if we are serious about wanting to improve our image and the throughput of young people into statistics, then perhaps this is where we need to start.

Over the years there have been a large number of inquiries and reports into education, many of them focusing on mathematics. In the previous 12 months alone several very important reports have been published. In December 2010, the Nuffield Foundation published 'Is the UK an outlier' (Hodgen *et al.*, 2010). In a survey of 24 countries, it was found that England, Wales and Northern Ireland had the lowest levels of participation in upper secondary (post-16-years) mathematics. These were the only countries in which fewer than one in five of upper secondary students studied mathematics (including all mathematics qualifications at this level, but excluding GCSE retakes). Scotland came out rather better though still below average with just under 50%. The Royal Society's (2011) fourth 'State of the nation' report found that in 2009 just 17% of students completing full A levels and Scottish Highers or Advanced Highers in the UK studied science and mathematics subjects at A level or equivalent. In consequence too few students were qualified to study science, technology, engineering and mathematics degrees at university, resulting in a shortage of graduates in these areas who are available to enter the workforce. In particular, the report notes the need to break a

'perpetual cycle of too few of these students feeding through to becoming specialist teachers in schools and colleges'.

These findings were reinforced in June 2011, when the Advisory Committee on Mathematics Education published the final report (Advisory Committee on Mathematics Education, 2011) on its 'Mathematical needs' project, focusing particularly on employers' needs. This noted the increasingly quantitative content of university courses and the discrepancy with the numbers of people that the UK is producing with mathematical skills beyond GCSE. Statistics featured prominently in the report, which especially noted the need for statistical skills in subjects that traditionally have not used mathematics. It highlighted the 'present lack of statistics, mathematical modelling and problem-solving skills' and recommended that these subjects should be covered in the post-16-years curriculum, going beyond the descriptive methods of GCSE to meet the needs of those studying courses in social and life sciences. Most recently, the Mathematics Taskforce report (Vorderman *et al.*, 2011) (the 'Vorderman report') spares no punches:

‘22% of 16–19-year-olds are functionally innumerate; this figure has remained stable for the last 20 years, Nearly half of all students “fail” GCSE Mathematics (ie do not get Grade C or above). ... Unless major alterations in our mathematics education are made, and quickly, we are risking our future economic prosperity.’

Again the report emphasizes the lack of well-qualified people to teach in schools and quotes President Obama’s State of the Union message in 2011 on the need for a cultural shift in American education, in which he cited the way in which countries like India and China are changing their educational systems and placing greater emphasis on mathematics and science as they respond to the technological transformations of recent years. America is not the only country in need of a cultural shift.

It is clear that there is an overwhelming need for collective action to improve mathematics and statistics in schools. The Department of Education opened a consultation on the national curriculum in January 2011 to which the Education Strategy Group sent in a very detailed response (Royal Statistical Society, 2011) concerning mathematics and statistics provision. In addition, with funding from the Institute of Actuaries, the Society has commissioned a report (Porkess, 2011) on statistics in schools from Roger Porkess, who was a leading contributor to the Advisory Committee on Mathematics Education and Mathematics Taskforce reports. In January 2012, the RSS will be hosting a discussion meeting to bring together researchers and stakeholders from higher education, the workplace and all phases of education, to consider this new report, as well as the Advisory Committee on Mathematics Education and Mathematics Taskforce reports and research by employers’ organizations and the Nuffield Foundation. Action in response to all the careful collection of evidence and expert discussion brought together in these reports is urgently needed.

4.2. Higher education

Having briefly discussed the statistical education of students at schools and colleges, I shall turn now to the position of statistics in higher education. The natural starting point here is the recent ‘International review of mathematical sciences’ (IRMS) commissioned by the Engineering and Physical Sciences Research Council (EPSRC) (2011). The report commends world leading research in probability and statistics across a whole range of areas, an important characteristic of which is its very strong motivation from and links to a vast array of important applications in the sciences, industry, business and government. It notes the deep connections between UK applied statistics and relatively theoretical contributions, and comments that the links between modern statistics and mathematics remain strong and are growing.

However, the report singles out structural issues in statistics for special mention. It talks of statistics being ‘in a fragile and weakened condition’ and paints a picture of the discipline of statistics diminishing as a recognizable field, highlighting ‘the lack of prominence of statistics in schools’ and

‘a falling number of universities offering access to stimulating modern statistics courses given by experts in the field’.

It notes that

‘At many universities where excellence is represented by a relatively small number of researchers, research strength in statistics has been diminished by retirements, job moves by prominent statisticians and locally decided closures of statistics departments, which tend (on average) to be small’.

It concludes that

‘... the situation in the UK statistics research community is of serious concern, even though its members are doing outstanding research’.

The first question is do we recognize this picture of statistics? Second, if we do, what are we doing about it? The quick answer to the first is that it is a very recognizable picture of the position of many university statistics departments (or sections within mathematics departments) but is not the whole picture. I shall return to this later. So, what can the RSS do about it? It had already identified the need to strengthen the position of academic affairs within the Society. With this in mind, as one legacy of his brief Presidency last year, Bernard Silverman created the role of Vice-President for Academic Affairs. The idea was to emphasize the place of academic affairs within the Society, in response to a feeling that perhaps it had to some extent lost sight of its role as a Learned Society given the recent efforts to develop its professional aspects and all the activities to do with outreach to the wider community. The Vice-President is supported by an advisory group, which is looking after the Society's response to the IRMS, interactions with research councils over support for statistics, responses to consultations and other actions in this area. In many ways it comes as a surprise that no such group has existed before.

The IRMS looked at the whole of mathematical sciences and it makes sense for some of our responses to be made in conjunction with the other learned mathematics Societies through the Council for the Mathematical Sciences (CMS). The CMS was founded in 2001 by the three main mathematical Societies—the Institute for Mathematics and its Applications, the London Mathematical Society and the RSS. In 2008, the CMS was widened to include the Edinburgh Mathematics Society and the Operational Research Society. Each Society nominates three representatives for the CMS (usually the President, Chief Executive and one other), which has regular liaison meetings with the EPSRC and with the Higher Education Funding Council for England, as well as on its own. On many occasions, it is very helpful if the mathematical sciences community can speak with a single voice on matters of common concern and agreement: on education in schools and at undergraduate and postgraduate levels, and on support for research. The community has been criticized in the past for letting its differences be heard more loudly than its common causes. The CMS is currently doing all it can to speak as one. The RSS, like the other constituent Societies, reserves the right to make additional comments that might not be relevant to other Societies or with which they might not agree, but the more we can say as a broad mathematical sciences community the stronger our voice will be. The findings of the IRMS strongly resonate with this approach. The report draws attention to the increasingly negative effects of making a distinction between 'pure' and 'applied' mathematics or between 'mathematics' and 'statistics', in the overall context of science and engineering. It comments that such distinctions create unnecessary barriers, urging the mathematical sciences community to adopt a 'united we stand' perspective.

It is vital that the EPSRC consults the community about how best to support research in this time of tightly constrained funding and that it engages in a genuine dialogue. The IRMS commented that

'Communication between the mathematical sciences research community and EPSRC is less open and clear than it should be, especially in light of the likely future funding environment'

and strongly recommended

'the establishment, as soon as possible, of a new structure for communication between EPSRC and the mathematical sciences community. A joint effort between EPSRC and leadership of the learned societies is an obvious way to begin to define such a structure.'

The CMS is currently in discussion with the EPSRC on the best way forward on this, but a start has been made in that the CMS has been allowed to send two observers to each of the last

three of the meetings of the Mathematics Strategic Advisory Team, providing a link with this group of EPSRC-selected advisors. Relations between the science community and the EPSRC are probably at an all time low following the EPSRC's 'Shaping capability' agenda, in which it seeks to decide for each subarea of science (including mathematics) whether it should be 'grown', 'maintained' or 'reduced'. For those interested, documents and letters relating particularly to mathematical sciences can be found on the CMS Web site (<http://www.cms.ac.uk/>). Fortunately for statistics, however, the clear message about its parlous state given in the IRMS report led to an early decision that statistics should be 'grown'. As the only area of mathematics for which a decision had been made on 'shaping', a recent call for fellowships in mathematics was confined to proposals in statistics and applied probability. This has resulted in an outcry from most of the mathematics community, as well as plenty of proposals for fellowships submitted by statisticians! It is said that future calls will be extended to other groups. Although there may be a short-term benefit for some fellow statisticians, I share the dismay of my CMS colleagues that no proposals for fellowships, however excellent, from other areas, can currently be submitted, with the consequent effects that this will have on career paths. It is essential that really outstanding mathematicians are supported whatever their field, even if it is not one that is currently regarded as being of most immediate importance.

The Academic Affairs Advisory Group (AAAG) has already had several useful and constructive meetings with the EPSRC Mathematics Programme managers to discuss how statistics can best be supported. It is agreed that, although statistics applications have many means of support across the research councils and charities, support for the core of statistics that comprises philosophical foundations, theory and generic methodology lies within the EPSRC's remit. AAAG priorities are to maintain the geographical diversity of statistics across the UK, with small groups as well as larger ones supporting teaching and research, and to ensure support for research students and new post-doctoral research assistants, thus protecting the 'people pipeline'. One issue is to understand why the success rate of research grant applications classed as lying in statistics and applied probability has tended to be low relative to those in mathematical sciences as a whole, and what actions might be taken to address this. Many reasons have been suggested but it is not easy to ascertain where the truth lies. For example, the EPSRC has suggested that the statistics and probability community itself may be unduly critical of proposals in this area. Appropriate funding mechanisms are needed, and the IRMS particularly recommended that flexible funding structures should be found to support excellent researchers wherever they are and to enhance the ability of small departments to compete internationally for faculty. Given that the shortage of trained manpower in statistics is an on-going problem, it is a pleasing small step that a presentation by the RSS at a CMS-EPSRC liaison meeting led to continued funding being earmarked for Master of Science training in statistics and operational research for a further 3 years, to improve the supply of candidates for doctoral degree study.

At the beginning of this section, I asked the question, do we recognize the picture of statistics that is painted by the IRMS? The report concentrates very much on statistics as it takes place within mathematics and statistics departments in universities, and this is certainly where the core of the subject lies, but as has already been emphasized the discipline spreads widely in many directions. Statistics research in applications is well known to be extremely strong in the UK and it receives funding from most or all of the research councils as well as from the National Institute of Health Research and from charities. The AAAG has embarked on a sequence of meetings to complement its relationship with the EPSRC by building up links with the other funding councils. Very helpful discussions have already taken place with the Biotechnology and Biological Sciences Research Council, Economic and Social Research Council, Medical Research Council and Natural Environment Research Council, which, between them, fund a

large amount of statistical research including methodology in areas aligned to their interests. In each case, there is considerable scope for further funding of statistics. Further meetings are planned and we look forward to much closer co-operation with all of them. In addition, the EPSRC's Mathematics Programme managers are instigating cross-research-council discussions specifically to look at support for statistics, in which the RSS will be taking part.

Data on the supply and demand for statisticians in the UK is very patchy and often unreliable and an aim of the RSS, when funding allows, is to collect robust data to form a coherent overall picture of where statistics teaching and research take place, and on which evidence-based policy can be developed. Anecdotally, it is often said that in academia many senior statisticians are retiring and there is a serious dearth of statisticians in their 40s, that there is strong demand for statisticians from outside academia (from finance, the pharmaceutical industry etc.), that increasingly more reliance is placed on international recruitment (which itself depends on a vibrant academic environment) and that comparatively few doctoral degrees in statistics are awarded each year compared with in other areas of mathematical and physical sciences. As a start in determining the true picture, the AAAG has commissioned Kevin McConway of the Open University to investigate the supply and demand for statisticians. His report will be available shortly, and a meeting at the RSS to discuss its findings and how best to take them forward is planned for 2012.

The investigation has been carried out with very limited resources and necessarily had to be based on data that were often unreliable or uncertain. It is not able to look at the complete picture but concentrated on undergraduate teaching in statistics, the availability of postgraduate training opportunities and on funding for research. A draft report makes very interesting reading and in many ways paints quite an upbeat view of the supply of trained statisticians across the field, although it notes a general pessimism and lack of confidence about the future of academic statistics. The issues are complex, but there is found to be a significant proportion (though not a majority) of academic statisticians who are based outside the traditional home departments of mathematics and statistics, and no major differences in the age distribution of academics across disciplines. Postgraduate student numbers, both taught and research, are found to be in a reasonably steady state—although this is presumably against a background of increasing numbers studying mathematics and statistics at undergraduate level—and, although some taught Masters courses in statistics have closed, many new courses have started up in the last few years. From the report, it is clear that not only are many academic statisticians working outside mathematics and statistics departments, but also that there are many people doing statistics who do not describe themselves as statisticians. We need to know much more about who and where these people are.

An important role for the RSS, and for the AAAG in particular, is to combine with other Societies in the CMS to contribute to the spending review that is being conducted by the Parliamentary Science and Technology Committee, and to try to ensure increased future funding for the mathematical sciences as a part of the government's science budget. Work on this has already started. It is essential to emphasize the international excellence of UK mathematical sciences, to stress the crucial role that they have to play in addressing national and global challenges and to highlight the contribution that they can make to the future prosperity of the country (not to mention pointing out their current impact). Already impact on society and the economy must be demonstrated in various places: applicants for funding from the EPSRC must supply a statement on the potential impact of their proposed research, and an important component of the research excellence framework will be submissions of case-studies to demonstrate impacts resulting from excellent research done up to 20 years ago. For some areas of pure mathematics external impact is difficult to demonstrate, especially because these benefits must be realized outside academia;

impact on another academic discipline is not sufficient for the research excellence framework. Fortunately, given all the work in applied areas, statisticians are in a strong position to demonstrate the influence and the huge societal and economic benefits of their research. Even the theoretical core of the subject can be demonstrated to have substantial impact over such time periods. It is vital that as a discipline we put the effort in to make our voice heard, not only in the academic arena, but also by the politicians and decision makers. In 2010, the EPSRC and the Royal Society of Chemistry published a very substantial and influential study on the economic benefits to the UK of chemistry research (Oxford Economics, 2010) and the CMS is beginning work with the EPSRC to produce a similar report for mathematical sciences.

The need for applicability and impact seem to go back a long way—at least as far as Charles Babbage, who was one of the founding fathers of the RSS. The following quote (Babbage, 1830) was recently drawn to the attention of the CMS by Penny Davies (immediate Past President of the Edinburgh Mathematics Society):

‘If, therefore, it is important to the country that abstract principles should be applied to practical use, it is clear that it is also important that encouragement should be held out to the few who are capable of adding to the number of those truths on which such applications are founded. Unless there exist peculiar institutions for the support of such inquirers, or unless the Government directly interfere, the contriver of a thaumatrope may derive profit from his ingenuity, whilst he who unravels the laws of light and vision, on which multitudes of phenomena depend, shall descend unrewarded to the tomb.’

A word of explanation may be helpful for those who, like me, have not met the word thaumatrope before; it is the children’s toy sometimes made at home, whereby two discs of card are attached to two pieces of string that are twisted together and then released, demonstrating that two distinct images (a bird and a cage say) alternating very quickly can create the optical illusion that the images merge and the bird appears inside the cage. Then, as now over 180 years later, it is clear that society needs, and must support, both the core ‘truths’ in statistics and across mathematics much more generally, and the substantive applications founded on them.

5. Conclusions

In this address, I have described something of how the Society has evolved since 1995, and the current directions and breadth of its activities. Over this period, the Society has devoted considerable energy to outreach activities, raising the profile of the discipline and seeking to influence decision makers. It takes a long view of what is needed to improve the public image of statistics and to convey the attractions, excitement and challenges of a career in statistics. It has been developing its role as a professional body to provide support for its Chartered members, and as a Learned Society to nurture the discipline. Much of its work is concerned with formal education, working at all levels from primary education through to research. After a period of substantial expansion in RSS activities, some consolidation is in order, particularly given the economic times in which we are living. The recent appointment of a new Executive Director provides an opportunity for re-evaluation. Nevertheless, there are many exciting ideas for the development and expansion of existing activities and the initiation of new ones, which the Society would like to explore as soon as it can.

Statistics is very much a discipline whose time has come. There is huge scope for statisticians to be involved in all sorts of decision-making processes and a wide range of research collaborations, as well as in educating young people and raising the statistical literacy of the general public. We need to take every opportunity to promote and support the discipline. The RSS operates over a wide sphere and in many ways ‘punches above its weight’, but it could extend its influence much further. It is making progress at getting its messages across. It achieves as much

as it does because of its hard-working and dedicated staff, and through the energies of the many volunteers who devote considerable time and expertise to furthering its objectives. With more resources, by securing increased funding, by combining its efforts with those of other groups or by mobilizing a bigger pool of volunteers, it could do much more. In various places throughout this address, I have suggested where members could help both in outreach and in nurturing the discipline, by contributing to particular activities of the Society and by promoting the unity of the profession.

One of the challenges facing us as a profession is to define the discipline of statistics and to explain what a statistician ‘does’, given the breadth of our interests and approaches. I have argued that the common element that brings us together is random variation and the need to take account of uncertainty, and that the great diversity of the subject is itself also a great strength. However, to realize this strength requires unity, that ‘united we stand’. This applies not only to statistics but also to the mathematical sciences. The divisions between different parts of statistics are harmful, just as they are between different parts of mathematics. The core methodological heart of probability and statistics lies firmly within mathematics even if many applications are further away. There are no clear boundaries between analysis and probability or between probability and statistical theory, any more than there are between computational statistics and computer science or between the models and techniques of classical applied mathematics and those of applied probability. What binds us is much stronger than what divides us and, especially in recessionary times, it is essential that divisions and petty rivalries do not give others the opportunity to disregard us.

This is very much a personal view but one that I hope will strike some chords with others in the Society: that only by standing together can we move forward. My subtitle ‘United we stand’ was originally suggested by the report of the IRMS (Engineering and Physical Sciences Research Council, 2011). The phrase ‘united we stand; divided we fall’ has a long history—apparently going back at least 2.5 millennia, where it is said to form the basis to Aesop’s fable ‘The four oxen and the tiger’ (see, for example, <http://www.bartleby.com/17/1/52.html>).

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References

- Advisory Committee on Mathematics Education (2011) *Mathematical needs. Report*. Advisory Committee on Mathematics Education. (Available from <http://www.acme-uk.org/news/news-items-repository/2011/6/launch-of-the-acme-mathematical-needs-project>.)
- Armitage, P. (1983) Trials and errors: the emergence of clinical statistics. *J. R. Statist. Soc. A*, **146**, 321–334.
- Babbage, C. (1830) *Reflections on the Decline of Science in England and on Some of Its Causes*. London: Fellowes. (Available from http://www.gutenberg.org/files/1216/1216-h/1216-h.htm#2H_4_0003.)
- Engineering and Physical Sciences Research Council (2011) *International Review of Mathematical Sciences*, 5–10 December 2010. *Report*. Engineering and Physical Sciences Research Council, Swindon. (Available from <http://www.epsrc.ac.uk/SiteCollectionDocuments/Publications/reports/InternationalReviewOfMathematicalSciences.pdf>.)
- Green, P. J. (2003) Diversities of gifts, but the same spirit. *Statistician*, **52**, 423–438.
- Hodgen, J., Pepper, D., Sturman, L. and Ruddock, G. (2010) *Is the UK an outlier: an international comparison of upper secondary mathematics. Report*. Nuffield Foundation, London. (Available from <http://www.nuffieldfoundation.org/uk-outlier-upper-secondary-maths-education>.)
- Kingman, J. (1989) Statistical responsibility. *J. R. Statist. Soc. A*, **152**, 277–285.
- Maxwell, J. C. and Harman, P. M. (eds) (1990) *The Scientific Letters and Papers of James Clerk Maxwell*, vol. 1, 1846–1862, p. 197. Cambridge: Cambridge University Press.

- Oxford Economics (2010) The economic benefits of chemistry research to the UK. *Report*. Oxford Economics, Oxford. (Available from http://www.rsc.org/images/Economic_Benefits_of_Chemistry_Sep_2010_tcm18-191337.pdf.)
- Porkess, R. (2011) Probability, risk, statistics and data handling: a review of curriculum content and assessment. To be published.
- Redmayne, M., Roberts, P., Aitken, C. and Jackson, G. (2011) Forensic science evidence in question. *Crim. Law Rev.*, no. 5, 347–356.
- Royal Society (2011) Preparing for the transfer from school and college science and mathematics education to UK STEM higher education. *4th 'State of the Nation' Report*. Royal Society, London.
- Royal Statistical Society (2005) Teaching statistics across the 14–19 curriculum. Royal Statistical Society, London. (Available from <http://www.rss.org.uk/uploadedfiles/documentlibrary/783.pdf>.)
- Royal Statistical Society (2011) Response to National Curriculum review. Royal Statistical Society, London. (Available from http://www.rss.org.uk/uploadedfiles/userfiles/files/Education_NC_Review_2011_response.pdf.)
- Smith, A. F. M. (1996) Mad cows and ecstasy: chance and choice in an evidence-based society. *J. R. Statist. Soc. A*, **159**, 367–383.
- Smith, A. (2004) *Making Mathematics Count*. London: Stationery Office. (Available from <http://www.mathsinquiry.org.uk/report/MathsInquiryFinalReport.pdf>.)
- The Times (1996) Juries do not apply mathematical formulae. *The Times*, May 9th.
- Vorderman, C., Budd, C., Dunne, R., Rahman-Hart, P. and Porkess, R. (2011) A world-class mathematics education for all our young people. *Report*. (Available from http://www.conservatives.com/News/News_stories/2011/08/~media/Files/Downloadable%20Files/Vorderman%20maths%20report.ashx.)

Vote of thanks

David J. Hand (*Imperial College London and Winton Capital Management, London*)

I would like to begin by congratulating our President for describing so eloquently the range of activities of the modern Royal Statistical Society. As was frequently remarked to me during my own presidency, the amount that the Society accomplishes is simply extraordinary. Officers of other Societies wondered how we did it, given the small central staff that the Society has.

As Valerie says, the Society does it through the engagement and commitment of its membership. This means that maintaining such a level of activity requires maintaining the size of its membership base, if not increasing it.

I raise this because it has been suggested to me that people are less enthusiastic about joining organizations nowadays, than they were 20 or 30 years ago. Perhaps social network sites mean that it is less important for people to have a professional network of their own.

Strangely enough, after I had written the above passage, a letter appeared in *The Times*, which commented that

‘the decline of Frome table tennis, I’m sure, is reflected in the membership of other types of club throughout the land. I speak from experience of chess and bridge clubs where the problem of falling numbers is routinely debated at AGMs’

(Habershon, 2011). Now it may be stretching things to regard the Royal Statistical Society as the same sort of beast as a tennis, chess or bridge club, but one cannot help wondering whether there is a common factor at work here. It is clearly something to which attention needs to be directed.

Although Valerie says that she adopts a broad view of the term ‘statistics’, I wonder whether she constrains it unnecessarily by *requiring* that randomness plays a role. Clearly randomness is central to statistics, but surely it is not a *necessary* aspect of its definition. I have in mind people applying and developing tools such as multi-dimensional scaling and biplots, as well as those concerned with statistical graphics. Naming no names, I am sure that many such people regard themselves as statisticians, and I would certainly want to include them in our ranks. I go further than Valerie, and prefer to adopt John Chambers’s definition of ‘greater statistics’ (Chambers, 1993):

‘everything related to *learning from data*, from the first planning or collection to the last presentation or report’.

I strongly endorse Valerie when she says that ‘Our subject is an interdisciplinary one *par excellence*’ and that ‘we need to avoid a silo mentality which separates theory from applications, and the many specific application areas from each other’.

In this context, perhaps I can parenthetically remark that, when I interview candidates for academic statistical positions, I always look for evidence of both theoretical advances and practical applications. (So, should you appear for an interview before me, you have been warned!)

Valerie takes this a little further, saying we should not worry

‘too much about the boundaries and about whether other fields are “encroaching on our territory”’.

From a scientific or technical perspective that is surely right—ultimately it does not matter who makes the advances, or what they call themselves. But, from the disciplinary perspective, I am not so sure. Narrow statistics, as taught in statistics departments, does need to be taught. If lack of understanding of what it brings means that the sustainability of such departments is called into question, with the real risk that the material they teach will not be available in the future, then we all suffer. I am horrified by the short-sightedness of a number of vice-chancellors around the country who have closed their statistics departments, failing to grasp the essential interdisciplinarity of statistics, and how a sound statistical base in their university can materially enhance all of their work, from research in psychology and chemistry, to student recruitment and staff appraisal.

Valerie also notes that the Society’s interactions with industry are not as strong as they could be. Even when it is recognized that the problem is fundamentally one of statistics, seldom do organizations think ‘ahha, the Royal Statistical Society might be able to help’—in recruitment or in directing them towards relevant people, for instance, or perhaps in short courses. In fact, I am currently working in a sector that is characterized by very tough data analysis problems and very large data sets. Although the sector does employ many people who have been trained to tackle precisely the sorts of inferential questions with which it is concerned, i.e. statisticians, it also employs people with backgrounds—doctorates, people with post-doctoral experience, and beyond—in other data-intensive areas, such as physics, who then have to learn the statistics. It does lead me to wonder, again, whether insufficient statisticians are being trained, and I wonder what the effect must be on the UK economy.

Valerie has identified a curious fact: that although the Society has close contacts with the other Learned Societies in the mathematical sciences, it has relatively few links with such ‘Societies in other subjects, particularly in science and engineering’.

This is indeed strange. Like a tree, statistics has multiple roots: the mathematical development of probability in the 17th century (by such as Pascal and Fermat); the understanding of correlation in the 19th century in psychology (by such as Galton); the growth of life tables in the 17th century (in, for example, Lloyds coffee house); the development of statistics describing society in the 19th century (by especially Quetelet); and so on. Furthermore, statistics is taught to all psychologists, to all medical students, and one would hope to all engineers and business students. Given the intertwining of statistics with these other disciplines, from the historical past right up to the present, is it not indeed curious that the Society does not have many interactions with Learned Societies in these other fields? This is perhaps something that needs to be developed in the future.

Valerie draws attention to the Nuffield report of a survey of 24 countries, in which

‘it was found that England, Wales and Northern Ireland had the lowest levels of participation in upper secondary (post-16-years) mathematics’.

I am sure that everyone here is as horrified as I am by this. It is something which should be nailed to the door of 10 Downing Street. It threatens to transform the UK’s gentle economic decline to a precipitous one.

Somehow we have not driven home how important mathematics and statistics are, both to the youngsters who need to study these things and to the teachers who need to teach them. Reasons for this have been well rehearsed, but one may be a puzzling lack of appreciation of the relevance of these disciplines to modern life. I am reminded of an episode of *The Simpsons*, in which Marge Simpson describes how she used to be a mathematics star when she was at school, that is, until she was swept off her feet and distracted by Homer Simpson. After which, she said, she had simply been unable to solve any of the calculus problems she had encountered in everyday life.

For statistics, at least, it ought to be easy to overcome *that* problem anyway—statistics has, so obviously to us, so many exciting and important impacts on everyday life.

I have great pleasure in proposing a vote of thanks to Professor Isham.

Bernard Silverman (*Home Office, London*) (© Crown copyright 2012)

I am one of the Presidents who got away without giving a Presidential address. My address would have been along the lines of my Presidential address to the Institute of Mathematical Statistics, on the importance

of Learned and Professional Societies not just in serving a community, but in creating the community within which scientific and professional advances actually take place. Picking up on tonight's title, evolution requires an environment in which to take place. The Royal Statistical Society (RSS), and its more recent international partners, has been crucial to the evolution of our discipline and profession. Taking a longer historical perspective, any period in which the RSS was *not* a Professional Society was merely an interlude.

Valerie has kindly mentioned my initiative in establishing the role of Vice-President for Academic Affairs. Another recent activity I undertook was to chair the honours review. If appropriately handled, awards and honours have a key part to play in maintaining a discipline's vitality and direction. Many of the review's recommendations have now been approved by the Council and will, I trust, be put into practice in the next few months, and this is not the occasion to rehearse them in detail. But I was particularly glad to be able to recommend that we should have separate medals for social statistics and for official statistics, by setting up a Howard Medal alongside the existing West Medal. And it was also good that, in an era of rising commodity prices, we could recommend, on the basis of the unanimous view of a sample of 20 existing medal holders, that medallists would be happy with plated or gilded medals rather than solid silver or gold—noting that for gold medals this brings us into line with 100 years of Olympic practice! However, only a minority of our respondents would have been happy with chocolate.

The Royal Statistical Society has always been instrumental in encouraging and facilitating the use of statistics in government. The most recent President to be concurrently in government service was Stella Cunliffe (President 1975–1977), who was as Head of Research in the Home Office the predecessor of one of my current roles. Miss Cunliffe, still well remembered in my office, was also the first woman President of the RSS, the first President I personally encountered chairing Society meetings, and she fails only by 9 days to be the oldest current surviving President[†]. It would nowadays be difficult simultaneously to hold Miss Cunliffe's combination of government and RSS roles, but I urge the Society to continue to engage closely with government and to pay attention to ways of supporting, as well as challenging, policy development.

One policy area of international importance is climate change and energy policy. The RSS has something to contribute to so many of the underlying issues: understanding and communicating uncertainty in models both of physical and social processes; data quality and experimental design; economics; decision making and collective action in the presence of uncertainty; social and behavioural science; public understanding and communication of statistical results; speaking 'truth to power'; and so on. I very much hope that the RSS will continue to put real effort into this topic, as an important, perhaps more important, complement to the day-to-day issues which are the proper usual business of the Society's policy focus.

Our diversity is of course a product of our success. Miss Cunliffe's Presidential address (Cunliffe, 1976) shows that it was still possible for a President to have strong personal knowledge and experience right across the range of mathematical statistics, industrial applications, government, and so on, but I note from an oblique reference in the second quote of today's Section 4.2 that diverse careers are not nowadays always seen in a positive light! Ordinary Meetings may indeed have become 'too technical for anyone but a specialist to understand' but this growing perception is a wake-up call, not just a matter, as Valerie suggests, where we need to give more of our time. A far more radical approach is now needed and I hope that Council will make this a priority. Another really important issue, building on the work that the Council for the Mathematical Sciences is doing with the Engineering and Physical Sciences Research Council on the mathematical sciences, is to construct a clear evidence-based picture of the economic benefit of all the different aspects in which the Society has an interest.

Under the first 100 RSS Presidents, statistics has flourished and grown and developed in ways which our founders could never have contemplated. The unity of purpose to which Professor Isham so rightly calls us can only be our first step in continuing to be the bedrock of the environment within which statistics in all its variety and ramifications can evolve. I have great pleasure in wishing Professor Isham all the best of success in her term of office, and in seconding this vote of thanks.

The vote of thanks was passed by acclamation.

References

- Chambers, J. M. (1993) Greater or lesser statistics: a choice for future research. *Statist. Comput.*, **3**, 182–184.
 Cunliffe, S. V. (1976) Interaction. *J. R. Statist. Soc. A*, **139**, 1–19.
 Habershon, P. (2011) Clubs trumped. *The Times*, no. 70429, Nov. 29th, p. 26.

[†] Note added in proof: Stella Cunliffe died on January 19th, 2012, aged 95 years.