

The Histories of Mathematics & Statistics at Warwick

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Early History of the Warwick Mathematics Institute

By Professor Sir Christopher Zeeman, FRS

Offer When Jolly Jack Butterworth, the first Vice-Chancellor of the new University of Warwick, invited me to become the Foundation Professor of Mathematics there he gave me a month to make up my mind. It was an agonising month of indecision. On the one hand I was 38 and had developed fairly strong ideas on how a mathematics department ought to be run; also I knew who were the up and coming young people to recruit. On the other hand who would want to leave the centre of research in Cambridge? And be sent to Coventry? On the last day of the month I wrote and turned it down; and that night I tossed and turned and didn't get a wink of sleep all night. Next morning I said to Rosemary "I think I've made the wrong decision", and gloomily cycled off to work. In the evening I wrote the opposite letter, accepting, and the VC very kindly agreed to tear up the first one. That night I slept like a babe, from which I deduced that I must have made the right decision (although it was probably just because I was so exhausted). In retrospect I realise that accepting the chair at Warwick was one of the best decisions I have ever made.

Foundation professors There were ten foundation professors appointed in 1963, all men, four in the sciences (mathematics, engineering, chemistry and physics, except that physics was delayed so we started with two chemists), three in the social sciences (philosophy, politics and economics) and three in the arts (english,

french and history). All four scientists came from Cambridge, with three from Caius College, and so we used to meet in my room in Caius to plan the university. No colleges, we decided, and a strong emphasis on research. The ten professors together with the VC, Registrar, Finance Officer and Librarian comprised a sort of pre-Senate, and the first time we all met each other was at the first meeting of the pre-Senate in 1963. The VC made a short speech telling us that the founding committee, who had appointed us, had left it up to us to determine the academic structure of the university. "So what do you want?" he asked. There was a deathly hush for a minute until I broke the silence: "The straight single subject honours degree for me" I said. "Me too" cried John Hale, the historian from Oxford, and we became buddies from then on. Going round the table all the others but one agreed, including the social scientists to the surprise of the VC, since coming from Oxford he had expected them to opt for an Oxford style PPE. The last person to speak was George Hunter, the english professor: "I've been betrayed" he blurted out "I came here to do transdisciplinary courses across the university and now the rest of you have all chickened out." Although we decided on single subject degrees we took George's words to heart in allowing students to take options in other subjects.

Departmental power Warwick differed from all the other new universities that were founded at that time in that there was no layer of deans between the VC and the first professors. This had profound consequences because power then accrued to the departments. There were no artificial uniformities imposed from above. Departments had direct access to the finance committee, and by and large this has been maintained. Later new departments were added, and a layer of deans introduced for administrative reasons, but this layer was not given financial power and so power has been retained

by the departments. All new ideas and new developments tended to be initiated by departments and sent up to the Senate for ratification. Joint projects between departments were arranged by bilateral negotiation. When asked whether mathematics should include statistics and computing I resisted the temptation because I thought those subjects would develop more effectively as separate departments. Consequently each department in the university has grown and flourished according to its own particularity, and thus has had the chance to become strong. In fact this is one of the main reasons why Warwick is robust, and has outstripped its contemporaries in size, quality and strength.

Planning Back in 1963 each of the foundation professors began to design his own course, examinations, staff, intake, graduate school, research and his own building. We left the planning of halls of residence and social spaces to the architect (who incidentally omitted to build a student's union - but more of that later). During the year 63/4 I was busy running a large year-long symposium at Cambridge on topology, and at the same time writing a treatise about teaching at Warwick. Two years earlier I had sat on a small committee at Cambridge attempting to modernise the mathematics syllabus, but our drastic proposals were all shot down by the old guard, and so they were all there ready for me to put into effect at Warwick.

I wanted to give students the choice of a wide variety of options such as at most American universities. But in my visits to the States I had noticed American students floundering in their first two years, for want of anybody to take individual responsibility for them and give them proper guidance. So I wanted to combine the flexibility of choice of options with the type of tutorial care to be found at an

Oxford or Cambridge college.

BA or BSc At one of the early meetings of the pre-Senate we discussed what to call the first degrees. The arts and social sciences wanted to call theirs a BA, while the scientists wanted a BSc. The Registrar, Dennis Linfoot, turned to me and asked me what mathematics wanted. I was caught unawares: I myself had a BA from Cambridge, but I now identified with the other scientists. I knew that some mathematics departments had both, but they were generally accompanied by a horrendous labyrinth of rules: to get a BA you had to take a philosophy option and to get a BSc you had to take a physics option, and in the third year you were liable to be caught by the rules because you hadn't done the right options in the first two years. While all this was whirling through my head I replied "We want both. When the students have passed their finals why can't we just let them choose what they want to be, either a BA or a BSc." "We can't allow students to choose" objected the Registrar, "we must have some rules." "But rules are the very thing I don't want I protested. "But two students might take exactly the same courses and examinations, and one might opt for a BA and the other a BSc" he complained. "So much the better" I replied, "some mathematicians think of themselves as scientists and others think of themselves as artists, and that choice is important to their very souls. Anyway" I added "by the time they have taken finals they will know much more about it than you do, so why not let them choose?" So that was what we agreed to do.

Options I also thought seriously about how to make the examination structure assist the student's freedom of choice. Initially the mathematics department taught only pure mathematics, and applied options were offered by the departments of physics,

engineering, statistics, computing, economics, and business studies. The university put themselves out to help solve the resulting timetabling problems of these more common options. But we also allowed students to take options from anywhere in the whole university and receive credit for it. For example one student might take 50% english, and another might take 10% history of art, 10% music, 10% philosophy and 10% business studies. Every student chose a different variety according to taste. Most departments welcomed mathematicians amongst their ranks because they tended to be enthusiastic about their chosen options, and some even came top of the examination in those other subjects. We formulated three rules.

Rule 1: mathematicians must spend at least 50% their time in the mathematics department.

Rule 2: they can do anything they like with the other 50%.

Rule 3: no more rules.

I am delighted that the basic idea of options has survived and flourished for 40 years.

Examinations We tackled the problem of the wide range of ability amongst mathematicians by allowing the best to take up to 150% of the normal load, and the weakest to take down to 70%. We allowed students to choose what examinations to take after they had attended the lectures, so as to enable them to explore more options, drop those they didn't like and select the ones that appealed to their imaginations. We restricted examinations to the end of the summer term because examinations are enemies, whereas teaching is friendly, and we didn't want to have to hop from foot to foot as they tend to do in America. We added each year's marks into the final degree so that students could then get rid of each year's material instead of having to memorise it to the next year. This enabled them

to launch with confidence into new options the following year, according to their developing interests. In the mathematics department we adopted the convention that examiner=lecturer, because I had observed that the opposite convention examiner≠lecturer at Cambridge had had the effect of paralysing and ossifying the syllabus, preventing change. At Warwick we wanted the syllabus to keep abreast of future discoveries. We avoided the resulting danger of lazy examiners merely requesting candidates to regurgitate their lectures by appointing someone else to vet the questions.

Tutorial system The next task was to design and pay for a tutorial system. The secret lay in having a large graduate school. The graduates could then be paid to give weekly supervisions to undergraduates in pairs, to help them solve the problem sheets issued by lecturers. And the staff would then be freed to give fortnightly one-to-one tutorials to undergraduates, to find and remedy gaps in their knowledge and to inspire their future dreams.

Graduates That of course was not the only reason for a graduate school. Graduate students are the life blood of any department, and the cornerstone of its research. The problem was how to attract graduates? It was a question of throwing all the balls in the air at the same time. Clearly we needed to develop strength in certain subjects, to make it worthwhile for graduates to come and do research at Warwick.

Topologists So I decided that the first six posts (including me) should all be in topology. Admittedly this raised some eyebrows up and down the country, but I thought they could surely cover the initial teaching needs, while enabling us to run a flourishing seminar

and build a graduate school in topology. My American friends had told me how to do it. So I wrote to David Epstein, Rolph Schwarzenberger, Colin Rourke, Brian Sanderson and Luke Hodgkin asking them all to join me at Warwick, but they all said no. So I wrote to them all again saying "But the other four say yes," and then they all said yes. Of course there was a certain amount of burning up of telephone wires in between.

David Epstein I thought it was important to start the graduate school ahead of the undergraduate school, because I had noticed that other new universities had initially become frozen in the undergraduate mode, whereas I wanted us to establish a research and graduate mode. So in 1964/5 I persuaded David Epstein to join me a year ahead of the rest of the university, and we brought with us seven research students in topology. There was also one engineer, and so that year the university had altogether eight students, all doing PhD's. I was very impressed and grateful to David for agreeing to come with me because, although he had been my student, he had just been appointed to a lectureship at Cambridge and bought a house there. He was a tower of strength and advised me on everything, especially whom to recruit. And he single-handedly built up a splendid collection of mathematics books in both the main library and our little departmental library.

First Mathematics Institute Our first home was a little house at 12 Gibbet Hill Road. There weren't even any bookshelves so we had to borrow bricks and planks from the building site and build our own. Meanwhile I had noticed a large empty house on the corner of the main road, at 135 Kenilworth Road, which was a defunct country club with holes in the floor and which I persuaded the university to buy for mathematics for £8000. I myself happened to live in the

town of Warwick opposite the house where David Rand now lives, and in which at that time there lived a sign-writer, to whom I paid a fiver to come and paint "Mathematics Institute" on the front door. Thus the Mathematics Institute was born. "What's a Maths Institute?" asked the Registrar suspiciously, so I reassured him that it was just the name of the building. In fact the title conjures up something more than a department, and Warwick has subsequently earned it by the size and quality of its graduate school, and by its impressive programme of visitors and symposia over the years. During the first 20 years the mathematics department awarded 180 PhD's, received over 1000 long-term visitors, and to date seven of the staff have been elected FRS.

Blackboards and greenglasses Initially it was an advantage to be off campus and away from the noise of the building site. I asked for the place to be filled with blackboards; the estates office installed a new make of board which they claimed to have been designed in Oxford. They were very easy to clean because they had a high polish; the only disadvantage was that no chalk would adhere to them. I remember the occasion when Raoul Bott came from Oxford to give the keynote address at the opening of the Institute. He strode to the board and said "Take X ", but unfortunately the wretched board refused to take X , so stroking his chin he stepped back and said "Ah, now I see what they mean in Oxford when they say 'provincial university'." Later we changed all the blackboards for greenglasses, which were made of glass with a rough surface on the front to take the chalk and green paint on the back that does not wear off.

Admissions In selecting the undergraduates we used only A-level offers. We allowed candidates to come and interview us, but we did

not use that interview as part of our selection process. The reason was that I had earlier done an experiment at Cambridge, marking candidates at the admissions interview and then again two years later when I knew them, and to my surprise I had found an anticorrelation. The articulate admissions candidates turned out to be natterers and worriers, while the tongue-tied candidates turned out to be those who thought before they spoke. Subsequently we found that the more we raised the offer the greater the number applying to Warwick. The average A-level score of mathematicians turned out to be greater than that in any other subject.

First undergraduates In 1965 the first undergraduates arrived. By chance I was allocated the first undergraduate lecture in the university, on group theory at 9am on a Monday morning in the science lecture theatre on the East site. Soon after I had started I was drowned out by the noise of an electric drill. After pressing various buttons I managed to open up a little cubbyhole behind the board which was for preparing demonstration experiments and found a non-english-speaking workman drilling away inside. I tried to explain the problem but he was adamant: "Must finish today" he kept on repeating, and so the very first undergraduate lecture at the University of Warwick had to be abandoned.

Algebraists Meanwhile the mathematicians were happily running the graduate school in our first Mathematics Institute, with the invaluable help of our able and devoted administrator, May Taylor. Soon we were able to appoint a second tranche of staff: six algebraists under the leadership of Sandy Green, with Roger Carter, Brian Hartley, Trevor Hawkes, Stewart Stonehewer and Ian Stewart. Thus we became internationally competitive in two fields, and doubled the number of graduates.

MSc With graduate students coming from so many different backgrounds we decided to put all PhD students through a compulsory MSc hoop in the first year, so that they acquired a common language and a secure foundation for research. All MSc lecture courses were optional, and were examined at the beginning of the summer term, so that the summer could be devoted to writing a thesis, that could be either expository or an original contribution towards their own research. One of the purposes of the thesis was to teach students to read papers, which the Cambridge Tripos Part III had notoriously failed so to do. Meanwhile the staff were delighted to give research courses at MSc level.

The matrix The big question arose of who was going to pay the graduates for supervising the undergraduates? I was on the first finance committee concerned with devising a fair and open method of allocating resources. Basically I thought that all subjects should have roughly the same staff-student ratio since all teaching was labour intensive and each subject had its own particular needs. Of course the experimental subjects needed additional technicians and laboratory assistants to deal with the experimental work, but there was no reason why they should have a better staff-student ratio than say mathematics or the arts. So I devised a matrix whose columns were departments and whose rows were degree courses. Each entry was the percentage of time that that department contributed to that course. For example a maths+economics row might have 50 in each of the mathematics and economics columns. And the maths row might have 7 in the computing column to reflect the fact that 7% of all the examinations that all the mathematicians took were taught by the computer science department. The matrix was continually adjusted by market forces: “Unless you increase that 7 to

8” the computer scientists might say “we can’t afford to teach your students.” “Unless you do a better job” the mathematicians might reply “we’re going to knock it down to 6.” On the 1st of May the Registrar would bang a gong and declare the matrix closed for the year. He would then premultiply the matrix by the row of numbers of students on each course, and obtain a row of numbers giving the proportions of money and staff to be allocated to each department. Everyone disliked the matrix, but tolerated it because it gave an effective and transparent method of allocating resources, and avoided the dodgy deals behind closed doors that beset some universities. The matrix had the effect of holding the staff student ratio in each department close to that of the university as a whole. No department was allowed to get overstaffed during the fat years of the 60’s and 70’s, and so no department had to be cut when these were followed by the lean Thatcher years of the 80’s. Warwick continued to grow during those lean years and its morale remained high.

Paying for supervisions The mathematics department was able to trade four of the staff that we were entitled to under the matrix (paid at the bottom of the lecturer scale) for money with which to pay the graduates for doing supervisions. Our tutorial system therefore was self-financing, and so the university liked it. The undergraduates liked it because they enjoyed being supervised by graduates, to whom they felt closer and could more easily confess their ignorance. The graduates liked it because it taught them to teach, and they got paid for it. The staff liked it because it freed them from the chore of going over example sheets, and enabled them to use the one-to-one tutorials more creatively. So everyone liked it, but one day the current chairman of the finance committee tried to undermine it by reducing the salary of our four mythical staff to just £600 a year, on

the grounds that he didn't see why mathematics students should be allowed to get better teaching than other students. By that time David Epstein was chairman of mathematics and he fought a stalwart battle to defend our system, even forcing the entire finance committee to resign during the process.

Old library In 1966 the main library building on the main site was ready to receive the library, and so it was moved out of its initial building on the East site. This left a nice big empty space that I had my eye on for a new mathematics institute, because by that time we were bursting at the seams in Kenilworth Road. I suggested to the VC that we might take it over, but unfortunately this got confused with the students Union Building as follows.

Students Union When the first undergraduates arrived in 1965 they said "Where's the student's union?", and we had to reply "We forgot to build one." Now in 1966 students all over the world were in revolt, and the VC was afraid that if our students had a union building they would use it as a bastion from which to foment revolutions. So he was strongly against building one, and even kept the dates of the building committee secret from the students. He built the Senate house like a fortress, so as to be able to defend it against the students. They invaded it anyway, by gaining access through the ventilation fan of the VC's private lavatory, which had been added as an afterthought to the fortress. They then held the fortress successfully against the staff for a month, relieving their boredom by reading all the secret files therein. At the time I was strongly in favour of a union building, because any group needs architectural expression of itself. Also I hoped that running a competitive food outlet would educate the students in the price of food, and keep down the costs in the university canteens.

Bribe One day the VC called me in and said “You can have your new Mathematics Institute.” However my pleasure was short lived because he then added “But if you go on supporting the students the Council will think you are a communist, so you won’t get your new Institute after all.” “Are you offering me a bribe?” I asked. He laughed and patted me on the back saying “You go away and think about it, my boy.” I went straight across to the Registrar and said “He’s offered me a bribe.” Dennis, however, advised “I think you ought to go for the new Maths Institute.” David Epstein agreed. But luckily I had just spent a semester in Berkeley, where students were holding angry meetings about civil rights and Vietnam. Going to their meetings I had gradually learnt the lesson that when faced with a choice between principle and pragmatism one must always come down firmly and swiftly on the side of principle. It takes a few weeks to learn this lesson, but having once learnt it one is then able to respond to difficult situations immediately. So the next day I rejected the bribe, and had to fight for the new Institute through the committees, which took four years but gave me the opportunity to plan it in detail.

Catastrophe model of committee behaviour Meanwhile I fought for the Students Union on Council, which is the senior body of the university. I used a catastrophe model of committee behaviour to decide what to do. The model suggested that the dependence of decision upon action and reaction was a cusp catastrophe, with normal factor my action in favour and splitting factor the reaction against. Had I managed to round the cusp point during the meeting then the vote would have been in my favour, but if not then the vote would be against. Shortly into the meeting I realised I was going to lose: if I stopped pursuing the matter there and then there would be

a mild vote against, but if I pressed on there would be a violent vote against. The model told me to press on, and sure enough the vote was 25 to 1 against, my vote being the lone voice in favour. But the model also predicted that this vote would have the effect of educating Council, and was a necessary precursor to an eventual surprise reversal once the reaction had died down. This happened two years later while I was on sabbatical leave, and David Epstein had taken on the students' cause. So we got a Students Union.

Vice Chancellor I would like to acknowledge that Jack Butterworth bore no grudge while we fought over these matters. He was always willing to receive me, and steadfastly supported mathematics academically throughout. He was a great Vice Chancellor.

Analysts In particular he supported our next tranche of six posts, so we chose six analysts, specialising in differential geometry and ergodic theory under the leadership of Jim Eells and Bill Parry, with David Elworthy, Peter Walters, Robert Elliott, and Mike Field. We had now become competitive for research students in three fields.

Mathematics Research Centre As a Trustee of the Nuffield Foundation the VC encouraged Sandy Green and myself to apply in 1966 for a grant to found the Mathematics Research Centre (MRC). Nuffield asked Sir William Hodge, the famous geometer at Cambridge, to referee our proposal and he nearly succeeded in shooting it down: he wrote to all his colleagues in Cambridge who all replied to him supporting us, and then he wrote to Nuffield saying that they were all against. I managed to trump this dastardly trick by writing to the others myself and sending their supporting letters straight to Nuffield. I think the reason for Hodge's hostility was that he could not forgive Warwick for, as he saw it, 'stealing'

staff and graduates away from Cambridge; and since it was to be 25 years before the Newton Institute was established he may have genuinely feared for the competition. Anyway Nuffield gave us £88,000 of which £10,000 was for books, £50,000 to build six houses for visiting mathematicians, and £28,000 towards the salaries of manager, secretary and visiting Nuffield professors.

Books to York David Epstein seized the opportunity of the book grant to buy volumes that any respectable mathematical library ought to have, such as the collected works of famous mathematicians and classics from the past. Twenty years later this collection was to give us a headache, as follows. We happened to be dining with Maurice Dodson in York when he said “By the way many thanks for all those lovely books that your library has given our library.” “What books?” I asked, and Rosemary told me afterwards that I went quite white. “Well here’s one” Maurice showed me. It was one of our Nuffield collection! I borrowed it, and when I got back to Warwick I took it into the office of Peter Tucker, the university Librarian with whom I was on good terms, and asked to see the list of the other mathematics books he had given away without consulting the mathematics department. “Only a few” he said “and we’ve thrown the records away because we didn’t need them any more, so I can’t tell you what they were.” Apparently when the main library filled up he had run a computer programme to locate books that had been bought in the first years of the university, but had not been recently published nor consulted very often. The computer unerringly homed in onto our Nuffield collection, which he had then given away to York. “Anyway” he said “all science books go out of date after about ten years.” “But not mathematics books” I replied and asked “if you didn’t have room for them any more why on earth didn’t you give them to our

departmental library?" "Because that would have broken the Rule" he said. "What Rule?" I demanded. "The Rule that if there is only one copy of a book in the university then it must be lodged in the main library" he explained; he had originally instigated this Rule to stop the chemists from nicking all the chemistry books out of the main library into their molecular sciences departmental library. But I pointed out that we had often unwittingly broken the Rule because many of our visitors had generously donated copies of their own books that they had written to our departmental library. He shrugged, so I stormed out, and to add insult to injury all the alarm bells went off because the York book hadn't been deactivated from our own burglar alarm system. I asked the York Librarian to give me the list of books he had received from Warwick but in solidarity with Peter Tucker he declined. So Maurice ran a computer programme to locate books in York that had been recently acquired but not recently published, which unerringly homed in onto our Nuffield collection of 200 books. At the next meeting of Senate I held up the proceedings for an hour until they agreed to order the Librarian to go back to York on bended knee and get them back. So in spite of the Rule we got our precious books back for the departmental library.

Symposia The MRC had two committees, an internal Management Committee to get money and an external Advisory Board to spend it. The main activity of the MRC was to run symposia. Each year the Advisory Board chose a subject and a leader for a symposium. The symposium itself resembled a year-long conference in that subject, except that it was a much more leisurely affair than a conference. In a conference everyone speaks and the listener is exhausted after a week, whereas in a symposium there is no fixed programme and no pressure; everyone arrives on a different day at their own convenience and stays for as long as they like. There may be a

seminar each day, but the main idea is to give time to do your own research, and spend hours in the common room talking mathematics over coffee and tea. There is the leisure to formulate conjectures, discuss them, solve them and then write them up. There were plenty of joint papers. The formula that we evolved was as follows: about three years ahead the leader chose the top 20 people in the world, including his or her favourites, and invited them to come for a year or a day or any period in between, offering to provide travel and subsistence, and telling them who else had been invited. They were asked to return a card saying whether they might be interested in coming and for which months. As soon as the cards came back we recirculated the information, which cemented the idea in people's minds. It also made an impressive case when asking for financial support from the Research Council, which to our surprise and delight they gave us every year. When the news of the forthcoming symposium spread around the world all the eager young postdoctorals would come at their own expense, and so each year we finished up with about 80 long term visitors. Warwick became the centre for research and the dissemination of information in that subject for that year. By the end of the year the participants found themselves not only fully up to date but also with enough new research ideas to last the next five years.

We chose the vehicle of symposia in order to maximise the ratio of what we got out over what we put in. Nowadays many centres including the Newton Institute have developed similar programmes, and the top people get so many invitations that they tend to go into orbit, not staying anywhere for very long. But in the early days at Warwick we were very fortunate to have many of them staying for several months.

MRC houses The housing problems for so many visitors were horrendous, so we set up an administrative structure for the MRC: myself as director, David Fowler as manager and Elaine Shiels (later Coelho) as secretary. I must say that the other two were fabulous, and became well known throughout the mathematical world. Later David also became an eminent historian of mathematics. Other universities tried running a symposium but found themselves so exhausted by the housing problems that they didn't try again. I myself had visited the IAS in Princeton and the IHES in Paris, and had much appreciated their housing projects, so we asked permission to spend the main part of the Nuffield grant on six houses for visiting mathematicians and their families. When the architect, Bill Howell, had been appointed I went to see him before he started thinking. "Each house must have a study" I said "away from the main part of the house so that the mathematician can work undisturbed, and there must be blackboards round all the walls." "How do you write in the corners where two walls meet?" he asked. "I suppose you could round the corners by building the blackboards out" I suggested. "Better still" he replied "I could build the walls in." "Fine" I said "and put the blackboards low enough for small children to use the bottom bit." And that brief conversation dictated the whole aesthetic, which is why the houses look like medieval castles from the outside. They won a prize architecturally, and have been filled with visiting mathematicians ever since they were built.

Nuffield Professors The first leaders of symposia were members of staff and the subjects were in our own specialties: topology in 65/6, group theory in 66/7 and differential geometry in 67. But then the Advisory Board thought that we also ought to run some symposia in fields that were flourishing internationally but relatively weak in the UK, in the hope of persuading some UK mathematicians to move

into those fields and plant the seeds in this country. We used the Nuffield Professorships to attract eminent leaders from abroad for the year: Hans Reiter to lead harmonic analysis in 67/8; Larry Markus to lead differential equations and dynamical systems in 68/9; and David Mumford to lead algebraic geometry in 70/1. To our delight these were also very successful. Larry Markus even bought a flat in Leamington so that he could continue to visit us every winter thereafter. Subsequently we had sufficiently many fields represented on the staff as to be able to lead the symposia ourselves every year, with roughly a five year periodicity.

Meanwhile to my surprise I was hoist by my own petard, for I was persuaded to move into dynamical systems myself. My own research in topology had dwindled to zero, what with founding the department and the university, and I was ready for a change. In 1969/70 we initiated a rolling chairmanship of mathematics, and David Epstein took over while I went on sabbatical leave to the IHES, where Rene Thom inspired me to move into catastrophe theory. This occupied my attention for the next two decades.

New Mathematics Institute When I returned in 1970 the Union issue had been resolved and we were duly given the old library building for a new Institute. In the intervening years I had had the opportunity to walk round and round the building and draw endless plans, so I had very precise and detailed instructions to give to the architect, Alan Goodman. It was he who had originally built the library and he made a beautiful job of adapting it to our needs. On the ground floor at the heart of the building was a large two-storey deeply-carpeted common room, where every morning coffee and every afternoon tea were wheeled in from a hidden kitchen and served in elegant china, in order to lure the staff, graduates and

visitors in for mathematical conversation. All round the walls were greenglasses and little round tables with comfortable narrow armchairs, so that small groups could talk close together and rise naturally in mid sentence from chair to greenglass as the occasion demanded. Next to the common room were the departmental library and seminar rooms, and all round the perimeter were well sound-proofed offices where people could escape and be alone. A mathematician likes to be a hermit 70% of the time and gregarious for the other 30%, and the architecture reflected this need. On a big plan I drew everybody's daily pathways, and where the pathways clustered together I put doors, and where there were no pathways I put the round tables and greenglasses. I walled off the circulation space from the discussion space so that the former would not disturb the latter (which subsequently the Newton Institute failed to do). And the circulation space was filled with carpets, maps and colours. At the other end of the building was an undergraduate common room with more greenglasses and small supervision carrells for three, a graduate supervisor with an undergraduate on either side. We tried to make the whole Institute comfortable but modest so that people would feel at ease; everyone loved it and treated it with great respect.

Applied mathematics I was fortunate to be given a Research Council senior fellowship for five years 1976-81, after which the department prevailed upon me to do another turn as chairman. I was particularly concerned about applied mathematics. I had slowly come to the conclusion that my original plan of delegating the teaching of applied mathematics to physics and engineering had failed, because those departments had naturally appointed physicists and engineers rather than applied mathematicians and our students had voted with their feet not to take those options. I was horrified to

find that we were turning out BSc's who had never even seen Newton's equations for planetary orbits. I had originally taught those as part of the first year foundations course but they had since dropped out of the syllabus. In desperation I began teaching a second year mechanics course myself, including the amazing fact that Newton's equations are contained naturally in the symplectic structure of the cotangent bundle of the configuration space (which most applied mathematicians don't know about). But, more seriously, we needed to appoint some proper applied mathematicians.

My successors as chairman had extended topology and algebra into geometry by appointing George Lusztig, Miles Reid and John Rawnsley, but otherwise had tended to expand the existing research groups rather than tackling the more difficult task of launching a new field. So we now appointed six posts in applied mathematics, specialising in dynamical systems, under the leadership of David Rand and Robert MacKay, with Anthony Manning, David Mond, Caroline Series, Greg King, and with Larry Markus, our guru, coming each winter as visiting professor. Greg King set up a laboratory for research in small precision experiments, and for teaching an experimental option to first year undergraduates, which they loved. Later this group was joined by Mark Roberts, Dietmar Salamon, Sebastian van Strien, Claude Baesens, Alan Newell and Colin Sparrow. My initial error had at last been corrected, and it was acknowledged nationally that Warwick had become strong in both pure and applied.

David Rand It is now 15 years since I left Warwick and I am impressed and delighted that the mathematics department seems to be as vigorous as ever. I have always regarded the present chairman

David Rand as a man of great vision, and I am reassured that it is he who is now in charge of the current move into a new Mathematics Institute on the main site. I wish him every good fortune, and the same to all those who now carry the flag at Warwick.

Christopher Zeeman - June 2004

A Brief History of the Early Years of the Statistics Department

By Professor Jeff Harrison

Has any university department ever opened its account with such a statistically significant event as that which launched the Warwick Statistics Department? On Tuesday 9th October 1972, in the first serious lecture given to a group of 45 second-year mathematicians, entitled Possibilities & Probabilities, the founding professor tossed a 2p coin high in the air. The coin descended to the vinyl floor of lecture theatre L5, spun as a perfect sphere, and, in full view, slowly came to rest on its edge! Stunned silence turned into massive applause. No further publicity was necessary – truly the Statistics Department had arrived in style!

Naturally, hypotheses related to this event were proposed, the three most favoured being:

- Pure chance – odds of 1 in a billion, according to Alan Turing's calculation;
- Psychokinesis – but whose mind was controlling the outcome?
- Divine intervention – a sign from God in response to elicited prayer for a successful department.

The last was definitely the explanation of the lecturer. But how do you incorporate this in a second year Mathematical Statistics lecture course - apart from by demonstration?

With no students to call their own, the critical decision confronting the founding staff – Robin Reed, Tom Leonard and Jeff Harrison – concerned the design of an undergraduate degree. Traditionally this would have been a straightforward degree in Mathematical Statistics, but computers were revolutionising statistical and mathematical application, particularly in business and commerce. Consequently the time was ripe for the design of a radically new degree. Furthermore Warwick was the ideal place to introduce it. The University was young, ambitious, flexible, trusting, unencumbered by red tape, with a philosophy of interdepartmental co-operation, and strongly promoting links with industry and government. Encouraged by the excellent Mathematics Institute, Economics Department, and Warwick Business School, each having a major interest in the mathematics of uncertainty, particularly in prediction and decision making, MORSE was conceived. The first 25 MORSE students arrived in October 1975. Soon the intake increased to 35 per year. But, at that figure, despite the great increase in applicants, government policy and University politics prevented further expansion. At the end of the '80s restrictions were eased and by 1998 the Department's intake had doubled. However, it was time for further development. With encouragement from the Institute of Actuaries, a four-year MMORSE degree was designed, introducing specialisation in the final years. The first students arrived in 1999, and by 2003 the Department's intake had doubled again, the mean point score of the students being the highest in the University. Overseas students now comprise half the intake, reflecting the growing international reputation of the degree and the University.

From inception Departmental research focused on the controversial field of Bayesian Statistics, identified as a major growth area offering the most powerful approach to sequential learning and forecasting.

Very quickly the Department gained an international reputation, presenting the most invited papers at the first three major international conferences on Bayesian Statistics in 1979, 1983 & 1987, and providing the largest contingent of staff and students. The American Statistical Association elected one of our papers as their 1984 Theory and Methods Paper, a matter of local interest as it generalised methods developed for what was then a largely unknown Leamington Spa company, Millward Brown, assisting its development into a successful international market research company. 1984/5 saw the Department host a very successful Bayesian Statistics Study Year, attracting visits and papers from most of the world's leading Bayesian statisticians. Since then research interests have grown to include Probability Theory and Random Processes, Statistical Methodology, Financial Mathematics, Medical Statistics and Social Statistics. In 1986 the University Grants Committee introduced Research Assessment. To date, apart from Cambridge, Warwick Statistics Department has the best UGC research record of all British statistics departments.

The Department has always encouraged links with industry and external organisations. In the beginning this took the form of individuals consulting for large companies such as ICI, IBM & British Gas, and external forecasting courses. In order to co-ordinate this activity, the University of Warwick Statistical Consultancy Unit was established in 1985 with Geoff Freeman as its Director. This unit has provided a focus for the provision of statistical advice, both to external and internal clients. The unit's current name is The Risk Initiative and Statistical Consultancy Unit (RISCU), with John Fenlon as director.

In its early years the Department was located in the Computer Science Building, followed by offices in the newly built Social

Sciences Building, with both Economics Department and the Business School as neighbours. Further University growth caused the Department to move into the Mathematics Institute building. In December 2003, both the Mathematics and Statistics Departments moved to their present newly built location on the main campus.

*Jeff Harrison, Founding Professor
& Chairman of the Statistics Department (1972-2000),
with assistance from Dr Robin Reed – June 2004*

Warwick Statistics Then and Now

An interview with Professor Jim Smith

Q: *Your ties with Warwick Statistics go back a long time – as suggested by your photograph attached here from your official Warwick file. How did your time at Warwick begin?*

JQS: I was an undergraduate at Nottingham, back in 1974, thinking of doing a PhD, and I was advised by Clive Grainger (now a Nobel laureate in Economics) to go to Warwick to work with Jeff Harrison on time series. I had attended a couple of statistics lecture courses at Nottingham, but otherwise had learned mostly mathematical analysis, so when I arrived at Warwick I found myself on a crash course, going to all the undergraduate statistics lectures. I had to do this so I knew what to say when taking undergraduate tutorials; sometimes it would take me all day to work out what should be the answer to a question for an upcoming class. I also went to Zeeman's lectures on catastrophe theory; in fact I went three years in a row, because each year they became more and more interesting.

Q: *What was it like, being a research student at Warwick Statistics in those early years?*

JQS: Jeff Harrison gave me some very simple advice on how to do research in statistics: “Think of a problem, and then solve it”. Easy to say, harder to do! I was the very first PhD student in the department; I had my own office all to myself for the first 18 months and was quite put out when I was told I would have to share it with someone else. At that time we were located in the old Computer Science building (now part of Physical Sciences). The department was small

and very lively. When I arrived there were just Jeff Harrison, Tom Leonard, and Robin Reed. Keith Ord came at the same time as me, and shortly afterwards Tony O'Hagan and Sylvia Richardson. One had always to be on the alert for cunning practical jokes; for example Jeff Harrison was sent a fake but convincing paper to referee as a potential read paper for RSS, which spoofed all the work I had been doing for my PhD. It fooled us completely!

Q: Did you have much contact with University administration?

JQS: I took part in the celebrated occupation of Senate House. When the police arrived, we had to leave, so we moved over to the Arts Centre and occupied that; this had the advantage that we couldn't be evicted ...

Q: Did you have contact with undergraduates?

JQS: After a couple of years I became a lecturer, at the same time as writing up my thesis. My first lecture course was a third-year course on Bayesian statistics, with 8 people attending. I remember that was considered a good number for a third-year lecture course. At that time MORSE was only just coming on stream, so most of the audience were Maths students. I then took up a lectureship at UCL, but returned after five years, in about 1986, to be lecturer here again.

Q: Had the department changed much over those five years?

JQS: By that time Mike West and Peter Whalley had joined. We now had some forceful advocates for the Bayesian approach to statistics, and this had a big effect on the teaching programme. MORSE had

grown greatly, to about 40 students per year. By this time we had moved to the Social Sciences Building. We ran a Bayesian study year (also known as “plant a Bayesian” year) which helped put Warwick on the map statistically speaking; Bayesian experts from all over the world visited to spend time working with us. Saul Jacka had just arrived, and he was put in charge of running the accommodation – he still grows pale when reminded of that.

Q: What do you remember most about that time?

JQS: There was a promotion blockage, with several lecturing staff chasing promotions, which could lead to tensions, and did lead to turnover of staff. The department acquired a more eclectic feel, since we had appointed a number of non-Bayesians – Saul of course, also Frank Critchley, as well as Ewart Shaw on the Bayesian side. At the time there was concern that we might have lost our distinctive strength, but with hindsight we were broadening out, not losing. I remember a distinct lack of physical space; the Social Sciences corridors were narrow and dark, and there was never enough room for offices. There was also a sense of vulnerability; we were a small department in a big university, and we had to watch out for ourselves and be careful.

Q: If we fast-forward to the present, what differences strike you now?

JQS: Sheer size! Now our third-year courses have attendances ranging from 60 to 100 students. Our annual undergraduate intake has grown from 40 to 150; we now have 20 lecturing staff instead of 5, in a brand-new building. If I have one regret, it is that it is now much harder to find opportunities to teach small classes; there is a

particular delight in interacting strongly as a teacher with a small group, though to some extent the same buzz now comes from supervising PhD students and undergraduate projects. On the other hand there is now a great pleasure which more than makes up for this; we now have so many different areas of statistics represented in the department, with so much expertise and energy. If I have got a statistical question for which I need an answer, then I can probably find someone in the department who can give me the information which I need to know.

Q: Looking to the future, to what are you looking forward?

JQS: Retirement :-) Seriously, I expect more and more research and teaching benefits to grow from the close association with Mathematics, as we take maximum advantage of our new building; I look forward to seeing yet more of the truly international growth of the department both in research and students; and I expect exciting developments in our engagement with industry, particularly through our consulting activity, and with society in general.

Jim Smith - June 2004