

Physics at Adelaide from 1984 to the present day

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In a mere half an hour it is impossible to do justice to the activities of so many remarkable scientists. Rather, my aim is to present some personal recollections of key moments in the development of Physics from my arrival to the present day, clearly with an emphasis on theoretical physics which did not exist in the Physics Department prior to 1984. The icing on the top is a brief summary of the current research highlights, which is fortunately a real pleasure. It is fair to say that in terms of its research Physics is today stronger than it has ever been. Flawed though the ERA ranking may be, the fact that the discipline as a whole was ranked 5, with two research areas ranked 5 and another ranked 4, is a fitting testament to that current strength.

At my appointment in 1983 I was 33 years old, at the time the second youngest professorial appointment in Physics (although Bert Green was appointed in Mathematical Physics at age 29); with Bragg appointed at 23 it is doubtful that anyone else could ever take the record as youngest. Of course, in this century Tanya Monro, who was appointed at age 31, took over second place.

Sadly, the origin of my appointment lay in the death of David Sutton, about whom much has been written. At the time, the department requested the release of a lecturing post. However, Prof. John Bowie, who was the Dean of Science, took the bold and in a sense selfless decision (because at that time a more expensive position in Physics almost certainly meant one less position elsewhere in the Faculty) that the Department was in need of the leadership that could only come through a professorial appointment.

The appointment of full professor at that time was a remarkable process with five candidates all at the University in the same week, circulating one after the other between the lecture room and the offices of the Vice Chancellor (Prof. Don Stranks), Registrar (Mr. Frank O'Neill) and Bursar (Mr. David Beecher), and of course Harry Medlin. Two of the other candidates were Eric Weigold and Bruce McKellar, both Fellows of the Academy and very senior figures.

I must recount one remarkable story about my own candidacy. I was a staff member at CERN attending a conference in Los Alamos which was also

attended by Bruce McKellar, a long term colleague and friend. (Indeed in 1981 I had spent 3 months study leave in Melbourne as his guest.) At the end of the meeting I accompanied Bruce to the airport and at that time one could walk onto the tarmac. As I was about to board the plane Bruce asked me whether I was aware of the chair being advertised at the University of Adelaide. When told that I was not he informed me that even though the deadline had passed Frank O'Neill would accept an application. It was only after I was short-listed and saw the other names that I realized how generous Bruce had been, given that he was also on the short-list.

The appointment committee included Profs. Ian McCarthy and Angus Hurst as well as Harry Medlin and, of course, the Vice Chancellor Don Stranks. I remember promising to "lead the department by example" and obviously choosing youth in place of experience they gave me the chance.

My arrival in February 1984 was greeted by a sense of excitement tempered soon afterwards by considerable unease. The Department of Physics, which was no longer regarded as a research powerhouse, had never had a theorist on staff. The Department of Mathematical Physics, which did have a distinguished history of research in both theoretical and mathematical physics, was in crisis with an FTE student load which at the time justified only half of its complement of four staff. I was simultaneously seen as a valuable colleague and a tremendous danger. At the time, neither department earned significant research funds and there was (I recall) only one research associate in each.

I was astonished in looking through papers from the time just how difficult the initial few months were. Indeed, when I look over the history of the discipline I am struck by just how incredibly unhelpful, at times damaging, reviews can be. A review of the Departments of Physics and Mathematical Physics had been completely organised long before I arrived. The reviewers had been carefully chosen and were "loaded for bear", with me wearing the fur coat. While having little to say and none of it positive about Physics, the sole purpose appeared to be to ensure the separate survival of Mathematical Physics with its complement of four academic staff. My modest proposal (remember as a rather young and raw Professor who could have used a little help) to create a "viable theory group of 2-3 staff, 2-3 postdoctoral fellows, 1-2 FTE visitors and students" met with little enthusiasm. In response to the more ambitious proposal to secure a high energy research institute for Adelaide (federally funded with a budget of \$500k per year and promised support from the Director General of CERN at the time

of \$50-100k) the committee simply remarked that there were "better claims". (It was to take a further 27 years to realize this ambition.) The result of this misguided review was a great deal of heartache and wasted time over the following four years.

In contrast with the review committee, the Head of Department, Dr. Graham Elford was a wonderful mentor, providing unfailing help and support. He carefully calculated the research income that would be associated with the group I had proposed to build, around \$10k per annum, and made it available so I could get a research program started. Don Stranks' advice that I should expect to be able to win 2 postdoctoral fellows through the ARGC proved correct and in November 1985 the Vice-Chancellor's report to Council included 2 grants totalling \$98,260 to J.R Prescott, A. G. Gregory, R.W Clay and J.R. Patterson, a grant of \$51,530 to W.K. Hocking, R.A. Vincent, W.G. Elford and B.H. Briggs and 2 grants totalling \$65,000 to A.W. Thomas and L.R. Dodd. These grants represented approximately 10% of the funds won by the entire university.

With the support of Graham Elford and the ARGC, a small group began to take shape. Dr. Anthony (Tony) Williams was hired as the first research associate in theory and for a while, with Tony Williams who had just been awarded a Ph.D. at Flinders University, Tony Signal the first Ph.D. student and myself, asking for "Tony" covered the entire group.

In the extremely democratic system that Harry Medlin's revolution had created in the University, any change required extensive debate within the Departmental Committee. It was not easy but in the end the consensus was that the way forward for the discipline was to build research groups of a critical mass (typically 3 or more academic staff). This single decision is possibly the major reason why Physics has grown to have such strong and successful research programs. New young staff do not have to make their way in a very harsh and competitive funding environment (nothing new about that) totally alone. Group members have colleagues with whom they can discuss issues as they arise and students have support when a group member is on travel or sabbatical.

In Theory we very quickly made the first appointment, Dr. Rodney Crewther, whom I had first met a decade earlier when he was a staff member in Theory Division at CERN. His impact on the teaching programs in the Department has been and continues to be extremely important.

It is fascinating to reflect that about this time the Vice-Chancellor distributed a paper ("Issues for 1986", Ed/86/1/8) in which he canvassed the previously unheard of idea of taking research performance into account in setting the staffing levels in each area - the so-called Compact. It may come as no surprise to anyone familiar with university politics that this failed for the simple reason that the majority of the Deans would not benefit. One may hope that there might be a more rational discussion in the context of the preparation of the next strategic plan for the University.

At times in the history of a Department it is valuable to reflect on what has happened, the achievements and the successes. In 1986 Harry Medlin, with his sense of history and purpose, ably supported by Graham Elford and a very active committee, decided to organise the Bragg Centenary celebration, recognising the passing of exactly 100 years after Bragg's arrival in Adelaide as the Elder Professor of Mathematics and Experimental Physics. A highlight of the celebration was the presence of three outstanding and internationally respected physicists, Frank Close, Paul Davies and Freeman Dyson, all of whom presented public lectures. They also took part in a public forum in which I joined them. Attendees included Senator Baden Teague who although a Ph.D. in History had studied physics as an undergraduate. The Departmental photo for 1986, which includes all of these visitors, is a very significant historical document. The experience of this visit was one of the reasons that we were later able to attract Paul Davies from Newcastle as Professor of Mathematical Physics.

By 1987, following the retirement (in 1985) of Professor Herbert (Bert) Green who had founded the Department of Mathematical Physics, it had become apparent that funding constraints meant there would be no replacement. It was inevitable that the two departments should join together and in 1988 the University created the new Department of Physics and Mathematical Physics. I was elected as Head of this new Department, which had a budget of around \$3M and a staffing level of around 20 academics.

This was an exciting and critical time as we had the opportunity to make two new professorial appointments. With Angas Hurst and John Prescott, both of whom had given tremendous service to the University, about to retire we advertised a Chair of Experimental Physics and a Chair of Mathematical Physics. Jesper Munch was appointed to the first and Paul Davies to the second.

The appointment of Paul Davies, who had already participated in the Bragg Centenary, offered the possibility of renewal and expansion of the research program in gravitation and fundamental quantum physics. In addition, his fame as a communicator of science to the general public was seen as an important addition to the Department. No-one anticipated the effect of the Australian cultural cringe, whereby anyone to whom the British press pays attention is immediately the darling of the local media. Soon after arrival Paul found himself the centre of attention of media all around Australia. I often think of it as akin to riding a tiger and in the end this side of his career took over at the expense of teaching and research. By the time Paul moved on the Dawkins destruction of the tertiary system had cut into staffing numbers in the Department to such an extent that his chair could not be re-filled.

On the face of it, the search for the new Chair of Experimental Physics presented a greater challenge, as a world-class appointment in a new experimental research area required a substantial investment in laboratories and equipment. I approached the State Government with the proposal that the appointment should be in either solid state physics or optics and perhaps because of the strength of the local optics industry and possibly also defence interest, they were willing to support optics. Their offer of \$250k required matching funds from the University and here the Vice-Chancellor, Prof. Kevin Marjoribanks showed real leadership. I recall the meeting with him in which he simply said, "of course, we must do it". With these two minor miracles we had half a million dollars to attract the appropriate candidate.

Even at the process of short-listing we had an incident that could have changed history. One of the panel members took the application from Jesper Munch and placed it in the discard pile with the comment "no teaching experience" - since he was working at TRW in California, not a university. I don't recall exactly what it was in the application that prompted me but I moved it into the short-list pile. Certainly I knew that the SA Government had an interest in providing support to local optics companies. Later I recall an enormous sense of relief during Jesper's lecture in the Kerr Grant theatre, when his infectious excitement over non-linear optics became apparent and it was clear that he would make an excellent appointment. The final process of convincing him and his family to move so far included two visits to Los Angeles where I was a guest at his house.

Apart from the superb work that Jesper carried out and the young staff that he attracted (Murray Hamilton and Peter Veitch), this appointment certainly

formed a solid foundation upon which the later appointment of Tanya Monro could be made.

During my time as Head of Department the appointment of the second theory lecturer always took a back seat but in 1993 we were finally able to appoint Dr. Anthony Williams from Florida State University (Physics and Supercomputing Institute), who had earlier been a postdoctoral fellow in the group. Tony's expertise in high performance computing was to prove tremendously beneficial to both research in theoretical physics and to computing in the whole State.

At this point I am reminded that the Physics Department did not exist in isolation but was a vital part of the University. As a University Council member who was young enough to still play cricket, I was chosen by the Chancellor Bill Scammell to captain the university team in the Town versus Gown game in 1994. The Town team was captained by a very capable batsman who also happened to be the Minister for Education, Rob Lucas, and our narrow win was somewhat fortunate.

As fortune would have it, my term as President of the Australian Institute of Physics (1991-93) was dominated by the preparation of the first Strategic Plan for Physics in Australia. Almost every editorial of the *Physicist* involved some mention of the need for input or the latest suggestions. A good deal of the reason for the strength of optics in Australia can be traced back to a recommendation in that Plan. The Plan also recommended the creation of a National Institute for Theoretical Physics (NITP) and as a result of a national competition the University of Adelaide was chosen to host it. The very negative reaction to this decision from a former President of the AIP, Tony Klein in Melbourne was a little sad but we set to work to make this happen.

In this context one can see just how important visionary leadership at the top levels can be. Both the Vice-Chancellor, Gavin Brown, and the DVC(R), Mary O'Kane, were strong supporters of our bid, setting aside ideally suited office space at 10 Pulteney St. Despite our best efforts, which included the organisation of many schools and workshops, the ARC never proved able to provide the necessary financial support for the NITP. However, our work and the support from the University was not wasted as in 1996 Tony Williams and I succeeded in winning the ARC Special Research Centre for the Subatomic Structure of Matter (CSSM). The idea of the SRCs was to give a small group of

top rate researchers the freedom to develop their research for a period of nine years without the need to worry about funding. What more could one ask for?

In establishing CSSM we were unbelievably fortunate to attract outstanding staff, from Sharon Johnson as my PA to Ramona Adorjan as our computing officer. The first academic staff member we hired to replace my teaching in the Department was Derek Leinweber, an outstanding young practitioner of lattice QCD, which was one of the key research directions that Tony and I had agreed upon. Derek's contributions to the University as Head of Physics and Chemistry are well known to all.

Already in the mid-90s it became apparent to me that in the post-Dawkins era, with student staff ratios in science heading from 9:1 to in excess of 20:1, university funds could not support the necessary infrastructure and technical support, let alone support expansion in new directions. Efficient day to day operations and growth could only come from winning external funds.

Unfortunately, for several years after the departure of Mary O'Kane the senior administrators at the University of Adelaide did not seem to understand this. This led to the appalling situation in 2002 when the new research institute, WISER (World Institute for Space Environment Research), which had strong support from the US Air Force and an extremely creative, dynamic Director, Abraham Chian, failed to receive University support.

Worse still, at a review (yet another review disaster!) of the CSSM involving three of the world's leading nuclear physicists who gave an unambiguously glowing report, the response of the DVC(R) was essentially "that is wonderful, we just hope we can afford it". Such attitudes led to me accepting the offer to move to Thomas Jefferson National Accelerator Facility (one of the US Department of Energy's two major nuclear physics laboratories) as Chief Scientist and Associate Director of Theoretical Physics.

Already by the time I left (in February 2004), these attitudes were beginning to change. Through strong support at Council and from the Vice-Chancellor, I was allowed to retain the title of Elder Professor of Physics, which I am proud to have held since 1989. The appointment of Tanya Monro, which has led to some incredibly exciting developments in research across the University, occurred around this time. Tanya did not take up her appointment until early 2005 and so we did not actually meet until considerably later.

The comparison between support for research in 2004 and 2009, when I decided to return, was like that between night and day. With Derek Leinweber as Head of School, Mike Brooks as DVC(R) and James McWha as Vice-Chancellor the decision was easy. The University support for Research Institutes such as Tanya Monro's IPAS and University Research Centres such as the re-born C²SSM (the University Research Centre for Complex Systems and the Structure of Matter) is now exactly what is needed to support winning bids for external funds. It was crucial to the success of my application for an Australian Laureate Fellowship and most recently for the new ARC Centre of Excellence in Particle Physics at the Terascale (CoEPP).

So where does the Discipline of Physics stand at the current time? In my view it is stronger than it has ever been. In Optics and Photonics Tanya Monro has proven an outstanding leader, managing an incredibly successful Research Institute through which her trans-disciplinary approach to problem solving has not only won large amounts of research funding but has also generated first rate publications and innovative new devices. She has developed even further the strong relations with the optics industry and defence that Jesper Munch succeeded in building, as we hoped at the time of his appointment. This group also plays a very significant role in the LIGO project which we expect to discover gravitational radiation in the next few years.

The High Energy Astrophysics (HEA) group has developed in multiple directions since its foray into meaningful international collaboration with the Cangaroo project in the 1990s. My Japanese colleagues, from both theory and experiment, still often ask about that project when I am in Japan and we should not forget that it was opened by the Japanese Ambassador to Australia. While Cangaroo is officially finished it has led to the HESS project (in high energy gamma-ray astronomy) in Africa and in which we are actively engaged. There is also a substantial role in the Auger detector which is searching for the highest energy cosmic rays. Finally HEA is also involved in the ICECUBE neutrino detector in the Antarctic.

Under the leadership of Prof. Robert Vincent, the Atmospheric Physics group has contributed to the development and application of radars to study the structure and dynamics of the atmosphere and ionosphere from the ground to geospace. This includes the SuperDarn Over-the-Horizon radar, meteor wind radars and boundary layer and Stratospheric wind profiling radars. The group created a very successful spin-off company, ATRAD, which sells radars

designed in Adelaide both nationally and internationally. They have developed and applied optical techniques, including lidar, to study the thermal structure and dynamics of the middle and upper atmosphere. Finally in collaboration with colleagues in France they have studied the destruction of ozone in the lower stratosphere of the Antarctic.

Finally, in subatomic physics the theorists continue a broad program of research in which lattice QCD and phenomenology are brought together to confront the outstanding questions in modern nuclear physics. Recent achievements include the determination of the contribution of strange quarks to the mass and electromagnetic form factors of the proton, a problem of comparable importance for QCD to the original calculation of the Lamb shift in QED. Innovative lattice techniques have led to new insights in hadron spectroscopy while the calculations of the equation of state of dense matter have been shown to have profound consequences for the structure of neutron stars.

Most recently, with the creation of CoEPP as a partnership between Adelaide, Melbourne, Monash and Sydney Universities Adelaide University was able to make its first appointment in experimental high energy physics, Paul Jackson who came to us from Stanford via CERN. Only in June this year was Adelaide University accepted into the ATLAS Collaboration at the Large Hadron Collider, just in time for us to be the first institution listed on the paper from ATLAS describing the discovery of what is almost certainly the famous Higgs particle. Theoretical work in Adelaide is not only supporting the experimental program but pursuing fundamental theoretical ideas from supersymmetry to the nature of dark matter and dark energy.

Together these research programs represent a remarkable effort to explore Nature at its deepest levels while simultaneously contributing to the defense of our nation and the health of local industry. The University and the people of South Australia can be very proud indeed of the Discipline of Physics at the University of Adelaide.