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The Australian Mathematical Society

Gazette

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- Reviews of books, particularly by Australian authors, or books of wide interest
- Classroom notes on presenting mathematics in an elegant way
- Items relevant to mathematics education
- Letters on relevant topical issues
- Information on conferences, particularly those held in Australasia and the region
- Information on recent major mathematical achievements
- Reports on the business and activities of the Society
- Staff changes and visitors in mathematics departments
- News of members of the Australian Mathematical Society

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We ask that your TeX files contain a minimum of definitions, because they can cause conflict with our style files. If you find such definitions convenient, please use a text editor to reinstate the standard commands before sending your submission.

Please supply figures individually as postscript (.ps) or encapsulated postscript (.eps) files.

Deadlines for submissions to Volumes 34(2) and 34(3) of the *Gazette* are 1 April 2007 and 1 June 2007.

Volume 34 Number 1 **2007**

Editorial

Welcome to the first issue of the *Gazette* for the new editorial team: Birgit Loch, Rachel Thomas and Eileen Dallwitz. We'd like to start the issue by thanking the previous team of Jan de Gier, Ole Warnaar, Maaike Wienk and Celestien Notschaele. Their excellent work has had a great impact on the *Gazette* and its readers, and we'd like to congratulate them on a job well done. We hope to continue their good work in making the *Gazette* a vital source of news, entertainment and debate for the Australian mathematical community.

We would also like to thank the regular contributors to the *Gazette* for their continuing assistance in making this magazine as diverse, current and interesting as it is. We are very pleased that Norman Do, who used to produce the popular Mathellaneous column, is now contributing a Puzzle Corner to each issue, complete with a prize on offer for the best solutions. Also Tony Roberts continues Style Files, his excellent column on writing that offers advice useful to anyone whether you are writing for an academic or general audience.

The Research Quality Framework (RQF) and the National Strategic Review of Mathematical Sciences Research have been discussed widely in the media in the last few months. In this issue, Peter Hall discusses research performance metrics in mathematical sciences, in light of the RQF. And Hyam Rubinstein reports on the national Forum discussing the future of mathematics in Australia, held in Canberra on 7 February.

The book *Counting Australia In: The People, Organisations and Institutions of Australian Mathematics* was published last year. The author Graeme Cohen tells us about the other authors of Counting Australia In, and the book is also reviewed in this issue.

We are also launching a new column in this issue, called Maths@work, which will highlight mathematics used outside of academia. This first column of the series is by John Henstridge of Data Analysis Australia who explains how his mathematics and statistics consulting firm operates. We are looking for future authors working in business and industry to give an overview of how maths is used in their area, or to provide a case study of a particular project or application. If you have any suggestions of suitable authors or areas we would be very pleased to hear from you.

As mentioned in the last editorial, the *Gazette* is written by members of the Australian maths community for members of this community. Therefore the *Gazette* will only continue to be a success with the generousity and enthusiasm of you, the readers. As always we would be very pleased for readers to offer articles or to review books, to alert us to new books or projects of interest by members, to review technical papers or to provide feedback and suggestions. We particularly encourage contributions from younger mathematicians, such as PhD students and early career researchers and lecturers, as they are the future of mathematics in Australia.

We hope that you enjoy the first issue of 2007, and we look forward to working with you all on future issues.

Birgit, Rachel and Eileen

President's column

Peter Hall

Editorial service

Three of the Society's editors stepped down at the end of 2006. They deserve our thanks for outstanding service.

Chuck Miller was Editor of the *Journal* from 1998 to December 2006, an unusually long period of tenure for this very demanding position. His wisdom and dedication served the *Journal* especially well, and we are grateful. As the workloads on Australian mathematical scientists increase, we are going to find it increasingly difficult to locate editors with the commitment and acumen shown by Chuck. Therefore we are especially thankful that Michael Cowling has agreed to take over the reins of the *Journal*.

Jan de Gier and Ole Warnaar took up editorship of the *Gazette* with the first issue in 2004, and transformed it into a vibrant, highly topical magazine of mathematics news and opinion. We are grateful for their dedication and commitment. I remember especially their instant response to a 'call to arms' to produce an online Supplement last August, celebrating Terry Tao's Fields Medal. Jan and Ole have been ably succeeded by Birgit Loch and Rachel Thomas; the issue of the *Gazette* in which you are reading this column is their first.

The review

By now you will have heard that the *National Strategic Review of Mathematical Sciences Research in Australia* has reported to the Australian Academy of Science. The review was a massive undertaking, and involved substantial effort over a long period. The ARC grant proposal that achieved partial funding for the Review was submitted in early 2005, the review itself got underway in September that year, and the final report was released 15 months later.

While many people contributed to the review, three stand out for their extraordinary dedication and leadership throughout the 15-month period. Indeed, they are still providing a great deal of assistance as we move forward after the review, spreading the review's message as widely as possible.

Hyam Rubinstein chaired the Academy's National Committee for the Mathematical Sciences, and took overall responsibility for the review's directions. His wisdom and experience have been crucial to the review's success. Barry Hughes, the review's Executive Director, and Jan Thomas, the Society's Executive Officer until last September, undertook the lion's share of the incredible amount of organisation that was necessary to bring the review to fruition. Their political acumen and unfailingly good advice were indispensable.

I should mention too the major contribution made by our three international reviewers, Jean-Pierre Bourguignon (Director, Institut des Hautes Études Scientifiques, France), Brenda Dietrich (Director, Mathematical Sciences, IBM Thomas J. Watson Research Centre, USA), and Iain Johnstone (Department of Statistics, Stanford University, Stanford, USA). In principle, Jean-Pierre, Brenda and Iain represented theoretical mathematics, applied mathematics and statistics, respectively, but in practice there was seldom any need to consider those fields separately during the review. The issues that arose, and the recommendations that turned out to be necessary to respond to difficulties, were virtually identical in each case, differing only in scale.

The international perspective that Jean-Pierre, Brenda and Iain brought to the review was critical to the authority, and hence to the impact, of the final report. However, this was not as clear to me at the beginning as it is today. The 2006 review reported 11 years after Australia's first national research review of the mathematical sciences, and that review was undertaken without any formal linkages outside the country. In particular, there were no international representatives on the review team.

I remember that, when the ARC grant proposal was being prepared two years ago, and it looked like the review could go perilously over budget, I asked Ah Chung Tsoi (then Executive Director for the ARC's Mathematics, Information and Communications interdisciplinary cluster) whether it was essential to include the international component. It added very substantially to the cost, I pointed out, and we would have limited resources. However, Ah Chung was adamant that the international reviewers were necessary; the ARC would no longer accept the advice of a review that lacked international calibration.

In addition to providing this benchmarking to the ARC, the international reviewers gave all of us on the Working Party a much-needed reality check. We have all seen the mathematical sciences slip, indeed fall, in Australia over the last decade, and it has been hard for us to conceive that the magnitude of the challenges we face is uniquely Australian. One part of the problem is that the slide has been incremental. Another is that we have not previously experienced, in our discipline, a substantial drop in Australia's international competitiveness, so there has been a tendency to suppose that the same sort of thing must be happening elsewhere, even though our own experiences abroad seem to contradict this.

The international reviewers declared authoritatively that the problems faced in Australia are remarkable for their severity. I urge you to read the international reviewers' Foreword to the review report. You can find the full report at http://www.review.ms.unimelb.edu.au/FullReport2006.pdf.

Today, post review, we are energetically following up wherever we can, working to deliver the review's message. We are talking and writing to politicians, political advisers, bureaucrats, senior scientists, and well-placed people in industry and business. We are writing submissions to government, and speaking to the press. A forum on the review, scheduled in Canberra for 7 February, will have been held by the time you read this.

I note that the press has already taken up the issues that the review raised, and has combined them with similar concerns about the difficulties faced more broadly by science in Australia. There was a flurry of articles on the review before Christmas, and more generally the messages of the review seem to be getting across. For example, *The Australian* noted on 4 January that:

> The number of school students studying science across the nation has dropped by one-third in five years, and the proportion of university graduates with a maths qualification is less than half the OECD average . . . OECD figures show only

> 0.4 per cent of university students in Australia graduate with qualifications in maths or statistics, compared with the OECD average of 1 per cent.

The figures of 0.4 per cent and 1 per cent are taken from the report. On 20 January *The Australian* ran an excellent interview with Terry Tao, and drew still further attention to the lamentable position of mathematics and science in Australia.

However, I should stress it will take us a long time to solve the problems identified by the review, and that doing so will require still more dedication and hard work.

Peter Hall
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Peter Hall is a statistician, with interests in a variety of areas of science and technology (particularly the physical sciences and engineering). He got his first degree from The University of Sydney in 1974, his MSc from The Australian National University in 1976, and his DPhil from University of Oxford in the same year. Peter is interested in a wide variety of things, from current affairs to railways and cats.

Letter to the editors

Another interpretation of Cherry's appointment over Wiener

Graeme Cohen's recent book *Counting Australia In* and the excerpt published in the *Gazette* (Volume 33, No. 1) tell a story of great interest, one that has been accorded a long and undeserved neglect. This is the account of Norbert Wiener's application for the Chair of Mathematics at the University of Melbourne in 1928. It is pleasing that this situation is now rectified and one can only agree with Cohen that the omission of this episode from Selleck's official history of that university was an egregious oversight.

To say all this, however, is not to conclude that Cherry's appointment over Wiener was an incorrect or unfair decision. One might so conclude from the quote from Franklin's testimonial 'Professor Wiener is of the Hebrew race, and he has some very peculiar traits', which, taken at face value, suggests the conclusion that Wiener was overlooked on account of a prevailing anti-Semitism.

However, another interpretation is possible, and, as I will here argue, is more plausible. First take account of what those 'very peculiar traits' actually were. They are described by Hans Freudenthal in his entry on Wiener in the *Dictionary of Scientific Biography.* Freudenthal devotes an entire (long) paragraph to their description. Some excerpts:

> He was a famously bad lecturer ... his papers, and especially his books, remain difficult to read. His style was often chaotic ... He would assume without proof a profound theorem that was seemingly unrelated to the preceding text, and then continue with a proof containing puzzling but irrelevant terms, ... quote [the wrong] chapter of the book ... treat unrelated questions consecutively, ... and [demonstrate] difficulty in separating the relevant mathematics ... even from his personal experiences.

There is no question that even at the time of the applications for the Melbourne chair, Wiener's achievements already overshadowed Cherry's. From Cherry's obituary in the *Journal of the Australian Mathematical Society* (Volume 9, No. 1), we learn that by the end of 1927, Cherry had published 10 papers for a total of just under 200 pages. Wiener was much more prolific. A precise count is somewhat difficult; his *Collected Papers* lists 70 papers published over this period, but this total includes some very slight items and others with little or no mathematical significance; Cohen quotes a figure of 56 published over a slightly longer period; *Poggendorffs Handwörterbuch* (Volumes 5, 6) lists 39 for a total of almost 400 pages. Even on this last figure, Wiener clearly outshone Cherry. Moreover, Wiener's work, even then, included his highly significant contributions to Potential Theory.

However, the mere counting of publications (even of the highest order) is not the only consideration facing a selection committee. In 1928, Melbourne was a very isolated place, and the fitness of a candidate for the social position that a chair implied, the administrative capacities required, and the quality of the applicant as a teacher were all matters also deserving of consideration.

As Cohen's article clearly demonstrates, these extra-mathematical matters were accorded great weight by the selection committee, and one need not put any sinister or even negative complexion on this emphasis. The subsequent course of events may actually be seen as justification of their choice. Even had Wiener stayed in Melbourne, there is no reason to think that his research career would have been any longer than in fact it was (it effectively ended during the years of World War II, whereas Cherry remained active almost to his death in the mid-1960s).

Finally, let me address the accusation of anti-Semitism. A hasty first reading of the sentence from Franklin's testimonial leaves us with that impression, it is true. However, another reading is possible, and is to my mind more plausible. It is really quite unlikely that Franklin was referring to 'very peculiar traits' as being characteristic of 'the Hebrew race' in general; clearly most Jews *do not* manifest the idiosyncrasies that Wiener displayed. Rather Franklin was most probably talking in specifics of Wiener's own case.

From a recent biography (*Dark Hero of the Information Age*, by Flo Conway & Jim Siegelman, Basic Books, 2005, pp. 23–25), we learn that Wiener was unaware until he was 15 (and a graduate student) that he was in fact Jewish. His mother (*née* Kahn) had so assimilated into the mainstream of American life that she actually denigrated Jews, and (pp. 57 *et seq.*) pushed him into marriage with a like-minded woman (who was later to become an admirer of Adolf Hitler!). Both *Dark Hero* and Gerald Alexanderson's review of it in *Mathematical Intelligencer* (Volume 28, No. 2) see this strange situation and the inner conflict that it entailed as the cause of recurrent severe depressive attacks that underlay the 'very peculiar traits' that observers remarked.

More plausible than the view that Franklin was offering an insulting and unsupportable generalisation, is the interpretation that has him addressing the particular, and highly unusual, case of Wiener himself.

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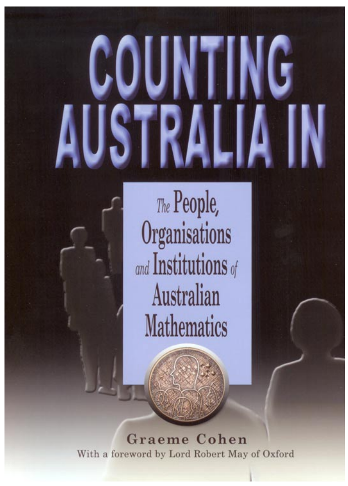
Maths matters

The other authors of *Counting Australia In*

Graeme Cohen

I happen to know that Ernie Tuck has a review of *Counting Australia In* in this issue of the *Gazette*. He tells us that there are about 1200 names in the Names Index. This is a count which I had not carried out myself but I have been cataloguing the material collected over five years, a job not yet finished, and have about 320 files of information on Australian mathematicians, dead and alive, here and abroad. These include published obituaries and other biographical reprints, but mostly consist of letters and emailed notes.

My intention here is to thank all of those who wrote to me, or emailed me, or spoke to me in person or by phone, by writing of some of the stories that arose that way.

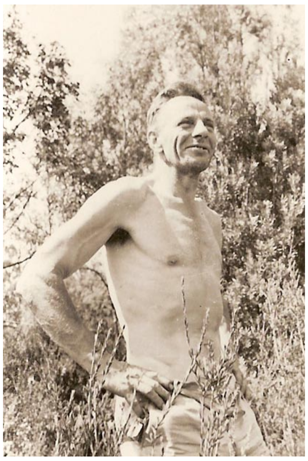


Motivation

My time involved more than research directed towards the writing of a history of Australian mathematics. The work as a whole was dubbed the Australian Mathematical Society History Project and an important aspect was the taping of interviews with 25 mathematicians who were foundation members of the Society or who had gained generally acknowledged eminence for their service to mathematics and the profession of mathematician. (By 'mathematics' and 'mathematician' I am covering the gamut of the mathematical sciences. I found that, in nearly all cases, statisticians and mathematical physicists and the rest were pleased to be known generally as mathematicians.)

Of those with whom I taped my interviews, five have since died: Oliver Lancaster, whose interview was sadly too late in his life to be useful for me, Fenton Pillow, Bernhard Neumann, Ren Potts and George Szekeres. It is likely that Neumann, Potts and Szekeres would appear on anybody's list of Australia's top ten all-time most influential and distinguished mathematicians, and I consider it a remarkable honour and a grim coincidence that I was able to conduct these interviews. On this morbid theme, perhaps I should record that others whom I wrote of and who died during the period of my work were Bruce Bolt, Arthur Jones, Ron McKay, Rainer Radok, Marta Sved and Esther Szekeres. Bolt was another with whom I had made email contact and Esther Szekeres was of course present and contributing during George's interview. Alex Rubinov and Max Kelly have died in the few months since the book was launched; I had had an enjoyable meeting, and lunch, with Max in July 2004.

The passing of Neumann, Potts and Szekeres marked the end of an era and pointed to a theme which I made often since beginning the work — how many countries around the world have a record of mathematics, ranging from the first university appointments in the area through to the establishment of a national mathematical sciences research institute, rich enough in all its aspects yet brief enough to fill a single volume of 400 pages? To me, the time was exactly right for that history to be described. That realisation (and the fact that I knew I would soon be looking for something to occupy myself) led me to volunteer for the job, even though the original specification was to document only the 50-year history of the Australian Mathematical Society.



Professor Sir Thomas MacFarland Cherry

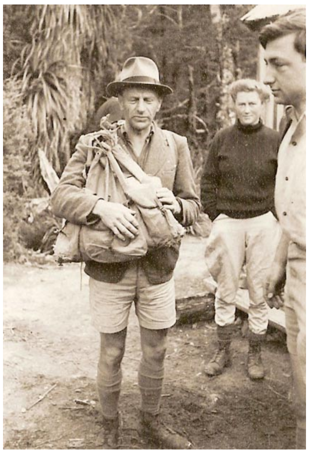
The formation of the Society in 1956 was part of the coming of age of Australian mathematics in the 1950s. Pat Moran had been appointed to the foundation chair of statistics at the Australian National University in 1951; the Australian Academy of Science was founded in 1954 with Tom Cherry on its first council; and the Society introduced its *Journal* in 1959. Soon after, in 1962, Bernhard Neumann arrived as foundation chair of mathematics at the Australian National University. Hans Schwerdtfeger had arrived in Adelaide in 1940 and George Szekeres in 1948; Felix Behrend joined the University of Melbourne in 1942; and John Blatt was appointed foundation professor of applied mathematics at the University of New South Wales in 1959. These and many others made Australian mathematics a direct beneficiary of the war in Europe and of course contributed to its maturation.

Letters, emails and other contributions

George and Esther Szekeres had been friends in Hungary with George and Marta Sved, who had come to Adelaide somewhat earlier, in 1939. Marta died in 2005 and notes from my manuscript, which contributed to a death notice, led to a delightful and prolonged series of emails involving Laci Kovács and Mike Newman at the Australian National University; Peter Taylor from the Australian Mathematics Trust; Tom Sag, who had lectured in mathematics at Flinders University in Adelaide; and John Sved, son of George and Marta and now retired from the School of Molecular and Biomedical Science at the University of Sydney. Together, we sorted out who of a number of Australian immigrant mathematicians had accomplished what in the famed Eötvös national mathematics and physics competitions in Hungary in the second half of the 1920s.

George Sved had apparently won a separate Hungary-wide schools competition. That had been difficult to confirm until it was pointed out that he had changed his name to Sved from Schossberger, to avoid antisemitic taunts as Marta had written in autobiographical notes excerpted by John and forwarded to us. The successes of Marta (née Wachsberger), George Szekeres and Esther (née Klein) in these competitions were better known but, on one website, there was also mention as a prizewinner in 1929 of a 'Székely Lilly', who had moved to Australia. I asked Tom if this might be his mother, Lily Sag, and indeed that was so. My file on this correspondence alone consists of 20 pages, but contributed to only a few lines and a footnote in the book.

Little has been written previously on the history of Australian mathematics as a whole. It interested me that, of the various branches of mathematics, it seemed to be the statisticians who were most keen to document their field and its early practitioners, or the wider subject itself. Jim Douglas, Joe Gani, Chris Heyde, Oliver Lancaster, Eugene Seneta and Terry Speed are notable in this regard. Joe, in particular, has also been a commentator on the state of Australian mathematics for many decades and was very helpful and encouraging in my work. He has recently given a comprehensive account of the statistics departments at the Australian National University, in the Academy's *Historical Records of Australian Science*. Lancaster had written in the *Gazette* of the Sydney University mathematics departments, and Ren Potts and Bert Green of those in Adelaide.



Cherry (left), Walter Freiberger (right). Can anyone identify the mystery person?

There was a deal of unpublished material available to me — John Clark's work on Melbourne University, as presented at a number of annual meetings of the Australian Mathematical Society, and internally produced documents at the Universities of New England, New South Wales, Newcastle, Queensland, Western Australia and Wollongong. Furthermore, it must be acknowledged that a great many senior mathematicians have contributed to obituaries for their past colleagues and these were of course essential reading for me.

If it is the statisticians who are keenest to document their history, then the applied mathematicians are certainly second best. Potts and Green have just been mentioned in this regard. Moreover, Roger Braddock wrote an *Anecdotal History* of the Society's Division of Applied Mathematics (now ANZIAM) in 1984 and Neville de Mestre updated it a few years ago. In the book, I described Roger's history as 'breezy but well-documented', a phrase which he seemed to enjoy when I checked the relevant passages with him in Brisbane.

Some people, more than others, were very keen to assist in writing the history of their slice of Australian mathematics. Barry Ninham and Rodney Baxter helped me sort out the unusual story of applied mathematics at the Australian National University. If you don't know it, then you need to read *Counting Australia In* to understand how the Department of Applied Mathematics, formed in 1970 with Ninham as foundation professor, was able to exist separately from Bernhard Neumann's department; it is still separate from Neil Trudinger's Mathematical Sciences Institute. There was another Department of Applied Mathematics in the old School of General Studies, but Baxter was representative of still another group, within the Department of Theoretical Physics. My statement in the book, that most members of that department regarded themselves as mathematicians as well as physicists, is due to him. Rodney is now an emeritus professor attached to the Mathematical Sciences Institute.

On many occasions there were six or more communications between individual correspondents and me, and nearly always they were people I had not previously met but had chased up by email and other means. Walter Freiberger, for instance, told me the delightful story of Tom Cherry's assault on Federation Peak in Tasmania in 1949. Walter was a student of Cherry's and later professor of applied mathematics at Brown University, Rhode Island. He is still active as managing editor of the *Quarterly of Applied Mathematics*. After the book came out, Walter wrote to me and, not previously aware that it would be illustrated, told me of photos he had taken on his mountaineering trips with Cherry. He sent six, and two appear hereabouts. One has Professor Sir Thomas MacFarland Cherry wearing not much. In the other, Cherry is on the left and Walter on the right, partly cut off. Can anyone identify the third person? These were taken on an earlier trip to Tasmania, before the unsuccessful attempt on Federation Peak.

Richard Dalitz was another with whom I exchanged many emails. Also a student of Cherry's, he went to Cambridge in 1946 and at Oxford became noted for his decisive work on elementary particle physics; he gained an FRS in 1960. I was very saddened when he died just on a year ago, hardly known amongst mathematicians in Australia.

Fenton Pillow, professor of applied mathematics at the University of Queensland from 1964 to 1986, became a good friend over two visits to his home in Brisbane and numerous letters and emails. He was eager to tell me of his student, Adrian Gill, who joined George Batchelor's Department of Applied Mathematics and Theoretical Physics at Cambridge. Gill could not find a suitable position back in Australia and died at Oxford, aged 49, a month after being elected FRS. Fenton was very keen to see the publication of my book, and again I was greatly saddened by his death last year.

Freiberger, Dalitz, Pillow and Batchelor are four of around 25 great mathematicians to come out of the University of Melbourne in the 1930s and 1940s. I spoke on this at the Society's annual meeting in Melbourne in 2004 and it is a persistent theme in the book, with the details based of course on information provided by my correspondents. Besides Freiberger, there are perhaps another six of the 25 alive today, including Angas Hurst in Adelaide, Phil Silberstein in Perth and Roy Smith in Armidale, all of whom I had interviewed.

Towards the end of Angas's interview, he suggested that I speak to Barbara Rennie, widow of Basil who is best remembered for his *James Cook Mathematical Notes*. The meeting with Barbara was arranged for later that day and I really felt like a historian when she asked rather casually if I would like to look through Basil's diaries. They contained a day-by-day account of the inaugural meeting of the Australian Mathematical Society, held in Melbourne in August 1956. There followed a number of letters between Barbara and me, involving also Basil's friend from his student days in Cambridge, John Parker.

Our 10 best?

Let me return to a statement above, that Bernhard Neumann, Ren Potts and George Szekeres must be acknowledged as three of Australia's all-time ten most distinguished mathematicians. The *Gazette*'s new editors, in inviting me to write this note, expressed the wish that it be 'provocative, stimulating a debate'. The closest I can get to that is to ask readers to contemplate who else might be on the list. John Michell and Kurt Mahler, almost certainly, but I won't venture any candidates from amongst our living, local mathematicians. I did ask the question of most of those I interviewed, and Bernhard's answer was the one that surprised me most (only because I had not then heard of the person). He pointed to John Miles, one of his first appointments to a chair (of applied mathematics) in his new department. Perhaps Miles is disqualified from the list because he is an American who spent only three years in Australia. He has been retired since 1983 but still holds a research chair at the University of California, San Diego. I was able to contact him by email for his recollections of Canberra, and dominant among those was the fact that Herbert Huppert had gone to study under him there.

When contemplating our 10 best, you must decide whether to include expatriate Australians, such as Huppert, George Batchelor, John Coates and now, of course, Terence Tao. Robert McCredie May, now Lord May of Oxford, must also be a candidate. It was a magnificent honour for me when he agreed to write the foreword; and in writing that he alerted me to the fact that I should add some information about Australia's other mathematical biologists.

I am well aware that I have mentioned very few women here. Are there any deserving of being on our list of the top 10? Top 20? I hope I did justice to our women mathematicians in the book — see the stories of Fanny Cohen, Margaret Moir and Betty Allan, among early examples — but the matter must be kept in proportion. As a mere chronicler, I can point out that, starting with Morris Birkbeck Pell in 1852, there have been well over 250 Australian professors of mathematics and statistics or equivalent, including foreigners who took positions in Australia and Australians who took positions overseas. Fewer than 20 of these are women.

Lynne Billard, who graduated PhD from the University of New South Wales in 1969, has had an outstandingly successful career as a statistician at the University of Georgia, Atlanta, with awards from the American Statistical Association both for her research career and her contribution to the profession. I mention her because she might not be known to those trying to compile their top 10 or top 20, and because she is another with whom I was pleased to make email contact. And finally I mention Elizabeth Yoffe, who, as Elizabeth Mann, was another of the 25 or so from the University of Melbourne in the 1930s and 1940s. She went to Cambridge after World War 2 and established a fine reputation in fracture mechanics there. Her letter to me describing the period in Melbourne and the background, as she understood it, of the rush of Australian mathematicians to Cambridge and Oxford after the war, is one of my many treasures from writing *Counting Australia In*.

I intend within a year or so, after the cataloguing is complete, to deposit all my files and images with the Society's archive in the Basser Library, Australian Academy of Science. To all the correspondents who made feasible the task of documenting the people, organisations and institutions of Australian mathematics, only a few of whom I have mentioned here, I would like to say a heartfelt 'Thank you'.

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Graeme Cohen, born in Sydney in 1943, has an MSc from the University of Sydney and a PhD from the University of New South Wales. He retired as associate professor from the Department of Mathematical Sciences at the University of Technology, Sydney in 2002 after 36 years there. His research interests include elementary computational number theory and the applications of mathematics to sport. Graeme has written more than 50 journal articles and three undergraduate texts including *A Course in Mathematical Analysis and its Applications* for the *Australian Mathematical Society Lecture Series* (Cambridge University Press, Cambridge, 2003). *Counting Australia In* is his first serious publication outside mathematics and has led to the further award of an MA in Public History from UTS. The Australian Mathematical Society made Graeme an Honorary Member on the occasion of the book's launch in September 2006.

Puzzle corner 1

Norman Do

Welcome to the inaugural installment of the Australian Mathematical Society *Gazette*'s Puzzle Corner. Each issue will include a handful of entertaining puzzles for adventurous readers to try. The puzzles cover a range of difficulties, come from a variety of topics, and require a minimum of mathematical prerequisites to be solved. And should you happen to be ingenious enough to solve one of them, then the first thing you should do is send your solution to us.

In each Puzzle Corner, the reader with the best submission will receive a book voucher to the value of $50, not to mention fame, glory and unlimited bragging rights! Entries are judged on the following criteria, in decreasing order of importance: accuracy, elegance, difficulty and the number of correct solutions submitted. Please note that the judge's decision — that is, my decision — is absolutely final. Please e-mail solutions to N.Do@ms.unimelb.edu.au or send paper entries to: Gazette of the AustMS, Birgit Loch, Department of Mathematics and Computing, University of Southern Queensland, Toowoomba, Qld 4350, Australia.

The deadline for submission of solutions for Puzzle Corner 1 is 1 May 2007. The solutions to Puzzle Corner 1 will appear in Puzzle Corner 3 in the July 2007 issue of the *Gazette*.

Fun with fuses

You are given two fuses, each of which burns for exactly one minute. However, since the fuses are not of uniform thickness, they do not burn at a uniform rate along their lengths. How can you use the two fuses to measure 45 seconds?

Is it possible to use one of the fuses to measure 20 seconds?

Fuel shortage

Due to the worldwide shortage, the fuel stations located along a circular route together contain exactly enough fuel for a car to complete one lap. Prove that a car starting at the right fuel station with an empty tank can make it around the route.

Folding quadrilaterals

Observe that the four corners of a square sheet of paper can be folded over, without overlapping, to meet at the centre of the square. In fact, the same is true for a sheet of paper in the shape of a rhombus. So we can see that a sheet of paper in the shape of a quadrilateral whose side lengths are all equal always admits such a folding. Is it possible to determine whether or not a sheet of paper in the shape of a quadrilateral admits such a folding given only its side lengths?

Self-referential aptitude test

The following unusual logic puzzle was designed by Jim Propp, a mathematician at the University of Wisconsin at Madison. It has a unique solution, although it is possible to find the unique solution without making use of this fact. Jim writes:

> I should mention that if you don't agree with me about the answer to 20, you will get a different solution to the puzzle than the one I had in mind. But I should also mention that if you don't agree with me about the answer to 20, you are just plain wrong!

1. The first question whose answer is B is question
   (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

2. The only two consecutive questions with identical answers are questions
   (A) 6 and 7 (B) 7 and 8 (C) 8 and 9 (D) 9 and 10 (E) 10 and 11

3. The number of questions with the answer E is
   (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

4. The number of questions with the answer A is
   (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

5. The answer to this question is the same as the answer to question
   (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

6. The answer to question 17 is
   (A) C (B) D (C) E (D) none of the above (E) all of the above

7. Alphabetically, the answer to this question and the answer to the following question are
   (A) 4 apart (B) 3 apart (C) 2 apart (D) 1 apart (E) the same

8. The number of questions whose answers are vowels is
   (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

9. The next question with the same answer as this one is question
   (A) 10 (B) 11 (C) 12 (D) 13 (E) 14

10. The answer to question 16 is

(A) D (B) A (C) E (D) B (E) C

11. The number of questions preceding this one with the answer B is

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

12. The number of questions whose answer is a consonant is

(A) an even number (B) an odd number (C) a square (D) a prime (E) divisible by 5

13. The only odd-numbered problem with answer A is

(A) 9 (B) 11 (C) 13 (D) 15 (E) 17

14. The number of questions with answer D is

(A) 6 (B) 7 (C) 8 (D) 9 (E) 10

15. The answer to question 12 is

(A) A (B) B (C) C (D) D (E) E

16. The answer to question 10 is

(A) D (B) C (C) B (D) A (E) E

17. The answer to question 6 is

(A) C (B) D (C) E (D) none of the above (E) all of the above

18. The number of questions with answer A equals the number of questions with answer

(A) B (B) C (C) D (D) E (E) none of the above

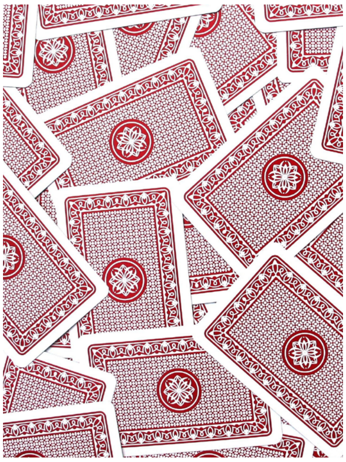
19. The answer to this question is

(A) A (B) B (C) C (D) D (E) E

20. Standardised test is to intelligence as barometer is to

(A) temperature (B) wind velocity (C) latitude (D) longitude (E) temperature, wind velocity, latitude, and longitude

Magic card trick



A prime source for appealing mathematical puzzles is the wealth of olympiad competitions for high school students from around the world. The following is an example from the 2000 International Mathematical Olympiad.

A magician has one hundred cards numbered 1 to 100. He puts them into three boxes, a red one, a white one, and a blue one, so that each box contains at least one card. A member of the audience selects two of the three boxes, chooses one card from each and announces the sum of the numbers on the chosen cards. Given this sum, the magician identifies the box from which no card has been chosen. How many ways are there to put all the cards into the boxes so that this trick always works? (Two ways are considered different if at least one card is put into a different box.)

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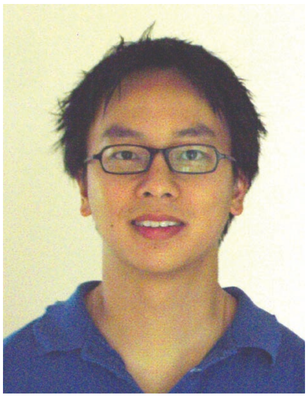

Norman is a PhD student in the Department of Mathematics and Statistics at The University of Melbourne. His research is in geometry and topology, with a particular emphasis on the study of moduli spaces of algebraic curves.

Maths@work

The consulting model

John Henstridge

The mathematical sciences are frequently claimed to be highly applicable to business and industry. Indeed mathematical theory such as that underpinning linear programming is one example with a lasting impact and the page rank algorithm of Google[1] has enormous practical and commercial value. However there are few mathematicians in industry (and those you do find rarely go under that name).

My career path has taken me very much into industry and I still call myself a mathematician and statistician. Indeed, I market the services of myself and my colleagues at Data Analysis Australia using those titles. In writing this column I have decided to take a very personal approach and relate how I have arrived at this point.

For me it goes back a long way, to when I was doing my graduate work. Despite starting off with the intention of being a very theoretical statistician and working with Ted Hannan, an exceptionally good mathematician, I found that my talents and interests were in seeing mathematics applied. This led initially to work in computational statistics and then to a consulting role as a biometrician at The University of Western Australia. There I was regarded as being very theoretical by the biologists and very applied by the statisticians of the mathematics department. This probably meant that I got it about right.

In 1983 I left academia to join Siromath, a commercial offshoot of the then Division of Mathematics and Statistics of the CSIRO. One attraction of the move was the number of colleagues already with Siromath. It had an almost evangelical feel, with statisticians and mathematicians wanting to do something worthwhile. And it was exciting, seeing mathematics applied across many industries. The timing was right for much of the work to be statistical — good software was available and computing was becoming cheap enough to be used commercially, even if the power seems miniscule by today's standards.

It was also a time to learn about business. When I look back at it now, I see that Siromath was always struggling to learn how mathematics could be made to work in a commercially viable way. Part of this challenge was simply learning basics such as how to run an accounting system and manage people, but the more difficult aspect was adapting what was an essentially academic discipline to a business environment. It took time to understand business communication — few consulting reports are like papers — and how services should be marketed.

I left Siromath in 1987 after a change in management, and in 1988 I set up Data Analysis Australia, initially competing directly with Siromath.[2] From a very small start — myself in

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[1] See Kurt. Bryan and Tanya Leise, The $25,000,000,000 Eigenvector: The Linear Algebra behind Google, Siam Review, 48, 569–581 (2006). It is rare to see the value of mathematics expressed so clearly in financial terms.

[2] Siromath collapsed financially in late 1989. The reasons were complex but one of the major issues was the difficulty in bridging the academic and business divide. Most of its employees have had successful careers since then, but I believe that I am the only one who is still doing commercial consulting.

a home office — the company has grown to about 20 employees, mostly mathematicians and statisticians. Over that time we have, sometimes by hard experience, developed a model of what seems to make commercial mathematical consulting successful.

Central to this is the recognition of the gap between the academic and commercial worlds, a gap not unique to mathematics but perhaps greater there then most other areas. The key issue is that commercial clients are naturally results oriented and mostly don't care whether the mathematics is advanced or not. Simple solutions are preferred, with 90% of the result for 20% of the effort often seen as appropriate. Once a solution is provided, often to inform a decision, clients move on. Publishing the work is low priority, even if appropriate — most work is covered by confidentiality agreements and open publishing runs counter to the commercial advantage of keeping work secret.

The staff of Data Analysis Australia

The reality is that mathematics in industry is hard work, particularly since the mathematician often has to learn enough about the application area to correctly pose the questions. In the consulting framework, this is a constant challenge since every project is potentially different — today forecasting in the justice area and tomorrow analysing benthic (bottom dwelling) communities for an environmental study of Cockburn Sound. Constant change and learning is a challenge not to everyone's liking but I believe it is of immense value. It is common for a solution first developed for one area of application to become useful in other areas.

I have consciously used the term 'mathematics' above even though many would describe most of what I do as 'statistics'. My reason is that the boundaries rapidly disappear in an application context. Problems don't respect the subtle distinctions between sub-disciplines used in academia and it is common for a project to require tools or at least thinking from several areas.

An example is a recent project on locating suburban Magistrates Courts in Perth. This had to consider locations that would be optimal in the future. The solution required demographic modelling (a relatively simple matrix model), a spatial statistical model giving the relationship between offence locations and where offenders live, a model for access to locations (actually a network model that optimised travel time) and finally an integer linear programming model for selecting optimal locations. The team included both statisticians and applied mathematicians but the work was only roughly split along those lines.

While no one denies its mathematical foundations, some of my statistician colleagues state that statistics is a subject separate from mathematics. I largely disagree with this approach. In my practical experience I have had to call upon almost everything I have learnt in mathematics, albeit often not in a formal sense. What makes statistics different is its strongly developed applicability to real problems — a set of tools that is remarkably useful and, since the advent of modern computing, highly accessible. This practical side of statistics co-exists with a strong theoretical side that is not so concerned with applications. Perhaps other areas on mathematics need to develop a similar duality.

The example above also illustrates another feature of applying mathematics — the mathematician's skills bring a logic to many problems that is quite distinctive. The mathematician can rapidly obtain 'guru status' that is surprising at first.[3] My success in the justice area means that I am now consulted on a range of quantitative issues associated with the Courts and sometimes have to take the lead on projects where I am supervising consultants from other areas such as social policy or even accounting. I strongly believe that there is no reason why mathematicians should see themselves as only having a support role — they should also lead.

My satisfaction comes from seeing clients use the results of my mathematical work, even more so when they come back with more work. This reward is not as public as publication in journals and such achievement is not often recognised by the profession.[4] But it does pay the bills and enable me to employ more mathematicians. That is the point in business. I don't just apply mathematics in industry; mathematics is my industry.

For myself, a second, but just as important source of satisfaction, is seeing the development of staff as effective and confident consultant mathematicians. In some respects this has taken me back to my academic roots since my role is often as a teacher and mentor, teaching what neither they nor I were ever taught at university. Much of this material is strongly based upon experience, such as which theoretical assumptions tend to be more important when applying a method, and what potential problems have to be checked before proceeding. But some of the material is about what is important to the clients and to the business.

This experience leads naturally to thinking about university courses. I would hate to see soft 'business mathematics' options diluting what is taught. Students need as much real mathematics as they can get. Perhaps what does need to change is the culture surrounding the courses to one that says, 'this is not just exciting, it is also really useful'. That is the culture that I try to have in my work.

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Dr John Henstridge is the founder and Managing Director of Data Analysis Australia, the largest commercial statistical company in Australia. Before becoming a consulting statistician in 1983, John worked at Weapons Research Establishment (now part of DSTO) on radar systems and The University of Western Australia, in both mathematics and agriculture. In 1983, John joined Siromath and in 1988 set up Data Analysis Australia.

John originally studied at Flinders University and then did his PhD at The Australian National University in time series and signal processing. He is a Chartered Statistician and Fellow of the Royal Statistical Society and an Accredited Statistician of the Statistical Society of Australia. He is a past President of the Statistical Society of Australia (WA Branch) and of the Geostatistical Association of Australasia.

John's early work was in time series and statistical computing but in recent years this has broadened to cover a number of other areas relevant to consulting.

[3] I first encountered this thirty years ago when I solved a major problem in the Western Australian egg industry by pointing out that, with inflation constant, absolute differences in prices lead to declining relative differences. This had led to an oversupply of small eggs because it was financially sensible for producers to produce them. My presentation of this led one member of the Egg Marketing Board to say that 'in his thirty years of working in the industry he had never heard anyone talk with such understanding and knowledge of the industry' as I did. I was too inexperienced to realise that I should have been charging them ten times as much as I was!

[4] A partial exception is the accreditation of the Statistical Society of Australia that focuses exclusively on applied work and evaluates non-published reports, giving them comparable weighting to published work.

The style files

Omit redundant words

Tony Roberts

> 'Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts. This requires not that the writer make all his sentences short, or that he avoid all detail and treat his subjects only in outline, but that every word tell.'
>
> Strunk 1918 [2, Section 13]

Redundancy occurs in so many forms that a smooth discourse is almost impossible to write. In a rather piecemeal fashion, let us look at just some ways to tighten your writing. Why? So that each word you write serves a definite useful purpose in communicating concepts, actions and results.

Two words that proliferate like weeds in academic writing are 'have' and 'has'. They occur unnecessarily in many 'have/has *verbed*' combinations. For example, not 'we have observed' but simply 'we observed', and not 'his colleagues have compared' but simply 'his colleagues compared'. As in the later examples, such padding seems to have crept in to scientific writing without notice. Omit such padding. After you have drafted an article, do a global search for 'have/has' and ask yourself whether each occurrence is necessary.

Remember that I do not advocate that shorter is better. Good writing experts just recommend that every word tell. Consequently, do not be tempted to use abbreviations and contractions [1, Sections 4.2 and 4.13] as they tend to make sentences stilted. For example, the most common abbreviations are probably 'e.g.' and 'i.e.', but many authorities contend that 'for example' and 'that is' make for smoother flowing sentences. Certainly avoid TLAs, three-letter acronyms, unless you invoke the acronym many times.

Instead I advocate that we simplify long-winded ways of writing. See how the following two examples cut out unnecessary waffle.

> *Long winded:* We initially reproduce ..., and very good agreement is confirmed.
> *Concise:* We reproduced accurately ...
>
> *Long winded:* The computed inviscid and viscid solutions were presented, and were shown to compare very well with ...
> *Concise:* The computed inviscid and viscid solutions compare very well with ...

You may think: easy, I do not write like that. Yet almost all the examples I use in these articles come from infelicities encountered in editing research articles (my apologies to those who recognise their sentence fragments). Ask a colleague to read your draft articles with a mandate to improve long winded exposition.

> In especial the expression 'the fact that' should be revised out of every sentence in which it occurs.
>
> [2, Section 13]

Other words to almost always omit are ‘actually’, ‘very’, ‘really’, ‘currently’, ‘in fact’, ‘thing’, ‘without doubt’ [1, Section 4.21]. Such words typically pad sentences to no advantage. Also cull ‘given by’, ‘expressed by’, and ‘the following equation’. These usually occur as a prelude to an equation. Omit them. For example, and also culling a useless ‘in this paper’,

> *Long winded:* In this paper, let us consider the fractional-order transfer function given by the following expression $G_n(s) = \cdots$
> *Concise:* Now consider the fractional order transfer function $G_n(s) = \cdots$

Writing cysts such as ‘It is noted here that blah’ should be mercilessly excised to ‘Note: blah’ or even just ‘blah’. Search for passive sentences beginning ‘It is’ and rewrite actively.

Active writing aids conciseness. The following example shows the simplification in writing actively:

> *Passive:* The two different representations of the manifold are clearly displayed in Figure 2
> *Active:* Figure 2 displays the two different representations of the manifold

> As positive statement is more concise than negative, and the active voice more concise than the passive [2, Section 13]

Summary. Describing science accurately is a difficult task: it is so easy to be misunderstood. We need to write from many different angles to cater for a wide variety of readers. Make each view of your discourse as concise as possible so that your reader’s attention is not exhausted. Expunge useless padding.

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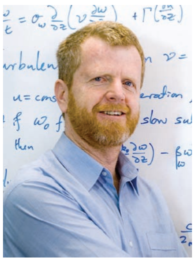

Tony Roberts is the world leader in using and further developing a branch of modern dynamical systems theory, in conjunction with new computer algebra algorithms, to derive mathematical models of complex systems. After a couple of decades of writing poorly, both Higham's sensible book on writing and Roberts' role as electronic editor for the Australian Mathematical Society impelled him to not only incorporate writing skills into both undergraduate and postgraduate programs, but to encourage colleagues to use simple rules to improve their own writing.

Maths in the media

First the Fields Medal, now South Australian of the Year

Congratulations to Terence Tao for being awarded the honour of South Australia's Australian of the Year for 2007. Tao's award follows his win of the Fields Medal at the International Congress of Mathematics last year (you can read the *Gazette* online supplement dedicated to his win at http://www.austms.org.au/Publ/Gazette/2006/Jul06/Supplement/). This Australian recognition of Tao's mathematical achievements sits alongside those of other Australian of the Year finalists; such as Tim Flannery's (awarded Australian of the Year) climate change campaigning and research, and Barry Marshall's and Robin Warren's Nobel winning research on gastric ulcers.

Science Magazine's breakthrough of the year: The Poincarè Theorem

In 2006, researchers closed a major chapter in mathematics, reaching a consensus that the elusive Poincarè Conjecture, which deals with abstract shapes in three-dimensional space, had finally been solved. Science Magazine saluted this development as the Breakthrough of the Year in their final issue of 2006, along with nine other of the years most significant scientific accomplishments.

The Poincarè Conjecture, from topology, was proposed in 1904 by Henri Poincarè. It describes a test for showing that a space is equivalent to a 'hypersphere', the three-dimensional surface of a four-dimensional ball. A century later, researchers were still trying to prove the conjecture. In 2000, the Clay Mathematics Institute named the Poincarè Conjecture as one of its million-dollar 'Millennium Prize' problems.

In 2002, Russian mathematician Grigori Perelman, who had been working mostly incommunicado for seven years, posted on the Internet the first of three papers that outlined a proof of Poincarè's conjecture as part of an even more ambitious result.

The work set experts abuzz. Though there were still many gaps to be filled in, it looked as if Perelman had scored a historic coup. But, after a visit to the United States in 2003, the reclusive mathematician returned to Russia and stopped replying to phone calls and emails. Other mathematicians were left on their own to determine whether Perelman had truly solved the Poincarè Conjecture.

By 2006, the others finally caught up. Three separate teams wrote papers that filled in key missing details of Perelman's proof, and there was little doubt among his colleagues that he had solved the famous problem. This summer, the International mathematics Union decided to award Perelman the Fields Medal, the 'Nobel prize of mathematics', though Perelman declined the award.

Unfortunately, the year has ended on a note of discord, with claims of plagiarism by some of the researchers who worked on the follow-up papers to Perelman's proof, and other mathematicians crying foul over how they were quoted in a prominent New Yorker article. Still, other researchers are ready to celebrate this landmark achievement in their field.

Science's list of the Top Ten Breakthroughs of 2006 appeared in the journal's 22 December 2006 issue (http://www.sciencemag.org/sciext/btoy2006/).

The front cover of the 'Breakthrough of the Year' issue of *Science* featuring an image by Cameron Slayden, based on data provided by Robert Sinclair, illustrating Perelman's approach. To prove the Poincarè Conjecture, Grigori Perelman used the equations for Ricci flow — a procedure for transforming irregular spaces into uniform ones. In this two-dimensional example, the equations prescribe that negatively curved regions must expand while positively curved regions contract. Over time, the original dumbbell-shaped surface evolves into a sphere. (Image courtesy *Science*.)

Communications

Report on Forum held at the Shine Dome, 7 February

An investment in Australia's future: Why the mathematical sciences matter

Hyam Rubinstein

A lively and well-attended forum was organised to coincide with the first week of Parliament, to publicise the case for the mathematical sciences in Australia, especially in the light of the findings of the National Strategic Review of Mathematical Sciences Research in Australia (http://www.review.ms.unimelb.edu.au/).

Jan Thomas, Peter Hall, Barry Hughes, Cathy Sage and Diana Wolfe did a splendid job of organising the event and we were delighted to see more than 100 participants, including a significant number of young people. A number of interviews in radio and the papers took place and some media attended, including a representative of the Financial Review and Win Television. Press coverage culminated in an excellent editorial in the Age 'Do the maths: neglect plus shortages equals crisis.'

The forum program included a wide cross section of representatives from education and training, industry and large government organisations. We also had two MPs, Pat Farmer (Parliamentary Secretary for Education, Science and Training) and Senator Kim Carr (Shadow Minister for Industry, Science and Innovation).

The Honourable Pat Farmer, MP

There were numerous excellent discussions — for instance Kim Carr spent about 15 minutes after his talk in dialogue with the audience. Peter Laver, Vice President of the Australian Academy of Technological Sciences and Engineering, and Kate Hurford, Director of Public Policy, Engineers Australia, reminded us of the crucial relationships between the mathematical sciences, engineering and industry and the necessity for us to communicate, lobby and publicise what we are doing which is of value to the community.

The utility of mathematics and statistics in biotechnology and medicine was discussed by Ian Marschner, head of biometrics at Pfizer and Melanie Bahlo from the Walter and Eliza Hall Institute of Medical Research. Ian was involved in setting up the biostatistics program, Biostatistics collaboration of Australia (http://www.bca.edu.au), which is a consortium of universities and several major pharmaceutical companies, to train people in an area of strong demand. Melanie discussed the challenges of an area where funding is uncertain and it is difficult to juggle career and family.

Peter Haggstrom from Deutsches Asset Management gave a stimulating presentation on the importance of mathematical thinking in investment decision-making and how ordinary people, and even financial planners, are missing out in this area. Frank de Hoog talked about successes in CSIRO stemming from the mathematical sciences, reflecting on his long and productive career. The acting chief statistician, Susan Linacre, and Jeff Kepert from the Bureau of Metereology talked about the key role of statistics and mathematical modelling in all aspects of their operations.

There was a very informative and interesting session on education, with Garth Gaudry talking on issues in school education and teacher training, John Rice as Chair of the Deans of Science discussing their reports on the shortage of qualified mathematics teachers and the difficulty of addressing this issue, John Vines from the Association of Professional Engineers and Managers talking about the general shortage of quantitatively trained people in Australian industry and William Dunsmuir talked about difficulties of university departments, especially in the area of statistics.

Senator Kim Carr

In the final session, Ian Sloan discussed the international concerns about what is happening in Australia to the mathematical sciences and Jonathan Manton showed that, from an ARC perspective, total funding in areas of research in the mathematical sciences is holding up reasonably well. Further details of the forum and summaries of some of the presentations are available from http://www.review.ms.unimelb.edu.au/Forum.html.

We were pleased with the interest from both sides of Parliament. Stephen Smith, Shadow Minister for Education and Training, met with several key people before the day commenced and apologised for not being able to stay. Pat Farmer arranged a meeting in his office after the Forum to hear about the day's discussion.

There have been several opportunities, since the forum, for us to put our case to Government. The current review of the discipline relative funding model will hopefully come up with some improvement in our situation and it is important that as many people as possible put in submissions to this.

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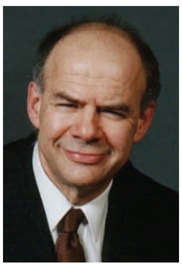

Hyam is Chair of the National Committee for Mathematical Sciences and was the Chair of the working party of the National Strategic Review of Mathematical Sciences Research which was completed during 2006. He is interested in geometric topology, differential geometry, shortest networks and has been at Melbourne University so long that he gets to walk behind the Chancellor at academic processions for graduation ceremonies.

Measuring research performance in the mathematical sciences in Australian universities

Peter Hall

The paper below was prepared in response to a request, in September 2006, from an Australian Mathematical Society committee. It was intended to provide background to general discussion of research-performance metrics in the mathematical sciences. At the time the paper was solicited it was still uncertain whether or when the Australian Government would implement the Research Quality Framework (RQF) to assess publicly funded research. But despite this uncertainty mathematical scientists in universities were coming under pressure to agree to metrics that could be used in submissions to the RQF, if it were to go ahead.

The Productivity Commission, in its Draft Research Report released on 2 November 2006, argued that 'it is too early to make a final decision about implementation of the RQF', and stated that the RQF's 'adoption should be delayed'. However, 12 days later the Australian Government endorsed the RQF, and announced that 'preparatory work and trialling will continue in 2007, with data collection in 2008 and funding implementation in 2009'.

Since that time, members of the Society have begun developing approaches and advice that might be used to assist mathematical sciences departments to prepare submissions to the RQF. An informal committee has been set up for this purpose, and can be contacted through Professor Peter Taylor (pgt@ms.unimelb.edu.au) at The University of Melbourne. Publication of the paper below stems from a request that it be made public so that it might be used in connection with that work.

Measuring research performance in the mathematical sciences in Australian universities

We live in an age where the notion that almost anything can, and should, be quantified and analysed, at an elementary and accessible level, is rapidly gaining adherents. In Australian universities the quantification of past research performance, and the prediction of performance in the future, have become major goals of research managers. The principal objective of quantification is its use as a management tool, creating an imperative that the means of quantification be closely scrutinised.

At least five numerical measures are, or have been, used frequently to quantify research performance: (i) number of research papers published, (ii) number of pages published in research papers, (iii) number of citations received, (iv) 'impact factors' of journals where publication takes place, and (v) usage data on published papers. Item (ii) is sometimes normalised, for example for words per page, and (iii) and (iv) can also involve crude standardisation, for example to correct for relative citation rates in different fields. Data of type (v) tend to be available only from primary sources (such as publishers and journal archivers), not secondary sources that address a broad range of journals. This restricts the opportunities for easy comparison, particularly in multidisciplinary fields.

Citation data for an individual can be treated in a variety of different ways. These include: the total number of citations, the average number of citations per paper, the number of papers with at least x citations, and the largest value of x for which there are at least x papers with x citations; see, for example, [3]. New methodologies are constantly under development (for example [6]).

The degree of accessibility of data is a major motivator of different approaches. Thus, although the use of publication-rate data, such as those in categories (i) and (ii), can be criticised fairly on the grounds that it addresses quantity rather than quality, that approach was employed widely until relatively recently, when citation data became easily accessible via the Internet. While citation and usage data are also widely criticised, and arguments against them are made frequently (for example [1], [2], [4]), their ready availability today makes them attractive.

Publication-rate data for highly-performing researchers in the mathematical sciences show particularly wide variation. In some areas of theoretical mathematics, for example number theory, it is not uncommon for career-long publication rates to be less than one paper per year, with runs of several years without publication while especially difficult problems are tackled. This applies even to acknowledged international high-achievers in the field, such as Fields Medallists.

However, in other areas of the mathematical sciences, publication rates can be substantially higher. This variability reflects a variety of factors, including different ways in which researchers work, disparate amounts of time needed in different fields to obtain significant new results, and cultural differences between areas as to what constitutes a 'significant advance'.

Graduate student numbers likewise show a remarkable degree of variability from one area to another in mathematics, reflecting both the amount of scholarly preparation needed and the level of demand for graduates. Several of Australia's most highly respected theoretical mathematicians have had relatively few graduate students during their careers. Reasons include the fact that, in some areas, the levels of knowledge required before embarking on PhD-level research are so great as to discourage all but the most able and dedicated students. On the other hand, in other areas of mathematics, including some where research frontiers change rapidly, significant results can be achieved relatively quickly, using tools that sometimes can be acquired in advanced undergraduate courses. Here students do not need to devote long periods of time to preparation, and tend to be more inclined to undertake graduate work.

In still other parts of the mathematical sciences, salaries and working conditions outside the university sector are so enticing that it can be very difficult to attract good graduate students. Ironically, these areas tend to be of substantial, immediate strategic importance to the nation, and so a deficit of graduate students can occur in precisely those areas where relatively large numbers would be desirable. For all these reasons, the numbers of PhD students supervised by individual mathematical scientists are very poor indicators of relative levels of research activity.

In the face of difficulties using information on publication rates and graduate student numbers to assess research performance, research managers in Australian universities are turning increasingly to citation data. Here several intrinsic, but subtle, statistical issues have a substantial bearing on interpretation. In particular, the distribution of citation data is very heavy-tailed; that is, a relatively large proportion of the distribution is concentrated among quite high values. Therefore it is unsurprising to learn that the mean or 'average value' of the distribution (for instance, of the distribution of the average number of citations of a given paper in a particular journal during a given time period), is almost always larger than, and can be substantially greater than, the median (or 'middle value'). Similar remarks apply to the totals that are used to compute means, for example to the total number of citations received by a paper in a given period. This has important implications for the use and interpretation of citation data.

For example, since most citation indices (for example impact factors) are means rather than medians, their values can be altered dramatically by including, or omitting, a single research paper in the calculations. This is one reason why impact factors tend to fluctuate significantly from one year to another. Another reason is that impact factors are often based on relatively narrow time windows, and so, at least in the mathematical sciences, tend to be based on relatively small amounts of data.

The width of the citation window is a contentious issue when gathering and interpreting citation data. Mathematicians, for many of whom the solving of important, years-old problems is a mark of singular achievement, naturally regard relatively wide windows (at least 10 years) as a major desirable feature of approaches to citation analysis. However, if the window is as wide as a decade then the period over which the mathematician's performance is supposedly being assessed is arguably wider still, and that is not necessarily desired by those doing the assessment. Moreover, researchers in other disciplines, with fast-moving research frontiers, often favour relatively narrow windows. The latter tend to prevail.

As a result, mathematicians generally find that they are judged using an unreasonably narrow citation window, which almost inevitably obscures the real degree of interest in, and impact of, their work. The two-to-three-year impact factors for some of the most prestigious mathematics journals, especially those in theoretical mathematics, are typically about 1. That is, on average a mathematics paper is cited approximately once in the year of publication or in the subsequent two years. This compares poorly with the two-to-three-year impact factors of approximately 30 for journals such as *Nature* and *Science*, but of course does not indicate any intrinsic inferiority of research in the mathematical sciences. Rather, it is the result of different citation cultures in different fields of science.

The speed of publication of mathematical results also has significant bearing on the use of citation windows. Publication in major international journals, which often have long lead times, is itself a validation of mathematical work. For many mathematicians, such publication is almost as much a goal as the research itself. However, papers in pre-eminent mathematics journals often take longer from submission to publication than an average citation window takes to run its course. This inevitably challenges conventional interpretations of citation data.

Other issues related to the reliability of citation data include the fact that those data do not identify the reasons for citation, or disclose which authors of a multi-authored paper are responsible for different aspects of the work. In applied areas, reasons for high citation rates can include the fact that a useful dataset was included in the paper, or that helpful settings for simulation studies were suggested. These contributions may not bear on the actual merit of the research.

Moreover, citation cultures can vary widely even within a single discipline, such as the mathematical sciences. This leads to very different 'natural' citation rates for people working in different parts of the same field. The Stanford statistical scientist David Donoho, interviewed when he was the 'most highly-cited mathematician for work in the period 1994–2004' [5], put it thus:

> Statisticians do very well compared to mathematicians in citation counts. Among the top ten most-cited mathematical scientists currently, all of them are statisticians. There's a clear reason: statisticians do things used by many people; in contrast, few people outside of mathematics can directly cite cutting-edge work in mathematics. Consider [Andrew] Wiles' proof of Fermat's Last Theorem. It's a brilliant achievement of the human mind but not directly useful outside of math. It gets a lot of popular attention, but not very many citations in the scientific literature. Statisticians explicitly design tools that are useful for scientists and engineers, everywhere, every day. So citation counts for statisticians follow from the nature of our discipline.

Donoho also commented on ways in which one can enhance one's visibility in citation counts:

> A very specific publishing discipline can enhance citation counts: Reproducible Research. You use the internet to publish the data and computer programs that generate your results. I learned this discipline from the seismologist Jon Claerbout. This increases your citation counts, for a very simple reason. When researchers developing new methods look for ways to show off their new methods they'll naturally want to make comparisons with previous approaches. By publishing your data and methods, you make it easy for later researchers to compare with you, and then they cite you.

Remarks such as these inevitably provoke the question of the relationships among impact, influence and quality in research. Research can have substantial impact (for example, through enabling other researchers to 'show off their new methods', as Donoho put it), and give rise to large numbers of citations, without significantly altering the intrinsic directions taken by future research, and therefore without having much influence in that sense. In much the same way, a movie can enjoy substantial box-office success without having a major influence on movie-making.

Occasionally, the order of authors on a paper is proposed by research managers as a measure of the relative importance of individual contributions. However, in much of the mathematical sciences the order of authors is almost religiously alphabetical. The suggestion by some managers that Australian mathematicians change these practices, by ordering author names so as to reflect respective contributions to papers, or by altering their culture of publication and citation (for example, by publishing and citing more frequently), or by submitting only to journals where lead-times to publication are measured in weeks or months rather than years, fail to take account of the fact that only a small fraction of the international mathematics literature originates in Australia. Profound cultural change cannot be brought about by doing things differently in Australia; the actions mentioned above would lead only to a substantial diminution of the international reputation of Australian mathematics.

The Australian Government Department of Education, Science and Training commonly refers to the metrics which inform its Research Training Scheme, Institutional Grants Scheme, and Research Infrastructure Block Grants Scheme, as indicators of 'research performance'.

These metrics, based on numbers of papers published, numbers of graduate students trained, and numbers of dollars of research funding brought into a university (through either competitive grants or commercial work), are applied to all universities. They lead to research budgets for individual institutions. Research managers, eager to increase the money flowing into their respective universities, sometimes carry these metrics right down to the level of individual mathematical scientists, pressuring them to increase what the managers term the mathematicians' 'research performance' (that is, to increase the university overhead income that results from the mathematicians' research), or suffer the consequences. This is a tawdry approach to research management.

In summary, research performance metrics, such as those based on publication rates, numbers of graduate students, or citation or usage data, often do not measure the research attributes that it is claimed they do. They lack comparability, even from area to area within a single discipline, such as the mathematical sciences, let alone from one discipline to another. So-called correction factors fail to compensate adequately for the marked inhomogeneity of citation cultures, for example those in applied and theoretical statistics. In the absence of reliable and accepted ways of correcting for the problems discussed above, the use of research performance metrics is inevitably a crude and unreliable way of assessing actual research performance.

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Obituary

Fenton Pillow
1921–2006

Fenton Pillow, Professor of Applied Mathematics at the University of Queensland from 1964 to 1986, died in Brisbane on 1 April 2006, a few days after his 85th birthday.

A tireless advocate of hard applied mathematics, especially of continuum mechanics, and most especially of viscous fluid flow, Fenton built on his experiences at the Universities of Sydney, Melbourne and Toronto to help develop an undergraduate program of courses at UQ with a Pass and an Honours stream. The Honours stream was particularly strong, and those students who pursued it successfully got a wonderful grounding in classical methods and models.

Fenton will be remembered with affection by former students and colleagues for his impish humour and good fellowship, which came to the fore over a beer or two during the 'aftermath' at the UQ Staff Club, following the traditional Friday afternoon seminar. These started at 4 pm, and often the bulk of the audience sweated in restless anticipation on a hot Queensland afternoon as 5 o'clock came and went, and questions continued from Fenton to the speaker about matched asymptotic expansions.

Albert Fenton Pillow was born in 1921 in the Belgian Congo, where his father was working as a mining engineer. The family moved back to Geelong in 1924, and Fenton was educated at Geelong College and then the University of Melbourne, from which he graduated with BA Hons in 1942.

His research career began at the Aeronautical Research Laboratories in Melbourne in 1943. At ARL he carried out both experimental and theoretical work under the direction of George Batchelor on compressible flow, hydrodynamic stability, and the low-turbulence wind tunnel. When Batchelor left for Cambridge in 1945, Fenton took charge of the Fluid Motion Group, being joined later by Harry Levey, who subsequently took a chair at UWA. Fenton's research from this period appeared in a number of technical reports, including a long review of research on hydrodynamic stability.

In 1947 Fenton began PhD studies at Trinity College, Cambridge, again under Batchelor's supervision. His thesis treated three problems of physical significance, all of which were approached by the use of singular perturbation theory, in its infancy at that time. These problems, which set a framework for his later work, dealt with heat regenerators in the unsteady state; the free convection cell in two dimensions; and the formation and growth of shock waves in the one-dimensional motion of a gas. Of particular significance was his estimate, using boundary layer concepts, that the rate of heat transfer through a Bénard convection cell is proportional to the temperature difference raised to the 5/4 power. This was not verified experimentally until 1975. All three thesis problems were difficult, and in each case Fenton's approach shows evidence of his physical insight and his skill with advanced mathematical techniques.

Fenton returned to ARL in 1950 to head a reconstituted Fluid Motion Group, and remained there until 1954 when he was appointed Senior Lecturer in Applied Mathematics at the University of Sydney under Keith Bullen. In 1957 he transferred to a similar position at the University of Melbourne under Tom Cherry. In 1959 he moved to the University of Toronto as Associate Professor, and became a full Professor there in 1962. His last academic move was to UQ in 1964 as Professor of Applied Mathematics.

After his PhD, Fenton's research mainly concerned the diffusion of heat and circulation in fluid flow, and his substantial 1964 paper on these topics in J. Mathematics and Mechanics further illustrates his style and skill. His final group of three papers in J. Fluid Mechanics in 1985 were in collaboration with PhD student Ross Paull. They provide new solutions of the Navier–Stokes equations, and give a thorough treatment of conically similar viscous flows, with conservation principles for ring circulation and kinematic swirl angular momentum.

An important contribution made by Fenton to applied mathematics lay in his supervision of research students. In the late sixties, it was not uncommon for academics to be appointed without PhDs, and Fenton supervised the PhD projects of four such recruits after they joined the Department at UQ. In all he supervised eighteen PhD students, including Ross and Allan Paull, both now involved in the Hyshot scramjet project which Allan directs.

On his appointment to UQ, Fenton secured from the Vice-Chancellor a remarkable deal that financed a visit to the Department each year for several months by a distinguished applied mathematician. Each visitor typically gave one of the advanced Honours courses, and Honours and postgraduate students, as well as staff, benefited from lectures and seminar series delivered by eighteen such notables in all, including Geoff Ludford, Richard Meyer, Julian Cole, Gerry Whitham and Keith Stewartson.

Fenton was charmingly disorganised and prone to minor accidents. One consequence was that his lecture and seminar presentations were sometimes chaotic. Humorous anecdotes abound, describing all manner of incidents.

The most famous is the wardrobe story, from Fenton's days as Head Tutor at Trinity College, Melbourne. The story is told in matchless style by Colin Rogers, and the reader is referred to him for the authoritative version, but in brief it is this: After a heavy night in the dining and common rooms, Fenton was left to turn off all the lights as he made his way to bed. Noticing one final light on at the far end of the billiard room as he passed down the passage to his bedroom, he dutifully wound his way through the tables and switched it off. Now in complete darkness, he found it more difficult to retrace his steps and, somewhat disoriented, he exited the billiard-room without realising it. Coming upon the door of the room opposite, he mistakenly assumed that he must have closed the billiard room door after entering, and was now opening that door back into the passage. In fact it was the bedroom door of a newly arrived and now rudely awoken resident, who lay cowering under the blankets as Fenton, believing he was in the passage, groped his way noisily and uncertainly through the bedroom, still in total darkness. Coming upon another door, and thinking it must lead from the passage to his own bedroom, Fenton opened it and stepped through. It was in fact the door to a large wardrobe, as yet unused by the new resident. Having shut the wardrobe door behind him and finding himself enclosed, Fenton panicked and pushed violently on the wardrobe walls and door in an attempt to escape, managing only to tip the wardrobe over on its face, with himself still inside. Violent thumping and banging ensued. It is not recorded who helped Fenton out of his predicament, nor how long it took the new resident to recover from his experience.

Fenton met his wife-to-be Jill Massey-Greene as a result of another accident — a happy and fortunate accident in this case — while skiing at Mt Hotham in 1957. They married and had four daughters, Libby, Jane, Louise and Heather, and one son, Richard. Jill and all five children survive him.

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On the rate of convergence of Wallis' sequence

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Abstract

Recent papers published in the *Gazette* deal with the asymptotic behaviour of Wallis' sequence $W_n = \prod_{k=1}^{n} 4k^2/(4k^2-1)$. Our purpose is to interpret the well-known formula of the rate of convergence: $W_n = \pi/2 - \pi/8n + o(1/n)$ as $n \to \infty$, in the language of the sequences of definite integrals.

Key words: the rate of convergence, sequences of definite integrals.
MSC: 26A15, 26A42, 40A05, 40A20.

Introduction

The famous Wallis' sequence $(W_n)_{n\geq 1}$ is defined by:

$$W_n = \prod_{k=1}^{n} \frac{4k^2}{4k^2-1} = \frac{\pi}{2} \frac{\int_0^{\pi/2} \sin^{2n+1} x\, dx}{\int_0^{\pi/2} \sin^{2n} x\, dx}, \qquad n \geq 1.$$

As shown by Hirshhorn [1], and earlier by Vernescu [8],

$$W_n = \frac{\pi}{2} - \frac{\pi}{8n} + o\left(\frac{1}{n}\right) \quad \text{as } n \to \infty.$$

In this paper, using the integral expression of W_n, we show that the limit

$$\lim_{n\to\infty} n\left(\frac{\pi}{2} - W_n\right) = \frac{\pi}{8} \tag{1}$$

follows from general properties of some sequences of definite integrals.

Basic results on the convergence of some sequences of definite integrals

We shall investigate the asymptotic behavior of the sequence of integrals $I_n = \int_a^b f^n(x)\, dx$, $n \in \mathbb{N}$, where $f\colon [a,b] \to \mathbb{R}$ is an integrable function. The following elementary theorem (see [5] for the proof) refers to the convergence of the sequence $(I_{n+1}/I_n)_{n\geq 1}$.

Theorem 1. *Let $f\colon [a,b] \to \mathbb{R}_+$ be a positive continuous function with $\|f\| = \max_{x\in[a,b]} f(x)$. Let us denote $I_n = \int_a^b f^n(x)\, dx$, $n \in \mathbb{N}$. Then $(I_{n+1}/I_n)_{n\geq 1}$ is an increasing sequence with:*

$$\lim_{n\to\infty} \frac{I_{n+1}}{I_n} = \|f\|.$$

The fact that the sequence $(I_{n+1}/I_n)_{n\geq 1}$ is monotonic increasing is a consequence of Bunyakovsky's inequality.

Now let us discuss the special case when f reaches its maximum $\|f\|$ in a unique point. We begin with the following useful statement.

Lemma 1. *Let $f\colon [a,b] \to \mathbb{R}_+$ be a positive continuous function with the property that there is a unique point $c \in [a,b]$ such that $\|f\| = f(c)$. Also let $g\colon [a,b] \to \mathbb{R}$ be a continuous function. Then the sequence:*

$$x_n = \frac{\int_a^b f^{n+1}(x)g(x)\,dx}{\int_a^b f^n(x)\,dx}, \qquad n \geq 1$$

converges to $\|f\|g(c)$.

Proof. Let us choose an arbitrary $\varepsilon > 0$. Since f and g are continuous at c it follows that there is $[u,v] \subset [a,b]$, with $u < v$ and $c \in [u,v]$, such that

$$|f(x)g(x) - f(c)g(c)| < \frac{\varepsilon}{2}, \quad \text{for all } x \in [u,v].$$

Let us denote $m := \max\{f(x) \mid x \in [a,b]\backslash[u,v]\}$. By the assumed uniqueness of the maximum point c we have $m < \|f\| = f(c)$. From the continuity of f at c, for a fixed $m_1 \in (m, \|f\|)$ there exists an interval $[s,t] \subset [a,b]$, with $s < t$, such that $f(x) \geq m_1$, for all $x \in [s,t]$. Also, since $(m/m_1)^n \to 0$, there is $n_\varepsilon \in \mathbb{N}$ such that $2A(b-a)/(t-s)(m/m_1)^n < \varepsilon/2$, for all $n \geq n_\varepsilon$, where $A := \max_{x\in[a,b]} |f(x)g(x)|$. Hence, for any $n \geq n_\varepsilon$, we have:

$$\begin{aligned}
|x_n - f(c)g(c)| &\leq \frac{\int_a^b f^n(x)|f(x)g(x) - f(c)g(c)|\,dx}{\int_a^b f^n(x)\,dx} \\
&= \frac{\int_{[a,b]\backslash[u,v]} f^n(x)|f(x)g(x) - f(c)g(c)|\,dx}{\int_a^b f^n(x)\,dx} \\
&\quad + \frac{\int_u^v f^n(x)|f(x)g(x) - f(c)g(c)|\,dx}{\int_a^b f^n(x)\,dx} \\
&\leq \frac{2A\int_{[a,b]\backslash[u,v]} f^n(x)\,dx}{\int_s^t f^n(x)\,dx} + \frac{\varepsilon}{2}\frac{\int_u^v f^n(x)\,dx}{\int_a^b f^n(x)\,dx} \\
&\leq 2A\frac{b-a}{t-s}\left(\frac{m}{m_1}\right)^n + \frac{\varepsilon}{2} \\
&< \varepsilon.
\end{aligned}$$

This shows that $\lim_{n\to\infty} x_n = f(c)g(c) = \|f\|g(c)$.

Below we present a deduction of the rate of convergence of the sequence $(I_{n+1}/I_n)_{n\geq 1}$ for twice-differentiable functions with continuous second derivatives.

Theorem 2. *Let $f\colon [a,b] \to \mathbb{R}_+$ be a positive twice-differentiable function with continuous second derivative. Assume that $f'(x) > 0$, for all $x \in [a,b)$ and $f''(b) \neq 0$. Then the sequence*

$$y_n = n\left(f(b) - \frac{\int_a^b f^{n+1}(x)\,dx}{\int_a^b f^n(x)\,dx}\right), \qquad n \geq 1$$

is convergent and we have:

$$\lim_{n\to\infty} y_n = \begin{cases} f(b), & \textit{if } f'(b) \neq 0, \\ \dfrac{f(b)}{2}, & \textit{if } f'(b) = 0. \end{cases}$$

Proof. It is obvious that b is the unique maximum point of the function f. We have

$$\lim_{x\to b^-} \frac{f(x)-f(b)}{f'(x)} = 0$$

(since $f''(b) \neq 0$ we use l'Hôpital's rule when $f'(b) = 0$). Thus, the function $g\colon [a,b] \to \mathbb{R}$ defined as

$$g(x) = \begin{cases} \dfrac{f(x)-f(b)}{f'(x)}, & x \in [a,b), \\ 0, & x = b, \end{cases}$$

is continuous. Also, we obtain

$$\lim_{x\to b^-} \frac{f(x)-f(b)}{(f'(x))^2} = \begin{cases} 0, & f'(b) \neq 0, \\ \dfrac{1}{2f''(b)}, & f'(b) = 0. \end{cases}$$

It follows that g is differentiable with continuous derivative on $[a,b]$ and we have

$$g'(b) = \lim_{x\to b^-} g'(x) = \begin{cases} 1, & f'(b) \neq 0, \\ \frac{1}{2}, & f'(b) = 0. \end{cases}$$

Therefore, using the method of integration by parts, we can write

$$\begin{aligned}(n+1)\int_a^b f^n(x)\big(f(b)-f(x)\big)\,dx &= -(n+1)\int_a^b f^n(x)f'(x)g(x)\,dx \\ &= -f^{n+1}(x)g(x)\Big|_a^b + \int_a^b f^{n+1}(x)g'(x)\,dx.\end{aligned}$$

Thus, we obtain

$$y_n = \frac{n}{n+1}\left(\frac{f^{n+1}(a)g(a)}{\int_a^b f^n(x)\,dx} + \frac{\int_a^b f^{n+1}(x)g'(x)\,dx}{\int_a^b f^n(x)\,dx}\right).$$

Let us choose $c \in (a,b)$. Since f is increasing on $[a,b]$, $f(x) \geq f(c)$, for all $x \in [c,b]$ and $f(a)/f(c) \in [0,1)$. From the obvious inequalities

$$0 \leq \frac{f^n(a)}{\int_a^b f^n(x)\,dx} < \frac{f^n(a)}{\int_c^b f^n(x)\,dx} < \frac{1}{b-c}\left(\frac{f(a)}{f(c)}\right)^n$$

we get $\lim_{n\to\infty} f^n(a)/(\int_a^b f^n(x)\,dx)$. Further, using Lemma 1, we find

$$\lim_{n\to\infty} \frac{\int_a^b f^{n+1}(x)g'(x)\,dx}{\int_a^b f^n(x)\,dx} = f(b)g'(b).$$

Hence, the sequence (y_n) is convergent with:

$$\lim_{n\to\infty} y_n = f(b)g'(b) = \begin{cases} f(b), & f'(b) \neq 0, \\ \dfrac{f(b)}{2}, & f'(b) = 0. \end{cases}$$

We have thus proved the theorem.

Computing the rate of convergence of Wallis' sequence

Let us consider the function $f\colon [0,\pi/2] \to [0,1]$, $f(x) = \sin x$ and the sequence of Riemann integrals

$$I_n = \int_0^{\pi/2} f^n(x)\,dx, \quad \text{for } n \geq 1.$$

We shall begin with a method (see [5]) which is based on the well-known recurrence relation:

$$I_{n+2} = \frac{n+1}{n+2}\, I_n. \tag{2}$$

By Theorem 1, we have for any positive integer n the following inequality:

$$\frac{I_{2n}}{I_{2n-1}} \leq \frac{I_{2n+1}}{I_{2n}} \leq \frac{I_{2n+2}}{I_{2n+1}}.$$

Hence, from (2) we obtain:

$$\frac{2n}{2n+1} = \frac{I_{2n+1}}{I_{2n-1}} \leq \left(\frac{I_{2n+1}}{I_{2n}}\right)^2 \leq \frac{I_{2n+2}}{I_{2n}} = \frac{2n+1}{2n+2}.$$

Therefore we find:

$$\frac{\pi}{2}\sqrt{\frac{2n}{2n+1}} \leq W_n \leq \frac{\pi}{2}\sqrt{\frac{2n+1}{2n+2}}.$$

Thus, the following inequalities arise:

$$\frac{\pi/4}{\sqrt{1+1/n}\left(\sqrt{1+1/n}+\sqrt{1+1/2n}\,\right)} \leq n\left(\frac{\pi}{2} - W_n\right) \leq \frac{\pi/4}{\sqrt{1+1/2n}\left(1+\sqrt{1+1/2n}\,\right)}, \quad \text{for all } n \in \mathbb{N}.$$

Consequently, limit (1) exists.

But we have not exposed a 'general method' because the particular recurrence relation (2) of (I_n) is used in the above proof. A more instructive general method of obtaining (1) is based entirely on Theorem 2. Thus, since $f'(x) > 0$, for all $x \in [0,\pi/2)$, $f'(\pi/2) = 0$ and $f''(\pi/2) \neq 0$, we have:

$$\lim_{n\to\infty} n\left(1 - \frac{I_{2n+1}}{I_{2n}}\right) = \frac{1}{2}\lim_{n\to\infty}(2n)\left(f\left(\frac{\pi}{2}\right) - \frac{I_{2n+1}}{I_{2n}}\right) = \frac{1}{2}\cdot\frac{f(\pi/2)}{2} = \frac{1}{4}.$$

If we multiply by $\pi/2$, then we obtain the limit (1).

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Pisano period and permutations of $n \times n$ matrices

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Abstract

Repeated application of a particular permutation to an $n \times n$ matrix results in the original matrix. The number of iterations $I(n)$ for $n = 1, 2, \ldots$ is the same as the length of the period of the periodic sequence that results from the Fibonacci sequence modulus n known as the Pisano period.

Introduction

The well-known Fibonacci sequence of numbers, $0, 1, 1, 2, 3, 5, 8, 13, \ldots$ shows periodicity modulus n [1]. For example, the Fibonacci sequence modulus 2 is $0, 1, 1, 0, 1, 1, \ldots$ which has the repeating pattern of length 3 $\{1, 1, 0\}$. Modulus 3 the pattern is of length 8, $\{0, 1, 1, 2, 0, 2, 2, 1, \ldots\}$. The length of the period modulus n, is called the Pisano period [2] after Fibonacci's real name Leonardo Pisano [3]. The Pisano sequence is the sequence of Pisano periods for $n = 1, 2, \ldots$. Table 1 gives the values of the Pisano sequence for $n = 1, 2, \ldots, 100$ [4].

Table 1. Pisano period values for $n = 1, 2, \ldots, 100$

1	3	8	6	20	24	16	12	24	60
10	24	28	48	40	24	36	24	18	60
16	30	48	24	100	84	72	48	14	120
30	48	40	36	80	24	76	18	56	60
40	48	88	30	120	48	32	24	112	300
72	84	108	72	20	48	72	42	58	120
60	30	48	96	140	120	136	36	48	240
70	24	148	228	200	18	80	168	78	120
216	120	168	48	180	264	56	60	44	120
112	48	120	96	180	48	196	336	120	300

Permutations of $n \times n$ matrices

There is a procedure for reordering the elements of an $n \times n$ matrix A which in this paper is called the diagrow procedure because it involves turning diagonals into rows. Start by taking two copies of A called $A1$ and $A2$ side by side as shown in Figure 1. The reordered matrix is formed from the elements along the diagonals $\{A1_{1,1}$ to $A1_{n,n}\}, \{A1_{1,2}$ to $A2_{n,1}\} \ldots \{A1_{1,n}$ to $A2_{n,n-1}\}$. In Figure 1, the reordered matrix is shown below the two copies of the original. If the process is repeated on the resultant reordered matrix, eventually the original matrix is obtained. The number iterations for $n = 1, 2, 3 \ldots$ required to get back to the original ordering is $1, 3, 8, 6, 20, 24, 16, \ldots$, respectively. This is exactly the same sequence as the Pisano sequence. Figures 2 and 3 illustrate the permutation cycles for 3×3 and 4×4 matrices.

$$\begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{vmatrix}\begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{vmatrix}$$

$$\begin{vmatrix} 1 & 6 & 11 & 16 \\ 2 & 7 & 12 & 13 \\ 3 & 8 & 9 & 14 \\ 4 & 5 & 10 & 15 \end{vmatrix}$$

Figure 1. Example of a 4×4 matrix reordering

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix} \xrightarrow{①} \begin{vmatrix} 1 & 5 & 9 \\ 2 & 6 & 7 \\ 3 & 4 & 8 \end{vmatrix} \xrightarrow{②} \begin{vmatrix} 1 & 6 & 8 \\ 5 & 7 & 3 \\ 9 & 2 & 4 \end{vmatrix}$$

$$\xrightarrow{③} \begin{vmatrix} 1 & 7 & 4 \\ 6 & 3 & 9 \\ 8 & 5 & 2 \end{vmatrix} \xrightarrow{④} \begin{vmatrix} 1 & 3 & 2 \\ 7 & 9 & 8 \\ 4 & 6 & 5 \end{vmatrix} \xrightarrow{⑤} \begin{vmatrix} 1 & 9 & 5 \\ 3 & 8 & 4 \\ 2 & 7 & 6 \end{vmatrix}$$

$$\xrightarrow{⑥} \begin{vmatrix} 1 & 8 & 6 \\ 9 & 4 & 2 \\ 5 & 3 & 7 \end{vmatrix} \xrightarrow{⑦} \begin{vmatrix} 1 & 4 & 7 \\ 8 & 2 & 5 \\ 6 & 9 & 3 \end{vmatrix} \xrightarrow{⑧} \begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$$

Figure 2. Example of 3×3 matrix permutations

$$\begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{vmatrix} \xrightarrow{①} \begin{vmatrix} 1 & 6 & 11 & 16 \\ 2 & 7 & 12 & 13 \\ 3 & 8 & 9 & 14 \\ 4 & 5 & 10 & 15 \end{vmatrix} \xrightarrow{②} \begin{vmatrix} 1 & 7 & 9 & 15 \\ 6 & 12 & 14 & 4 \\ 11 & 13 & 3 & 5 \\ 16 & 2 & 8 & 10 \end{vmatrix}$$

$$\xrightarrow{③} \begin{vmatrix} 1 & 12 & 3 & 10 \\ 7 & 14 & 5 & 16 \\ 9 & 4 & 11 & 2 \\ 15 & 6 & 13 & 8 \end{vmatrix} \xrightarrow{④} \begin{vmatrix} 1 & 14 & 11 & 8 \\ 12 & 5 & 2 & 15 \\ 3 & 16 & 9 & 6 \\ 10 & 7 & 4 & 13 \end{vmatrix}$$

$$\xrightarrow{⑤} \begin{vmatrix} 1 & 5 & 9 & 13 \\ 14 & 2 & 6 & 10 \\ 11 & 15 & 3 & 7 \\ 8 & 12 & 16 & 4 \end{vmatrix} \xrightarrow{⑥} \begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{vmatrix}$$

Figure 3. Example of 4×4 matrix permutations

Why is this so?

Consider referencing the rows and columns of a matrix starting with row 0 and column 0 as is common with some programming languages. Let $\mathbb{N}_0$ be the set of non-negative integers and consider a mapping f from $\mathbb{N}_0^2$ to $\mathbb{N}_0^2$. In general the diagrow procedure can be characterised as the mapping f on the indices (i, j), $i, j \in \{0, 1, \ldots, n-1\}$, of an $n \times n$ matrix where:

$$f(i, j) = (k, i) \quad \text{and} \quad k = (j - i) \bmod (n).$$

In relation to the diagrow procedure this means that the element indexed by (i, j) is relocated to the index (k, i).

For example, the application of the diagrow procedure to each index of a 3×3 matrix results in:

$$\begin{array}{lll} (0,0) \to (0,0) & (0,1) \to (1,0) & (0,2) \to (2,0) \\ (1,0) \to (2,1) & (1,1) \to (0,1) & (1,2) \to (1,1) \\ (2,0) \to (1,2) & (2,1) \to (2,2) & (2,2) \to (0,2). \end{array}$$

In the 4×4 matrix case, the diagrow procedure results in the following translations:

$$\begin{array}{llll} (0,0) \to (0,0) & (0,1) \to (1,0) & (0,2) \to (2,0) & (0,3) \to (3,0) \\ (1,0) \to (3,1) & (1,1) \to (0,1) & (1,2) \to (1,1) & (1,3) \to (2,1) \\ (2,0) \to (2,2) & (2,1) \to (3,2) & (2,2) \to (0,2) & (2,3) \to (1,2) \\ (3,0) \to (1,3) & (3,1) \to (2,3) & (3,2) \to (3,3) & (3,3) \to (0,3). \end{array}$$

The Fibonacci sequence is generated by successive addition of the previous two terms. The translation of indices using the diagrow procedure is performed by the successive difference modulo n of the previous row and column numbers. Given any two numbers in order from the Fibonacci sequence all the smaller Fibonacci numbers can be generated by a similar process of successive differences. More clearly, the inverse of the diagrow mapping is

$$f^{-1}(i, j) = (j, k) \quad \text{where } k = (i + j) \bmod (n)$$

which uses the same generating process as the Fibonacci sequence.

The generalised Fibonacci sequence has the same recursive formula as the Fibonacci sequence $G(a, b) = (b, a + b)$ but with different starting values. With $a = 0$ and $b = 1$ or $a = 1$ and $b = 0$, the usual Fibonacci sequence is generated, starting with 0 with the former and 1 with the latter initial values. The generalised Fibonacci sequence is shown to be related to the Fibonacci sequence as follows: Start with

$$a, b, a + b, a + 2b, 2a + 3b, 3a + 5b, 5a + 8b, \ldots$$

and separate terms into two groups with terms in each group having the same factor;

$$a, 0a, 1a, 1a, 2a, 3a, 5a, \ldots + 0b, 1b, 1b, 2b, 3b, 5b, 8b, \ldots$$

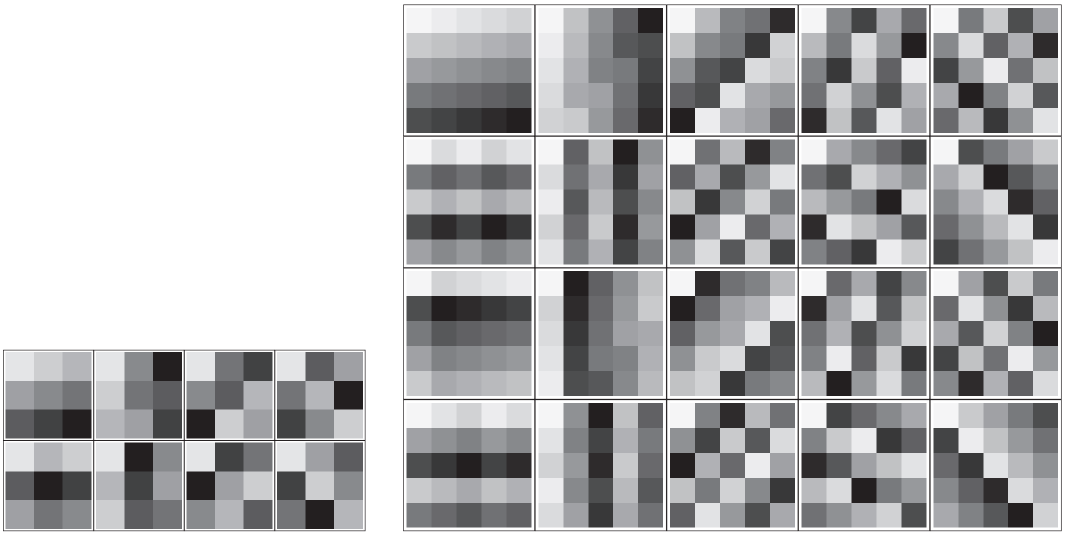
then factor the common factors from each group

$$a(1, 0, 1, 1, 2, 3, 5, \ldots) + b(0, 1, 1, 2, 3, 5, 8, \ldots).$$

The first sequence is a times the Fibonacci sequence starting with $1, 0$ and the second sequence is b times the Fibonacci sequence starting with $0, 1$. Clearly, the lengths of the periods modulus n of the first sequence will be the same as the lengths of the periods modulus n of the second sequence. Both of these lengths are the Pisano sequence. The lengths of the periods modulus n of the sum of the two sequences will therefore also be the same as the Pisano sequence. It is clear that the Pisano sequence will also apply to the generalised Fibonacci sequence. Since the diagrow procedure follows the same generating process as the generalised Fibonacci sequence, except in reverse, the repeated diagrow procedure applied to an $n \times n$ matrix has a period with the same length as the length of the period modulus n of the Fibonacci sequence, that is the Pisano period.

Extra bits

An $n \times n$ matrix can be represented graphically in the manner of a chessboard with each square filled in with a shade of grey ranging from white for the lowest number to black for the highest number. The elements of the matrices used in the graphical representations shown in Figures 4, 5, 6 and 7 have the same numbering convention as shown in the examples of Figures 2 and 3 except that each number has been divided by n^2 so that the smallest number is $1/n^2$ and the largest number is 1. This is most clearly seen by comparing Figure 2 with Figure 4(a).



(a) 8 permutations of a 3×3 matrix

(b) 20 permutations of a 5×5 matrix

Figure 4. Graphical representation of the permutations resulting from a diagrow reordering of a 3×3 matrix Figure 4(a) and a 5×5 matrix Figure 4(b). Each matrix has elements with values $1/n^2, 2/n^2, \ldots, 1$ represented by squares filled with shades of grey.

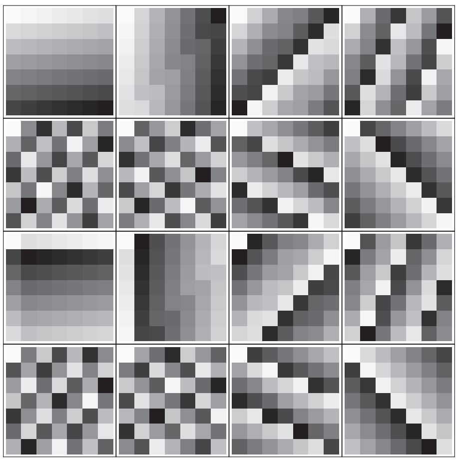


Figure 5. Permutations resulting from a diagrow reordering of a 7×7 matrix. Each matrix has elements with values $1/7^2, 2/7^2, \ldots, 1$ represented by squares filled with shades of grey.

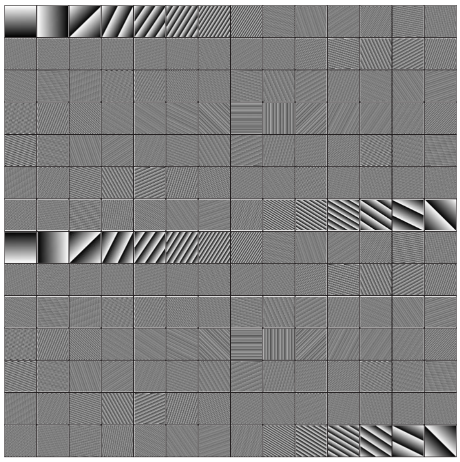


Figure 6. The 196 permutations resulting from a diagrow reordering of a 97×97 matrix with elements $1/97^2, 2/97^2, \ldots, 1$ represented by squares filled with shades of grey.

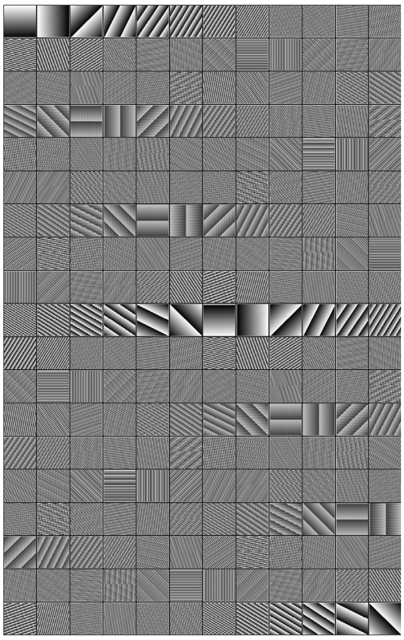


Figure 7. The 228 permutations resulting from a diagrow reordering of a 74×74 matrix with elements $1/74^2, 2/74^2, \ldots, 1$ represented by squares filled with shades of grey.

Interesting patterns appear in these graphical representations especially for larger values of n as seen in Figures 6 and 7. Some representations have the appearance of woven fabric. Diagrow permutations of the $n \times n$ matrices with $n = 81, 82, \ldots, 160$ shown as simultaneous animations can be found at [5].

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Book reviews

Counting Australia In
The People, Organisations and Institutions of Australian Mathematics

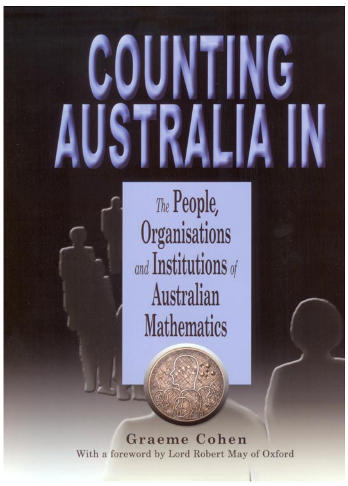
Graeme Cohen
Halstead Press 2006, ISBN: 1-920-831-398

This book is a history of mathematics in Australia. Graeme Cohen has succeeded in the difficult task of combining a comprehensive survey with an interesting story. I can't say that I liked the too-cute title, but I did enjoy reading everything that follows it.

The extent of the coverage can be seen from the titles of the chapters, namely:

1. Mathematics and the beginnings of the colonies
2. Mathematics and the rise of the universities
3. Mathematics outside the universities
4. Mathematics in the universities in the first half of the twentieth century
5. Australia's mathematicians in World War 2
6. Post-war mathematics in the older universities
7. Mathematics in Canberra's colleges and universities
8. National organisations and mathematics
9. Mathematics and the later universities
10. The Australian Mathematical Society

which are supplemented by appendices consisting of articles originally written by Horatio Carslaw in 1914 and Keith Bullen in 1956, lists of Society members, office holders and award winners, and comprehensive bibliographic end-notes and indices.



For example, there are about 1200 names in the 'Names Index', almost all of whom are mathematicians, and a further 600 entries in the 'General Index'. At various times while reading the narrative, I began to think 'Graeme has omitted X', only to find that X got an appropriate mention within a page or two, and such X's invariably also appeared in the Names Index (if X was a person), or the General Index (if X was an organisation or an event). Chapters 1 to 5 constitute the first half of the book, and perhaps make the most interesting and informative reading, as they describe people who lived and events that occurred before most of the book's present-day audience were born. In my own case this is almost true, but in addition, as a participant in some of the events described in the second half of the book, I feel less able to make a dispassionate review.

As the title of Chapter 1 suggests, Cohen starts right at the beginning, when few of us would have thought there were any mathematicians in the colonies at all. Actually, he starts even before there were colonies, with mention of the mathematical competence of James Cook himself and others on his ship when it arrived in Botany Bay in 1770. (Going even further back, he briefly documents Aboriginal and Islander mathematics.) Then we hear about other explorers such as La Perouse (who nearly had the mathematician Gaspard Monge in his crew when it arrived in Sydney in 1788 and was lost with all hands soon after) and Nicolas Baudin (whose 1802 place names like Bai Laplace and Cap l'Hopital sadly were replaced by more boring names due to Flinders).

Once New South Wales was established as a colony, a need for some form of mathematical education and activity became apparent by the beginning of the 19th century. Thomas Brisbane, governor from 1821 to 1825, took a great interest in science including mathematics. Brisbane hired Carl Rumker, who Cohen claims to be Australia's first practising mathematician, as a private astronomer. However, little real mathematical activity occurred until the middle of that century.

Statistics played a somewhat more substantial early role and even the first governor Arthur Phillip demanded from 1788 that almost everything be counted and recorded meticulously. Later in the mid-19th century, there was some professional activity in statistics via the census, and in areas like surveying, geodesy and genetics (the last by the famous wheat breeder William Farrer) which depended to some extent on mathematics. At the same time, tentative beginnings of scientific societies like the Philosophical Society of New South Wales involved mathematics, including a paper by James Cockle in the first issue of its Transactions in 1866. Cockle was the Chief Justice of Queensland, but was already an FRS, and remained an active amateur in mathematical research for decades.

But mathematics as a profession could only really get a start with the universities, beginning with The University of Sydney in 1852. Australia's first professor of mathematics was Morris Pell, and Cohen records not only the names of the selection panel (which included Herschel and Airy), but also those of Pell's rivals for the chair. This is a pattern repeated throughout the first part of the book, and in particular Cohen documents some famous names who served on early selection committees. Neither Pell nor his 1876 successor Thomas Gurney had a great influence on the development of the profession, either inside or outside Australia. The same can be said of the first two professors at The University of Melbourne, William Wilson from 1855 and Edward Nanson from 1875, even though the latter stayed for 48 years, still a record professorial tenure.

The same could definitely not be said of the first two professors at The University of Adelaide, Horace Lamb (author of the famous textbook 'Hydrodynamics') from 1876 and William Bragg from 1885. Both were professors of mathematics and physics, but both were more active in mathematics in their early years at Adelaide, although Bragg later became more famous as a physicist, and won the 1915 Nobel prize in physics jointly with his son Lawrence who was born in Adelaide. The fourth Australian university was the University of Tasmania, and Alexander McAulay was appointed the first professor of mathematics in 1893, subsequently to make good contributions in physics-oriented mathematics.

Chapters 4 and 5 take us into the first half of the 20th century, and establishment of The University of Queensland (1911) and The University of Western Australia (1912). Charles Weatherburn, the second Professor of Mathematics at UWA, from 1929, became very well known for his often-reprinted text on vector analysis. Also at UWA, Margaret Moir was notable for at least two reasons, as (perhaps) Australia's first female lecturer in mathematics in 1929, and later as (perhaps) Australia's first retrenched mathematical academic, in times of financial hardship in 1931.

Meanwhile the next generation of professors at the older universities was also to become very well known internationally. Horatio Carslaw at Sydney (from 1903), John Michell at Melbourne (lecturer from 1891 and promoted to professor in 1923), and John Wilton at Adelaide from 1920 were perhaps Australia's first group of truly outstanding mathematicians on a world scale. I have had to point out Michell and Wilton's Australian-ness to colleagues overseas, who doubted that such a backwater could produce mathematicians of stature in the early 20th century. Michell in particular deserves mention as the first Australian-born mathematical FRS in 1902, though sadly that year also signalled the end of his period of published research activity.

The next pre-war group of professors also included very important researchers on a world scale, such as Thomas Cherry at Melbourne, Thomas Room at Sydney, and Edwin Pitman at Tasmania. World War II then intervened, and Cohen tells some fascinating stories about mathematicians involved in the war effort, including code-breaking and operations research. After the war, a significant build-up occurred, and again some outstanding professorial appointments were made, including Keith Bullen at Sydney, Eric Barnes and Ren Potts at Adelaide, Fenton Pillow at Queensland, and Larry Blakers and John Mahony at UWA. Cohen gives ample discussion of each of these appointments, not glossing over difficult matters like the Room–Bullen antagonism, which damaged mathematics at Sydney for decades.

Cohen also does not confine his narrative to professors, giving almost everyone who contributed to the mathematical profession a generous mention. He is almost too democratic, and perhaps the real stars could have been given a little more proportionate space. For what it is worth, Room is the citation star of the book, being mentioned on 34 of its pages, with Cherry next on 28 and Bullen on 24.

He is also perhaps a little too kind. We have not always performed well on the international mathematical stage. Cohen does mention the very negative quantitative review in *Vestes* (1968) by Ian MacDonald, who essentially concluded that George Szekeres was the only significant (pure) mathematician working in Australia at that time. This particular review was neither impartial nor entirely acceptable in its methodology, but nevertheless not too many at that time were close to the Szekeres standard.

Expatriate Australian mathematicians of distinction (such as George Batchelor and most recently Terry Tao), closely-associated short-term or visiting mathematicians (such as Ronald Fisher, Hans Schwerdtfeger, Richard Meyer and John Miles) and almost or should-have-been appointees (such as William Young, Edward Ince, Louis Milne-Thomson and Norbert Wiener) are also well discussed, as are people whose connection to mathematics is perhaps minimal but nevertheless interesting. The latter group includes Princess Mary of Denmark (daughter of the Tasmanian mathematician John Donaldson), the politician Herbert Evatt and the political commentator Mungo MacCallum who both were mathematics honours graduates, astronauts such as Paul Scully-Power Philip Chapman and Andy Thomas, and the wife-murderer Rory Thompson (incidentally surely not the only CSIRO theoretical oceanographer worthy of mention in a history of mathematics in Australia).

As anticipated, I shall say little about the second half of the book, which mainly deals with relatively contemporary events and persons. But here again the coverage in the book appears to be comprehensive and accurate, and in particular documents the role of mathematics in each of the universities founded in the second half of the 20th century. Specific rankings of mathematical departments are not emphasised by Cohen, but it is possible to discern a clear leadership by Monash University during the last three decades of the 20th century, from references quoted by Cohen. These involve data on honours and postgraduate student numbers collected over that period for the Society by Jim Douglas, Peter Petocz and Peter Johnson, and separately in 1982 by Martin Bunder (I hesitate to note which university consistently came second!). Although output of research-oriented students is only one measure of strength, other measures such as publication rates generally (except in the case of the ANU) correlate well with it. In the same period there was a relatively poor performance by the senior universities in Sydney and Melbourne, a problem that has now been very substantially remedied, even reversed.

Chapter 10 concerns the Australian Mathematical Society, founded in 1956, and its publications and offshoots, and seems to be an accurate summary. There is almost no actual mathematics in this book, except in Appendix 2, where Bullen was attempting to define 'Applied Mathematics', though this article appears to have been mainly written as his excuse for not joining the Society (whereas some quoted by Cohen felt that the real reason was that if Room joined, Bullen would not).

Graeme Cohen has done a superb job of surveying the development of our discipline in Australia. It is hard to imagine how anyone could have compiled a more complete story, and yet it is eminently readable. Read it!

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Introduction to Modern Number Theory
49 Number Theory 1, Second Edition

I. Manin and A.A. Panchishkin
Springer 2004, ISBN: 0938-0396

From the introduction:

> Among the various branches of mathematics, number theory is characterised to a lesser degree by its primary subject ('integers') than by a psychological attitude ... The question whether a given article belongs to number theory is answered by its author's system of values.

The purpose of agreeing to review a book is to acquire a free copy. I was therefore annoyed with myself to find I already owned the 1995 edition, likely acquired on some occasion from Springer filling my hands with golden books as reward for some task I had performed. Whatever, I had barely looked at the book, somehow put off by its austere presentation as volume 49 in Springer's Encyclopædia of the Mathematical Sciences.

I was, and am, mistaken, several times over. First, this book was, and remains, a *good book* in the sense that George Szekeres once defined such a thing for me: an article or book is *good* if you're (not too unfavourably) quoted in it. Second, this book *is* good also in a less subjective sense, as I suggest below. Third, this edition feels altogether different from the earlier one, in meaningful part, I suspect, because of better editing and typesetting (with more white space on the page). And, frankly, a less forbidding cover — a useful reminder not to pay attention to false truisms about roses with another name or how to judge books.

In any case, there is much new and more in this edition than in the 1995 edition: namely, one hundred and fifty extra pages. Of course, more is not necessarily better, but here the 'more' is fifty helpful pages on the proof of the Modularity Conjecture and Fermat's Last Theorem, and a hundred page survey 'Analogies and Visions' dealing *inter alia* with analogies and differences between numbers and functions and specifically providing an introduction to Arakelov geometry and noncommutative geometry.

The purpose of reviewing a book is to explain to the reader why she personally, or at the least her institution's library, should promptly order a copy. In the alternative, the reviewer illustrates that, had he bothered, he could and would have written far better on the subject than did the authors (actually, many reviewers do that in both circumstances, but are less scathing in the first alternative). For my part, I come to praise this fine volume.

This book is a highly instructive read with the usual reminder that there are lots of facts one does not know. But it also has the less usual charm that lots of things one did know are true for rather more insightful reasons than one had recalled. Of course, the book is an encyclopædia volume, so many topics are treated somewhat telegraphically giving you, as reader, a little more to do. Nonetheless, the quality, knowledge, and expertise of the authors shines through. The notion of an encyclopædia also connotes a certain completeness. I noticed that some relevant topics seemed to get excessively cursory treatment, but then realised both that this volume is dedicated to *modern* number theory, and that it has three companion volumes: Number Theory II: Volume 62, 'Algebraic Number Fields', by H. Koch (1992); Number Theory III: Volume 60, 'Diophantine Geometry', by S. Lang (1990); Number Theory IV: Volume 44, 'Transcendental Numbers', by N.I. Fel'dman and Yu.V. Nesterenko (1997).

The present volume is almost startlingly up-to-date, in part because plainly just prior to publication the authors added updates on very recent significant results (for example, the Green–Tao Theorem on primes in arithmetic progressions).

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Researching Mathematics Classrooms: A Critical Examination of Methodology

Editors: Simon Goodchild and Lyn English
Information Age Publishing 2002, ISBN: 1-59311-182-7

This collection represents a novel approach to developing a stronger understanding of researching mathematics education. All chapters explore particular (and different) approaches to methodologies for exploring classroom practice. There is a very good diversity in representation of approaches ranging from longitudinal, statistical approaches (Yates) to the microculture of classrooms (David and Lopes; Goodchild). The chapters represent an excellent collection of approaches in which the authors discuss the ways in which they planned, executed and reflected on their studies. The detail in which each chapter is written provides a very sound overview of the methods and methodological issues for each study.

In writing this review, it is not my intention to provide a summary of each chapter as this has been done by the invited series editor, Professor Leone Burton. Each chapter is a personal account of the six chapter authors' research methodologies. Each chapter represents a very different approach to very different research problems and contexts. This is a strength of the book and provides the reader with a very clear idea of the research process and decision making processes undertaken by the chapter authors as they go about their projects. Burton's opening chapter provides a context for the book by proposing a contextualising problem — the 'why' of methodology — why researchers make the decisions they do as they go about their research processes. This is a strength of the book in that each of the authors seek to articulate the decisions they make as they go about their work. Each chapter addresses this to varying degrees, depending largely on the problem under investigation and the approach that was taken.

There is a good diversity in the chapters in that they give a strong representation of methodological approaches to the conduct of research (qualitative, quantitave, longitudinal, ethnographic); foci of problems in mathematics education (preservice, special needs, primary classrooms, whole school); theoretical positions; problems of learning, metacognition, affect, engagement. This collection is an interesting read just of the basis of the diverse problems that are addressed by the chapter authors.

Unlike traditional accounts of methodology, the editors clearly set up a process for the chapter writers in which they would outline their approaches, discussing the background to the study. This included an in-depth discussion about the dilemmas, issues, problems, and resolutions to such problems, the outcomes and consideration of ethical issues. This format, while not explicitly stated, is evident throughout the chapters, thus giving an overall coherence to the book. This makes the book easy to read and gives the reader a sense of what to expect in each chapter. The accounts are very personal stories of the studies in which the authors tell a 'warts-and-all' account of their research. This is a strength of the book as it shows the critical decisions that researchers make as they undertake their projects. This represents a considerable step forward in research methodology since it shows that research is not a clear case of logical and objective processes but one fraught with human decisions. For beginning researchers, this represents a challenge to the dominant approaches in research design and methodology where there is little said about the human-ness of research.

While this last point may be seen as problematic in terms of the conduct of research and engender a highly individualistic 'anything goes' approach to research, this is not the case with the book. One of the interesting and novel approaches offered by the book is the genre. Each chapter has a respondent whose task has been to critically appraise the chapter. Each of the respondents has taken this task seriously and been quite open in drawing out both strengths and issues with the chapter. For new researchers (whether new to research or the particular approach of the chapter), this process achieves two major goals. First, it highlights the important and relevant processes in the methodology of any chapter. Second, it then discusses what might have been done in the research process that would have enhanced the project. Of course, these reactions are a reflection of the respondents' views of the research process but they draw out considerations that could be made in the conduct of similar work.

The reflexivity between the chapter authors and reviewers is similarly adopted with the overall book where the editors have employed Leone Burton to provide an introduction to the book and then to provide a final response to all of the chapters. This style gives further coherence to the book. Burton's chapters reflect her particular approach to understanding methodology; that is, that the chapters should have a stronger focus on the beliefs and dispositions of the authors about their particular choices and reactions to problems/issues in the research process. This perspective comes out strongly in Burton's introduction and conclusion and is perhaps a reflection of Burton's position on methodology. The authors have, to varying degrees, embraced Burton's challenge to make explicit their subjective positions in terms of methodology.

Overall the book is a very good read and highlights the processes undertaken by the authors in the research process. This is done to varying degrees of success by each chapter author. Some chapters are quite rigorous in how they justify their approaches whereas others are very subjective accounts and articulate the pragmatics of their decision making. While this can be a very open and frank process, there is some sense that it may not be a very structured approach to the conduct of research. This is particularly the case where a conservative agenda governs a considerable amount of research. Clearly, the world views of the authors are instrumental in the decisions that are made in the conduct of research but these must be made explicit but within justifiable and legitimate frameworks. This has been undertaken to greater and lesser strengths by different authors. The respondents, in all cases, have highlighted these issues, drawing attention to the problematic nature of such decision-making.

For early career researchers, these justifications are extremely critical and it would be highly contentious for a new researcher to adopt, unproblematically, the highly subjective position of some of the authors. Having such decision-making counter-balanced by respondents is a very effective strategy used by the editors. In some cases, the bias of the respondent can be evident. For example, the study outlined by Yates (a longitudinal, statistical study) was complex in design because of the original catalyst for the study (a problem of one school) along with the design features of a statistical study. Burton was particularly critical of this study — in part, I would contend, due to the positivist worldview of the author. However, the inclusion of this chapter by the editors is critical since it portrays a balanced view of research potentials. Its inclusions ensures a balance of approaches and does not prioritise qualitative approaches over quantitative approaches.

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AMSI News

Philip Broadbridge

I start by reminding you that the Australian Mathematical Sciences Institute continues to offer significant benefits to researchers, such as a continuing program of workshops and conferences. I am pleased to report that at the time of writing, a successful four-week AMSI theme program is running at the University of Melbourne, entitled 'From Statistical Mechanics to Conformal and Quantum Field Theory'.

From 26 November to 14 December, AMSI and MASCOS (Centre of Excellence for Mathematical and Statistics of Complex Systems) will run their first joint theme program, 'Concepts of Entropy and their Applications'. The early part of the theme will re-examine the historical foundations in thermodynamics. However, these concepts have much wider applications. Since 1950, entropy concepts have been closely linked to information theory. From that connection, there have evolved applications in quantum computing, computational complexity, coding, genetics, approximation theory and forecasting. Improvements continue to be made on algorithms involving maximum entropy methods, simulated annealing and earlier Monte Carlo simulation techniques. There is also an increasing role for entropy arguments in the qualitative theory of partial differential equations, having some bearing on well-posedness and stability. I invite anyone interested to contact me. The structure of the program will be determined by your interests.

The report 'Critical Skills for Australia's Future', from the National Strategic Review of Mathematical Sciences Research in Australia, recognises that research performance depends on the health of the education system (http://www.review.ms.unimelb.edu.au/Report.html). Because of that interdependence, AMSI works to improve research and education together, along with industry involvement.

A good example is the forthcoming workshop and ICE-EM (International Centre of Excellence for Education in Mathematics) Industry Short Course, 'Mathematics of Electricity Supply and Pricing'. The workshop, organised jointly by AMSI, MASCOS and MITACS (The Mathematics of Information Technology and Complex systems), will be held in Surfers Paradise during the week 22–27 April 2007 (see http://www.amsi.org.au/Electricity.php for more information). Registration is offered at a subsidised rate to AMSI members, who may also apply to their Head of Discipline for AMSI travel support.

The relationship with Engineering is very important to the Mathematical Sciences, both in research and in education. All states will be involved in the AMSI-initiated discipline-based scoping project, 'Mathematics for 21st Century Engineering Students', funded by the Carrick Institute. Whether or not you are an AMSI member, I would be pleased to hear from you if you have local examples of engineering service teaching that are exemplary in helping us to determine what is good practice, what is poor practice and what is mediocre practice.

Finally, I am intrigued and disturbed by the way mathematics educators appear to have moved away from interaction with mathematicians and statisticians. It used to be common for university mathematical scientists to be members of the local and national mathematics teachers' associations. The celebration of the centenary of the Mathematical Association of Victoria in 2006 reminded us all of the crucial role of university mathematicians in the history of that body.

More disturbing is the lack of communication between education faculties and mathematical sciences departments. A study undertaken by ICE-EM found primary BEd courses with little or no mathematical discipline study.

It is important for us to work closely with mathematics education staff who do understand the importance of discipline content as well as pedagogy in the teaching of mathematics. And we need to work hard to address the unfortunate situation that has arisen in too many universities where there are large numbers of teacher education students, and mathematics departments that cannot offer a three-year sequence of mathematics and statistics to these students. I have always found it self-contradictory that teachers are expected to encourage curiosity among their students but to devote no time to developing their own interests in their subject. Ultimately, the state of health of mathematics is a strong indicator of the success of mathematics education.

Australian Mathematical Sciences Institute, The University of Melbourne, VIC 3010
E-mail: phil@amsi.org.au

Director of AMSI since 2005, Phil Broadbridge was previously a professor of applied mathematics for 14 years, including a total of eight years as department chair at University of Wollongong and at University of Delaware.

His PhD is in mathematical physics (University of Adelaide). He has an unusually broad range of research interests, including mathematical physics, applied nonlinear partial differential equations, hydrology, heat and mass transport, and population genetics. He has published two books and more than 80 refereed papers, including one with 147 ISI citations. He is a member of the editorial boards of three journals and one book series.

News

Completed PhDs

University of Adelaide:

- Dr Nectarios Kontoleon, *The Markovian binary tree: a model of the macroevolutionary process*, supervisors: N. Bean and P.Taylor.
- Dr Amy Glen, *On sturmian and episturmian words and related topic*, supervisors: A. Wolff and R. Clarke.
- Dr Mark McDonnell, *Theoretical aspects of stochastic signal quantisation and suprathreshold stochastic resonance*, supervisors: C. Pearce and D. Abbott.
- Dr Kieran McCaul, *Bilateral breast cancer incidence and survival*, supervisors: P. Solomon, P. Ryan and D. Roder.
- Dr John Moran (Doctor of Medicine), *Statistical issues in the analysis of outcomes in critical care medicine*, supervisors: P. Solomon and R. Ruffin.
- Dr Clare Saddler, *Quantitative methods for investment decisions in communication networks*, supervisors: J. Van der Hoek, A. Filinkov and M. Roughan.

University of Melbourne:

- Dr Richard Brak, *The enumeration of heaps and almost-convex polygons*, supervisors: Professor Tony Roberts, Associate Professor Aleks Owczarek.

University of Newcastle:

- Dr Nathan Brownlowe, *Crossed products, endomorphisms and transfer operators*, supervisor: Professor Iain Raeburn.
- Dr Zead Mustafa, *A new structure for generalised metric spaces, with application to fixed point theory*, supervisor: Dr Brailey Sims.
- Dr Shaun Thompson, *Symmetric imprimitivity theory for twisted crossed products and reduced cross products*, supervisor: Professor Iain Raeburn.
- Dr Trent Yeend, *Topological higher-rank graphs, their groupoids and operator algebras*, supervisor: Professor Iain Raeburn.

University of South Australia:

- Dr Manju Agrawal, *Dynamics and control of drug user populations*, supervisor: Professor Jerzy Filar.
- Dr Boda Kang, *Measures of risk: time consistency and surrogate processes*, supervisor: Professor Jerzy Filar.
- Dr Sergiy Kravchuk, *Study of abrupt transitions in two-dimensional ideal flows: a singular perturbation approach*, supervisor: Professor Vladimir Gaitsgory.
- Dr Xuan Vu, *Analysis of necessary conditions for the optimal control of a train*, supervisor: Professor Phil Howlett.

University of Sydney:

- Dr Peter O'Sullivan, *The generalised Jacobson–Morosov theorem*, supervisor: Professor Gus Lehrer.
- Dr Gregory White, *Enumeration-based algorithms in linear coding theory*, supervisor: Professor John Cannon.

Nominations for 2008 ANZIAM Medal

A search is underway to identify nominees for the 2008 ANZIAM Medal, and interested persons should forward their nominations in confidence to the Chair of the Selection Panel, Professor E.O. Tuck by the end of October 2007 at eotuck@internode.on.net.

Nominees must have given outstanding service to the profession of Applied Mathematics in Australia and/or New Zealand through their research achievements and through activities enhancing applied or industrial mathematics or both. The person nominated must be a long-term member and valuable contributor to ANZIAM and its predecressor, The division of Applied Mathematics of the Australian Mathematical Society.

ANZIAM Award for outstanding new researchers: J.H. Michell Medal

Nominations are called for the award of the J.H. Michell Medal for 2008 for ANZIAM outstanding new researchers. Nominees must be in their first 10 years of research on 1 January 2008 after the award of their PhD, and be members of ANZIAM for at least three years. Nomminations close on 30 September 2007. Further information can be obtained from http://www.anziam.org.au/Medals/michell.html.

The Chair of the Selection Panel for the 2008 award is Professor Larry Forbes (School of Mathematics and Physics, University of Tasmania, Private Bag 37, Hobart TAS 7001, *Email:* Larry.Forbes@utas.edu.au).

Nominations can be made by any member of ANZIAM other than the nominee. A nomination should consist of a brief CV of the nominee together with the nominee's list of publications and no more than a one-page resume of the significance of the nominee's work. Nominations should be forwarded to the Chair of the Selection Panel, in confidence.

Please note that, where necessary, the Selection Panel will consult with appropriate assessors concerning evaluation of any nominee's research.

W. Summerfield
Honorary Secretary, ANZIAM

Appointments

Edith Cowan University:

- Associate Professor Lyn Bloom, Mr Geoff Comber and Dr David McDougall have accepted redundancies.
- Dr Tapan Rai is replacing Dr Sandra Pereira who is on maternity leave.

Queensland University of Technology:

- Ms Susan Barrett, Associate Lecturer.
- Dr Tim Moroney, Associate Lecturer.
- Mrs Helen Thomson, Lecturer.

University of Adelaide:

- Dr Robert Clarke has retired after 37 years service in Pure Mathematics.
- Professor Robert Elliot, as Research Professor of Mathematical Sciences from 18 December 2006 until 20 July 2007. Robert is currently the Royal Bank of Canada's Financial Group Professor of Finance at the University of Calgary.
- Dr Matthew Finn from Imperial College London, as a continuing Lecturer (level B) in Applied Mathematics. Matt's research interests are in fluid mechanics with an emphasis of fluid mixing and topological chaos.
- Dr Adrian Koerber, as a fixed term Lecturer (Level B). Adrian's research interests are in mathematical medicine with particular emphasis on quorom sensing in bacteria colonies.
- Dr Trent Mattner from CSIRO, as a continuing Lecturer (level B) in Applied Mathematics. Trent's research interests are in all aspect of fluid mechanics: experimental, computational and theoretical.
- Mrs Sue Middleton has been appointed as a fixed term Lecturer (Level B) in Statistics.
- Ms Lorenza Morello has been appointed as a Visiting Teaching Fellow for 2007.
- Mr Simon (Jono) Tuke, as a continuing Lecturer (Level A) in Statistics. Jono is currently completing his PhD here at Adelaide in the area of bioinformatics.

University of Ballarat:

- David Yost has taken over as the Deputy Head of School.

University of Melbourne:

- Dr Jan de Gier has been awarded an ARC Queen Elizabeth 2 Fellowship
- Dr Aurore Delaigle has been appointed as Belz Fellow.
- Professor Peter Hall has been appointed as ARC Federation Fellow.
- Dr Iwan Jensen has been promoted to Australian Research Fellow.
- Ms Olivia Madill has been appointed as Research Assistant.
- Dr Antoinette Tordesillas has been promoted to Associate Professor and Reader.

University of Newcastle:

- Dr Toke Carlsen has been appointed to a research position in analysis.
- Dr Richard Gerlach has resigned to take a position at University of Sydney
- Dr Zahirul Hoque has resigned to take a position in the UAE.

- Dr John Raynor has been appointed as Professor of Statistics.
- Mr Paul Rippon has been re-appointed and promoted to Lecturer in Statistics.
- Ms Elizabeth Stojanovski has been appointed as Lecturer in Statistics.
- Mr Mal Williams retired in late 2005.

University of New England:

- Dr B.Bleile has been invited to the Max Planck Institute in Bonn, Germany, for twelve months from September, 2007.

University of New South Wales:

- Three Senior Lecturers in Pure Maths are retiring this year, with more than 100 years of service between them: David Tacon (April), Dennis Trenerry (July) and Michael Hirschhorn (November).
- Three Lecturers have been promoted to Senior Lecturer: Astrid an Huef, Daniel Chan and Catherine Greenhill.
- In Statistics, Professor Matt Wand has left the University.

University of Queensland:

- New Level B appointment, October 2006 until December 2007. Andriy Kvyatkovskyy, working on a Carrick-funded teaching development project with Min-chun Hong, Joseph Grotowski, Victor Scharaschkin, Michael Bulmer, Michael Jennings and Peter Adams.
- Phillip Simon Isaac has had his appointment at Associate Lecturer (level A) extended until 29 July 2010. Phil is interested in many algebraic aspects of mathematical physics, and his most recent research has been on solutions to the Yang–Baxter equation arising from the quantum doubles of finite group algebras, and potential applications to exactly solvable anyonic models.

University of South Australia:

- Dr Zen Lu has been promoted to Senior Lecturer (Level C).
- Professor Stan Miklavcic has been appointed as the new Head of the School of Mathematics & Statistics, starting 19 March.

University of Sydney:

- David Easdown and Andrew Mathas have been promoted to Associate Professor.
- Dr Qiying Wang has been promoted to Senior Lecturer and in 2007 takes up an ARC Fellowship.

Awards and other achievements

Professor Mirka Miller from the University of Ballarat, has won the prestigious Leverhulme Visiting Professorship. The award enables a UK university to ‘host an internationally distinguished academic from outside the UK (chosen and invited by the host institution), for up to ten months, in order to enhance the research skills and work of the host institution.

The Visiting Professor is expected to offer a short course of Leverhulme Lectures while in the UK.'

More information is available at:
http://www.leverhulme.ac.uk/grants_awards/grants/visiting_professorships/

The list of recipients is not published, but it is believed that there are usually five awards given annually, across all disciplines, worldwide. In the past, several Nobel prize winners have received this award.

Mirka plans to take up the award for four months, during June–September 2007, at the Kings College in London, working with Professor Costas Iliopoulos.

Mirka's research interests are in Graph Theory, Combinatorics, and Information Security.

Courses

Flatness-based control design

This course will be delivered in Room EF122 at the University of Newcastle on Mondays and Thursdays from 10:00 am to 1:00 pm between 5 March and 12 April. On Monday 12 March and Thursday 05 April it will be held in Room ES309. Interested parties from the mathematical community are warmly encouraged to join us in the experience; the content is essentially applied differential algebra.

The course is free of charge and is aimed at postgraduate students and researchers in control theory and applied mathematics.

Assumed knowledge: Mainly linear algebra, differential calculus and differential equations, basics of linear system theory.

Presenter: Professor Jean Levine, Centre Automatique et Systemes, Ecole des Mines de Paris, France.

Biography: Jean Levine is Director of Research at the Centre Automatique et Systemes (Systems and Control Lab) of Ecole des Mines de Paris. He has been working on nonlinear filtering and control design for nonlinear systems since 1980, on theoretic aspects as well as industrial applications.

Address: Room EF122/Room ES309, The University of Newcastle, University Drive, Callaghan NSW 2308.

Contacts: Dr Jose De Dona (e-mail: Jose.Dedona@newcastle.edu.au, Tel: (02) 49216088) or Dr Jacqui Ramagge (e-mail: jacqui.ramagge@newcastle.edu.au, Tel: (+61 2) 4921 5545).

Conferences

Conference marking Professor Gavin Brown's 65th birthday

On 5 and 6 March the School of Mathematics and Statistics will host a conference called 'Expansions, inequalities and approximations', in honour of the mathematical achievements of the Vice-Chancellor of the University of Sydney, Professor Gavin Brown.
Organisers: Donald Cartwright, Don Taylor, Bartek Trojan
Web: http://www.maths.usyd.edu.au/u/donaldc/gbrown/index.html

GL07 Geometry and Lie Theory: A conference marking Gus Lehrer's 60th birthday

First week: 2–6 July 2007, Australian National University, Canberra.
Second week: 9–13 July 2007, University of Sydney, NSW
Organisers: James Borger, Peter Bouwknegt, Anthony Henderson, Bob Howlett, Amnon Neeman and Andrew Mathas.
Web: http://www.maths.usyd.edu.au/u/SemConf/lehrerfest.html

Call for Papers: 8th International Conference on Finite Fields and Applications (Fq8)

9–13 July 2007, Melbourne, Australia.
The aim of this conference is to bring together researchers from all aspects of finite fields, theory, computation and applications. Previous meetings have been in Las Vegas (USA), Glasgow (Scotland), Waterloo (Canada), Augsburg (Germany), Oaxaca (Mexico) and Toulouse (France). The conference is organised by Deakin University.
Web: http://fq8.it.deakin.edu.au

The 2007 AustMS Annual Conference

The 51st Annual Meeting of the Australian Mathematical Society will take place at La Trobe University, Melbourne, 25–28 September 2007.

This is a call from the program committee for informal nominations for plenary speakers from amongst those eminent mathematicians who will be visiting Australia during the period of the meeting. Please contact the conference director Geoff Prince (G.Prince@latrobe.edu.au) with your nominations before 1 March 2007. These nominations will augment our existing list and the program committee will attempt to bring you an exciting line up in September.

The conference will also host special sessions that cover a broad range of topics in mathematical research and its applications. Each special session will have a keynote speaker and suggestions for these speakers can be made directly to the session organisers once the session details are announced in the near future.

Web: http://www.latrobe.edu.au/mathstats/maths/conferences/AMS2007/

Visiting mathematicians

Visitors are listed in the order of the last date of their visit and details of each visitor are presented in the following format: name of visitor; home institution; dates of visit; principal field of interest; principal host institution; contact for enquiries.

Dr Daniella Leonte; U. NSW; February 2007; –; QUT; Professor Kerrie Mengerson

Dr Cathal Walsh; Trinity College, Dublin, Ireland; February 2007; –; QUT; Professor Kerrie Mengerson

Professor Chris Field; Dalhousie University; 21 January 2007 to 3 March 2007; –; UMB; –

Professor Feng Dai; University of Alberta, Canada; 3 to 11 March 2007; expansions, inequalities and approximations; USN; D.I. Cartwright

Professor James Byrnes; Prometheus Inc; 1 to 16 March 2007; expansions, inequalities and approximations; USN; D.I. Cartwright

Prof Derek Holt; University of Warwick; 13 January 2007 to 17 March 2007; computational group theory; USN; J.J. Cannon

Dr Hidekazu Nagahata; Okayama University; 27 September 2006 to 20 March 2007 –; UMB

Prof Wieslaw Krawcewicz; University of Montreal; 15 January 2007 to 31 March 2007; Symmetric topological invariants and their application to non-linear elliptic partial differential equations; USN; E.N. Dancer

Prof Christopher Field; Dalhousie University; 28 March 2007 to 4 April 2007; asymptotic approximations; USN; J. Robinson

Dr Robert Carls; –; 12 March 2007 to 6 April 2007; p-adic methods; USN; D.R. Kohel

Vladimir Rittenberg; University of Bonn; 15 January 2007 to 20 April 2007; –; UMB; –

Prof Philip Maini; –; 3 to 24 April 2007; mathematical biology; USN; N. Joshi

Mr Sergei Haller; Justus-Liebig-Universität, Gießen; 16 January 2006 to 11 May 2007; algorithmic methods for lie groups; USN; S. Murray

Mr Henrik Baarnhielm; Queen Mary College, London; 1 April 2007 to 16 May 2007; group theory algorithms; USN; J.J. Cannon

Dr Ruth Baker; University of Oxford; 4 December 2006 to 25 May 2007; –; UMB; –

Dr Alex Kiteav; Steklov Mathematical Institute; 24 January 2007 to 25 May 2007; singularities and other properties of integrable systems; USN; N. Joshi

Serge Kruk; Oakland University; 16 January 2007 to 30 May 2007; –; UMB; –

Dr Willem de Graaf; Universita Di Trento; 9 April 2007 to 8 June 2007; computational group theory; USN; J.J. Cannon

Professor Phil Howlett; University of South Australia; 8 January 2007 to 30 June 2007; –; UMB; –

Dr Yan Wang; University of South Australia; 15 January 2007 to 30 June 2007; –; UMB; –

Inessa Epstein; University of California; 15 January 2007 to 31 July 2007; –; UMB; –

Prof Buyung-Moo Kim; Chungju National University; 31 July 2006 to 31 July 2007; integral theory; USN; D.E. Taylor

Dr Toshio Ohnishi; Institute for Statistical Mathematics, Tokyo, Japan; 5 Feb 2007 to 31 July 2007; –; USQ; Dr Peter Dunn

Dr Eric Badel; INRA (National French National Institute for Agricultural Research): Wood Material Laboratory (LERMAB) – Nancy, France; February–November 2007; –; QUT

Honorary Fellows: call for nominations

In the *Gazette* Vol. 33 No. 1, March 2006, pp. 69–70, the Rules for Honorary International Fellowship of the Australian Mathematical Society are listed. (See also http://www.austms.org.au/Publ/Gazette/2006/Mar06/austmsnews.pdf.)

In accordance with Rule 4(a) I hereby call for nominations. These should be sent electronically to secretary@austms.org.au before the end of June.

AustMS Accreditation

The secretary has announced the accreditation of:

- Associate Professor Ian R. Doust of the University of New South Wales as an Accredited Fellow (FAustMS);
- Dr Andrew Mathas of the University of Sydney as an Accredited Fellow (FAustMS);
- Dr Adam Rennie of the University of Copenhagen as an Accredited Member (MAustMS).

Officers of Council

Nominations are invited for the following Officers for the Session commencing after the Annual General Meeting to be held in September 2007:

One Vice-President and one President-Elect

Note. According to Paragraph 34 (i) of the AustMS Constitution, after the AGM in September 2007, Professor P.G. Hall will continue in office as the President, and Professor M.G. Cowling steps down as Immediate-Past-President, and is not eligible for immediate re-election as a Vice-President.

According to Paragraph 34 (ii), Professor N. Joshi steps down as Elected Vice-President, and is not eligible for immediate re-election to that office.

According to Paragraph 34 (iii), the positions of Secretary and Treasurer will be appointed by Council at its September 2007 meeting.

The present Officers of the Society are:

President: P.G. Hall	Immediate-Past-President: M.G. Cowling
Vice-President: N. Joshi	Secretary: E.J. Billington
Treasurer: A. Howe	

Ordinary Members of Council

The present elected Ordinary Members of Council are:

(1) Members whose term of office expires in mid-2007
J. Denier; P. Trotter
(2) Members whose term of office expires in mid-2008
P. Cerone; L. Jennings; A.J. van der Poorten
(3) Members whose term of office expires in mid-2009
A. Hassell; G. Prince; H.B. Thompson

Accordingly, nominations are invited for two positions as Ordinary Members of Council, who shall be elected for a term of three consecutive sessions. Note that according to Paragraph 34(iv) of the Constitution, J. Denier and P. Trotter are not eligible for re-election at this time as Ordinary Members. Paragraph 35 of the Constitution requires that the elected Officers and elected members of Council shall include residents from all the States and the ACT. Accordingly, nominations for the two Officers and two Ordinary Members must include members from Tasmania and from South Australia.

To comply with the Constitution (see Paragraphs 61 and 64), all nominations should be signed by two members of the Society and by the nominee who shall also be a Member of the Society.

Nominations should reach the Secretary (whose name and address appear inside the back cover of the *Gazette*) no later than Friday 22 June 2007.

For the information of members, the following persons are presently ex-officio members of Council for the Session 2006–2007.

Vice President (Chair of ANZIAM):	P.G. Taylor
Vice President (Annual Conferences):	M. Varghese
Representative of ANZIAM:	W. Summerfield
Public Officer of AustMS and AMPAI:	P.J. Cossey
Chair, Standing Committee on Mathematics Education:	F. Barrington
AustMS member elected to Steering Committee:	J.H. Rubinstein

Editors: B. Loch/R.G. Thomas (Gazette)
A.S. Jones (Bulletin)
R. Moore (Electronic Site)
M.G. Cowling (Journal of AustMS)
M.K. Murray (Lecture Series)
C.E.M. Pearce (ANZIAM Journal)
A.J. Roberts (ANZIAM Journal Supplement)

The Constitution is available from the Society's web pages, at
http://www.austms.org.au/AMSInfo/Const/amsconst.html

Elizabeth J. Billington
AustMS Secretary

The Australian Mathematical Society

President:	Prof. P. Hall	School of Mathematics & Statistics University of Melbourne VIC 3010, Australia. halpstat@ms.unimelb.edu.au
Secretary:	Dr E.J. Billington	Department of Mathematics University of Queensland QLD 4072, Australia. ejb@maths.uq.edu.au
Treasurer:	Dr A. Howe	Department of Mathematics Australian National University ACT 0200, Australia. algy.howe@maths.anu.edu.au
Business Manager:	Ms May Truong	Department of Mathematics Australian National University ACT 0200, Australia. office@austms.org.au

Membership and Correspondence

Applications for membership, notices of change of address or title or position, members' subscriptions, correspondence related to accounts, correspondence about the distribution of the Society's publications, and orders for back numbers, should be sent to the Treasurer. All other correspondence should be sent to the Secretary. Membership rates and other details can be found at the Society web site: http://www.austms.org.au.

Local Correspondents

ANU:	J. Cossey	Swinburne Univ. Techn.:	J. Sampson
Aust. Catholic Univ.:	B. Franzsen	Univ. Adelaide:	D. Parrott
Aust. Defence Force:	R. Weber	Univ. Ballarat:	P. Manyem
Bond Univ.:	N. de Mestre	Univ. Canberra:	P. Vassiliou
Central Queensland Univ.:	R. Stonier	Univ. Melbourne:	B. Hughes
Charles Darwin Univ.:	I. Roberts	Univ. Newcastle:	J. MacDougall
Charles Sturt Univ.:	J. Louis	Univ. New England:	I. Bokor
CSIRO:	T. McGinnes	Univ. New South Wales:	M. Hirschhorn
Curtin Univ.:	J. Simpson	Univ. Queensland:	H. Thompson
Deakin Univ.:	L. Batten	Univ. South Australia:	J. Hewitt
Edith Cowan Univ.:	U. Mueller	Univ. Southern Queensland:	S. Suslov
Flinders Univ.:	R.S. Booth	Univ. Sydney:	M.R. Myerscough
Griffith Univ.:	H.P.W. Gottlieb	Univ. Tasmania:	B. Gardner
James Cook Univ.:	S. Belward	Univ. Technology Sydney:	E. Lidums
La Trobe Univ. (Bendigo):	J. Schutz	Univ. Western Sydney:	R. Ollerton
La Trobe Univ. (Bundoora):	P. Stacey	Univ. Western Australia:	V. Stefanov
Macquarie Univ.:	R. Street	Univ. Wollongong:	R. Nillsen
Monash Univ.:	S. Clarke	Victoria Univ. Techn.:	P. Cerone
Murdoch Univ.:	M. Lukas		
Queensland Univ. Techn.:	G. Pettet	Univ. Canterbury:	C. Price
RMIT Univ.:	Y. Ding	Univ. Waikato:	W. Moors

Publications

The Journal of the Australian Mathematical Society

Editor: Prof. M. Cowling
School of Mathematics and Statistics
The University of New South Wales
NSW 2052
Australia

The ANZIAM Journal

Editor: Prof. C.E.M. Pearce
Department of Applied Mathematics
The University of Adelaide
SA 5005
Australia

Bulletin of the Australian Mathematical Society

Editor: Dr A.S. Jones
Bulletin of the Australian Mathematical Society
Department of Mathematics
The University of Queensland
QLD 4072
Australia

The *Bulletin of the Australian Mathematical Society* aims at quick publication of original research in all branches of mathematics. Two volumes of three numbers are published annually.

The Australian Mathematical Society Lecture Series

Editor: Prof. M. Murray
Department of Pure Mathematics
The University of Adelaide
SA 5005
Australia

The lecture series is a series of books, published by Cambridge University Press, containing both research monographs and textbooks suitable for graduate and undergraduate students.

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