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Gazette

David Yost and Sid Morris (Editors)

Gazette of AustMS, CIAO,
Federation University Australia, PO Box 663,
Ballarat, VIC 3353, Australia

Eileen Dallwitz (Production Editor)

E-mail: gazette@austms.org.au
Web: www.austms.org.au/gazette
Tel: +61 3 5327 9086

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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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Editorial

Sid and I welcome you to the first issue of the Gazette of the Australian Mathematical Society for 2020.

We cannot avoid mentioning Covid-19, whose shadow hangs over all of us. It provides a vivid example of exponential growth, more relevant than some of the artificial examples in our calculus textbooks. The most immediate effect specific to our community is the move to online teaching. There is a diverse range of models for this, which can be more labour intensive than some people realise. Another significant effect is the inevitable postponement, cancellation and virtualisation of many meetings in the coming months. Thus the conferences and courses section is noticeably shorter than normal.

This issue contains one conference report, from the AustMS meeting at the University of Adelaide in December 2018. From the more recent AustMS meeting at Monash University in December 2019, we have a report on the Debate, and another report on the Medal winners. Calls for nominations for the next round of Society Medals appear in the regular report from the Secretary, Deborah Jackson. Applications for the next round of WIMSIG support awards are called for in the column from Jessica Purcell, as well as announcement of the next WIMSIG conference.

Our occasional series of reflections from longstanding members of the society continues, with Rodney Baxter being interviewed by Geoffrey Campbell. Even earlier years of mathematics in Australia are brought to our attention in the Bibliography of Australian Mathematics by Graeme Cohen, which has recently been published by CSIRO.

The perennial issue of secondary mathematics standards is addressed in the regular Talking Teaching column, and in two separate articles by Diane Donovan and Jan Thomas. The latter points out a time in history when there was no shortage of mathematics teachers. Why cannot we return to this situation?

This time, Anthony Henderson and Ole Warnaar report on the most recent Simon Marais competition, which had almost a thousand participants from undergraduate students from Asia-Pacific universities.

In the Presidential column, Jacqui Ramagge addresses several important issues which should not be completely eclipsed by more recent news, particularly the evident politicisation of the timing of ARC grant announcements.

Other regular features are the book reviews, which resume after a brief gap, and the Puzzle Corner.

Finally, research continues at least at an individual level. Perhaps we should remember that Isaac Newton did his early work on differential calculus, mechanics, universal gravitation and optics working from home in Woolsthorpe, isolating himself from the Great Plague.

David Yost, Centre for Informatics and Applied Optimisation, Federation University Australia, Ballarat, VIC 3353. Email: d.yost@federation.edu.au

David Yost is a graduate of the University of Melbourne, the Australian National University and the University of Edinburgh. He has lived in eight countries and ten cities, returning to Australia in 2003, where he has now completed 16 years at Federation University Australia and its predecessor institution, the University of Ballarat, including a three-year period as Deputy Head of School. While most of his research is in functional analysis, he has lately been interested in convex geometry.

President's Column

Jacqui Ramagge*

My last column for 2019 seems almost a world away now. Since then we have seen a summer that has broken all sort of records. The bushfire season has been devastating. As well as the loss of life and damage to property and the environment, it provided an eerily precise confirmation of the projected impacts of climate change described in the 2008 Garnaut Climate Change Review. The Garnaut Review predicted we would see longer and more intense bushfire seasons with the impact likely to be noticeable as early as 2019. It said we could also expect extreme weather events, such as floods, to occur more often. This year was the second-ever hottest summer on record with an average temperature 1.88°C over the 1961–1990 average. Last year was the hottest year on record with an average temperature 2.14°C higher than the same benchmark. These are alarming figures.

This summer has left us with many questions. How much time do we have to implement mitigations that will prevent climate change from getting worse? Can we persuade governments that urgent action is required and will that make a difference? How can we better support our rural fire service? Some of our members are helping by either volunteering for the rural fire service or by helping to model various events. In some cases they are doing both. It is clear that we must all do whatever we can and that even small contributions can help.

At the end of last year I also mentioned concerns over increased politicisation of grant outcomes. After consultation, I sent a letter to the Australian Research Council (ARC) on behalf of the Society with a copy to our umbrella organisation, Science and Technology Australia (STA) on 5 December 2019.

> Dear Professor Sue Thomas,
>
> The Mathematical Sciences in Australia values funding from the Australian Research Council. Funding enables us to attract and retain excellent mathematical scientists for the future of the discipline in Australia, particularly early career researchers. On behalf of the Australian Mathematical Society, I wish to draw your attention to some concerns that our members have regarding the delays to the announcement of ARC outcomes this year and the manner in which those announcements were made.
>
> First, there are the Discovery Early Career Award (DECRA) applicants. They already wait 8 months for the outcomes, with many only finding out in November whether they have a job in January. The delay from approval to formal announcement this year was so long that Research Offices felt the need to reveal outcomes to candidates while they were still under embargo. We are very glad they did, because the added delay of spreading announcements over 11 days would

*Email: President@austms.org.au

have otherwise caused applicants extra anxiety. Delays in announcement of other Fellowships are of similar concern.

Then there are the Discovery Projects which were only announced yesterday. Almost all Discovery Project grant applications include a postdoctoral position for an early-career researcher. We want to attract and retain the best researchers we can, so we try to synchronise with the global market. The northern hemisphere hiring cycle runs October-February and by the time adverts for positions go live we will have missed most of it. Early career researchers will likely take jobs elsewhere in the intervening time, and who can blame them? We have made magnificent appointments in recent years, but if this pattern of announcements continues it will negatively impact the future of the discipline in Australia.

Aside from the impact on the discipline itself, we are also concerned by the tendency to use research outcomes for political expediency. Delaying the announcement of research outcomes delays the research itself; positions associated with the grant can't be advertised until the outcome has been announced. Moreover, the DECRAs were announced by government members of parliament even if the award was hosted in an electorate not held by the government. It is vital that research be, and be seen to be, completely independent of all external influences, including politics. To confound research outcomes with a particular brand of politics is as unacceptable as having research sponsored by vested interests. We ask that the practice of staged announcements be avoided in future.

We appreciate that these concerns may be better directed at the Minister directly, and we are keen to do so should you feel it is appropriate.

Yours sincerely,
Jacqui Ramagge

We received a response from STA within days. The response from the ARC took a little longer. However, when it did arrive, the ARC website had been updated. We are now able to advertise positions while the outcomes are still under embargo provided that we do not explicitly mention the grant in any advertising material. This is a major advance, although the issue of politicisation of the announcement of outcomes remains a concern. We were grateful that Adam Bandt MP, the Federal Member for Melbourne and now leader of the Australian Greens, proposed a bill that would stop the practice. Unfortunately, it was opposed by both major parties in the House of Representatives and the Senate and the bill did not pass.

On a somewhat happier note, we saw with relief that Murdoch University dropped a financial claim against our colleague Associate Professor Gerd Schröder-Turk. In a move that had been widely denounced as intimidatory, the institution had been suing for purported loss of earnings claiming that there was a drop in international student numbers as a direct consequence of his appearance with colleagues on a Four Corners program investigating international admissions and the wellbeing of international students. Another legal case regarding Gerd's membership of the University Senate is still pending, with Murdoch trying to remove Gerd from his position on Senate and Gerd invoking Western Australia's Public Interest Disclosure Act which provides legal protection for whistleblowers. We hope that the remaining issues can be resolved so that everyone can move on from what appears to have been a very distressing period in Murdoch's history.

Personally, over the last couple of months I have seen the UK system up close for the first time in 30 years and I am struck by a number of differences in the way the mathematical sciences have been faring in the UK compared to Australia. The first difference is in domestic undergraduate student enrolments. Both mathematical sciences and cognate areas such as computer science are seeing strong and sustained growth in the UK compared to stagnation and, in some cases, decreases in Australia. The second difference is in the level of government support for research in the mathematical sciences. For example, on 27 January the UK government announced £60 million of new funding per annum for the mathematical sciences including

- £19 million pa additional funding for PhD studentships, doubling current funding, moving to 4-year studentships as standard and offering 5-year funding for research associates to compete with the US and Europe.
- £34 million pa additional funding for career pathways and new research projects, including multi-institutional projects and programmes.
- £7 million pa additional funding for new PhDs/research fellows at the Heilbronn Institute (Bristol), and funding to increase participants/workshops by a third at each of the Isaac Newton Institute (Cambridge) and International Centre for Mathematical Sciences (Edinburgh).

I look forward to seeing similar levels of investment in the mathematical sciences in Australia although I fear I may be waiting quite some time.

Jacqui Ramagge is a Fellow of the Australian Mathematical Society with research interests across algebra, analysis, and geometry. She is currently Executive Dean of the Faculty of Science at Durham University in the UK.

Jacqui has won awards for: teaching from the University of Newcastle; research environment from the University of Wollongong; and contributions to mathematics enrichment from the Australian Mathematics Trust. She has served on various Australian Research Council panels for eight of the last ten years including as Chair of the Australian Laureates Selection Advisory Committee.

Letters to the Editors

The Rise and Fall of Mathematical Sciences in Australia

The opinions expressed here are those of the author and not necessarily those of the editors of the Gazette*, the Australian Mathematical Society or the Australian Mathematical Sciences Institute.*

Many readers of the *Gazette* are too young to remember Sputnik and the Menzies government. So, as a senior citizen who has always had an interest in politics, I will briefly explain the effect this had on mathematics in Australia. I will then discuss why mathematics in Australia is now in so much trouble and how difficult it is going to be to get back to what Australia had in the past. I particularly want to challenge what appears to be a growing perception that Australia has always had a shortage of mathematics teachers. It is wrong and it leads to notions of a problem that can't be solved. In writing this I am using my experience as a student at the University of Adelaide and subsequent career in the mathematical sciences as a teacher, educator and policy analyst. There are large gaps in educational history in Australia, particularly pertaining to the school teaching workforce. However, a time as a researcher for the Victorian Education department left me with documents that can be assumed to representative of Australia in the 1980s.

Australia has always had some great mathematics teachers and has produced some brilliant mathematicians and statisticians. The establishment of centres like MATRIX at Melbourne and the Sydney Mathematical Research Institute show the strengths of Australian mathematics. These are wonderful developments but they are only icing on a crumbling cake. The recent Programme for International Student Assessment (PISA) results show there are clearly problems with mathematics education[1]. The latest results come after a steady decline in Australian students' results in international tests from the mid 1990s. Australia has participated in the Trends in International Mathematics and Science Study (TIMSS) since 1993. In the early studies Australia outperformed both England and the USA, both countries that Australia has traditionally looked to in educational matters. By 2015 Australia was well below both England and the USA[2].

History

Why were Australia's international testing results so good when TIMMS and PISA were established? For a start there was a good supply of secondary mathematics teachers although this was becoming more of an issue. There were mathematics educators with a very strong discipline background in the university education

[1] https://www.oecd.org/pisa/Combined_Executive_Summaries_PISA_2018.pdf
[2] https://timss.bc.edu/isc/publications.html

faculties and the Colleges of Advanced Education (CAEs) where most of the primary teachers were trained. Mathematics pre-requisites were the norm for science and engineering and the mathematical content of those courses was explicit. When I was involved with a DipEd secondary course twenty years or so ago, it was assumed that a career change engineer was likely to be able to teach both mathematics and physics to year 11 or 12. This would be a dubious assumption for many modern engineering graduates.

Where did all these mathematics teachers and mathematics educators come from? One of the reasons was Sputnik, the world's first satellite launched by the Soviet Union in 1957. It had been comfortably assumed that Western science and technology were far ahead of the Soviet Union and the political reaction in the West caused an educational revolution. In Australia, the then Prime Minister Robert Menzies had already increased spending on universities and on scholarships. While Menzies was wary of the approach taken in the USA[3], as an undergraduate and postgraduate student at the University of Adelaide at the time, I found the focus was on science. It was a given that science students studied at least a year's mathematics. I think I was in my second year undergraduate before a quota was introduced for medicine.

Cohen's history of Australian mathematics details the expansion of university mathematics departments. I particularly like the quote from Professor Smith at UNE that "for the whole of the 1960s any student of reasonable ability ended up doing mathematics"[4]. The expansion of tertiary education begun by Menzies, reinforced by the response to Sputnik that made science popular, was the basis for a very strong mathematical sciences base in the universities, mathematically highly qualified educators in university and CAEs, and in schools.

There were additional factors ultimately affecting teacher supply. Many science students were supported with scholarships and there were large numbers of students bonded to become teachers. Again, studying science and mathematics was encouraged and support continued for those who wanted to complete honours before teaching. There was no differentiation in what was taught to either cohort so all studied at least a year of mathematics.

The net result of this was many teachers of mathematics and science from the bonded education students and from the science graduates who subsequently went into teaching. There were acute teacher shortages during the 1970s and many teachers were recruited from overseas. However, they were not usually mathematics teachers but teachers of subjects such as physical education and history. Talk to mathematics teachers who were in schools then and they confirm this. This is one of the aspects of Australian education where there appears to be little documentation. A recent ABC story shows there are some interesting stories that could be told[5].

[3]See, for example,
https://thestrategybridge.org/the-bridge/2016/10/4/responding-to-a-sputnik-moment

[4]Cohen, G. (2006). *Counting Australia In*. Halstead Press, p. 165

[5]https://www.abc.net.au/news/2018-12-06/american-teachers-in-australian-classrooms-during-the-1970s/10589850

One of the teachers was impressed that the principal from a small town had driven almost 400 km to Melbourne to pick him up. He joined eight other Americans.

The healthy situation in regard to teachers of mathematics is shown in a 1981–82 survey of mathematics teaching in Victoria[6]. It shows a very highly qualified teaching force and very little out-of-field teaching. As someone who had responsibility for the timetable in a secondary school around that time, having no out-of-field teaching is impossible. However, what little out-of-field teaching that did occur was usually done by teachers who at least had a science background. The school was not short of mathematics teachers, one of whom had a PhD, but fitting them into classes was another matter.

Cracks in mathematics teacher supply began to appear in the late 1980s. This was a period of large increases in post-secondary student enrolment and programs that encouraged more young women to pursue mathematics. The initial response by schools to the shortfalls was a decrease in class time for mathematics documented in a 1987 Victorian review[7]. It was at about this time that out-of-field teaching first started being mentioned. I was research officer for the 1987 Victorian review that identified this as an emerging issue as class time for mathematics had been reduced as far as it could. A Federal government review in 1989 noted:

> ...the Panel wishes to note the further development needs of a group of teachers that are somewhat unique to mathematics (and science), that is teachers who are currently teaching mathematics in secondary schools, but have not been fully qualified in mathematics or mathematics education[8].

Unfortunately, neither review was acted on and the serious situation documented in AMSI Occasional Papers 1[9] and 2[10] that now exists is not going to be easily remedied.

The crumbling cake

The crumbling cake begins with poorly trained primary teachers. The recent introduction of compulsory numeracy tests and minimum ATAR scores may help but there are no standards for what mathematics primary teachers should know. There are many existing primary teachers whose mathematical knowledge needs improving.

Primary teacher education is further compromised by the decline in mathematical knowledge in teacher education faculties. The mathematically very well qualified mathematics educators who came from the ranks of post-Sputnik mathematicians,

[6] https://amsi.org.au/wp-content/uploads/2020/02/1981-2_maths_staffing_report.pdf

[7] https://amsi.org.au/wp-content/uploads/2020/02/wg_1987_report.pdf

[8] Department of Employment, Education and Training. *Discipline Review of Teacher Education in Mathematics and Science*, 1989, p. 32

[9] https://amsi.org.au/?publications=amsi-occasional-paper-1

[10] https://amsi.org.au/?publications=amsi-occasional-paper-2-australian-secondary-mathematics-teacher-shortfalls-a-deepening-crisis

have largely retired. In the USA there are mathematical discipline requirements for enrolment in a PhD in mathematics education. There are no such requirements in Australia. Who is teaching mathematics to trainee primary teachers, and with what mathematical background, is largely unknown.

Inadequately trained primary teachers impact on students' readiness for secondary school. Unfortunately, students with gaps in their understanding of key mathematical concepts may then encounter one or more years with an out-of-field teacher. It is unlikely there will be special needs staff to offer extra assistance. The result is that not all students are getting the background or confidence to continue with the higher level mathematics courses. Further, many schools do not offer these courses. The number of students studying the higher level mathematics at Year 12 in 2017 was the lowest level recorded in more than twenty years[11].

What is crucial in the supply of secondary mathematics teachers is the number of students studying mathematics at university. That depends not only on the number of students studying higher level mathematics at Year 12 but universities offering a degree in mathematics. Some large city based universities with big teacher education enrolments do not offer a mathematical sciences degree, nor do some of the regional ones.

In the universities, the expansion of mathematics documented by Cohen slowed. There was a review of mathematics sciences in 1996 and the expectation at the time was that there were retirements coming and departments would be revitalised with new appointments. Instead a new government changed funding for universities and this seriously impacted on mathematics. Instead of new appointments and opportunities, there was a brain drain of many of Australia's top mathematical scientists and university departments contracted[12]. While there are now some very strong departments, some never recovered and, as noted above, some do not have an undergraduate degree in the mathematical sciences.

Then there is Technical and Further Education (TAFE). It is a sector that is largely ignored when discussing mathematics education. It should be an additional pathway for students to hone their mathematical knowledge for both trade careers but also to transition into tertiary qualifications. It requires teachers who have the very special skills to assist students who have missed out on key concepts and restore their confidence in dealing with mathematics. They also need a depth of mathematical knowledge that enables them to distil out the mathematics needed in particular professions and link it to their teaching. I knew a couple of teachers with these attributes in Footscray TAFE years ago but they moved on. I doubt they were replaced.

To summarise the crumbling cake:

- Poorly qualified primary school teachers in schools and inadequate guidelines for new teachers,

[11] https://amsi.org.au/?publications=year-12-mathematics-participation-in-australia-2008-2017

[12] https://www.austms.org.au/AustMath/lookfuture.pdf

- A serious shortage of secondary mathematics teachers, an ever declining pool of new teachers who tend to have less mathematics than in the past, and no coherent plan anywhere to address out-of-field teaching,
- A TAFE sector that seems to be largely ignored in discussions about mathematics education but is critical to business and industry.
- A decline in the mathematical background of mathematics educators in the education faculties, and
- Universities that do not have an undergraduate degree in the mathematical sciences.

Every year this situation continues, the impact on Australia's economic future will grow. That future is in a technological world that depends on a mathematically capable population. Yet TIMSS and PISA show a population becoming mathematically less capable. The immediate call for curriculum and assessment changes following the latest PISA results were a typical reaction, a distraction that does not address the interconnected issues above.

What can be done?

In looking back over my 30+ years of involvement in the politics of the mathematical sciences, I am struck by how much the mathematical community has done to promote the importance of mathematics and statistics. Many of the good things that have happened including programs for schools, centres of excellence and, especially AMSI, have come about with the commitment of funding from university departments, professional societies, business and government agencies. When I first became Executive Officer for the AustMS in the 1990s, one of the first things I had to do was arrange for some letterhead paper. The community now knows how to show a professional face. It has shown that it can collaborate across schools, research and industry. Getting widespread media coverage has been happening for years and it hasn't worked.

I can think of two occasions where a report received considerable media coverage and ultimately some results. One involved FASTS Occasional paper in 2000 and its follow-up in 2002. Dr Brendan Nelson was Minister for Education, Science and Training (2001–2006) and appointed Dr Thomas Barlow as his science advisor. Garth Gaudry and I met with Thomas in Sydney and shortly afterwards we had a meeting with the Minister. The net result of this was funding for the first AMSI Summer School and subsequently the opportunity for AMSI to bid for ICE-EM. A remarkable aspect of this was that AMSI had just been established with funding from a state Labor government. The second occasion involved the Review of Mathematical Sciences in 2006. A key recommendation was for a change in the funding of mathematical sciences. When nothing happened an open letter to the Prime Minister was organised and eventually the funding model was changed. However, the then Minister, Julie Bishop, did not specify that the increased funding be used for mathematical sciences and it did not have the impact it should have had.

These are not particularly reassuring examples and clearly there have been other programs, typically 3–5 years duration, especially in school education. It is obvious that the mathematical sciences need a coherent strategy that takes a long term approach over a 10- to 20-year timeframe. However, that is not the way things are done in Australia. About the only government program that has had longevity is Teach for Australia[13], first introduced by Julia Gillard and used by all governments since as supposed proof that they are doing something. There have been few mathematics teachers come from this program. The dollar cost per graduate teacher is huge and the retention rate is poor. There are other programs suggested both by AMSI in the Occasional Papers and the Grattan Institute that would very likely be better value.

There is nothing simple about solving Australia's mathematical problems. Further the mathematical community does not always respond to new threats. Back when I was a teacher educator I asked a new DipEd intake how many of them would be there if it was a two-year course. About half put up their hands. Yet that has happened with apparently no monitoring of the impact, especially in shortfall subject areas.

In 1996 I had a piece in the *Canberra Times* that discussed how the Menzies legacy was being strangled. More recently another writer in the same paper wrote: "The last prime minister who can claim that he made a real difference to science retired nearly 50 years ago. We need to have his mantle passed to someone with a plan"[14]. I don't see much chance of that happening. There have been some enthusiastic and helpful Ministers for science over the years, including Brendan Nelson and Barry Jones, but not a Prime Minister who had the Menzies enthusiasm for both the Arts and Science in the universities.

The mathematical sciences need a plan

I was involved in the 1996, 2006, and 2016 national reviews of the mathematical sciences. Thanks to the work, especially that of Noel Barton and Ian Sloan, I believe the 1996 review had one very positive outcome. It created much greater awareness in the mathematical community of the importance of mathematical sciences to business, industry and society and that this could, and should, be used in gaining support. However, the review was completely derailed by changing government policies that were unanticipated and disastrous for mathematical sciences in the universities.

The 2006 Review had the advantage of overseas experts whose contribution as outsiders was invaluable. Their statements concerning the perilous state of Australian mathematical sciences received attention from both sides of politics

[13] https://teachforaustralia.org/2019/10/18/annual-report-2018/

[14] https://www.canberratimes.com.au/story/6064147/australia-should-invest-in-science-to-create-a-new-smart-economy/

and huge media coverage. Even so, as mentioned above, it took an open letter to the Prime Minister before there was even a limited response.

The 2016 Review had a very inclusive process and had many recommendations that overlapped with those of 2006. If it had a weakness it was that there were no outside experts that so helped the profile of 2006.

The weakness for both the 2006 and 2016 Reviews was in proactive long-term follow-up. The 2006 review set key performance indicators and for a few years there was some reporting against them. The 2016 Review was to be monitored through the Academy's National Committee for Mathematical Sciences. It may be happening but I would question whether this is appropriate as it excludes many of the people, and therefore expertise, of many of those involved in its creation. The community puts considerable time and money into reviews. The same effort is needed to get them implemented.

I am going to suggest something that may cause a collective groan. The government won't come up with a plan covering the interconnected issues, so give them one. I suggest this be in the form of KPIs constructed initially from the 2006 and 2016 Reviews. I'm encouraged in suggesting this by the late Peter Hall's reaction to KPIs. He went from being very opposed to being very supportive. KPIs can be adjusted to take account of changes and eliminate the need for prioritising research, for example, over school mathematics.

I suggest this would be a worthy task for the Australian Council of Heads of Mathematical Sciences and would clearly be assisted by other documents such as the AMSI Discipline Profiles. It should not be a big document — the KPIs in the 2006 review occupied two pages. However, it would give a framework for looking at the interrelated, and very serious, issues. Perhaps call it an ACTION PLAN.

Jan Thomas
Email: janthomas41@gmail.com

Jan Thomas is a graduate of the University of Adelaide (BSc Hons) and LaTrobe University (DipEd and BEd TESOL). She has been a secondary teacher, education consultant, teacher educator and Executive Officer for the AustMS and AMSI. She was president of the Australian Mathematical Sciences Council and board member and then vice-president of the Federation of Scientific and Technological Societies (FASTS, now Science & Technology Australia, STA). With Tony Guttmann, she wrote the business plan for the establishment of AMSI. She was involved in the 1996, 2006 and 2016 reviews of the mathematical sciences in Australia. She was the first woman to be made a life member of AustMS and has been awarded an OAM and AMSI medal.

Peter M. Higgins*

A Diophantine trick

Welcome to Puzzle Corner 61 of the *Gazette* of the Australian Mathematical Society. In this first section I will introduce: "A Diophantine Trick". After that I will give a solution to Puzzle Corner 60 on "More than one way to skin a mathematical cat".

I would be happy to receive your solutions to Puzzle Corner 61 not later than 21 April 2020. The email address for solutions is austmspuzzles@gmail.com. Any particularly interesting solutions will be mentioned in the next Puzzle Corner.

Diophantus is one of the more celebrated mathematicians of antiquity. He is forever tied to Fermat's Last theorem through the 1637 marginal annotation in a copy of his *Arithmetica* where Pierre de Fermat scribbled his famous claim. His life though is extremely obscure. We only know for certain that he lived in Alexandria during the period from 150 CE to 350 CE. (Wikipedia claims to be quite confident he lived some time between 201 CE and 299 CE.) We do however know how long he lived as someone in the 5th century left behind this riddle, which all Greek children know from their school days. Dipohantus lived one sixth of his life as a child, one twelfth as a youth, and one seventh as a bachelor. Five years after his marriage, a son was born who lived only half as long as did his father and died four years before him. How long was the life of Diophantus? (The solution of the underlying linear equation is 84 years.)

Diophantus displayed a recognizably algebraic approach to equations involving unknowns. In contrast to the life span riddle, his problems were difficult and the explanations offered were idiosyncratic, betraying little development of general techniques. Nonetheless some useful ideas may be gleaned from their solution. John Stillwell, in one of his excellent books *Mathematics and its History*, gives the following example, taken from an intermediate source (Heath, 1910).

Problem 1. Find a second *rational point* (a point with both coordinates rational) on the curve C given by the equation:

$$x^3 - 3x^2 + 3x + 1 = y^2$$

by finding the intersection of C with its own tangent from the more obvious rational point on C.

Problem 2. Explain why this approach works.

*Email: peteh@essex.ac.uk

Solution to "More than one way to skin a mathematical cat"

The problems represented three different ways of showing that

$$\arctan 1 + \arctan 2 + \arctan 3 = \pi.$$

1. First we note that each the three angles θ lies in the range $0 < \theta < \frac{\pi}{2}$ so the sum S on the left of our equation certainly lies in the interval $(0, 2\pi)$. Next take the tan of the first two terms:

$$\tan(\arctan 1 + \arctan 2) = \frac{1+2}{1-(1)(2)} = -3.$$

Now we may apply tan to the sum on the left of our sum:

$$\tan((\arctan 1 + \arctan 2) + \arctan 3)$$
$$= \frac{\tan(\arctan 1 + \arctan 2) + \tan(\arctan 3)}{1 - \tan(\arctan 1 + \arctan 2)\tan(\arctan 3)}$$

and we now see the numerator is 0. Hence $\tan S = 0$ and since $0 < S < 2\pi$ we get $S = \pi$.

Alternatively, almost everyone knows that $\arctan 1 = \frac{\pi}{4}$ and for the other two terms we have

$$\tan(\arctan 2 + \arctan 3) = \frac{2+3}{1-(2)(3)} = \frac{5}{-5} = -1$$

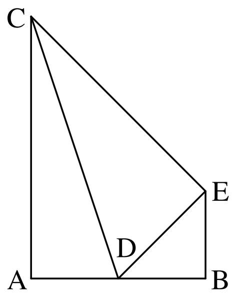
and so it follows that $\arctan 2 + \arctan 3 = \frac{3\pi}{4}$, and we are home.

2. The trick here is to take a trio of complex numbers such that the tangents of their arguments are respectively 1, 2, and 3. The simplest to use are $1+i$, $1+2i$, and $1+3i$. Then we have

$$(1+i)(1+2i)(1+3i) = (-1+3i)(1+3i) = (3i)^2 - 1^2 = -9 - 1 = -10.$$

The product is a negative real number, which therefore has a complex argument of π. Equally the argument is the sum of the arguments of the terms in our product, which is to say

$$\arctan 1 + \arctan 2 + \arctan 3 = \pi.$$



3. In the diagram take $AD = DB = BE = 1$, $AC = 3$ with $\angle DBE$ and $\angle DAC$ both right angles. We then see that $\angle EDB = \frac{\pi}{4} = \arctan 1$ and $\angle ADC = \arctan 3$. It remains to convince ourselves that the middle angle, $\angle CDE$, is equal to $\arctan 2$, as these three angles together comprise a straight angle of π. By Pythagoras, $CD^2 = 1^2 + 3^2 = 10$. By considering the line through E parallel to AB we may observe that $\angle CED = \frac{\pi}{4} + \frac{\pi}{4} = \frac{\pi}{2}$. Applying Pythagoras to the resulting

triangle gives $EC^2 = 10 - 2 = 8$. Hence $\tan(\angle EDC) = \frac{2\sqrt{2}}{\sqrt{2}} = 2$, which is to say this middle angle is indeed $\arctan 2$.

Peter Higgins is a Professor of Mathematics at the University of Essex. He is the inventor of Circular Sudoku, a puzzle type that has featured in many newspapers, magazines, books, and computer games all over the world. He has written extensively on the subject of mathematics and won the 2013 Premio Peano Prize in Turin for the best book published about mathematics in Italian in 2012. Originally from Australia, Peter has lived in Colchester, England with his wife and four children since 1990.

Talking Teaching

Edited by Diane Donovan*, Birgit Loch and Sid Morris*****

The opinions expressed here are those of the author and not necessarily of the Editors of this column or the Editors of the Gazette or the Australian Mathematical Society.

In the last *Gazette*, Sid Morris challenged us to consider the selection of, and therefore desirable qualities for, future high school teachers. Sid proposed:

> . . . that to be an excellent high school mathematics teacher one should be passionate about mathematics, passionate about teaching, and be able to teach well.

Are these also the qualities that make a good tertiary mathematics educator?

Certainly passion for mathematics and a passion for growing mathematical understanding in others are desirable. Most of us would add that an understanding of some mathematics at an in-depth level is desirable.

Given that academics are generally appointed for their knowledge base and their advancement of a branch of mathematics, this latter point is probably largely covered. Such mathematical knowledge is often complemented by a passion for research and a desire to inform others about the beauty and significance of their discoveries.

These qualities, coupled with a sound educational ethos, willingness to learn and use modern educational technology, and effective communication skills, go a long way towards characterising a good tertiary mathematics educator.

We would argue that "a sound educational ethos" is central to being a good tertiary mathematics educator and given the limited student/educator face-to-face time the other qualities are not enough.

We hear you ask "What is a sound educational ethos?" Here are some of our thoughts.

We would all agree that knowledge of mathematical theory is extremely important, along with the skills of logical and analytical thinking, but it must be coupled with the following.

A good mathematics educator should:

- go beyond focussing on content;
- structure learning experiences to increase a student's ability to problem solve and argue analytically. To do this, educators need to focus on the sequencing of topics, the structuring of examples, student exercises and discussions so that there is a progression of ideas that elucidate connections and culminates in a comprehensive understanding that advances the knowledge base;

*Email: dmd@maths.uq.edu.au;
**Email: B.Loch@latrobe.edu.au;
***Email: morris.sidney@gmail.com

- demonstrate how complex problems can be decomposed into constituent pieces, each being resolved by drawing together the threads of existing knowledge to build well-reasoned arguments;
- recognise which topics the students will find challenging and provide extra support for those;
- explain how the topics studied are relevant to, and of significance to, further study and the student's future.

It is crucial to devote time to developing understanding as well as advancing skills, not just the delivery of content. But let us consider what often happens in practice.

At the start of primary school much effort is invested in ensuring students understand basic number systems and arithmetic operations. This is taught in a very concrete way with an emphasis on understanding. These approaches are repeated across a large number of topics including fractions.

But what happens between age 12 and 18, and how do we teach mathematics at a tertiary level? Under the guise of ensuring students are exposed to a large number of topics we often given them a recipe, for say differentiation and integration, rather than an understanding of the ideas, why they work, and what techniques are useful and how we can apply the same fundamental methods to other ideas.

It is our belief that a good tertiary mathematics educator is prepared to invest time and effort into moulding their students so they may grow their analytical thinking skills and recognise how and when to apply them.

Diane is AustMS Vice President, Learning and Teaching, a Fellow of the Australian Mathematical Society, a Foundation Fellow of the Institute of Combinatorics and its Applications and a Life Member of the Combinatorial Mathematical Society of Australasia. She has broad experience teaching mathematics across the secondary and tertiary sectors, as well as being an active researcher publishing widely on educational matters, combinatorial mathematics and applications of mathematics. She has been a Chief Investigator on research grants including an Australian Learning and Teaching Council Grant to develop a Professional Development Program for the Mathematical Sciences.

Sid Morris has taught mainstream and service mathematics and computing courses to classes of up to 500 students at 12 universities on 4 continents at all undergraduate levels. His online text, accompanied by videos, is used in over 100 countries, and is translated into 8 languages. The facebook group of readers of his book has 8,000 members. He has published internationally 5 other undergraduate and advanced books and served as chair and member of university-wide teaching and learning committees.

Australian Mathematical Society Awards

The Society's major awards were presented on 3 December 2019, at the opening session of the 63rd Annual Meeting, held at Monash University.

At the conference dinner on 5 December, the BH Neumann prize for the best student talks was awarded.

Australian Mathematical Society Medal 2019

Awarded to Associate Professor David Harvey

Jacqui Ramagge and David Harvey (photo: Mark McGuinness)

David Harvey is a computational number theorist at the University of New South Wales. His work has focused on fast algorithms for computing quantities of interest in number theory, such as zeta functions, as well as fast algorithms for fundamental computational operations such as integer multiplication. His first major result was an average polynomial time algorithm for finding the zeta function of a hyperelliptic curve: Counting points on hyperelliptic curves in average polynomial time, Annals of Mathematics, 2014. This was generalized to more general varieties in Computing zeta functions of arithmetic schemes, Proceedings of the London Mathematical Society, 2015. This result improved algorithms that were previously exponential to (average) polynomial time, and has enabled numerical investigations of major conjectures in number theory such as the Birch–Swinnerton–Dyer conjecture in far bigger ranges than was previously possible. Harveys second major result, on the complexity of integer multiplication, was announced in March this year. The problem is to find the fastest algorithm for multiplying two n-digit numbers, in the limit of large n. The naive algorithm learned in primary school has complexity $O(n^2)$. This was improved during the 1960s, culminating with the famous Schönhage–Strassen algorithm of Schönhage and Strassen from 1971, which realised the bound $O(n \log n \log\log n)$. They also conjected that the best possible complexity bound for multiplication should be $O(n \log n)$. Between 2007 and 2016, progress was made on this conjecture, with a 2016 result of Harvey with Hoeven and Lecerf the state of the art at that time. In March 2019, Harvey and van der Hoeven announced a new multiplication algorithm achieving the conjectured $O(n \log n)$ upper bound, which would settle this part of the almost 50-year-old Schönhage–Strassen conjecture. (The paper is still under review at a journal, but all referees seem very confident of the correctness of this result.) This remarkable result attracted considerable media attention, with news reports, interviews and articles appearing in mainstream outlets such as New Scientist, BBC World Service, The Australian, Le Monde, Quanta magazine and Triple J.

Gavin Brown Prize for 2019

Awarded to the paper:

Botev, Z.I., Grotowski, J.F. and Kroese, D.P. (2010). Kernel density estimation via diffusion. *Annals of Statistics* **38**(5), 2916–2957.

Jacqui Ramagge, Zdravko Botev and Joe Grotowski (photo: Mark McGuinness)

The non-parametric estimation of a kernel density is a key problem in applied statistics, which therefore has a long history of intense research. One major problem of existing methods for this is having to assume some parametric reference distribution, generally a normal distribution. This paper develops a highly innovative and original method for non-parametric kernel density estimation which deals with this, and other, drawbacks of existing methods. The kernel from which the density estimator is constructed is taken to be the transition density of a general diffusion process which has a given limiting and stationary probability density. This results in a simple kernel estimator which has excellent accuracy in terms of asymptotic bias and mean square error without the need to specify a reference distribution for the bandwidth selection. An additional nice result of this diffusion estimation is that it deals with boundary bias. Finally, this new diffusion based estimation unifies many ideas from the non-parametric density literature in one conceptual framework. In a generous act, the authors have made software for their diffusion method (written in R) freely available. The assessors were uniform in their high praise for this paper, judging it to be a stunningly nice paper, with real conceptual and practical novelty, "exceptionally well written, "comprehensive, "authoritative" and an extraordinary paper, but "also wonderfully accessible". In summary, one assessor judged the paper to be an "outstanding, important and profound piece of work" for both statistical theory and practice. The paper well deserves the award of the Gavin Brown Prize.

Mahoney–Neumann–Room Prize for 2019

Awarded to the paper:

Magnani, V. (2013). Towards differential calculus in stratified groups. (2013). *J. Aust. Math. Soc.* **95**(1), 76–128.

Stratified groups form a quite general class of graded Lie group generalizations of Heisenberg groups. This is a long, complete body of work setting out a particular version of differential calculus with outcomes we can all recognise such as the inverse function theorem, implicit function theorem etc. The author has received praise for clear explanations of why proofs differ from the Euclidean case. It is considered a very solid body of work in a technically difficult but mathematical important area, and has achieved impact in the study of Heisenberg and (more generally) Carnot groups.

Award for Teaching Excellence (Early Career)

Awarded to Dr Belinda Spratt, Queensland Univrsity of Technology

Awarded for increasing student engagement in mathematical studies and improving student perception of mathematics, particularly for students from diverse backgrounds and those with mathematics anxiety. For developing innovative teaching techniques including on-line videos, quizzes and live coding which are supplemented by personalised feedback, resulting in a notable impact on her students learning experience and improved learning outcomes.

Belinda Spratt (photo: Mark McGuinness)

Belinda has played a key role in the development and delivery of mathematics service units in the Bachelor of Education, Bachelor of Science, and Master of Data Analytics. Her focus is on reducing mathematics anxiety in students with diverse backgrounds. In class, she uses live coding and problem solving with examples relevant to the students career aspirations. Outside of the classroom, Belinda has developed a blended and online learning approach that includes YouTube videos and online quizzes. Additionally, Belinda utilises learning analytics from her online resources to deliver personalised emails, tailored to each student's needs.

The 2019 B.H. Neumann Prize

This prize for the best student talk at the Annual Meeting was awarded jointly to Yudhistira Bunjamin (University of New South Wales) and Trang Thi Thien Nguyen (University of South Australia). Honourable mentions were given to Grace Garden (Australian National University) and Kelly Maggs (University of Sydney).

L to R: Grace Garden, Kelly Maggs, Yudhistira Bunjamin, and Trang Thi Thien Nguyen (photo: Mark McGuinness)

Australia Day Honours

Emeritus Professor Anthony Guttmann AM FAA FTSE

Tony Guttman, of the University of Melbourne, has been made a Member of the Order of Australia (AM) in the General Division, "for significant service to the mathematical sciences, and to education".

Tony is a leading researcher in equilibrium statistical mechanics, in particular discrete models of phase transitions and related combinatorial problems, and algorithmic complexity.

Tony is Director of the Centre of Excellence for Mathematics and Statistics of Complex Systems (MASCOS), a former President of the Australian Mathematical Society and founding Director of the Australian Mathematical Sciences Institute (AMSI).

We offer him our congratulations on this well deserved distinction.

An interview with Rodney James Baxter

Geoffrey B Campbell*

For the first 24 years of my life I had no intention of becoming an academic. Rather I expected to earn my living as an employee of some large company, such as the Iraq Petroleum Company that I joined in 1964 as a reservoir engineer. However, things panned out differently and I'm very happy that they did.

– *An Accidental Academic*, autobiography of Rodney Baxter [3]

1. Rodney Baxter's honours and awards

Year	Award
1975	Pawsey Medal, Australian Academy of Science, Canberra, Australia
1977	Fellow of the Australian Academy of Science, Canberra, Australia
1980	Boltzmann Medal, International Union of Pure and Applied Physics (IUPAP), New York, USA
1982	Fellow of the Royal Society of London, UK
1983	Thomas Ranken Lyle Medal, Australian Academy of Science, Canberra, Australia
1984	Doctor of Science, Cambridge, UK
1987	Dannie Heineman Prize for Mathematical Physics, American Physical Society
1992	Royal Society Research Professor at Cambridge
1994	Harrie Massey Medal and Prize, Australian Institute of Physics and Institute of Physics (UK)
2003	Centenary Medal, Australian Government
2006	Lars Onsager Prize, American Physical Society, New York, USA
2006	Lars Onsager Lectureship and Medal, Norwegian Society of Science and Technology, Norway
2013	Royal Medal, Royal Society London, UK

*Geoffrey Campbell is a published Australian mathematician and poet with affiliations to Australian National University and Deakin University. He completed his mathematics PhD under Rodney Baxter in 1998. He has worked in government roles over the past 20 years including for Prime Minister and Cabinet and for a Royal Commission.

Address: Mathematical Sciences Institute, The Australian National University, Canberra, ACT 0200. Email: Geoffrey.Campbell@anu.edu.au

2. Interview

Geoff: And so, there you were, a non-academic at 24. Yet after receiving the 2013 Royal Medal, you're grouped with names such as Sir Andrew Wiles, Sir Roger Penrose, Francis Crick, Sir Michael Atiyah, Paul Dirac, Lord Rayleigh, James Joseph Sylvester, Arthur Cayley, Sir Michael Faraday, George Boole and Sir John Herschel. And nearing your 80th birthday Conference at ANU, there's a strong case that your research has guided Statistical Mechanics and many related topics into a new world.

Rodney: You're too kind, but I'm certainly glad I returned to being an academic. I've enjoyed my work in a way I couldn't have done if all my research was directed.

Geoff: Thanks Rodney for agreeing to this interview. You were born in 1940 in wartime England. Do you think that war impacted your first years of school at Bancrofts and later at Cambridge? I mean, did World War 2 in London have an impact on your motivation or was it a family upbringing thing?

Rodney: It was an upbringing thing. In 1945, when I was five years old I didn't really understand the street parties to celebrate the 'Victory in Europe Day'. I thought it quite normal for bombs to fall and leave craters where houses had been, so I was a bit puzzled by the celebrations.

Rodney Baxter at a conference in Cairns in 2015

Geoff: You did well in the Trinity College scholarship entry exam. Not everybody could've done so.

Rodney: Somehow I got through that well. And post-war United Kingdom grants involved no fees and provided a living allowance. It meant I could study at Trinity College, live modestly but comfortably, and afford the occasional treat, like a smoke or a beer.

Geoff: Was there a lifestyle contrast in 1961, when you came from Cambridge to Australia?

Rodney: People in Australia were much more comfortable. For example, with a friend I could buy a car in Australia, and you needed a car in Canberra. I doubt that in England I could have done that. Canberra was like a country town then. University House was one of the few places to eat unless you wanted to pay the prices at the Hyatt. Canberra's population was just 50,000 and there were no traffic lights in Civic.

Geoff: You had been awarded a series of scholarships. Did your early English upbringing give you an edge; set you apart in some special way? Compared with say a US or Australian upbringing?

Rodney: I doubt it. I was encouraged to follow my interests. That's the point I was making that it was all free education. I was always interested in mathematics.

Geoff: You seemed to be channelled into physics. Do you think there was some reason?

Rodney: Yes there was. My parents were anxious that, if I went to Cambridge, I should study something 'useful', so they urged me to go into the applied side more. I did so, and it was probably the right field for me, but it was the wrong reason, as I ended up as an academic in theoretical physics, whereas there are probably more posts in pure mathematics than there are in theoretical physics.

Geoff: You had your office in physics, as well as an office in mathematics. There was an overlap?

Rodney: Yes, but I was always primarily in physics, up until my 2002 'retirement' when I quickly realised it was silly to still keep two offices at the ANU. I gave up the less convenient one in physics.

Geoff: Your mode of researching seemed to be, you intuitively had a hunch, then followed it with calculations, choosing an apt 'way in'.

Rodney: No, usually the hunch is based upon evidence. Well, one example is the hard hexagon model[1]. What happened there was that Metcalf and CP Yang (brother of CN Yang) had performed a numerical calculation of the entropy of the hard hexagon model and observed that to four figures it was 0.3333, so conjectured that it might be exactly 1/3. I knew from experience that my corner transfer matrix method could probably provide greater accuracy, so I suggested to my student Shiu Kuen Tsang that she numerically calculate the eigenvalues. We quickly obtained 12 figures of accuracy and observed that the answer was certainly not 1/3, rather it began 0.333243 . . . .

That would have been the end of the matter if I had not also noted that there was a remarkable pattern in the eigenvalues, suggesting that they were all integer powers of the same number. Patterns like that don't occur without a reason. If

[1] The reader is referred to the original paper [4].

you take a matrix and calculate its eigenvalues you usually get what appears to be a set of arbitrary numbers.

Geoff: And that was something you had observed that with other models?

Rodney: Well, I had observed it, but in the case of the eight-vertex model, I saw it after I had already solved it. It was after I had solved the eight-vertex model and started working on corner transfer matrices. They gave me the clue that something special was happening with the corner transfer matrices of the eight-vertex model. They had that sort of property. And that way I was able to calculate the order parameters of the eight-vertex model and the spontaneous magnetisation and the spontaneous polarisation.

Geoff: And often the proof of the magnetisation comes later than the solving the model proof. For example, Lars Onsager in 1944 solved the Ising Model then announced a few years later the magnetisation for it.

Rodney: Yes, about five years later.

Geoff: And it wasn't published straight away.

Rodney: That's correct. In fact Onsager announced his result in 1949 at a conference in Florence, and he had derived it; it wasn't a conjecture, but he didn't publish it because he felt he'd been pipped at the post, so nobody could see how he'd done it.

I think what happened was that he and Bruria Kaufman derived it, they showed their workings to a mathematician. For some reason they seemed to feel he'd taken over the technique so they didn't publish their derivation. It remained a conjecture only in the sense there was no published result. Then in 1952 CN Yang published a different, and much more complicated, derivation. He announced that it had been six months' solid work to do it — the longest sum he'd ever done!

Geoff: Yang later got a Nobel Prize?

Rodney: Yes, but not for that. CN Yang and TD Lee received the 1957 Nobel Prize in Physics for their 'weak parity conservation' violation theory. In 1967 Yang found a consistency condition for a one-dimensional factorized scattering many body system; the equation now known as the Yang–Baxter equation.

Geoff: After he and you, of course.

Geoff: Seemingly important moments in your academic career from my reading about you, are the PhD years at ANU in the 1960s and the post-doc time at MIT in the late 1960s.

Rodney: We didn't use the term 'post-doc' back then and I dislike it. In 1965 I went back to the ANU from Iraq Petroleum as a Research Fellow, and doubt if I would have done so as a post-doctoral student. I felt my student days were behind me. At MIT I was first a lecturer, then an assistant professor, in the Mathematics Department.

I quite liked what happened to me as a PhD student from 1961 to 1964 at the ANU. I was given my freedom to study, and I did do some useful work on exactly solvable models in one dimension. And then I came back as a research fellow. I solved the

'Percus-Yevick equation' in three dimensions for a system of hard spheres (see [1]), which turned out to be very good. It increased my citations immensely because it was used and quoted a lot by the engineers. So that was an example of being an applied mathematician. It was only an approximation as a closure relation to solve the Ornstein–Zernike equation. It wasn't really until I went to MIT that I got into the real stuff, with Elliott Lieb.

Geoff: I was going to ask you about Lieb, being one of many 'stand-out' individuals that influenced your career. Another was Ken Le Couteur, can you say a few things about him?

Rodney: Well, Le Couteur was my PhD supervisor at the ANU. He originally got me looking at S-Matrices in Field Theory, but I wasn't making much progress as I wasn't sure where it would go[2]. I had some ideas of what the properties were when looking at S-Matrices in the complex plane, to see what could be worked out from them, but we didn't really have enough information. Now, I realise that a physicist has the gift of looking at a problem and saying 'forget everything else, this is what matters most in the physics'. For instance, the 'Kirkwood approximation' I think in statistical mechanics is quite simple. The many body function product is a product of two-body functions. And that coupled with known relations gives you an integral equation to solve. And it's not bad, it's reasonably accurate. I, on the other hand, tried just playing mathematical games with that sort of idea — maybe the direct correlation function has some useful similar property. Years later when I actually tested it, it wasn't a good approximation at all. Both fitted the low temperature expansion to the same order, but whereas Kirkwood's did follow the curve fairly accurately, mine did not. Obviously I didn't have Kirkwood's physical understanding.

Going to work with Elliott Lieb in 1968 was a real game-changer for me. He had solved the six-vertex models. I was able to extend some of his work and ultimately found a way (via commuting transfer matrices and functional matrix relations) to solve the eight-vertex model. I also enjoyed teaching mathematics at MIT — it made me feel I belonged.

Geoff: Many physics models you dealt with seem combinatorial. For example, there was the colours on the chessboard model that reminds one of the old Major MacMahon Combinatorial Analysis book. The interesting departure from this is the physicality, such as with the hard hexagon model involving adsorption of helium.

Rodney: Yes, the hard hexagon model can be regarded as modelling helium adsorbed into graphite.

Geoff: So, that brings us to your exact solution of the hard hexagon model (see [4]). That really put your achievements 'on the map' internationally and proving something as well-known as the Rogers–Ramanujan identities by solving a statistical

[2]S-Matrices were abandoned in the 1970s in favour of what has become String Theory. Baxter evidently realized this limitation ahead of time.

mechanics model with physical interpretation really was a major 'wow' thing to do.

Rodney: I wondered often if Hardy had turned in his grave; Hardy the pure mathematician, who says proudly in one of his books that his mathematical works have no use in physical reality at all. This contrasted with his colleague Littlewood, who was doing war work, including in ballistics. So, I don't know that Hardy would have been very pleased to find that Rogers–Ramanujan identities (which Hardy knew well) cropped up in a practical, physical way.

Geoff: That reminds me. The book *Exactly Solved Models in Statistical Mechanics* [2], first published in 1982, is clearly your master work. The first 400 pages set the scene with one dimensional models, Ice-Type Models, the Square Lattice and Kagome Lattice Eight Vertex Models, Corner Transfer Matrices, and so on. Then, in Chapter 14, the whole narrative gets exhilarating when you describe the adventure in science you had with solving the 'Hard Hexagon and related Models'.

Rodney: That was originally the last chapter on the then solved models, so maybe it was a kind of climax, or maybe I was just relieved that the end was in sight!

Geoff: There is something 'larger than life' about your chapter 14 on solving the 'Hard Hexagon and related Models'. The gravity of the discovery draws in the big personalities. To start, you asked the great Kurt Mahler (then at ANU) regarding your rediscovery of the Rogers–Ramanujan identities. Then your worldwide announcements brought the famous George E Andrews to Canberra for a year, and he found new and related results, based on your work. Your theories 'broke new ground'. Now, physicists are coming to collect the pieces and carve them into new and beautiful things.

Rodney: The Russians particularly, led by Ludwig Faddeev, have taken up the Yang–Baxter relation. There are now many papers on various applications, some of them three-dimensional.

Geoff: I see the 2007 edition of *Exactly Solved Models in Statistical Mechanics*, has a Chapter 16 to cover some more recent developments such as the three dimensional models and the chiral Potts model. It would be nice to have further updates added to your book.

Rodney: No doubt it would, but someone else will have to do it. It would be a new book, preferably by a single author.

Geoff: I am now overjoyed to see that your work is inspiring a new generation of research, especially having attended the conference at ANU just after your 80th birthday 'Baxter 2020: Frontiers in Integrability' (see [5]). We were privileged to hear accounts from the likes of Barry McCoy, Paul Fendley, Charlotte Kristjansen, Bernard Nienhuis, and to also appreciate the trailblazing works of the younger researchers. Did these talks provoke new thoughts for you?

Rodney: I did find the talks stimulating: it's certainly good to see so many young people entering the field. I hope they find it as interesting as I've done and pursue successful careers.

Geoff: Also, in reading your biography, I've marvelled at some of the wonderful travels you've experienced over the many years, and especially where you could combine academic meetings with life experience. Is there a message for researchers in the professional and life experience balance?

Rodney: Well I think you should look outside your own academic speciality, not that I have a huge range of outside interests, but I have been interested in the theatre, and also in religion.

Geoff: Yes, I saw you took a Graduate Diploma at the Anglican theological school of Charles Sturt University in 2004. Also, there's your railway train interest.

Rodney: Well that's happened in my leisure time, way back, exploring trains. I look back on when I was in Australia in the 1960s, and all those New South Wales 'country lines' were still running. And I could have travelled on all of them, but I was too busy and not that interested. In 1962 or so I did lead a party on a trip on the line to Captains Flat. Even then, when I asked at the Queanbeyan railway station for ten return tickets to Captain's Flat the ticket seller seemed dumbfounded. "I've been working here for eight years, but no one's wanted to go to Captain's Flat", he replied. Now those lines are no longer there. When I retired, I started to travel on excursion trains, some of them quite comfortable, which travel on the railway lines that are still open, but not necessarily with a scheduled passenger service. On one trip we went to Adelaide that way, from Wollongong via Robertson, Cootamundra, Stockinbingal, Parkes and Broken Hill, travelling by day and overnighting at motels.

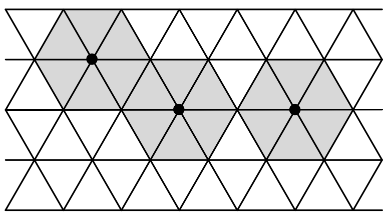
Geoff: So, do you have any advice for people taking up physics or mathematics today? Do you believe there is something you can offer the young aspirant?

Rodney: Well, you've only got one life to lead. Of course, you have to be realistic about your own abilities, but if you're really interested in something, do your very best to pursue it.

3. Rogers–Ramanujan identities, Baxter [2, Chapter 14]

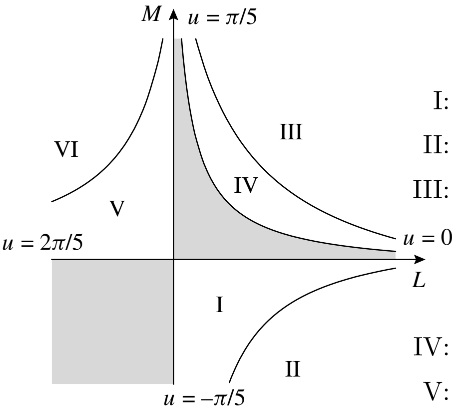
The hard hexagon model

A typical arrangement of particles (black circles) on the triangular lattice, such that no two particles are together or adjacent. The six faces around each particle are shaded: they form non-overlapping (i.e. 'hard') hexagons.



We find we need to consider six separate regimes (or phases), of which the first is most relevant here.

The six regimes



I: $\Delta > \Delta_c$, $q^2 < 0,\ -\pi/5 < u < 0$,
II: $0 < \Delta < \Delta_c$, $q^2 > 0,\ -\pi/5 < u < 0$,
III: $-\Delta_c < \Delta < 0$, $q^2 > 0,\ 0 < u < \pi/5$,

IV: $\Delta < -\Delta_c$, $q^2 < 0,\ 0 < u < \pi/5$,
V: $\Delta > \Delta_c$, $q^2 < 0,\ \pi/5 < u < 2\pi/5$,
VI: $0 < \Delta < \Delta_c$, $q^2 > 0,\ \pi/5 < u < 2\pi/5$.

The six regimes in the (L, M) plane, as listed at right. Shaded areas are unphysical, since

$$z = \frac{(1 - \mathrm{e}^{-L})(1 - \mathrm{e}^{-M})}{(\mathrm{e}^{L+M} - \mathrm{e}^{L} - \mathrm{e}^{M})}$$

and

$$\Delta = z^{-1/2}(1 - z\mathrm{e}^{L+M})$$

for $\Delta = \Delta_1$ gives z therein to be negative. Regimes I, III, V are disordered, II and VI have triangular ordering, IV has square ordering. The system is critical on the (I, II), (III, IV) and (V, VI) boundaries, where $|\Delta| = \Delta_c$ the values of u on the (L, M) axes are indicated.

When Regime I is examined, we arrive at the Rogers–Ramanujan identities:

$$\frac{1}{(1-q)(1-q^4)(1-q^6)(1-q^9)(1-q^{11})\cdots} = 1 + \frac{q}{1-q} + \frac{q^4}{(1-q)(1-q^2)} + \cdots + \frac{q^{n^2}}{(1-q)(1-q^2)\cdots(1-q^n)} + \ldots,$$

$$\frac{1}{(1-q^2)(1-q^3)(1-q^7)(1-q^8)(1-q^{12})\cdots} = 1 + \frac{q^2}{1-q} + \frac{q^6}{(1-q)(1-q^2)} + \cdots + \frac{q^{n(n+1)}}{(1-q)(1-q^2)\cdots(1-q^n)} + \ldots.$$

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A Bibliography of Australian Mathematics

Graeme L. Cohen*

I am very grateful to the editors of this *Gazette* for allowing me to describe here a bibliography of Australian mathematics that has just been published in the CSIRO's *Historical Records of Australian Science* (Cohen [2]). Its full title is "A bibliography of Australian mathematics to 1960 with observations relating to the history of Australian mathematics", and, as stated in the article's Abstract, it is largely an addendum to my book *Counting Australia In*, published in 2006 (Cohen [1]). The work consists of a main article of nine pages giving, first, the background to the compilation of the bibliography, and then a number of historical observations. Separately, the bibliography itself is issued as Supplementary Material to the main article, and is available as a free download.

Only books, independently issued pamphlets, and higher degree theses are included. (Journal articles are not included.) The Supplementary Material gives these in three Lists.

List 1 contains more than 200 books and pamphlets in chronological order of publication to the year 1900. List 2 continues this to 1960, with more than 350 titles, but in alphabetical order by author. The lists are described as "complete", but some exclusions had to be made. Schoolbooks are the prime example: there is little attempt in List 1 to include editions beyond the first, or books of answers to exercises that were issued separately, and List 2 ignores many schoolbooks altogether. Other exclusions concern ready reckoners and children's counting books, for example.

In List 3, I have attempted to include every thesis held by an Australian university library in mathematics or a closely related area (but not for higher doctorates if consisting very largely of bundled, previously published research papers). There are 127 theses listed. This answers some questions people have posed over the years, such as who earned the first PhD degree in mathematics in Australia? The answer is Charles Hamblin at the University of Melbourne in 1950. Philip Guest (in 1953) and Oliver Lancaster (1954), both from the University of Sydney, were next. The first relevant Masters degree by thesis in Australia was awarded in 1928. This was the MA won by Timothy Mulry at the University of Queensland.

This bibliography came about when I noticed that John Alexander Ferguson's superlative work had come on line in 2017. His *Bibliography of Australia* (Ferguson [3]) in seven volumes published over the years 1941 to 1969 (plus an addendum to the first four volumes, Ferguson [3], published after his death) aimed to capture every written piece of Australiana (according to his definition of that) up to 1900. I initially scanned all volumes, then moved to university and state libraries, most of which have their catalogues on line, and, only then, I discovered Trove, the

*Formerly: School of Mathematical Sciences, University of Technology Sydney, New South Wales. Email: g.cohen@bigpond.net.au

magnificent digital resource of the National Library of Australia. Nearly all of my bibliographic items will be found (not always very easily) on Trove. Ferguson gave a detailed commentary for many of his items, but this has not been attempted here—only very brief publishing details have been included, where they are known.

The Supplementary Material ends with an eleven-page index to the Lists.

I took the opportunity in the main article to write a few more pages on the story of Martin Gardiner, as I had found a few pamphlets of his that had not previously been mentioned. His life story had intrigued me since I came across his papers (in the *Proceedings* of the Royal Societies of Victoria and New South Wales and their predecessors, for example) and I told as much as I knew at the time of that story in *Counting Australia In*. Much of his diverse life, as a mathematician of some international standing, a competent surveyor, an unfulfilled educator, a bankrupt and a wife-beater, could be traced through newspaper records (available on Trove, again) and various birth and death certificates. His years in Australia were from the 1850s to the 1890s. I have also written up, for the first time anywhere, as much as I know of Walter Marsham Adams, who, in Melbourne in 1866, published *Outlines of Geometry; or, the Motion of a Point*. This is a very strange book which might be claimed as the first in Australia with an original point of view in mathematics. In the article, I quote from the humorous, damning reviews of the book in *The Sydney Morning Herald* and the Sydney *Empire*.

Other historical observations concern the most prolific authors (H. S. Carslaw in the University of Sydney, C. E. Weatherburn in the University of Western Australia, and G. H. Knibbs, the country's first Commonwealth Statistician), and the most prolific in terms of editions of a book (perhaps, K. E. Bullen and his *Theory of Mechanics*). There are numerous footnotes through the Lists offering further historical titbits.

Publication details for the bibliography are as below. I mention again that the Lists that comprise the actual bibliography can be downloaded separately and freely as Supplementary Material.

As I state in the article, I would be pleased to hear of any errors in the Lists, or omissions other than those that are intentional. Use my email address. Such errors or omissions are of course my own, and the Australian Mathematical Society has no responsibility for them.

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Who is responsible for falling mathematics standards in Australian schools?

Diane Donovan*

The PISA proficiency tests results clearly demonstrate that the ranking of Australian school students is declining across reading, mathematics and science (https://www.oecd.org/pisa/publications/pisa-2018-results.htm). In 2018, Australian students' mathematics performance was close to being ranked the lowest across OECD countries, with rankings of 20 or above on a decreasing scale of 1 to 26.

But who is responsible? It is easy to blame teachers, however the reality is that most early childhood teachers are not given adequate training in the foundations of mathematics and most mathematics classes are taken by non-specialist mathematics teachers. This, when coupled with a reduction in the number of hours devoted to the mathematics curriculum, is a recipe for a disaster.

The lack of recognition and support for highly proficient teachers is another area of concern. The Australian Mathematical Society is seeking to address this issue by supporting emerging tertiary educators through the AustMS Teaching Excellence Awards (Early Career). The 2019 recipient of this award was Dr Belinda Spratt, a lecturer in the School of Mathematical Sciences at Queensland University of Technology, and the 2018 award was given jointly to Dr Daniel Mansfield, a lecturer in the School of Mathematics and Statistics at UNSW and Dr Glen Wheeler, a lecturer in the School of Mathematics and Applied Statistics at the University of Wollongong. In each of these cases the recipients showed outstanding commitment to high quality mathematics education, supported by innovative use of technology.

Further analysis of students' mathematics performance in the 2018 PISA test indicates that the education system is not equipping Australian students with the necessary skills and knowledge to survive in a technological age. This test is designed to assess students' performance across 6 proficiency levels, testing their ability to reason mathematically and to use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena.

The fast pace of changing technology dictates that Australia graduates students that can perform at a higher level, showing a capability for advanced mathematical thinking and reasoning (level 6). However, it is also vital for both individuals and the country that all students can perform at the minimal level of identifying information and executing routine procedures and instructions in explicit situations (level 1).

*Mathematics, University of Queensland; Vice President, Learning and Teaching, Australian Mathematical Society. Email: dmd@maths.uq.edu.au

The Australian trade and health sectors require a workforce that can demonstrate proficiency in the fundamental topics of percentages, fractions and decimal numbers and can apply simple problem solving strategies (level 3). The ability to express these ideas in equations and formulae and to link these ideas with real world situations, such as business and finance (level 4), cannot be overstated. Indeed the Australian economy requires us to educate a large number of engineers and other professionals who have the capacity to apply these concepts to complex problems, working strategically with well-developed reasoning skills (level 5).

While it is fundamental that highly competent teachers are needed to educate all students, even at the lower levels, it is also important to educate the community about the value of having more school students studying higher level mathematics and the value of these students transitioning to tertiary mathematics programs. Further, a significant proportion need to return to the education sector thus ending the practice of out-of-field educators teaching mathematics.

By addressing these issues the community and the Australian Government can acknowledge the contribution of all teachers and the value of the discipline of mathematics to the economy.

Australian Mathematical Society Annual Meeting 2018

University of Adelaide
4–7 December 2018

Thomas Leistner*

The 62nd Annual Meeting of the Australian Mathematical Society was hosted at the North Terrace Campus by the School of Mathematical Sciences with administrative support from the Faculty of Engineering, Computer and Mathematical Sciences. The Meeting was preceded by the Early Career Workshop at West Beach (organised by Luke Bennetts (Adelaide) and Michael Coons (Newcastle)), the 6th Australian Mathematical Sciences Student Conference in the week before the conference, and the Women in Mathematical Sciences Dinner on the night before the conference.

The conference was very well attended with 301 participants from 22 countries, 254 from Australia, and with 71 female participants and 83 students.

The meeting was opened by the Pro Vice-Chancellor (Research Operations) Professor Michael Liebelt and with a Welcome to Country by Uncle Rod, followed by a video welcome address by the Minister for Education, the Hon Dan Tehan MP. This was followed by an address from the Vice President of the International Mathematical Union Professor Nalini Joshi (USydney) and by the presentation of awards by Professor Kate Smith-Miles: the Australian Mathematical Society Medal was awarded to Geordie Williamson, the George Szekeres Medal to Peter Taylor, and the Teaching Excellence Awards to Leesa Sidhu, Daniel Mansfield and Glen Wheeler. This was followed by talks of the awardees.

The 12 plenary lectures were given by 7 Australian and 5 international mathematicians, all internationally renowned and from a broad range of fields ranging from representation theory to climate modelling. Originally 13 plenary speakers had accepted our invitation, however Isabelle Gallagher had to cancel her participation one week before the conference. With her this would have been the first Annual Meeting with a majority of female plenary speakers; without her, we had 6 female and 6 male plenary speakers. The plenary speakers who presented were:

1. Renato Ghini Bettiol, City University of New York, differential geometry, Early Career Lecturer and speaker at the Early Career workshop;
2. Regina Burachik, UniSA, optimisation;
3. Josef Dick, UNSW, numerical analysis;
4. Etienne Ghys, École Normale Supérieure de Lyon, geometry and dynamics, public lecturer and and speaker at the Education Afternoon;
5. Manjunath Krishnapur, Indian Institute of Science, Bangalore, Probability;

*Conference Director Email: thomas.leistner@adelaide.edu.au

6. Joan Licata, ANU, geometry and topology;
7. Malwina Luczak, Melbourne, probability;
8. Hinke Osinga, University of Auckland, dynamical systems and numerical analysis, Hanna Neumann Lecturer and speaker at the Early Career Workshop and the Education Afternoon;
9. Nageswari Shanmugalingam, University of Cincinnati, potential theory and analysis on metric measure spaces;
10. Steven Sherwood, UNSW, statistics, climate dynamics, ANZIAM Lecturer;
11. Ngamta Thamwattana, Newcastle, mechanics;
12. Geordie Williamson, Sydney, representation theory.

In addition to the plenary talks, 234 talks were given in 18 special sessions, with some of the largest sessions comprising more than 20 talks. A key event at the conference was the Education Afternoon (on Wednesday — sponsored by AMSI) for which about 50 students and high school teachers attended to enjoy very exciting talks and activities, including a fascinating talk by Etienne Ghys about the mathematics of traffic jams. Most of the students and teachers stayed for the evening public lecture by Etienne Ghys, entitled "The shape of our planet Earth: a mathematical challenge!", which was full of interesting facts and entertaining anecdotes from the history of mathematics. This public lecture was another highlight of the conference. It was very well attended and finished with a lively discussion after the lecture.

Apart from the scientific highlights of the conference, several evening and social events took place. On the evening before the conference, the Women in Mathematics Dinner took place at The Playford in Adelaide. The event was funded by ACEMS and the ARC Georgina Sweet Laureate Fellowship, held by Professor Kate Smith-Miles and with about 110 participants it was fully booked. During the dinner we heard inspiring talks by the female plenary speakers and by South Australia's Chief Scientist Caroline McMillan.

Other social events were the opening reception on Tuesday night, the reception before the public lecture and the conference dinner at the National Wine Centre on Thursday night. During the conference dinner the Bernhard Neumann Prize for the best student talk was awarded to Maria Kleshina with an honourable mention given to Timothy Roberts. The Bernhard Neumann Prize Committee lead by Masoud Kamgarpour worked tirelessly to evaluate all of the over 80 student talks. Another very successful and entertaining event was the second edition of the debate, this time on the question whether or not mathematics is better done by computers than by humans, during which many serious and amusing opinions on the topic were discussed.

The detailed financial report for the meeting is being sent directly to Council.

In my view the 62nd Annual Meeting of the Australian Mathematical Society was a successful event and I would like to thank everyone who helped to organise it.

The 2019 Simon Marais Mathematics Competition

Anthony Henderson* and S. Ole Warnaar**

On 12 October 2019 close to a thousand undergraduate students from the Asia-Pacific region participated in the third edition of the Simon Marais Mathematics Competition (SMMC). As in previous years, the competition consisted of two three-hour sessions, each containing four problems chosen from a broad range of topics in mathematics, including algebra, analysis, combinatorics, number theory and probability. The problems for both sessions as well as fully worked-out solutions — except for the open problem B4(b) on the asymptotic enumeration of certain recursively defined sets of binary strings of length n — may be found on the SMMC website at https://www.simonmarais.org.

The competition organisers are pleased with the steady growth in overall participation numbers shown in Table 1. In 2019, India increased its lead over Australia as the country supplying the largest number of entrants, and there is every chance that the number of Indian universities in the competition will continue to grow.

More concerning is the gender imbalance among participants: see Table 2 for the gender breakdowns by country in the 2019 competition. Given that around 33% of Australian mathematics undergraduates are female, it is a shame that only about 20% of Australian SMMC entrants are female, a percentage which lags behind Malaysia, New Zealand and Hong Kong. Of course, the problem of under-representation of female students is not unique to the SMMC, and one would expect some flow-on effect from the gender imbalance in high school competitions such as the International Mathematics Olympiad. Nevertheless we urge all participating universities to encourage more of their female undergraduate students to enter this year's competition.

The winners' lists in 2019 were heavily dominated by participants from South Korea: the top three individual competitors and the top three pairs all came from that country. The first-placed individual, Jongwon Lee from KAIST (a former IMO gold medallist), and the equal first-placed pairs, Jeonghyun Ahn–Kyu Hyeon Choi and Junghun Ju–SeoYeon Yang from Seoul National University, all achieved the remarkable score of 50 out of a possible 56, a new record for the competition.

The university prize was won by the National University of Singapore, which narrowly beat The Chinese University of Hong Kong. The University of Melbourne ranked third and was, as in previous years, the best performing Australian university. It boasted the top Australian individual entrant Ilia Kucherov and the top Australian pair Michelle Chen–Zoe Schwerkolt.

*Sydney Mathematical Research Institute A14, The University of Sydney, NSW 2006.
Email: anthony.henderson@sydney.edu.au
**School of Mathematics and Physics, The University of Queensland, Brisbane, QLD 4072.
Email: o.warnaar@maths.uq.edu.au

Table 1. Participation in the Simon Marais Mathematics Competition for 2017–2019 (registered entrants who submitted at least one solution for marking)

	2017	2018	2019
Total entrants	459	891	971
Female	118 (25.7%)	180 (20.2%)	200 (20.6%)
Male	340 (74.1%)	711 (79.8%)	770 (79.3%)
Other	1 (0.2%)	—	1 (0.1%)
Individual entrants	217	355	393
Female	37 (17.1%)	59 (16.6%)	61 (15.5%)
Male	179 (82.5%)	296 (83.4%)	331 (84.2%)
Other	1 (0.5%)	—	1 (0.3%)
Pairs entrants	242	536	578
Female	81 (33.5%)	121 (22.6%)	139 (24.0%)
Male	161 (66.5%)	415 (77.4%)	439 (76.0%)
Other	—	—	—
Participating universities	33	50	50
Australia	14	15	13
China (Hong Kong)	4	5	6
India	1	9	12
Indonesia	—	1	—
Malaysia	7	7	7
New Zealand	4	6	6
Philippines	—	2	2
Singapore	2	2	2
South Korea	—	2	2
Thailand	1	1	—

Table 2. Gender breakdown of entrants in the 2019 Simon Marais Mathematics Competition by country

	Female	Male	Other	Total
All countries	200 (20.6%)	770 (79.3%)	1 (0.1%)	971
Australia	49 (20.2%)	193 (79.4%)	1 (0.4%)	243
China (Hong Kong)	30 (24.0%)	95 (76.0%)	—	125
India	54 (16.7%)	269 (83.3%)	—	323
Malaysia	36 (37.1%)	61 (62.9%)	—	97
New Zealand	11 (29.7%)	26 (60.3%)	—	37
Philippines	4 (18.2%)	18 (81.8%)	—	22
Singapore	13 (20.0%)	52 (80.0%)	—	65
South Korea	3 (5.1%)	56 (94.9%)	—	59

In addition to the usual prizes for top-ten individuals, top-ten pairs and top-three universities, there was a new category of prize in 2019. Thanks to a generous gift by the Stonehage Fleming company which was matched by the Marais family, prizes of $100 each were awarded to the 30 individual and 42 pairs entrants who topped their category at their own university and also met the top quartile cut-off score of 22 for individuals or 28 for pairs.

We wish to congratulate the prize winners, and thank all 971 entrants for participating and making the 2019 competition a success. We would also like to thank the local coordinators for their help in running the competition on the day, the members of the Problem Committee and Organising Committee for all of their hard work, the individuals who proposed competition problems, the competition markers, the Australian Mathematical Sciences Institute for providing logistical support and Luna Liu for running such a tight administrative ship. Special thanks are due to the Marais family for making the competition possible through their generous financial support and to Norman Do, who did a brilliant job in chairing the Problem Committee in the past three years, and who in 2020 is handing over this important task to Christopher Tuffley of Massey University.

Australian Mathematical Society Meeting 2019 Debate
Mathematics is discovered not created

Monash University
4 December 2019

Organiser: Daniel Horsley (Monash University),
Moderator: Simon Pampena (Standup Mathematician)

Speakers for

Asha Rao (RMIT University): Invited us to go on a journey out into the cosmos. But did we create the universe or did we discover it? “We create tools to understand mathematics.” If we go down to a nano scale with a micron microscope, we discover what is at the level. So when we think about mathematics we are discovering the ideas that are there and our understanding of this.

Michael Coons (University of Newcastle): Challenged the language of the negative argument. So challenged the definition of finding, noticing and that these are really discovering things not creating. Finding things in topology and other mathematics are fundamental to mathematics and what we do is really discovery. Discovery of the most beautiful results in mathematics is what we are all about as mathematicians. So Pythagoras is an example of a theorem that has been found and a proof by contradiction argument is about discovering the contradiction for instance the proof of infinitely many primes is a contradiction argument.

Barbara Maenhaut (University of Queensland): Mathematics is beautiful and it is the beauty of mathematics that we discover. So patterns are already there and we are discovering the beauty and explaining this. Yes we create some of the language around mathematics but the essence of mathematics is already there and we only discover it. When we have a result that we think is worthy of being published, we have discovered it. Australia existed before, just the same as Steiner triple systems existed and we are only discovering them and creating the language needed to describe the theory. “Mathematics is beauty and we discover the beauty every day in the work that we do.”

Speakers against

Julia Collins (Edith Cowan University): First we must decide what mathematics is. It is a study of patterns. But don’t we formalise patterns? We don’t just find them, we create them, and we do this by bringing our creativity to the study of mathematics. By way of example, the axioms of topology are not intuitive — they have been created not discovered. So in axiomatic mathematics we can set up lots of axioms but we chose the system of axioms and so we create them.

Benjamin Burton (University of Queensland): Reasoned that discovery is like finding a theorem putting a flag in it and then taking over. Ben reasoned that it is the joy of building mathematics, like you build a tower of blocks when you are a child. So we see these as creating things and not discovering things. We as mathematicians enjoy this process of creating the mathematics. He compared it to the creation of art and referred to creation of mathematics. For instance Donald Knuth's book *The Art of Computer Programming*. Mathematics is about putting together ideas in ways that show the beauty of the ideas.

Yann Bernard (Monash University): The truth is as stated by the 'against' side and not the 'for' side. He challenged the idea of beauty being important, suggesting this is boastful that we could find the essence of the world by discovering it — we do it by creating. He argued this by making the point that an apple on the front side is the representation of an apple, but not an apple. So we need to go beyond such representations and we create the maths to discover the phenomenon. So the opposition is making a classic mistake by saying that it is the discovery, we are creating maths because it did not exist before we created it.

Summing up

The moderator said that truth is outlawed. Asha summed up by saying Nature discovered us to create mathematics. Julia summed up for the 'created' side.

Negative got better clapping . . . negative wins.

Moderator (Simon Pampena): Took us through some weird and wacky ways to look at mathematics. It ended with a proof for Pythagoras' Theorem told with the music and voice-over of a Hollywood trailer that woke the crowd up to the possibilities of communicating mathematics.

The rough notes on the debate were taken by Diane Donovan

Book Reviews

Fundamental Fluid Mechanics and Magnetohydrodynamics*

Roger J. Hosking and Robert L. Dewar
Springer, Singapore, 2016, ISBN 978-981-287-599-0

This book takes us through chapters on Vectors and Tensors; Fundamental Equations; Basic Fluid Dynamics; Waves in Fluids; Magnetohydrodynamics (MHD); and MHD Stability Theory. Exercises appear at the end of every section. The level of the treatment is appropriate for postgraduate students in strongly mathematical disciplines who have already studied undergraduate courses on Partial Differential Equations (PDEs), and their interpretation and relevance in physical Mathematical Modelling. The book then presents a nicely structured, systematic, largely self-contained, and thorough, development of the main concepts, equations, and interpretation of mathematical fluid dynamics and magnetohydrodynamics (predominantly plasmas).

Both fluids and magnetohydrodynamics are fascinating areas in geophysics and astrophysics, and also appear in many human, laboratory and engineering applications, including fusion reactors. Importantly, both topics share many concepts and parallel mathematics so it makes good sense for the book to combine both.

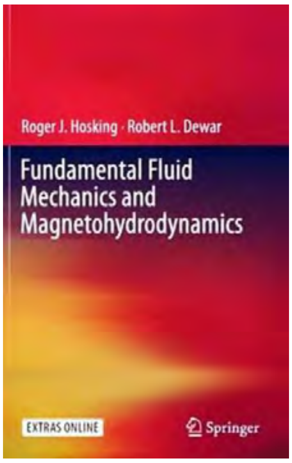
Chapter 1 on vectors and tensors introduces notation and reminds a reader of various vector and tensor properties, including the classic integral theorems used in the mathematical modelling of continuum mechanics. Also discussed is how given vectors and given tensors have different representations in different coordinate systems.

As is usual in physical problems, conservation principles are the foundation of the mathematical modelling by PDEs of continuum dynamics. Chapter 2 leads us, quickly and cleanly, through the mathematics of conservation of mass, momentum, and energy, and then the required closure by the dependence of the pressure field on velocity gradients appropriate for Newtonian fluids. It is then a straightforward step for the book to discuss the complexities of the effect of magnetic fields on the pressure, and the derivation of a magnetic induction PDE required for MHD.

Chapter 3 develops the mathematics and physics of fluid dynamics. It discusses ideal fluids, vorticity and irrotational flow, and the incompressible approximation, along with potential flow, Laplace's equation, boundary layers and Stokes flow. This is a good classic mathematical development done crisply and concisely.

Waves are a fundamental feature of the world around us: from sound we hear, waves we enjoy at a beach, to the propagation of weather systems across the Earth. Chapter 4 develops various mathematical approaches to characterising and

*http://dx.doi.org/10.1007/978-981-287-600-3 understanding waves in continuum mechanics, often using the examples of sound waves and water waves. In the rich possibilities of overall fluid flow in space there are a variety of parameter regimes for waves. This variety leads to various mathematical methods introduced in this chapter, including the basic Fourier superposition in uniform environments, short-wavelength (WKB-like) approximations, averaging methods, and weak solutions with shocks. Further, the chapter discusses the effect of waves on the background mean flow — an effect whose analogues are unfortunately often ignored in other fields when addressing cognate problems.



A steep increase in mathematical complexity occurs when progressing to the magnetohydrodynamics of Chapter 5. Nonetheless this book uses the kinship with the earlier fluid dynamics to ease the transition, with the aim to empower a reader to understand and address plasma physics, thermonuclear reactors, and the geophysical magnetic field and magnetosphere. One parallel is the existence of ideal MHD and its non-ideal modifications. The basics come from the Maxwell equations, and their invariants, as applied to conducting fluids and plasmas, and using a magnetic stress tensor. One useful concept discussed is the 'frozen-in' magnetic field, which leads on to the analysis of ideal MHD waves. More complicated physics then requires the mathematics of describing equilibria, possibly with special 'magnetic' coordinates, and leads to the mathematics of discontinuities in MHD as an analogue of shocks in a fluid.

The last Chapter 6 develops the mathematics and physical interpretation of MHD stability theory. In one way it is a tour-de-force of various MHD scenarios and the physics and mathematics that helps us to understand the complicated dynamics. Variational principles, the Calculus of Variations, provide useful mathematical methods to attack MHD problems in laboratory, astrophysics, and thermonuclear reactors. The approach is first clearly developed for ideal MHD scenarios such as the stability of cylindrical and toroidal flows. This chapter then extends the mathematics of the variational approach to illuminate instability in the non-ideal MHD that includes viscosity. With this they finish the book by addressing magnetic confinement and the Hall effect.

In summary, this is a quality book for postgraduate students needing a grounding on, or interested in, the applied mathematics and physics of magnetohydrodynamics.

A.J. Roberts
The University of Adelaide, SA 5005. Email: anthony.roberts@adelaide.edu.au

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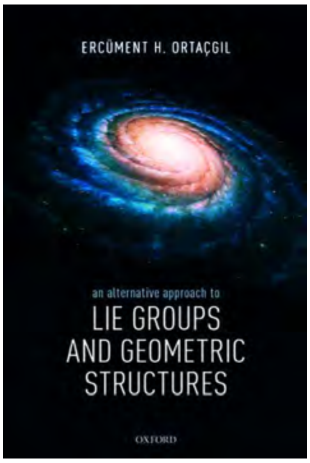
An Alternative Approach to Lie Groups and Geometric Structures

Ercüment H Ortaçgil
Oxford University Press, 2018, ISBN 978-0-19-882165-6

Continuous transformation groups and their associated algebras, now called Lie groups and Lie algebras, were introduced by Sophus Lie in 1870 in order to apply Klein's Erlangen programme to the study of symmetries of partial differential equations analogous to the way in which Galois theory of finite groups of permutations is applied to the study of symmetries of polynomial equations. But as we do, mathematicians soon ignored the applications and began the study of these topological and algebraic objects in their own right.



There are many ways of approaching the topic: one may begin with a differentiable manifold and impose a continuous group structure on it, or with a suitable group and construct a smooth manifold on it. When introducing the subject to students with a modest background in topology and linear algebra, one may begin with a few important matrix group examples such as $GL(n\,\mathbb{C})$ and its subgroups. Other approaches in the literature are to begin with an important result such as the solution to Hilbert's 5th Problem or the properties of 1-parameter subgroups.

The author of this work proposes an alternative approach, motivated by the geometric theory of partial differential equations and closer in spirit to the original works of Lie and Klein. His main idea is to show that a manifold M admits geometric structures for which, when the curvature is zero, M is locally a Lie group. Having established this foundation, the author presents new points of view on various facts such as cohomology, deformation theory and a version of Ricci flow that might simplify the proof of Poincaré's Conjecture. A detailed review of the work can be found at MathSciNet MR3838387.

When one asks to whom is this book addressed, the answer is certainly not students facing their first introduction to Lie group theory, since right from page 1, it assumes a deep knowledge of differential geometry and Lie group theory. The purpose rather is to present to mathematicians the author's novel way of looking at the subject.

Phill Schultz
Department of Mathematics and Statistics, The University of Western Australia.
Email: phill.schultz@uwa.edu.au

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News from the Women in Mathematics Special Interest Group

Jessica Purcell*

There are a few important upcoming WIMSIG events for your calendars.

WIMSIG Conference 2020: A celebration of Women in Australian Mathematical and Statistical Sciences

Following the success of the first WIMSIG conference held in 2017, a second WIMSIG conference will be held at Monash University on 30 September through 2 October, 2020 (see http://staging.austms.org.au/about-us/wimsig/wimsig-conference-2020/).

The conference will showcase research of women in mathematical sciences. It is open to people of any gender, but all research presentations will be given by women.

Four outstanding plenary speakers have agreed to attend and present their research:

- Hamideh Anjomshoa (IBM, Melbourne Uni): Industrial mathematics
- Shelly Harvey (Rice University): Pure mathematics
- Kristian Lum (Human Rights Data Analysis Group): Statistics
- Asha Rao (RMIT): Applied mathematics.

We will additionally run parallel special sessions, in several areas of pure and applied mathematics and statistics, with 20-minute research talks. There will be two panels, one on mathematics in industry and one on the state of the discipline. There will also be a workshop for early career researchers.

To express interest in organising or speaking in a special session, please fill out the following form: https://forms.gle/55dhKJ2r79Sq3C2XA, or contact an organiser.

Organising committee: Jessica Purcell (Monash), Joanne Hall (RMIT), Sevvandi Kandanaarachchi (Melbourne/RMIT), Amy Glen (Murdoch), Jessica Kasza (Monash and SSA), Jennifer Flegg (Melbourne), Christina Kazantzidou (QUT), and Lynn Batten (Deakin).

12 May: International Women in Mathematics Day

The birthday of mathematician Maryam Mirzakhani has been designated the International Women in Mathematics Day, since 2019. We encourage universities

*Email: WIMSIG-chair@women.austms.org.au

around Australia to set up activities to support women in mathematics around this date.

To encourage such activities, ACEMS has stepped up with generous funding again in 2020, as they did in 2019. Similar to last year, to receive funding for your International Women in Mathematics Day activity, please apply through WIMSIG. We will be sending instructions to contacts at various universities; if you don't hear from us, please feel free to email me (WIMSIG-chair@women.austms.org.au) or another member of the WIMSIG executive committee (see below) directly.

Awards: Praeger, Street, and Mirzakhani Awards, closing 1 April 2020

The next round of WIMSIG awards closes on 1 April 2020. Please consider applying, or encouraging your colleagues to apply.

Cheryl Praeger Travel Awards provide full or partial support for Australian female mathematicians to attend conferences or visit collaborators for research. The awards are funded by AustMS, and administered by WIMSIG. http://staging.austms.org.au/about-us/wimsig/austms-wimsig-cheryl-e-praeger-travel-awards/

Anne Penfold Street Awards provide additional financial support to Australian mathematicians, both male and female, for their caring responsibilities while they travel for conferences or research visits to collaborators. It is also open to members of organising committees for mathematics and statistics conferences to be held in Australia. http://staging.austms.org.au/about-us/wimsig/austms-wimsig-anne-penfold-street-awards/

The *AustMS WIMSIG Maryam Mirzakhani Award* was established in 2019 to support international female students pursuing a postgraduate degree in mathematics in Australia. http://staging.austms.org.au/about-us/wimsig/austms-wimsig-maryam-mirzakhani-award/

Additionally, we frequently seek women to serve on the Selection Committee. We ask junior and senior academics, across pure mathematics, applied and industrial mathematics, and statistics, to volunteer.

New WIMSIG Executive Committee Members

We welcome Prof Catherine Greenhill of UNSW as the WIMSIG Incoming Chair in 2020. Catherine will take over as Chair in 2021–2022.

We also welcome Rose Crocker of Adelaide as our new Student Member.

Thanks to Prof Yvonne Stokes of Adelaide who concluded her term as Chair, and then Immediate Past Chair in February 2020. Also thanks to Kimberly Becker of Adelaide/Oxford who concluded her term as Student Member.

The current members of the WIMSIG Executive Committee are:

- Jessica Purcell (Monash University), Chair;
- Catherine Greenhill (UNSW), Incoming Chair;

- Valentina Wheeler (University of Wollongong), Treasurer;
- Jennifer Flegg (Melbourne University), Secretary;
- Sevvandi Kandanaarachchi (Melbourne/RMIT), Ordinary Member;
- Julia Collins (Edith Cowan University), Ordinary Member;
- Rose Crocker (Adelaide), Student Member.

Please feel free to contact us with any WIMSIG related questions or comments.

Jessica Purcell is an ARC Future Fellow and Professor at Monash University. She is the Chair of the Women in Mathematics Special Interest Group (WIMSIG) of the Australian Mathematical Society. Jessica's research interests are in geometry and topology.

News

General News

Griffith University

Dr Melanie Roberts attended Science meets Parliament in November 2019.

Western Sydney University

The Centre for Research in Mathematics has changed its name to the Centre for Research in Mathematics and Data Science, to reflect the growing strength and presence of data scientists in the Centre.

Completed PhDs

Charles Sturt University

- Paul Kew, *Adaptive grid refinement using the generalized finite difference method*, supervisors: Zhenquan Li, Philip Charlton and Michael Kemp.

La Trobe University

- Dr Tareq Alodat, *On asymptotics of functionals of random fields with long-range dependence*, supervisors: Andriy Olenko and Agus Salim.
- Dr Christeen Wijethunga, *Confidence intervals by model averaging an bootstrap smoothing*, supervisors: Paul Kabaila and David Farchione.
- Dr Dilruk Gallage, *Solutions of 4th order evolution equations in material science*, supervisors: Phil Broadbridge, Dimetre Triadis and Pierluigi Cesana.
- Dr Jodie Smith, *Influence functions for dimension reduction methods*, supervisors: Luke Prendergast and Bob Staudte.
- Dr Shenal Dedduwakumara, *Contributions to estimation and modelling using quantiles*, supervisors: Luke Prendergast and Bob Staudte.

Macquarie University

- Dr Philipp Schönhöfer, *Entropically driven self-assembly of pear-shaped nanoparticles*, supervisors: Gerd Schröder-Turk and Mark Lukas.

Royal Melbourne Institute of Technology

- Dr Dewi Anggraini, *Development of multivariate quality control and quality assurance models to monitor and improve the capability process of antenatal care in primary health care in South Kalimantan, Indonesia*, supervisors: Mali Abdollahian and Kaye Marion.
- Dr Gabriel Makuei, *Modelling and monitoring maternal mortality rate in South Sudan*, supervisors: Mali Abdollahian and Kaye Marion.

- Dr Denwick Munjeri, *Development and application of process capability indices*, supervisors: Mali Abdollahian and Sandamali Dharmasena.

University of Adelaide

- Dr Johnny Lim, *Analytic Pontryagin duality*, supervisors: Mathai Varghese, Guo Chuan Thiang and Hang Wang.

  Dr Lim was awarded 2019 Elsevier Young Scientist Award and Dean's commendation for Doctoral Thesis Excellence and is now Lecturer, University Sains Malaysia, Penang.
- Dr Alex Tam, *Mathematical Modelling of Pattern Formation in Yeast Bioflims*, supervisors: Ben Binder, Ed Green and Sanjeeva Balasuriya.

  Dr Tam received a Dean's commendation for an excellent thesis.

University of South Australia

- Dr Joseph OLeary, *General relativistic and post-Newtonian dynamics for near-Earth objects and solar-system bodies*, supervisors: James M. Hill, James C. Bennett and Samuel Drake.

University of Southern Queensland

- Dr Andrei Ermakov, *Development of rigorous methods in fluid mechanics and theory of water waves*, supervisors: Yury Stepanyants and Dmitry Strunin.

University of Sydney

- Dr Weichang Yu, *Bayesian variable selection for high-dimension discriminant analysis*, supervisor: John Ormerod.
- Dr Huda Daefallh Alrashdi, *q-discrete Painleve equations, their hierarchies and properties*, supervisor: Nalini Joshi.
- Dr Nathan Paul Duignan, *On the regularisation of simultaneous binary collisions*, supervisor: Holger Dullin.
- Dr Brent Matthew Giggins, *Stochastically modified bred vectors*, supervisor: Georg Gottwald.
- Dr Hugh Ford, *Theory and experiments on cannibalism in macrophages*, supervisor: Mary Myerscough.

University of Western Australia

- Dr Pietro Miraglio, *Estimates and rigidity for stable solutions to some nonlinear elliptic problems*, supervisors: Enrico Valdinoci and Xavier Cabré.

Awards and other achievements

Australian National University

- Scott Morrison, James Tener, Pinhas Grossman and Arnaud Brothier were awarded an ARC Discovery Grant for the project ‘Physical realisation of enriched quantum symmetries’.
- Xu-Jia Wang and Jiakun Liu were awarded an ARC Discovery Grant for the project ‘Monge-Ampere equations and applications’.
- Amnon Neeman was awarded an ARC Discovery Grant for the project ‘Topics in triangulated categories’.

Central Queensland University

Student Voice Commendations 2019

- Educator of 2019: Dr Roland Dodd for MATH 11246 Introductory Mathematics.
- Educator of 2019: Professor William Guo for MATH 12224 Calculus and Linear Algebra B.
- Distance Educator of 2019: Professor William Guo for MATH 12224 Calculus and Linear Algebra B.

La Trobe University

- Mumtaz Hussain and David Simmons (PI) have received an ARC Discovery Grant for the project ‘Measure theoretic frameworks for limsup sets’ ($428,256).

Macquarie University

- Adam Sikora, Zihua Guo, Daniel Hauer (Univ. Sydney) and Melissa Tacy won an ARC Discovery Grant for the project ‘Nonlinear harmonic analysis and dispersive partial differential equations’.

Murdoch University

- Associate Professor Gerd Schröder-Turk was awarded an ARC Discovery Grant for the project ‘Meta-microscopy of insect tissue: How nature grows bicontinuous nanosolids’ (with Bodo Wilts, Peta Clode and Nipam Patel).
- Associate Professor Gerd Schröder-Turk was elected as a 2019 Fellow of the American Physical Society.

Queensland University of Technology

- Dr Kate Helmstedt was awarded an ARC Discovery Early Career Research Award for the project ‘DE200101791 Mathematically optimal R&D for coral reef conservation’ ($427,082).
- Prof Matthew J. Simpson was awarded an ARC Discovery Grant for the project (DP200100177) ‘Mathematical models of 4D multicellular spheroids’ (with Prof Nikolas Haass and Prof Michael Plank) ($495,000).

- A/Prof James McGree has been awarded an ARC Discovery Grant for the project (DP200101263) 'Precision ecology: the modern era of designed experiments in plant ecology' (with A/Prof Jennifer Firn, Prof Eric Seabloom and Prof Elizabeth Borer) ($360,000).
- A/Prof Christopher Drovandi was awarded an ARC Discovery Grant for the project (DP200102101) 'Advances in sequential Monte Carlo methods for complex Bayesian models' (with Prof Chris Oates and Dr Anthony Lee) ($390,000).
- A/Prof Petrus van Heijster was awarded an ARC Discovery Grant for the project (DP200102130) 'A novel geometric approach to shocks in reaction-nonlinear diffusion models' (with Prof Martin Wechselberger, Dr Robert Marangell and Dr Bronwyn Hajek) ($480,000).
- Prof Zhi-Yong Li was awarded an ARC Discovery Grant for the project (DP200103492) 'Mathematical modelling of the mechanobiology of arterial plaque growth' (with Prof Karlheinz Peter) ($420,000).
- Dr Belinda Spratt was awarded an AustMS Teaching Award for Excellence in the Early Career category at the AustMS conference 2019.
- Prof Matthew J. Simpson was awarded the E.O. Tuck Medal at ANZIAM 2020 in recognition for outstanding research and distinguished service to the field of Applied Mathematics.
- Mr Alexander Browning, Ms Solene Hegarty-Cremer and Ms Tamara Tambyah were commended with honourable mentions in the TM Cherry prize for best student presentation at ANZIAM 2020.

Royal Melbourne Institute of Technology

- Xinghuo Yu, Andrew Eberhard and Chaojie Li were awarded an ARC Discovery Grant for the project (DP200101197) 'Switching dynamics approach for distributed global optimisation' ($420,000).

University of Adelaide

- Sanjeeva Balasuriya and Nicholas Ouellette have been awarded an ARC Discovery Grant for the project 'Uncertainties in coherent transport of particles and intrinsic properties'.
- Yvonne Stokes, Thomas Harding and Andrea Bertozzi have been awarded an ARC Discovery Grant 'Prediction of inertial particle focusing in curved microfluidic ducts'.
- Tony Roberts and Ioannis Kevrekidis have been awarded an ARC Discovery Grant for the project' Modeling, mathematical analysis, and computation of multiscale systems'.
- Mathai Varghese, Peter Hochs and Guo Chuan Thiang have been awarded an ARC Discovery Grant for the project 'Coarse Geometry: a novel approach to the Callias index & topological matter'.
- Mr Ahnaf Tajwar Tahabub (M.Phil. Principal supervisor Mathai Varghese, Co-supervisor David Baraglia) is a 2020 Fulbright Future Scholarship recipient.

University of Melbourne

- David Grayden, Levin Kuhlmann, Philippa Karoly and Mark Cook have been awarded an ARC Discovery Grant for the project 'Creating subject-specific mathematical models to understand the brain'.
- Jennifer Flegg, Jonathan Keith, Kate Smith-Miles and Jack Richards have been awarded an ARC Discovery Grant for the project 'Optimising progress towards elimination of malaria'.
- Sophie Hautphenne, Giang Nguyen and Melanie Massaro have been awarded an ARC Discovery Grant for the project 'Computational methods for population-size-dependent branching processes'.

University of New South Wales

- Associate Professor David Harvey has been awarded the 2019 Australian Mathematical Society Medal. David was honoured for his work in the fields of algorithmic number theory and computer algebra. His achievements include the development of highly efficient algorithms for counting the number of solutions to certain polynomial equations that play a central role in number theory and cryptography, and his widely reported breakthrough discovery (jointly with Joris van der Hoeven) of the fastest known method for multiplying huge numbers together.
- Dr Zdravko Botev is a joint winner of the 2019 Gavin Brown prize for his paper 'Kernel density estimation via diffusion' published in the *Annals of Statistics*, Vol. 38(5) (2010), jointly with Professors Joseph Grotowski and Dirk Kroese. The winning paper has been described as 'stunning', 'exceptionally well written' and 'extraordinary'. Marrying ideas from mathematical analysis and applied statistics, the authors have been praised for their fast kernel density estimator, which also achieves excellent accuracy thanks to an ingenious bandwidth selection algorithm.
- Associate Professor Guoyin Li was awarded a 2019 ICCM best paper award (BPA) in mathematics by the 2019 International Consortium of Chinese Mathematicians (ICCM) for his joint work with Dr Ting Kei Pong 'Global convergence of splitting methods for nonconvex composite optimization', published in *SIAM Journal on Optimization*, Vol. 25(4) (2015).
- Professor Jeya Jeyakumar and Associate Professor Guoyin Li were selected as one of the two winners of the 2019 Journal of Global Optimization Best Paper Award. The paper is 'Extended trust-region problems with one or two balls: exact copositive and Lagrangian relaxations' by Immanuel M. Bomze, Vaithilingam Jeyakumar and Guoyin Li (Vol. 71(3)).
- Yudhistira Bunjamin is a joint winner of the BH Neumann Student Talk Prize at the 63rd Meeting of the Australian Mathematical Society.
- Professor David Warton has joined the Highly Cited authors list in 2019.
- Dr Alina Ostafe and Professor Igor Shparlinski have been awarded an ARC Discovery Grant for the project 'Multiplicative structure of rational functions'.
- Professor Wolfgang Schief and Professor Alexander Bobenko have been awarded an ARC Discovery Grant for the project 'Multi-dimensionally consistent integrable systems in geometry and algebra'.

- Associate Professor Scott Morrison, Dr James Tener, Dr Pinhas Grossman and Dr Arnaud Brothier have been awarded an ARC Discovery Grant for the project ‘Physical realisation of enriched quantum symmetries’.
- Dr Christopher Angstmann and Professor Bruce Henry have been awarded an ARC Discovery Grant for the project ‘New mathematics to improve understanding of anomalously diffusing reactions’.
- Dr Vera Roshchina, Professor Roberto Cominetti and Professor Hong-Kun Xu have been awarded an ARC Discovery Grant for the project ‘Geometry in projection methods and fixed-point theory’.
- Professor Beniamin Goldys, Associate Professor Thanh Tran and Dr Kim Ngan Le have been awarded an ARC Discovery Grant for the project ‘Mathematics for breaking limits of speed and density in magnetic memories’.

University of Queensland

- Jorgen Rasmussen, S. Ole Warnaar and Masoud Kamgarpour have been awarded an ARC Discovery Grant for the project ‘Towards logarithmic representation theory of W-algebras’.
- Jon Links, Phillip Isaac and Angela Foerster have been awarded an ARC Discovery Grant for the project ‘Quantum control designed from broken integrability’.

University of South Australia

- Stanley Miklavcic and Megan Shelden have been awarded an ARC Discovery Grant for the project ‘Root-to-shoot: modeling the salt stress response of a plant vascular system’.

University of Southern Queensland

- Associate Professor Ravinesh Deo was awarded 2020 Australian Academy of Science Australia-India Strategic Research Fellowship (AISRF $8,500). The AISRF project will look at the latest artificial intelligence technologies to address drought and water management, collaborating with National Institute of Hydrology (Ministry of Water Resources), Indian Agricultural Statistics Research Institute, a pioneer Institute of Indian Council of Agricultural Research and Anand Agricultural University, Gujarat.

University of Sydney

- Nalini Joshi was awarded the NSW Premier’s Prize for Excellence in Mathematics, Earth Sciences, Chemistry, or Physics.
- Anna Aksamit and Ellis Patrick were awarded ARC DECRAs.
- Nalini Joshi and Milena Radnovic (Geometric analysis of nonlinear systems); Marek Rutkowski and Shige Peng (Fair pricing of superannuation guaranteed benefits with downturn risk); Andrew Mathas (Graded semisimple deformations); James Parkinson, Jeremie Guilhot and Bernhard Mühlherr (New directions in Hecke algebras); Mary Myerscough, Christina Bursill and Helen Byrne (New mathematics for lipids and cells: structured

models for atherosclerosis); Ben Goldys, Thanh Tran and Kim Ngan Le (Mathematics for breaking limits of speed and density in magnetic memories); Martin Wechselberger, Robert Marangell, Bronwyn Hajek and Petrus van Heijster (A Novel Geometric Approach to Shocks in Reaction-Nonlinear Diffusion Models); and Lamiae Azizi were all awarded ARC DPs.

University of Western Australia

- Honours student James Evans is the winner of the Dr Vincent Harry Cooper Memorial Prize for 2019. The prize is awarded to the graduated Bachelor of Philosophy (Honours) student who has submitted the most outstanding Honours dissertation.
- Sergei Kuzenko, Evgeny Buchbinder, Stefan Theisen and Arkady Tseytlin have been awarded an ARC Discovery Grant for the project 'Advances in conformal field theory with extended symmetry'.
- John Bamberg, Michael Giudici and Gordon Royle have been awarded an ARC Discovery Grant for the project 'The synchronisation hierarchy of permutation groups'.
- Alice Devillers and Cheryl Praeger have been awarded an ARC Discovery Grant for the project 'Exceptionally symmetric combinatorial designs'.
- Michael Small, Debora Correa, David Walker and Dominique Blache have been awarded an ARC Discovery Grant for the project 'TSuNAMi: Time Series Network Animal Modelling'.

University of Wollongong

- Aidan Sims, Jacqui Ramagge (Univ. Sydney), David Pask, Nathan Brownlowe (Univ. Sydney) and Lisa Clark have been awarded an ARC Discovery Grant for the project 'There and back again: operator algebras, algebras and dynamical systems'.

Western Sydney University

- James East has been awarded an ARC Future Fellowship.

Appointments, departures and promotions

Federation University

- Adil Bagirov has been promoted to Professor.

Griffith University

- Dr Barbara Johnston has been promoted to Senior Lecturer, effective 1 January 2020.

La Trobe University

- Prof Luke Prendergast has been promoted to Level E.

- Dr Mumtaz Hussain has been promoted to Level C.
- Prof Birgit Loch, who is Professor of Mathematics Education and Associate Pro Vice-Chancellor Coursework, College of Science, Health and Engineering, has been appointed to the Deputy Provost Learning and Teaching role in the College.
- Dr Rebecca Chisholm has joined the department as a lecturer, continuing.

Macquarie University

- John Power has been appointed Honorary Professor at Macquarie University, following his retirement from the University of Bath and subsequent relocation to Sydney. Power is a researcher in category theory and its applications in computer science.

Monash University

New staff:

- A/Prof Ricardo Ruiz Baier
- Dr Amogh Deshpande
- Dr Jian He
- Dr Simon Bowly

New Research Fellows:

- Dr Tony Huynh
- Dr Marcos Origlia
- Dr Alberto Martin

Queensland University of Technology

- Dr Matthew Adams joined the School of Mathematical Sciences at QUT as Lecturer and ARC-DECRA fellow.
- Dr Christopher M. Baker is leaving QUT to join the School of Mathematics and Statistics at the University of Melbourne as a Research Fellow in Statistics for Biosecurity Risk.
- A/Prof Paul Corry is acting Head of School until a new Head of School is appointed.

Royal Melbourne Institute of Technology

- Dr Mali Abdollahian was promoted to Associate Professor.
- Dr Joanne Hall was promoted to Senior Lecturer.
- Dr Sharmila Kayastha has joined RMIT Maths Discipline as a Postdoc, working under supervision of Professor Asha Rao. Dr Kayastha obtained her PhD from the University of New South Wales on 'Dynamic modeling and motion control of free-flying space robots incorporating flexible manipulator'.

University of Adelaide

- Luke Bennetts has been promoted to Associate Professor.

University of New England

- Dr David Robertson and Dr Jock McOrist took up positions as Lecturers.
- Dr Jelena Schmalz was promoted from Associate Lecturer to Lecturer.

University of New South Wales

- Pierre Lafaye de Micheaux was promoted to Associate Professor for his outstanding contributions in research, teaching, engagement and leadership.
- Spiridon Penev and Thanh Tran were both promoted to Professor for their outstanding contributions in research, teaching and leadership.

University of South Australia

- Dr Amie Albrecht has been promoted to Associate Professor.
- Associate Professors Regina Burachik and Lesley Ward have been promoted to Professor.

University of Southern Queensland

- Ravinesh Deo has been promoted to Associate Professor.

University of Sydney

- Kitty Lo has been promoted to Level B.
- Garth Tarr has been promoted to Level C.
- Di Warren has been promoted to Level C.
- James Parkinson and Milena Radnovic have been promoted to Level D.
- Stephan Tillmann has been promoted to Level E.

Western Sydney University

- Rosalind Wang has joined as Senior Lecturer in Data Science.
- Andrew Francis has been promoted to Deputy Dean of the School of Computer, Data and Mathematical Sciences.
- Laurence Park has been promoted to Associate Professor.

New Books

Federation University Australia

Bagirov, A.M., Gaudioso, M., Karmitsa, N., Mäkelä, M.M. and Taheri, S. (eds) (2020). *Numerical Nonsmooth Optimization: State of the Art Algorithms*. Springer, Cham, Switzerland. ISBN: 978-3-030-34910-3.

Bagirov, A.M., Karmitsa, N., Taheri, S. (2020). *Partitional Clustering via Nonsmooth Optimization*. Springer, Cham, Switzerland. ISBN 978-3-030-37826-4

University of Adelaide

Metcalfe, A., Green, D., Greenfield, T., Mansor, M., Smith, A. and Tuke, J. (2019). *Statistics in Engineering With Examples in MATLAB® and R*, 2nd edn. CRC Press, Boca Raton, FL. ISBN 9781439895474

University of Southern Queensland

Pijush, S., Bui, D.T., Subrata, C., Deo, R. (eds) (2020). *Handbook of Probabilistic Models*. Elsevier, Oxford. ISBN 978-0-12-816514-0. https://doi.org/10.1016/C2017-0-04723-7.

Western Sydney University

Ambily, A.A., Hazrat, R. and Sury, B. (eds) (2020). *Leavitt Path Algebras and Classical K-Theory*. Springer, Singapore. ISBN 978-981-15-1611-5.

Conferences and Courses

Conferences and courses are listed in order of the first day.

Information given here is the most up to date we have at the time of going to press. In view of the disruption caused by CoViD-19, you should check the links given, or directly with the organisers, for updates.

For information about MATRIX programs, see the report by Jan de Gier in the previous issue.

Women in Maths at Western Sydney University

Dates: Thursday 14th of May, starting at 4pm
Venue: Western Sydney University, Parramatta
Web: https://2020wimd.eventbrite.com.au
Organiser: Roozbeh Hazrat

We are very excited to announce our second Women in Mathematics Day, again around the birthday of Maryam Mirzakhani, who was the first ever woman who won the Fields medal. The event consists of several invited talks given by women mathematicians active in Australia as well as a new film about the life and work of Mirzakhani.

You are invited to join us in celebrating women in mathematics. Your attendance and support means a lot to us. Please confirm your attendance at the link above.

POSTPONED: The 15th Australasian Conference on Mathematics and Computers in Sport

Previously scheduled: 25–27 May 2020
Web: https://www.anziam.org.au/The+15th+Australasian+Conference+on+Mathematics+and+Computers+in+Sport

The ANZIAM Mathsport 2020 meeting, previously scheduled for Victoria University [Wellington, New Zealand], is now postponed due to the heath, budgeting and travel restrictions imposed by the unfortunate corona-virus outbreak. Our main concern is for your safety. We plan to reschedule the meeting, possibly sometime in the September to November time frame, as the situation evolves. Look at the link above for updates. We welcome additional abstracts and papers under the new deadlines below. We will publish a Proceedings, regardless of what the future may hold, so that your work will be honoured and available to others.

POSTPONED: The Mathematics of Conformal Field Theory II

Previously scheduled: 6–10 July 2020
Venue: Australian National University
Web: https://maths.anu.edu.au/news-events/events/mathematics-conformal-field-theory-ii

This event has been postponed due to COVID-19. It will take place in 2021 — dates to be confirmed.

vISEC2020: virtual International Statistical Ecology Conference

Dates: 22–26 June 2020
Web: http://www.isec2020.org/

ISEC2020 is going remote — we will use a mix of video conferencing and discussion forum tools to bring as many of the planned elements of the conference experience as we can to you at your workstation. Including trivia night! And whale-watching. Maybe even karaoke . . . .

The International Statistical Ecology Conference is a biennial meeting of researchers at the interface between ecology and statistics. At vISEC2020 we have planned an exciting list of keynote speakers that bridge these two disciplines, as well as training opportunities for attendees, a forum for interdisciplinary collaboration, and a healthy dose of fun — all online, via the website!

Did you miss out on submitting an abstract because you didn't think you could make it to Sydney? Well you are in luck . . . we have re-opened abstract submission until Friday 3 April (5pm GMT).

Plenary speakers: Christl Donnelly (Imperial, Oxford), David Borchers (St Andrews), Dianne Cook (Monash), Kiona Ogle (Northern Arizona) and Mark Bravington (CSIRO).

POSTPONED: Aboriginal and Torres Strait Islander Mathematics Alliance 2020 Conference

Previously scheduled: 27–30 July 2020
Venue: Yirrkala, Northeast Arnhem Land
Web: https://atsimanational.ning.com/atsima-2020-yirrkala
Contact: Melinda Pearson (0414 322 372 or melindapearson@atsima.org)

Due to the global pandemic caused by the new coronavirus disease (COVID-19), ATSIMA has received official notification from the Yirrkala Community Action Group that there will be no events held in Yirrkala Community until further notice. This means the ATSIMA 2020 conference has been postponed, the conference committee is anticipating the conference will be rescheduled for 2021. If you would like to be kept in the loop with further updates email as above. If you registered for ATSIMA 2020 you do not need to leave your details as you will be updated automatically.

Please contact Melinda Pearson as above if you would like to discuss any details regarding refunds of registration or future plans for ATSIMA Conference.

Computational & Algorithmic Topology, Sydney (CATS 2020)

Dates: 27–31 July 2020
Venue: The University of Sydney
Web: https://sites.google.com/view/cats-2020 Organisers: Jonathan Spreer (The University of Sydney), Stephan Tillmann (The University of Sydney), Katharine Turner (Australian National University)

Abstract: This workshop at the University of Sydney will bring together experts and emerging researchers from Australia, the USA and Europe to report on recent results and explore future directions in computational and algorithmic topology and related areas. There will be a focus on problems in computational geometric topology and computational algebraic topology. This workshop aims to stimulate interaction between researchers in order to bring about new collaborations on difficult problems that cannot be tackled from one viewpoint alone. We plan to have talks by our invited speakers in the mornings, and open problem sessions, a poster session, and plenty of time for collaboration in the afternoons.

Invited Speakers:

- Herbert Edelsbrunner (Institute of Science and Technology Austria)
- Brittany Fasy (Montana State University)
- Gregory Henselman (Princeton University)
- Feng Luo (Rutgers University)
- Zuzana Patáková (Institute of Science and Technology Austria)
- Jessica Purcell (Monash University)
- Vanessa Robins (Australian National University)

Computational Techniques & Applications Conference (CTAC 2020)

Dates: 30 August to 2 September 2020
Venue: UNSW Sydney
Web: https://www.ctac2020.unsw.edu.au/
Contact: ctac2020@unsw.edu.au

We are monitoring the rapidly evolving Covid-19 situation, and have put registration on hold. Please wait with booking flights and accommodation.

Organising committee:

- Josef Dick (UNSW)
- Bishnu Lamichhane (Newcastle)
- Ngan Le (Monash University)
- Quoc Thong Le Gia (UNSW, Chair)
- Shev MacNamara (UTS)
- William McLean (UNSW)
- Thanh Tran (UNSW)
- Vera Roschina (UNSW)

WIMSIG 2020

Dates: 30 September to 2 October 2020
Venue: Monash University
Web: http://staging.austms.org.au/about-us/wimsig/wimsig-conference-2020/
Chair of Organising Committee: Jessica Purcell (Monash)
Secretary of Organising Committee: Joanne Hall (RMIT)

Activities: The conference will showcase the research of women in the mathematical sciences. It is open to people of any gender, but all research presentations will be given by women. The conference will commence with an Early Career Workshop on Wednesday 30 September, with workshops on grant writing, research writing, and mathematical presentations led by Joanne Hall (RMIT) and Emily Edgeley (Speaking Coach).

There will be four plenary speakers:

- Hamideh Anjomshoa (IBM, Melbourne University): Industrial Mathematics
- Shelly Harvey (Rice University): Pure Mathematics
- Kristian Lum (Lead Statistician, Human Rights Data Analysis Group): Statistics
- Asha Rao (RMIT): Applied Mathematics

There will also be several parallel streams in areas of pure mathematics, applied mathematics, statistics, and industrial mathematics. We will run two panels, one on mathematics and industry with several industry panelists, and one on the state of the discipline.

2nd International Conference on Mathematics, Science and Technology Teaching and Learning (ICMSTTL 2020)

Dates: 28–30 October 2020
Venue: Central Queensland University, Sydney Campus
Web: http://www.msttl.org/index.html
Conference General Chairs: Prof Chris Tisdell, University of New South Wales, and Prof. William W. Guo, Central Queensland University

The Conference Theme is Promotion and Evaluation of Integrated Teaching: Good practices, Effectiveness, and Implications. The conference is organized by Central Queensland University Australia and co-organized by the University of New South

Wales, University of Technology Sydney, and National Tsing Hua University, Taiwan. Fully refereed papers will be published in ACM conference proceedings indexed by EI Compendex and Scopus.

ICMSTTL aims to bring together tertiary educators, researchers and students, primary and secondary school teachers, education administrators and policy makers from all over the global to discuss theoretical, technological, practical, pedagogical, social, cultural, economic, and managerial issues in all relevant areas of mathematics, science and technology teaching and learning in the digital age. It is a timely interdisciplinary forum for all participates to share and/or appreciate the recent innovations, trends, challenges, and possible solutions in mathematics, science and technology (MSL) teaching and learning, with a particular focus on all disciplines in mathematics, statistics, computer science, information and communication technology, and other physical sciences.

If the conference cannot be held on time due to the force majeure such as politics, weather and disasters, the organizer shall have the right to postpone or cancel the conference. Participants are required to comply with the organizer's arrangements and refund policy.

64th Annual Meeting of the Australian Mathematical Society

Dates: Tuesday 8 December 2020 to Friday 11 December 2020
Venue: University of New England, Armidale, NSW
Further info: Gerd Schmalz (schmalz@une.edu.au)

Bioinfo Summer 2020

Dates: 30 November to 4 December 2020
Venue: Australian National University
Web: https://amsi.org.au/events/event/amsi-bioinfosummer-2020/

Vale

Federation University Australia

We are saddened by the passing of our colleague, Dr Andrew Percy who succumbed to a long illness on 18 December 2019.

Andrew completed his PhD in algebraic topology at the University of New England in 2004, under the supervision of Imre Bokor. Soon after he moved to the Gippsland campus of Monash University, where he supervised two PhD students, Jillian Dickinson and Ahsan Jaleel, both completing in 2016. In 2014, Andrew remained in place as the Gippsland campus was detached from Monash and folded into Federation University.

During his many years in Gippsland, Andrew played a significant role in course development. He acquired a reputation amongst undergraduate students as passionate, inspiring, and talented at explaining complicated maths. His commitment and enthusiasm will be sorely missed.

University of Adelaide

It is with sadness that we report the death, on 22 December 2019, of Associate Professor David Clements, aged 78. David was a long-time academic in the School of Mathematical Sciences at the University of Adelaide and a long-time member of the Australian and New Zealand mathematics community.

Visiting mathematicians

Visitors are listed in alphabetical order 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.

Information given here is the most up to date we have at the time of going to press. In view of the disruption caused by CoViD-19, it is clear that some of these visits will not go ahead. Please check directly with the contacts listed for updates.

Sufang (Sarah) An; China University of Geosciences, Beijing; September 2020 to August 2021; UWA; Michael Small

Miaomiao Cai; Dalian University of Technology; September 2019 to September 2020; UWA; Enrico Valdinoci and Serena Dipierro

Dr Jianji Cao; Shanxi University of Finance and Economics; 15 April 2020 to 14 April 2021; UWA; Michael Giudici

A/Prof. Jian Chen; Foshan University, China; applied and computational mathematics; 1 March 2019 to 1 March 2020; QUT; Fawang Liu

Yufei Chen; East China Normal University; October 2020 to October 2021; UWA; Michael Small

Dr Jan De Beule; Vrije Universiteit Brussel; end-July to mid-August 2020; UWA; John Bamberg

Alessandra De Luca; University of Milan Bicocca; 27 February 2020 to 25 May 2020; UWA; Enrico

Teresa Dias; Federal University of Sao Carlos; March 2020 to Feb 2021; UWA; Adriano Polpo

Dr Jochen Glueck; University of Passau; 9–27 March 2020; USN; Daniel Daners

Xinyu Han; Harbin Institute of Technology, Shenzhen; September 2020 to August 2021; UWA; Michael Small

Dr Hongmei Hu; 1 September 2019 to 31 August 2020; degenerate quantum groups associated with finite dimensional and affine Lie algebras; USN; Ruibin Zhang

Edoardo Proietti Lippi; University of Florence; March to May 2020; UWA; Enrico Valdinoci and Serena Dipierro

Mr Manavendra Maharana; 7 January to 1 May 2020; data science and deep learning; USN; Sally Cripps

Zak Mesyan; University of Colorado; May 2020; algebra; WSU; Roozbeh Hazrat

Ms Sayantika Mondal (FRT scholar); 28 May to 31 March 2020; ANU; Joan Licata

Dr Vidit Nanda; Oxford Univerisity; 18 September 2018 to 30 June 2021; applied algebraic topology; USN; Jacqui Ramagge

Fumihiko Onoue; Scuola Normale Superiore di Pisa; 23 February 2020 to 31 March 2020; UWA; Enrico Valdinoci and Serena Dipierro

Lihong Qiu; Xi'an Jiaotong University; 1 September 2019 to 31 August 2020; UWA; Gordon Royle

Dr Nancy Scherich; Wake Forest University; 26 May to 25 June 2020; finite type invariants in the Kashiwara–Vergne problem; USN; Zsuzsanna Dancso

Prof Vicente Vergara; Universidad de Concepción; 24 February to 31 March 2020; UWA; Enrico Valdinoci and Serena Dipierro

Dong Wang; Harbin Institute of Technology; 19 Sept 2019 to 18 March 2020; UWA; Michael Small

Dr Jasper Weinburd; Harvey Mudd College; 16–27 March 2020; pattern formation/ collective motion/mathematical biology/ modelling locust swarms; UAD; Ed Green and Jerome Buhl

Hui Zhang; Jinling Institute of Technology; 14 October 2019 to 15 October 2020; UWA; Enrico Valdinoci and Serena Dipierro

Jing Zhang; China University of Mining and Technology; September 2019 to November 2020; UWA; Michael Small

Dr Jianguo Zhang; Taiyuan University of Technology; September 2020 to August 2021; UWA; Michael Small

Dr Jingkui Zhang; Qingdao University of Technology; 30 March 2019 to 29 March 2020; ANU; Matthew Hole

Dr Zelin Zhang; Hubei University of Automotive and Technology; 1 April 2020 to 31 March 2021; UWA; Michael Small

Lili Zhou; Shaanxi University of Science and Technology; November 2020 to November 2021; UWA; Michael Small

Prof Yi Zhao; Harbin Institute of Technology, Shenzhen; February–March 2020; UWA; Michael Small

Nominations sought for the 2020 Australian Mathematical Society Medal

The Medal Committee for the 2020 Australian Mathematical Society Medal is now seeking nominations and recommendations for possible candidates for this Medal, which will be awarded to a member of the Society for distinguished research in the Mathematical Sciences. Section 2(i) of the rules have been changed from 2019. Please note that candidates who previously met the 'under age 40' rule are not ruled immediately ineligible by virtue of the rule change. A grace period is set by the AustMS Medal Committee (see 2(i) below).

Nominations close on **22nd May 2020**, should comply with rule 9 below and should be sent to http://journal.austms.org.au/ojs/index.php/AMPA/login. Nominators should receive an acknowledgement of the nomination: if this is not received, please contact the Committee Chair. Nominations will not be automatically rolled over from previous years.

For further information, please contact the Chair of the 2020 AustMS Medal Committee, Professor Y.M. Stokes (yvonne.stokes@adelaide.edu.au). The other members of the 2020 Medal Committee are Professor A.W. Hassell (Outgoing Chair), Professor A. Henderson (Incoming Chair) and Professor R. Burachik (one year).

See http://www.austms.org.au/AMSInfo/medal.html for a list of past AustMS Medal winners.

Rules for the Australian Mathematical Society Medal

1. There shall be a Medal known as "The Australian Mathematical Society Medal".
2. (i) This will be awarded annually to a Member of the Society for distinguished research in the Mathematical Sciences, who has been conferred a PhD (or equivalent) (a) no more than 15 years before 31 December of the year in which the Medal is awarded, or (b) with allowable periods of career interruption that would be commensurate with part 2(i)(a). Through to 2023 nominees that are no more than 40 years of age as at 31st December of the year in which the Medal is awarded will also be accepted and the Medal Committee may waive this age limit by up to five years in cases where there have been significant interruptions to a mathematical career.

   The term "commensurate" allows for part-time employment of equivalent duration to be considered; "career interruption" should include those accepted by the Australian Research Council in their Fellowship application guidelines.

   The final decision on allowable periods due to career interruption will be made by the AustMS Medal Committee. Likewise, this

Committee may accept for conferral of PhD that all requirements for a PhD have been met, or rule that an alternative pathway of recognised distinguished research is equivalent to the PhD requirement. In the case that a candidate for the Medal has not received a doctoral degree, the Committee will make their best determination of a date analogous to that of a PhD conferral.

Nomination of a candidate for the AustMS medal who has had a career interruption should include a statement to this effect, including a quantification of the total number of years of interruption, plus present details of recognised distinguished research if they have not received a doctoral degree.

(ii) A significant proportion of the research work should have been carried out in Australia.

(iii) In order to be eligible, a nominee for the Medal has to have been a member of the Society for the calendar year preceding the year of the award; back dating of membership to the previous year is not acceptable.

3. The award will be approved by the President on behalf of the Council of the Society on the recommendation of a Selection Committee appointed by the Council.
4. The Selection Committee shall consist of 3 persons each appointed for a period of 3 years and known as “Incoming Chair”, “Chair” and “Outgoing Chair” respectively, together with a fourth person appointed each year for one year only.
5. The Selection Committee will consult with appropriate assessors.
6. The award of the Medal shall be recorded in one of the Society’s Journals along with the citation and photograph.
7. The Selection Committee shall also prepare an additional citation in a form suitable for newspaper publication. This is to be embargoed until the Medal winner has been announced to the Society.
8. One Medal shall be awarded each year, unless either no one of sufficient merit is found, in which case no Medal shall be awarded; or there is more than one candidate of equal (and sufficient) merit, in which case the committee can recommend the award of at most two Medals.
9. Nominations for the Australian Mathematical Society Medal should include: (a) A nomination form (available from the AustMS website) to be completed by the nominee (b) an extended citation, not more than two pages in length, arguing the case for awarding the Medal to the nominee; (c) a full list of publications of the candidate, with the most significant marked by an asterisk; (d) a curriculum vitae of the candidate’s professional career, highlighting any achievements which add support to the nomination; and (e) the names of three suitable referees, along with a brief statement as to their appropriateness.

Nominations sought for the 2020 Gavin Brown Prize

The 2020 Gavin Brown Prize Selection Committee is now seeking nominations and recommendations for possible candidates for this prize, to be awarded for an outstanding and innovative piece of research in the mathematical sciences published by a Member or Members of the Society. The award will be for a single article, monograph or book consisting of original research, and published in the 9 calendar years 2010–2018.

Nominators should provide a brief (1–2 pages) summary of what makes the nominated publication important and original, with appropriate references to prior or subsequent work in the field. They should also suggest the names of three assessors.

Nominations close on **22 May 2020** and should be sent to http://journal.austms.org.au/ojs/index.php/AMPA/login. Nominators should receive an acknowledgement of the nomination: if this is not received, please contact the Committee Chair.

For further information, please contact the Chair of the 2020 Gavin Brown Prize Selection Committee, Professor N. Thamwattana (Natalie.Thamwattana@newcastle.edu.au). The other members of the 2020 Gavin Brown Prize Selection Committee are Professor N.F. Smythe (Outgoing Chair), Professor P. Bouwknegt (Incoming Chair) and Professor A. Delgaigle (one year).

See http://www.austms.org.au/Gavin+Brown+Prize+winners for a list of past Gavin Brown Prize winners.

Rules for the Gavin Brown Prize

1. The Gavin Brown Prize will be awarded annually for an outstanding and innovative piece of research in the mathematical sciences published by a Member or Members of the Society.
2. Each award will be for a single article, monograph, or book, consisting of original research, and published in the 9 calendar years $Y - 10$ to $Y - 2$, where Y is the year of the award.
3. To be eligible for the award of the Gavin Brown Prize, a publication must have at least one author who must
   (i) be a member of the Society, and have been a member of the Society for the calendar year at the time of publication of the paper (back-dating of membership is not allowed);
   (ii) normally be resident in Australia, and have been normally resident in Australia at the time when the research was carried out.
4. In the case of publications with multiple authors, the prize will be shared by all authors. The existence of authors who do not meet the conditions in Rule 3 will not preclude this award, although the Selection Committee may take it into account in assessing the achievement of the author(s) who do meet those conditions.

5. The Selection Committee may deem a publication ineligible if an author has previously received an award from the Australian Mathematical Society for a body of research which included the publication in question.
6. Nominations for the Gavin Brown Prize will be called for in the first half of each year. A publication may be nominated for the award by anyone who is not an author of that publication.
7. The award will be decided by a Selection Committee appointed by the Council.
8. The Selection Committee will consist of 4 persons:
   (i) 3 persons each appointed for a period of 3 years, namely a Chair, an Incoming Chair who will become the Chair in the following year, and an Outgoing Chair who has been the Chair in the preceding year;
   (ii) 1 person appointed for one year only.
9. The Selection Committee may consult with appropriate external assessors. Nominators are requested to suggest names of three assessors.

Nominations sought for the 2020 George Szekeres Medal

The Medal Committee for the 2020 George Szekeres Medal is now seeking nominations and recommendations for possible candidates for this Medal. The George Szekeres Medal is awarded for outstanding research achievement for work done substantially in Australia. It is awarded only in even numbered years.

Nominations close on **22 May 2020**, should comply with rule 6 below and should be sent to http://journal.austms.org.au/ojs/index.php/AMPA/login. Nominators should receive an acknowledgement of the nomination: if this is not received, please contact the Committee Chair.

For further information, please contact the Chair of the 2020 George Szekeres Medal Committee, Professor R.H. Street (ross.street@mq.edu.au).The other members of the 2020 George Szekeres Medal Committee are Professor P. Taylor (Incoming Chair), Professor C.E. Praeger (outgoing chair) and Professor M. Myerscough (one year).

See http://www.austms.org.au/The+George+Szekeres+Medal for a list of past winners of the medal.

Rules for the George Szekeres Medal of the AustMS

Rule 1. The award is for a mathematical scientist who is a member of the Australian Mathematical Society and normally resident in Australia.

Rule 2. The medal may, in exceptional circumstances, be shared by at most two candidates.

Rule 3. The Medal is awarded every two years.

Rule 4. (i) The award is for a sustained outstanding contribution to research in the mathematical sciences. The candidate should have been resident in Australia when the bulk of the work was completed.

(ii) The successful candidate will have an excellent record of promoting and supporting the discipline, through activities such as extensive graduate student supervision, outstanding contributions to leadership in the Australian Mathematical Society, or other activities which have materially promoted the mathematical sciences discipline within Australia.

Rule 5. (i) The George Szekeres Medal can be awarded to a recipient of the Australian Mathematical Society Medal, provided that the sustained outstanding contribution to research in Rule 4(i) is subsequent to the work for which the Australian Mathematical Society Medal was awarded.

(ii) The George Szekeres Medal cannot be awarded to the same person on more than one occasion.

Rule 6. Nominations should include: (a) an extended citation, not more than two pages in length, arguing the case for awarding the Medal to the nominee; (b) a shorter citation, of not more than 100 words, which may be used to report the candidate's achievements in the event that the nomination is successful; (c) a full list of publications of the candidate, with the most significant (up to a maximum of 20) marked by an asterisk; (d) a curriculum vitae of the candidate's professional career, highlighting any achievements which add support to the nomination; and (e) the names of between three and six suitable referees, along with a brief statement as to their appropriateness.

Applications for Special Interest Meetings

Applications are considered twice a year. The next closing date is Wednesday 11 March 2020, for meetings between July 2020 and June 2021, and the following one is Thursday 10 September 2020, for meetings in 2021.

If funding is being sought from both AustMS and AMSI, a single application should be made at http://research.amsi.org.au/workshop-funding/.

If funding is not being sought from AMSI, please use the application form available at http://www.austms.org.au/Special+Interest+Meetings and send it to the secretary, Deborah Jackson (Secretary@austms.org.au).

The maximum grant from the Society for each meeting is $3,500.

News from the annual conference

The Society's 63rd Annual Meeting was held in December at Monash University. The Director, Professor Ian Wanless, his team of local organisers and the Program Committee, led by the Vice-President (Annual Conferences), were responsible for a very successful conference.

The following matters from the meeting are provided here for the information of those who could not attend.

1. The Australian Mathematical Society Medal for 2019 was awarded to Assoc Professor David Harvey of The University of New South Wales.
2. The Gavin Brown Prize for 2019 was awarded to the paper Z.I. Botev, J.F. Grotowski and D.P. Kroese (2010), Kernel density estimation via diffusion, *The Annals of Statistics* **38**(5), 2916–2957.
3. The 2019 Mahony-Neumann-Room Prize, for a publication in the *J. Aust. Math. Soc.*, was awarded to the paper V. Magnani (2013), Towards differential calculus in stratified groups, *J. Aust. Math. Soc.* **95**(1), 76–128.
4. The 2019 Award for Teaching Excellence (Early Career) was awarded to Belinda Spratt of Queensland University of Technology.
5. The 2019 B.H. Neumann Prize was awarded jointly to Yudhistira Andersen Bunjamin (University of New South Wales) for the talk 'Equity considerations and design of mathematics outreach to schools' and Trang Thi Thien Nguyen (University of South Australia) for the talk 'Non-homogeneous T(1) theorem for singular integrals on product quasimetric spaces'.
   Honourable mentions were given to Grace Garden (Australian National University) and Kelly Mags (University of Sydney).
6. At the AGM, it was confirmed that the 64th Annual Meeting of the Society will be held at the University of New England from Tuesday 8 to Friday 11 December 2020, with Associate Professor G. Schmalz as Director.

   It was also confirmed that the 65th Annual Meeting of the Society be held at the University of Newcastle in December 2021, with Professor F. Breuer as Director.

   It was also confirmed that the 67th annual meeting in the year 2023 will be a joint meeting with the American and New Zealand Mathematical Societies, to be held at the University of Auckland from Monday 4 December to Friday 8 December.

Deborah Jackson AustMS Secretary
Email: Secretary@AustMS.org.au

Deborah Jackson (née Trueman) is a lecturer at La Trobe University. She began her academic career at Monash University and then moved to Swinburne University. After several years back at Monash, she joined La Trobe in 2010. Deborah was honorary Chair of the Victorian Algebra Group from 1996 to 2003 and its Secretary from 1994 to 1995. Deborah took over as Secretary of the Society in September 2019.

The Australian Mathematical Society

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: www.austms.org.au.

Local Correspondents

Publications

The Journal of the Australian Mathematical Society

Editor: Professor Jon Berrick
Sydney Mathematical Research Institute (SMRI)
The University of Sydney, NSW 2006, Australia

The ANZIAM Journal

Editor: Professor Andrew Bassom
School of Mathematics and Physics
University of Tasmania, Australia

Editor: Professor Graeme Hocking
School of Chemical and Mathematical Sciences
Murdoch University, WA 6150, Australia

Bulletin of the Australian Mathematical Society

Editor: Professor John Loxton
Western Sydney University, Penrith, NSW 2751, 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: Professor Jacqui Ramagge
School of Mathematics and Statistics
The University of Sydney, NSW 2006, 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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