Melbourne University Mathematics and Statistics Society

MUMS AGM 2003

Friday, 4 April
1:00pm
Thomas Cherry Room,
Richard Berry Building

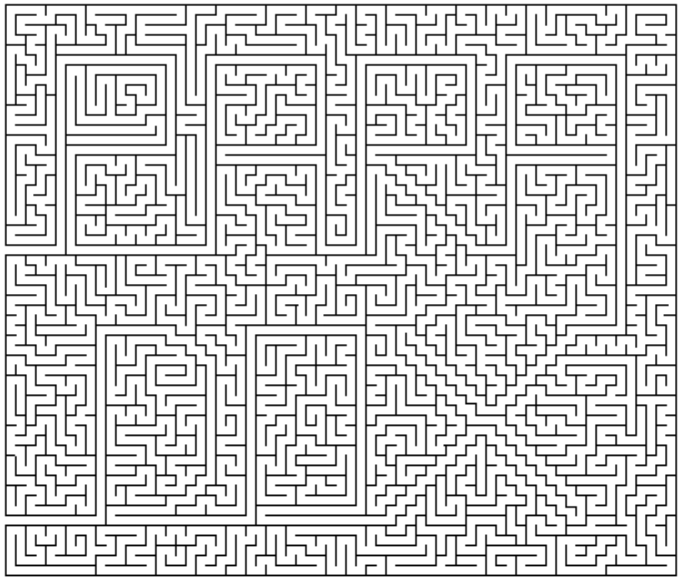
Are you sick and tired of bland maths subjects? Do you want to get more involved in the *fun* side of mathematics? Come and have your say in who will run MUMS for this year, and pick up some free food while you're at it. That's right folks,

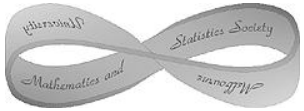
Free Pizza
will be served at the meeting!!

Issue 1, 2003

Paradox

The Magazine of the Melbourne University Mathematics and Statistics Society





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Paradox

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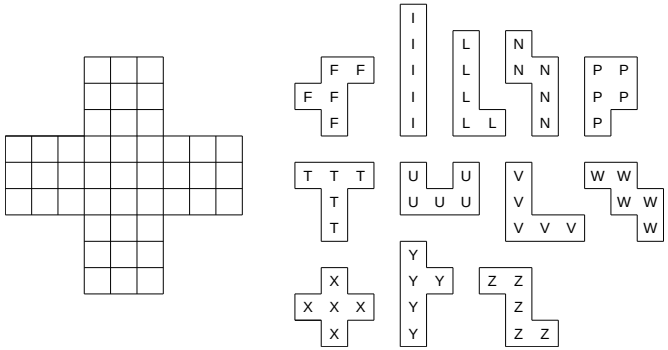
Paradox Problems

The following are some maths problems for which prize money is offered. The person who submits the best (i.e. clearest and most elegant) solution to each problem will be awarded the sum of money indicated beside the problem number. Solutions may be emailed to paradox@ms.unimelb.edu.au or you can drop a hard copy of your solution into the MUMS pigeonhole near the Maths and Stats Office in the Richard Berry Building.

1. ($2) You are given a large supply of each of the standard denomination Australian coins: 5c, 10c, 20c, 50c, $1, $2. What is the smallest n such that it is impossible to select n coins that make exactly two dollars?

2. ($5) Below are 12 pentominoes and a game board. Place four different pentominoes on the board so that none of the other eight can be placed. Pentominoes may be rotated and/or reflected. You must follow the grid lines.



3. ($5) A confused bank teller transposed the dollars and cents when he cashed a cheque for Ms Smith, giving her dollars instead of cents and cents instead of dollars. After buying a newspaper for 50 cents, Ms Smith noticed that she had left exactly three times as much as the original cheque. What was the amount of the cheque?

4. ($5) A rectangular sheet of paper is folded so that two diagonaly opposite corners come together. If the crease formed is the same length as the longer side of the sheet, what is the ratio of the longer side of the sheet to the shorter side?

5. ($10) Prove that for every integer $n > 0$ there exists an integer $k > 0$ such that $2^n k$ can be written in decimal notation using only the digits 1 and 2.

A Statistics Joke

A famous statistician would never travel by aeroplane, because he had studied air travel and estimated the probability of there being a bomb on any given flight was 1 in a million, and he was not prepared to accept these odds.

One day a colleague met him at a conference far from home. "How did you get here, by train?"

"No, I flew."

"What about the possibilty of a bomb?"

"Well, I began thinking that if the odds of one bomb are one in a million, then the odds of TWO bombs are $\frac{1}{1{,}000{,}000} \times \frac{1}{1{,}000{,}000}$. This is a very, very small probability, which I can accept. So, now I bring my own bomb along!"

A Maths Website

With the catchy slogan

> "Yep, that's right! Numbers are fun! Numbers are your friends."

who could resist entering the wonderful website, Fun With Numbers: The Home Page?! Found at `http://www.newdream.net/sage/old/numbers/9.htm`, this wacky page presents the following useful numerical titbits:

- the first 25,000 decimal digits of the square root of nine;
- the first 28,915 odd primes;
- the first even prime;
- the first 50,000 random numbers;
- the first 999 factorials;
- fractional approximations of π;
- the first 1058 powers of 2; and
- all 100,000-and-a-bit digits of 2^{333333}.

Words from the Editor...

Welcome to the first issue of *Paradox* for 2003, the magazine of the Melbourne University Mathematics and Statistics Society (or MUMS, as we are more affectionately known). For those unaware, *Paradox* has provided an entertaining and informative read for those of mathematical bent since the days when your maths lecturers were students themselves. Since this could very well be the last issue with me as editor, I have made sure that this copy of *Paradox* which you hold in your hands is more bumper than ever, packed with hilarity and mathematical goodness.

This issue features articles on hot celebrities who once studied mathematics and on mathematicians who liked to be hot. There is also an article on summer vacation scholarships, the usual menagerie of jokes, and various mathematical problems for which prizes are awarded. And who can forget *Paradox*'s very own comic strip superhero, *Knot Man*, who makes a return in this issue to tangle with the most evil villain he has ever encountered! So whether you carry a calculator in your pocket, wear your sandals with socks, or simply like reciting the first one thousand digits of pi, there is something in *Paradox* for everyone!

We always like to receive comments, suggestions, jokes and articles from our readers, so please feel free to e-mail us at `paradox@ms.unimelb.edu.au`. Happy reading...

— Norman Do, *Paradox* Editor

... and some from the President

Welcome to the first edition of *Paradox* for 2003, and, indeed, to 2003 (although this may be a little belated)!

I'd like to say a bit about what MUMS does, for all of you who are either new to Melbourne Uni, or for those of you that haven't found out about us in the past. MUMS is the student club for maths and stats students. This means we put on all sorts of events during the year: trivia nights, free barbecues, an honours information session and, of course, our much loved Maths Olympics, held in semester two and definitely something to look out for!

I would encourage all maths and stats students to get involved with MUMS to some extent, whether it's simply reading this copy of *Paradox*, attending one of our events, or getting yourself on committee — it's all good fun and worthwhile.

Ahh, yes... committee! Each year MUMS (like every other student club and society at Melbourne University) has an AGM to elect a new committee. Being on a committee is a great way to really get involved in a club, meet some new

people and learn something on the way. Whilst there is some work involved, it's often enjoyable, and most certainly rewarding.

If you are interested in running for committee, or just finding out more about MUMS, (OK, OK, or just interested in eating free pizza) then please turn up to the MUMS AGM this Friday 4th April at 1:00pm in the Thomas Cherry Room (it's opposite the drinking fountain on the main corridor of the maths building). Whilst not as competitive as a maths olympics or as corny as this edition of *Knot Man*, it's still got free food and that's got to be worthwhile!

— Luke Mawbey, President of MUMS

FAMOUS PEOPLE WHO STUDIED MATHEMATICS

Politics

Corazon Aquino (193–) was president of the Philippines from 1986 to 1992. She graduated with a Bachelor of Arts degree, with a minor in mathematics at the College of Mount Saint Vincent in New York.

David Dinkins (1927–) was the first African American mayor of New York City, a position which he held from 1989 to 1993. He received a Bachelor of Science in mathematics from Howard University.

Alberto Fujimori (1938–) was president of Peru from 1990 to 2000. His term in office was often shrouded in controversy and he announced his resignation by leaving the country. He has a Master of Arts degree in mathematics from the University of Wisconsin.

Lee Hsien Loong (1952–) is the deputy prime minister of Singapore. He graduated with first class honours in mathematics and a diploma in computer science from Cambridge.

Paul Painlevé (1863–1933) was twice president of France, once in 1917 and then again in 1925. He received a doctorate in mathematics and went on to become a professor at the Sorbonne, the Polytechnique and the University of Lille. He had a distinguished mathematical career and the Painlevé theory of transcendents is still widely studied.

Leon Trotsky (1879–1940) was a Russian communist revolutionary and one of the principal leaders in the establishment of the USSR. He began to study pure mathematics at Odessa, but imprisonment and exile in Siberia seem to have ended his mathematical efforts.

George Saitoti is the former vice president of Kenya. He has a PhD in algebraic

Renè Descartes (1596–1650)

Unlike Fourier, if Descartes had stayed warm, he probably would have been fine. But if you thought nothing could tempt Descartes out of bed, you thought wrong. Queen Christina of Sweden invited Descartes to become her personal live-in philosophy tutor. Descartes was offered a position in her court — a life amongst royalty. After some consternation, Descartes finaly accepted.

Descartes had two problems.

The first problem was (and still is) that Sweden was not a very warm place. It certainly wasn't the sort of place conducive to the longevity of people as fragile as René Descartes. However, you can suppose that Descartes could have spent plenty of time in bed and wouldn't have caught too much of a chill. Indeed, for some time he did precisely that, as Queen Christina remained engrossed in the frivolities of the court.

This, however, did not last for long. Problem number two was Queen Christina of Sweden, once she regained a taste for philosophy: a young, healthy, energetic and demanding woman with little consideration for the frailty of her genius guest or his proclivity for extreme somnolence. And she was a morning person. (Not a mathematician, obviously.)

The disruption to Descartes' usually rather light morning schedule was terminal. The queen woke him three mornings a week at 5 am, which would be painful enough for a fit and healthy person, but was devastating for one like Descartes. No amount of coffee could save him; the extreme cold and early mornings ruined his health. He contracted pneumonia and was dead within months.

The moral of the story? Beware of those cold early morning starts - they can kill you!

– Daniel Mathews

what is today called Fourier's theorem, while stated by Fourier himself, was not proved properly until 150 years later, and indeed his writings were riddled with mistakes and inaccuracies. Nevertheless, his theorem broke new ground in areas where other great mathematicians like Euler, Daniel Bernoulli and Lagrange had not, and won him the Grand Prize of the French Academy of Sciences. But it was his work as a physicist — in particular, his fascination with heat — which took his predilections in an unexpected direction. He liked it hot!

René Descartes (1596–1650) is, of course, a household name in mathematics and philosophy. He signed his name Renatus Cartesius to his works (which were in Latin), hence the origin of the term 'Cartesian' to describe his thoughts. It's difficult now to believe that there was actualy someone who invented the Cartesian coordinate system, and the whole idea of representing geometric points by co-ordinates. But there was a time when these things were not invented, and before which nobody had used them, and nobody had even thought of them — and that time was not so long ago in historical terms. Before that all of geometry was in the vein of the ancient Greeks. His philosophy is also, of course, foundational to much Western thinking.

Returning to the thermophile Fourier, he served as a soldier in the French Revolution under Napoleon, and accompanied him to Egypt in 1798. There, so the story goes, he suffered a disease of the thyroid which heat helped to relieve. And so Fourier developed a belief in the healing power of heat — the more heat, the better! Not only did this spur on his work in thermodynamics, it also gave him a much hotter lifestyle!

Fourier took to wearing layer upon layer of clothes, no matter what the weather. He stoked up the fireplace and cranked the heating to ever hotter temperatures. His house was unbearable for guests to visit. Even if Fourier did find it uncomfortable, he bathed glady in the heat, believing it could only do him good. He became ever more wary of leaving his house, where much more moderate but 'unhealthy' low temperatures prevailed.

But it did not do him so much good. He cooked his own goose. The extreme heat exacerbated his heart condition and undoubtedly accelerated his demise.

Descartes also liked it hot, though perhaps not as hot as Fourier. He was happy enough to be snuggled under the sheets of his bed. Indeed, bed was where he spent a lot of his time. He was part of a wealthy family, and lived a pampered lifestyle. And despite his incredible mind, it was trapped in a very frail body (a very Cartesian distinction!). The story goes that his greatest discoveries — including, of course, the Cartesian coordinate axes — came to him while in bed. (Have you ever heard a better reason to sleep through your next 9am lecture?) His family let him sleep in as long as he liked, and his career as a gentleman officer in the Dutch and Bavarian armies also allowed him no shortage of rest!

Leon Trotsky

topology from Warwick University and was a professor at the University of Nairobi before entering politics.

Eamon de Valera (1882–1975) was the long-time prime minister and then president of the Republic of Ireland. He was a mathematics professor before Irish independence.

Music

Clifford Brown (1930–1956) was a famous fifties jazz trumpeter who majored in mathematics at Delaware State College. His wife once said about him, "Music was his first love, I was his second, and math was his third."

Art Garfunkel (1941–) is a renowned singer and rose to fame as part of the folk rock duo Simon and Garfunkel. He earned his masters degree in mathematics from Columbia University and began work on a PhD, but chose to pursue his musical career instead.

Philip Glass (1937–) is a famous composer who received a bachelors degree from the University of Chicago, majoring in mathematics and philosophy.

Tom Lehrer (1928–) is a U.S. songwriter and parodist. He was a PhD student in mathematics at Harvard University.

Teri Hatcher

Film and Literature

Lewis Carroll (1832–1898) is the author of Alice in Wonderland, Through the Looking Glass, and other works. He lectured in mathematics at Oxford and was a logician under his real name, Charles Lutwidge Dodgson.

Teri Hatcher (1964–) shot to fame playing the character Lois Lane on the television show, "Lois and Clark: The New Adventures of Superman". Originaly, she majored in mathematics and engineering at DeAnza Junior College.

Danica McKellar (1975–) played Winnie Cooper on the television show, "The Wonder Years". She graduated summa cum laude from UCLA in 1998 with an honours degree in mathematics. Her research project was entitled "Percolation and Gibbs-states multiplicity for ferromagnetic Ashkin-Teller models in two dimensions". She once said, "When I originally entered UCLA, I had planned to go for a film major, but I kept finding myself taking math classes for fun, cause I missed them from high school!"

Larry Niven (1938–) is a science fiction writer, winner of the Nebula and Hugo awards. He gained a Bachelor of Arts degree in mathematics from Washburn University, Kansas.

Alexander Solzhenitsyn (1918–) won the 1970 Nobel prize for literature, after obtaining a degree in mathematics and physics from the University of Rostov.

Bram Stoker (1847–1912) is best remembered as the author of Dracula. He graduated with honours in mathematics from Trinity College, Dublin.

Paul Verhoeven (1938–) is a director of many Hollywood movies, such as Total

Some Mathematicians Like it Hot: Fourier and Descartes

Those of us who study mathematics are all accustomed to bandying about mathematicians' names. We throw them around all the time when we do mathematics, quoting their theorems, using their methods, retracing their thoughts, imagining their genius, but most often scratching our heads. Their mathematics is often more than enough for anybody's brain to handle. Some mathematicians' names are enough to make your head spin; others are enough to make you want to scream!

Rarely, however, do we get a glimpse into the lives of great mathematicians. Rarer still is a glimpse into the quirks and idiosyncrasies that a life in mathematics almost invariably produces! For every great mathematician there is a story: sometimes heroic, sometimes controversial, sometimes romantic, sometimes tragic. Behind most there is at least one story of gross ineptitude.

The stories of Fourier and Descartes' demises are in a class of their own — flowing from gross miscalculations of elementary properties of the temperature scale!

Jean Baptiste Fourier (1768–1830)

Jean Baptiste Fourier (1768–1830) is certainly counted amongst the greatest mathematicians and scientists of all time. Anybody who has studied applied mathematics will have heard of Fourier series. Many of his discoveries came as a result of his investigations into what is today called thermodynamics — the nature of heat. In his work he developed the notion of the Fourier series, an infinite trigonometric series approximating any periodic function. Incidentally,

Justin Numbers: What Page Am I On Again?

I was on the bus one day, reading a book, when suddenly I realised that we had arrived at my stop. I hurriedly closed my book and got up, but not before noting that I was up to page 154. Worried that I might otherwise forget this page number, I decided, as any self-respecting mathematician would, to embed it in my memory by discovering some elegant mathematical property of the number. A moment's consideration led me to the following realisation:

In decimal notation, the number 154 is comprised of the three digits 1, 5 and 4. Now, if we take the 1st prime number, the 5th prime number, and the 4th prime number, and multiply them together, we get $p_1 p_5 p_4 = 2 \times 11 \times 7 = 154$ — the very number we began with!

I thought this was a pretty exciting property of the number 154 and, needless to say, when I got back to reading my book that evening, I had no trouble remembering where I was up to. However, the adventure didn't stop there. I was now determined to find more numbers with this wonderful property.

It wasn't too hard to find the smallest such number, 14 ($= p_1 p_4 = 2 \times 7$). A quick computer search revealed two more: 1196 ($= p_1 p_1 p_9 p_6 = 2 \times 2 \times 23 \times 13$) and 279174 ($= p_2 p_7 p_9 p_1 p_7 p_4 = 3 \times 17 \times 23 \times 2 \times 17 \times 7$). These numbers are known (currently only by me, but once this is printed, by people all over Melbourne) as Justin numbers.

Of course, the criterion for Justin numbers hinges upon decimal (base 10) representation. However, it is possible to have Justin numbers in other base systems. For example, in base 9, 5571_9 is a Justin number, for $p_5 p_5 p_7 p_1 = 11 \times 11 \times 17 \times 2 = 4114_{10} = 5571_9$. In base 45, 78_{45} is a Justin number, for $p_7 p_8 = 17 \times 19 = 323_{10} = 78_{45}$.

It is very simple to prove that there cannot be any binary (base 2) Justin numbers, and almost as easy to prove that there is but a single ternary (base 3) Justin number, namely, 11_3. However, in number systems with higher bases, it becomes difficult to find all of the Justin numbers. At this time, it is unknown (to me) whether there exist any more decimal Justin numbers beyond the four mentioned above (14, 154, 1196 and 279174). However, I am hopeful that this situation will soon be rectified, for *Paradox* is offering $14 to the first person to either find a fifth decimal Justin number, or else prove that no such number exists!

— Justin Ghan

Recall, Basic Instinct, Robocop, Showgirls and Starship Troopers. He received a PhD in mathematics and physics from the University of Leiden in the Netherlands. He never used his degree, opting instead to invest his energies in a career in film.

Finance

John Maynard Keynes (1883–1946) spawned the branch of Keynesian economics and is probably the best known of all economists. He earned a degree in mathematics from Cambridge University.

J. Pierpont Morgan (1837–1913) was an investment banker, art collector, and philanthropist, considered by many the greatest financier in the history of United States business. He majored in mathematics at the University of Gottingen where some of the faculty tried to convince him to become a professional mathematician. His company, J. P. Morgan & Co. Incorporated, is still one of the most respected and influential investment banking institutions.

Sport

Michael Jordan (1963–), the basketball superstar, began studying mathematics at the University of North Carolina before changing to another major later on.

Emanuel Lasker (1868–1941) was the world chess champion from 1894 to 1921. He received his PhD in mathematics from Erlangen University, studying under David Hilbert, one of the greatest mathematicians of the 20th century. His research on geometrical calculus and ideal numbers is still relevant today. Lasker was also good friends with Albert Einstein, and shared an apartment with him in the 1930's.

Virginia Wade (1945–) was one of the leading stars in women's tennis in the 1970's, winning the US Open, the Australian Open and Wimbledon. She has a Bachelor of Science degree in mathematics and physics from the University of Sussex.

Australian

Adam Spencer currently co-hosts Triple J's breakfast radio show with fellow comedian Wil Anderson and also hosts Quantum, the ABC's science program. After beginning an Arts/Law degree at the University of Sydney, he decided to try his hand at pure mathematics. After spending a few years on his PhD, he became a media celebrity after being spotted at the 1996 Raw Comedy Finals.

Adam Spencer

Adam Spencer is also an accomplished debater — his successes include winning the Australasian Debating Championships in 1988 and 1990 and being voted best speaker in the world in the 1996 World Championships.

Red Symons (1949–) performed in the band Skyhooks, worked as a musical director for The Melbourne Theatre Company, was a cast member of the Rocky Horror Show, and appears on 774 ABC Melbourne breakfast radio. He has appeared as an actor, worked as a record producer, and is an award winning jingle writer. Most people will remember him as the "gong man" from the long running television show, "Hey Hey It's Saturday". However, before entering the entertainment industry, Red graduated with a science degree majoring in computer science and pure mathematics.

Miscellaneous

Ted Kaczynski (1942–) is the real name of the infamous "Unabomber" who killed three people and injured twenty-nine others after sending out sixteen package bombs over the space of seventeen years. He holds a PhD in mathematics from the University of Michigan and was a mathematics professor at Berkeley for some time. He published papers in complex variables before retreating to the woods and living as a recluse. Kaczynski is now serving a life sentence in prison.

Ludwig Wittgenstein (1889–1951) is one of the giants of twentieth century philosophy. He studied mathematical logic with Bertrand Russell at Cambridge.

Summer Vacation Scholarships

Most people spent their summer holidays on the beachlying on the sand. I spent mine at uni, studying sand — I participated in a maths and stats summer research project.

This program allows later-year undergraduate students to experience research in mathematics. Each participant is assigned a supervisor, and given 6–8 weeks to complete their project. From conversations with other students, it seems there was a huge range of topics selected: from evaluating impossible-looking triple integrals, to statistical analysis.

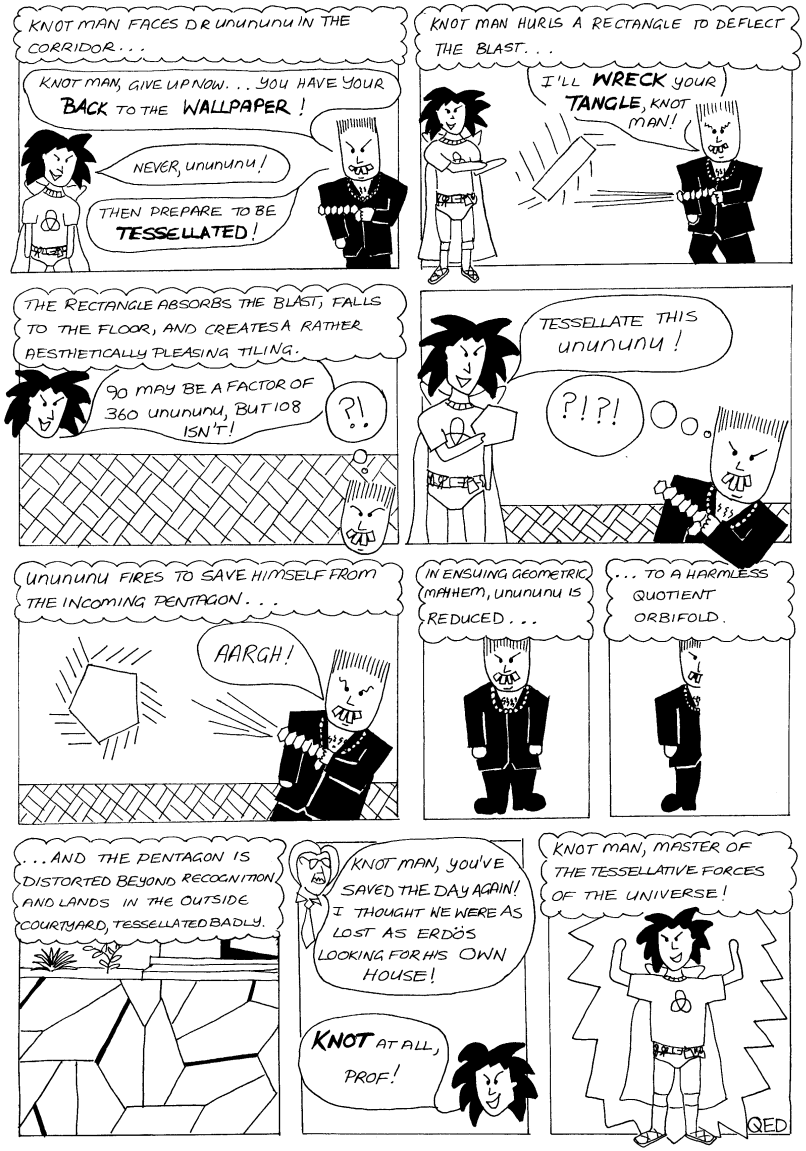
By now you may be wondering — why study sand? I'm not sure if I should answer that — my project was conducted in collaboration with the US army (top secret???). In order to train their soldiers, the army is planning to develop a simulator. Eventualy this should be capable of replicating conditions anywhere in the word. Say, for some reason, America wanted to simulate driving a tank through an Iraqi desert surrounded by smoke. Engineers could push a few buttons and immerse trainees in an accurate depiction of this environment. To successfuly build this, the developers of this technology require a mathematical model for the sand, and the sand-tyre interaction.

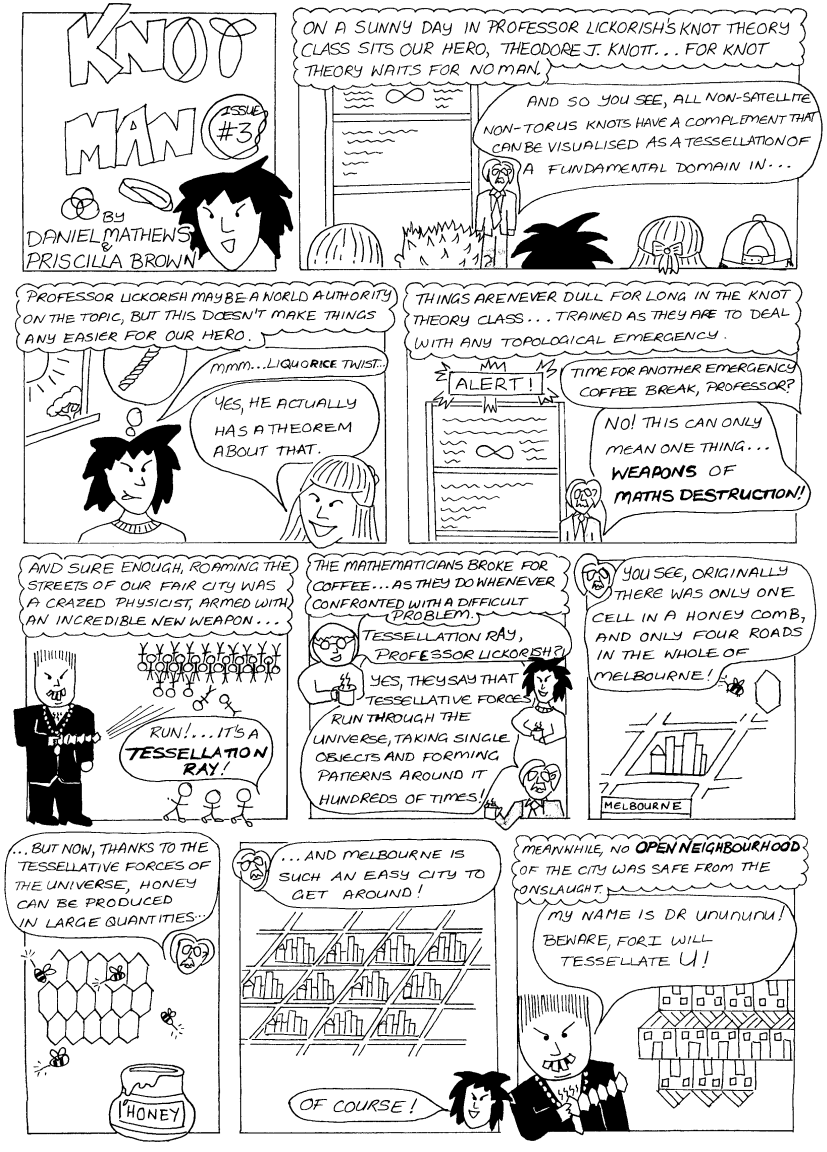
Fortunately, there is a research group in this department (Mechanics of Granular Media Group) that is a world-leader in this field. Researchers from this group have developed a constitutive relationship for the mechanics of granular materials (i.e. a mathematical model for sand). That's where I come in. Together with Maya Muthuswamy, I designed a computer simulator and visualiser (based on software provided by the US army), which can model certain standard experiments. The output can be compared to the predictions of the mathematical model, to test its accuracy. Our preliminary results seem realistic, but we are still analysing the data (so you can't blame me for the war!).

As the department promised, this project was a great opportunity to experience research. It allowed me to apply the knowledge I have gained at uni to a real-life problem, and see its purpose and potential. I also improved dramatically at playing backgammon. Compared to my summer job last year of stacking boxes, well... it doesn't compare.

To anyone considering a vacation scholarship, I highly recommend them! Or, you could just spend the summer lounging on the sand.

— Daniel Arber

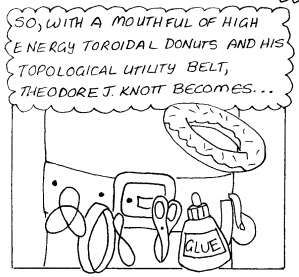

KNOT MAN FACES DR UNUNUNU IN THE CORRIDOR...
KNOT MAN, GIVE UP NOW... YOU HAVE YOUR BACK TO THE WALLPAPER!
NEVER, UNUNUNU!
THEN PREPARE TO BE TESSELLATED!
KNOT MAN HURLS A RECTANGLE TO DEFLECT THE BLAST...
I'LL WRECK YOUR TANGLE, KNOT MAN!
THE RECTANGLE ABSORBS THE BLAST, FALLS TO THE FLOOR, AND CREATES A RATHER AESTHETICALLY PLEASING TILING.
90 MAY BE A FACTOR OF 360 UNUNUNU, BUT 108 ISN'T!
?!
TESSELLATE THIS UNUNUNU!
?!?!
UNUNUNU FIRES TO SAVE HIMSELF FROM THE INCOMING PENTAGON...
AARGH!
IN ENSUING GEOMETRIC MAYHEM, UNUNUNU IS REDUCED...
... TO A HARMLESS QUOTIENT ORBIFOLD.
...AND THE PENTAGON IS DISTORTED BEYOND RECOGNITION, AND LANDS IN THE OUTSIDE COURTYARD, TESSELLATED BADLY.
KNOT MAN, YOU'VE SAVED THE DAY AGAIN! I THOUGHT WE WERE AS LOST AS ERDÖS LOOKING FOR HIS OWN HOUSE!
KNOT AT ALL, PROF!
KNOT MAN, MASTER OF THE TESSELLATIVE FORCES OF THE UNIVERSE!
QED

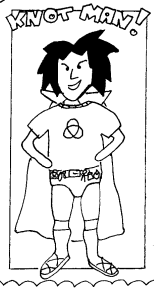

KNOT MAN
ISSUE #3
BY DANIEL MATHEWS & PRISCILLA BROWN
ON A SUNNY DAY IN PROFESSOR LICKORISH'S KNOT THEORY CLASS SITS OUR HERO, THEODORE J. KNOTT... FOR KNOT THEORY WAITS FOR NO MAN.
AND SO YOU SEE, ALL NON-SATELLITE NON-TORUS KNOTS HAVE A COMPLEMENT THAT CAN BE VISUALISED AS A TESSELLATION OF A FUNDAMENTAL DOMAIN IN...
PROFESSOR LICKORISH MAY BE A WORLD AUTHORITY ON THE TOPIC, BUT THIS DOESN'T MAKE THINGS ANY EASIER FOR OUR HERO.
MMM... LIQUORICE TWIST...
YES, HE ACTUALLY HAS A THEOREM ABOUT THAT.
THINGS ARE NEVER DULL FOR LONG IN THE KNOT THEORY CLASS... TRAINED AS THEY ARE TO DEAL WITH ANY TOPOLOGICAL EMERGENCY.
ALERT!
TIME FOR ANOTHER EMERGENCY COFFEE BREAK, PROFESSOR?
NO! THIS CAN ONLY MEAN ONE THING... WEAPONS OF MATHS DESTRUCTION!
AND SURE ENOUGH, ROAMING THE STREETS OF OUR FAIR CITY WAS A CRAZED PHYSICIST, ARMED WITH AN INCREDIBLE NEW WEAPON...
RUN!... IT'S A TESSELLATION RAY!
THE MATHEMATICIANS BROKE FOR COFFEE... AS THEY DO WHENEVER CONFRONTED WITH A DIFFICULT PROBLEM.
TESSELLATION RAY, PROFESSOR LICKORISH?
YES, THEY SAY THAT TESSELLATIVE FORCES RUN THROUGH THE UNIVERSE, TAKING SINGLE OBJECTS AND FORMING PATTERNS AROUND IT HUNDREDS OF TIMES!
YOU SEE, ORIGINALLY THERE WAS ONLY ONE CELL IN A HONEY COMB, AND ONLY FOUR ROADS IN THE WHOLE OF MELBOURNE!
MELBOURNE
...BUT NOW, THANKS TO THE TESSELLATIVE FORCES OF THE UNIVERSE, HONEY CAN BE PRODUCED IN LARGE QUANTITIES...
HONEY
...AND MELBOURNE IS SUCH AN EASY CITY TO GET AROUND!
OF COURSE!
MEANWHILE, NO OPEN NEIGHBOURHOOD OF THE CITY WAS SAFE FROM THE ONSLAUGHT.
MY NAME IS DR UNUNUNU! BEWARE, FOR I WILL TESSELLATE U!

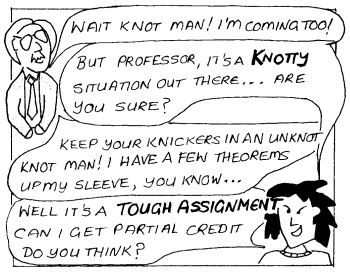

IT MUST BE THAT EVIL PHYSICIST FROM LATRASHKIN, DR...ununun!
DR ununu... WHO?
IF HE'S NOT A DOCTOR THEN WHAT'S HIS TITLE...?
I KNEW THOSE PHYSICISTS COULDN'T BE TRUSTED WITH GROUP THEORY!

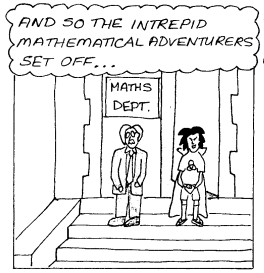
SOMEONE MUST HAVE HARNESSED THESE TESSELLATIVE FORCES FOR THE POWER OF EVIL... IN A TESSELLATION GUN!
I'LL BET HE HAS A GREAT BATHROOM FLOOR WHOEVER HE IS!

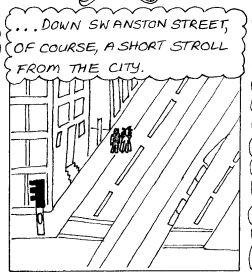
WITH THE CITY HELPLESS BEFORE IMPENDING DOOM, THEODORE J KNOTT TAKES CHARGE...
THIS SOUNDS LIKE A JOB FOR...

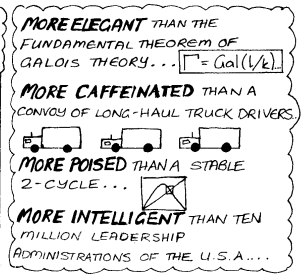

SO, WITH A MOUTHFUL OF HIGH ENERGY TOROIDAL DONUTS AND HIS TOPOLOGICAL UTILITY BELT, THEODORE J. KNOTT BECOMES...
GLUE


KNOT MAN!

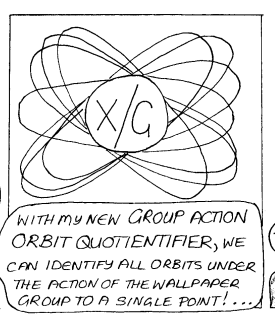

WAIT KNOT MAN! I'M COMING TOO!
BUT PROFESSOR, IT'S A KNOTTY SITUATION OUT THERE... ARE YOU SURE?
KEEP YOUR KNICKERS IN AN UNKNOT KNOT MAN! I HAVE A FEW THEOREMS UP MY SLEEVE, YOU KNOW...
WELL IT'S A TOUGH ASSIGNMENT CAN I GET PARTIAL CREDIT DO YOU THINK?


AND SO THE INTREPID MATHEMATICAL ADVENTURERS SET OFF...
MATHS DEPT.

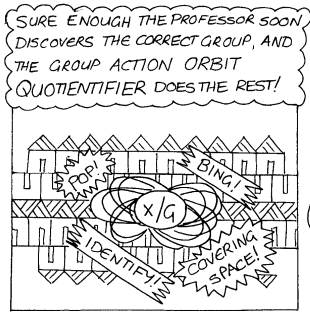

...DOWN SWANSTON STREET, OF COURSE, A SHORT STROLL FROM THE CITY.

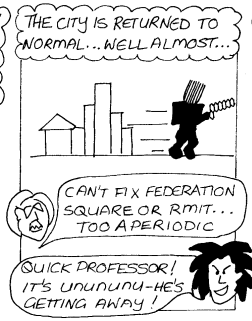

MORE ELEGANT THAN THE FUNDAMENTAL THEOREM OF GALOIS THEORY... Γ = Gal(L/k).
MORE CAFFEINATED THAN A CONVOY OF LONG-HAUL TRUCK DRIVERS.
MORE POISED THAN A STABLE 2-CYCLE...
MORE INTELLIGENT THAN TEN MILLION LEADERSHIP ADMINISTRATIONS OF THE U.S.A....

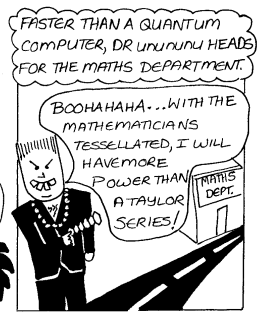

THE TWO EVENTUALLY ARRIVE IN THE CITY, BUT DR ununun IS NOWHERE TO BE SEEN...
WHAT CAN WE DO ABOUT ALL THIS TESSELLATION?!
ACTUALLY KNOT MAN, I'VE GOT SOMETHING MORE UNBELIEVABLE THAN THE BANACH-TARSKI THEOREM!


X/G
WITH MY NEW GROUP ACTION ORBIT QUOTIENTIFIER, WE CAN IDENTIFY ALL ORBITS UNDER THE ACTION OF THE WALLPAPER GROUP TO A SINGLE POINT!...


IT ALL SOUNDS A BIT TOO MUCH LIKE A GROUP THEORY LECTURE FOR KNOT MAN.
mmm...Z... Z...
NO KNOT MAN, IT'S NOT $\mathbb{Z}_2$, WALLPAPER GROUPS ARE MORE COMPLICATED!

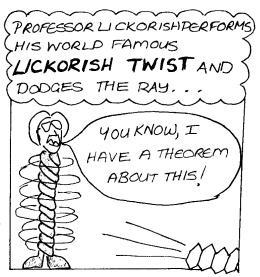

SURE ENOUGH THE PROFESSOR SOON DISCOVERS THE CORRECT GROUP, AND THE GROUP ACTION ORBIT QUOTIENTIFIER DOES THE REST!
POP!
BING!
X/G
IDENTIFY!
COVERING SPACE!

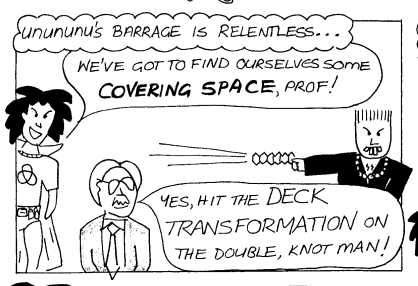

THE CITY IS RETURNED TO NORMAL... WELL ALMOST...
CAN'T FIX FEDERATION SQUARE OR RMIT... TOO APERIODIC
QUICK PROFESSOR! IT'S ununun-HE'S GETTING AWAY!

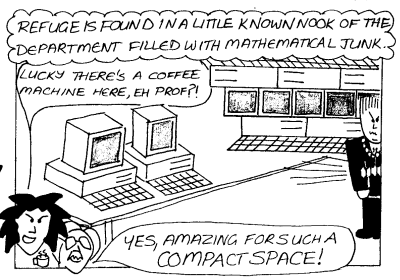

FASTER THAN A QUANTUM COMPUTER, DR ununun HEADS FOR THE MATHS DEPARTMENT.
BOOHAHAHA...WITH THE MATHEMATICIANS TESSELLATED, I WILL HAVE MORE POWER THAN A TAYLOR SERIES!
MATHS DEPT.

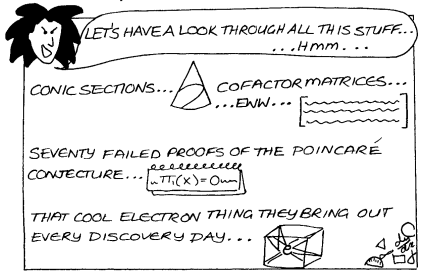

KNOTMAN AND THE PROFESSOR TAKE THE EMERGENCY TELEPORTER BACK TO THE UNIVERSITY...
AND PEOPLE THINK THESE ARE JUST EMERGENCY TELEPHONES!

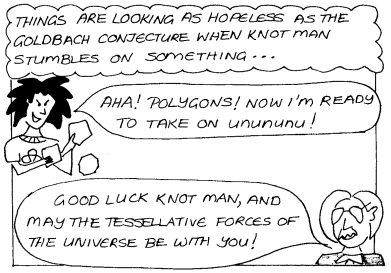

LOOK OUT!
TAKE THIS, PROF!


PROFESSOR LICKORISH PERFORMS HIS WORLD FAMOUS LICKORISH TWIST AND DODGES THE RAY...
YOU KNOW, I HAVE A THEOREM ABOUT THIS!


ununun's BARRAGE IS RELENTLESS...
WE'VE GOT TO FIND OURSELVES SOME COVERING SPACE, PROF!
YES, HIT THE DECK TRANSFORMATION ON THE DOUBLE, KNOT MAN!


REFUGE IS FOUND IN A LITTLE KNOWN NOOK OF THE DEPARTMENT FILLED WITH MATHEMATICAL JUNK...
LUCKY THERE'S A COFFEE MACHINE HERE, EH PROF?!
YES, AMAZING FOR SUCH A COMPACT SPACE!


LET'S HAVE A LOOK THROUGH ALL THIS STUFF...
...Hmm...
CONIC SECTIONS...
COFACTOR MATRICES...
...EWW...
SEVENTY FAILED PROOFS OF THE POINCARÉ CONJECTURE...
$\pi_1(X) = 0$
THAT COOL ELECTRON THING THEY BRING OUT EVERY DISCOVERY DAY...


THINGS ARE LOOKING AS HOPELESS AS THE GOLDBACH CONJECTURE WHEN KNOT MAN STUMBLES ON SOMETHING...
AHA! POLYGONS! NOW I'M READY TO TAKE ON ununun!
GOOD LUCK KNOT MAN, AND MAY THE TESSELLATIVE FORCES OF THE UNIVERSE BE WITH YOU!