

NeMeSiS News 2009

Newsletter of the National Mathematics Summer School

Maeva!

Welcome to the 11th edition of NeMeSiS News! We hope that you enjoy reading it. If you have any comments, ideas or submissions for the next issue, you can either tell Terry (terry@maths.usyd.edu.au) or contact me (merryn.horrocks@gmail.com). Thank you to everyone who contributed.

Merryn Horrocks (editor)

Terry Gagen, AM



In the Queen's Birthday Honours List, Terry Gagen was appointed to the Order of Australia as a Member of the Order (AM).

Here is the press release:

“Associate Professor Terence Matthew (Terry) GAGEN, Sydney NSW 2000

For service to higher education in the field of mathematics as an educator, researcher and mentor and through the National Mathematics Summer School.

Honorary Associate Professor, School of Mathematics and Statistics, University of Sydney, since his retirement in 2003; Associate Professor, 1984-2003; Senior Lecturer, 1973-1984; Head, former Department of Pure Mathematics, 1985-1987 and

1989-1990. Co-instigator and Tutor (voluntary), Chatswood Mathematics Enrichment Program, 1984-2003; an after-school-hours program for gifted and talented school students interested in challenging mathematical problems; the concept was adopted by secondary schools around Australia and New Zealand.

Chairman, NSW Higher School Certificate Mathematics Syllabus Committee, NSW Board of Studies, 1988-1990; Supervisor, NSW Higher School Certificate Mathematics Marking, for many years.

Director, National Mathematics Summer School, since 1993; Deputy Director, 1984-1992; Assistant Director, 1978, 1982 and 1983; Course Leader, for 34 years; involved since 1975; the School is held over a period of 2 weeks each summer at the Australian National University.

Awards/recognition include:

Distinguished Service Award, Australian Association of Mathematics Teachers, 2000.

B H Neumann Award, Australian Mathematics Trust, for his important contributions over many years to the enrichment of mathematics learning in Australia and its region, 1993.

Award for Excellence in Teaching, University of Sydney, 1992.”

We congratulate Terry on this well-deserved honour.

A Puzzle

(a) What comes next in this sequence:

1
1 1
2 1
1 2 1 1
1 1 1 2 2 1
3 1 2 2 1 1
?

(b) Show that the number 4 never appears in this sequence.

Useful Mathematics

Epidemiology, the science dealing with the incidence, spread and control of a disease in a population, is underpinned by mathematics. The mathematical methods used (abstraction, classification and statistics) have been instrumental in the saving of many lives. The complexities of trying to model humans, and work out which factors are relevant to the problem at hand (age? diet? blood type?) and how to build a model that represents the spread of the disease make it very interesting work. This story is about the first recorded epidemiological study.

In the 19th century, most physicians believed that cholera was transmitted by miasmas (poisonous gases). Dr John Snow (1813-1858) was an exception. He thought that if cholera was caused by bad air then it should affect the lungs, but it didn't. Instead it affected the digestive tract. He hypothesised that cholera was transmitted through contaminated water.

However, he could not explain how this could happen (this was before the theory of germs became established in medicine). So instead, he set about collecting evidence in support of his theory.

In the summer of 1854 there was an outbreak of cholera in the London district where Snow worked. He suspected that it was being spread by contaminated water piped from the Thames River.

The district was supplied by two water companies, the Southwark and Vauxhall Water Company which took its water downstream of the sewage outlets, and the Lambeth Water Company which took its water upstream of the sewer outlets.

Snow wrote

"No fewer than three hundred thousand people of both sexes, of every age and occupation, and of every rank and station, from gentle folks down to the very poor, were divided into two groups without their choice, and, in most cases, without their knowledge; one group being supplied with water containing the sewage of London, and amongst it, whatever might have come from the cholera patients – the other group having water quite free from such impurity."

Snow visited each house where there had been a cholera death and, where possible, determined which water company served that house. Of the 44 deaths in his immediate district, 38 had occurred in houses supplied by the Southwark and Vauxhall Water Company.

With the help of an associate he expanded his survey. They found that 334 people had died in a 4-week period. Of these, 286 had used Southwark and Vauxhall water while only 14 had used Lambeth water.

Snow took further samples from other districts and found that the ratio of deaths between the two water supplies was 71:5.

Snow now claimed that he had "*very strong evidence of the powerful influence which the drinking water containing the sewage of a town exerts on the spread of cholera when that disease is present.*"

However, Snow's claims were not widely accepted. This was the first time that anyone had made a survey of the incidence and distribution of a disease and his evidence was regarded as novel and unreliable.

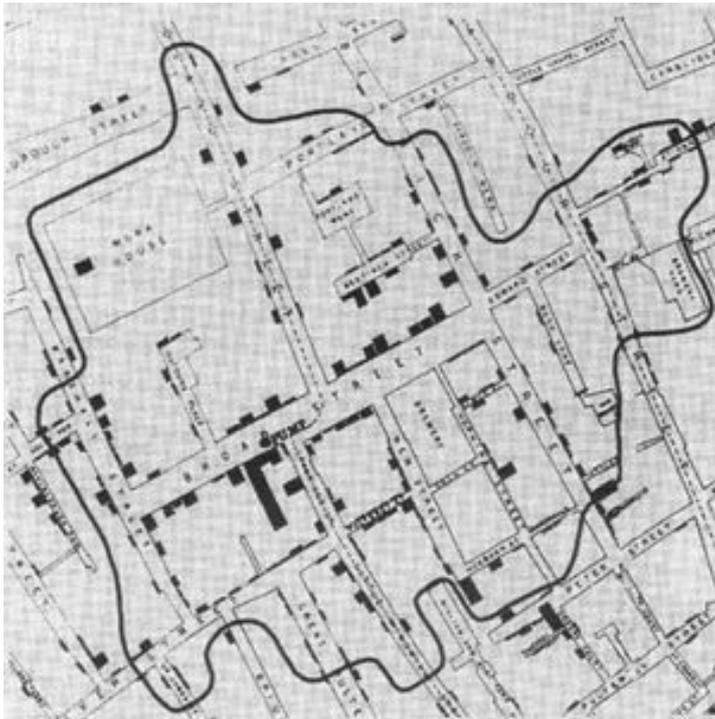
His critics pointed out that he had no evidence of cholera poison in water; that any cholera poison that got into the Thames would be so diluted that it became harmless; and that some people who drank from "good" water got sick and many people who drank "bad" water did not get sick.

In August 1853 cholera broke out suddenly in the nearby district of Soho. Snow made a map showing the address where each cholera death occurred. He found that the vast majority of deaths occurred in homes where the Broad St Pump was the closest water supply. He concluded that the Broad St well was the culprit, even though he could not explain how this pure water source had become contaminated.

Snow recommended that the pump handle be removed to stop the epidemic. The handle was duly removed and the epidemic stopped.

Health inspectors were appointed to investigate the outbreak. The pump-well was opened and inspected but no "*hole or crevice by which any impurity might enter*" was found and no particular contamination was found in chemical tests of the water. So the inspectors entirely rejected Snow's theories.

However, Snow carried out his own investigation and found that, just before the outbreak, a baby girl had died of "*exhaustion after an attack of diarrhoea*". The nappy waste had been dumped in a cesspit located within a metre of the well. Digging found evidence of seepage from the cesspit into the well.



Snow's map. The black bars indicate locations of cholera deaths. The black line (added) shows the area whose closest pump is the Broad St Pump.

Snow died before learning of the discovery of the cholera bacillus (1854 by Filippo Pacini) and before his theory about the spread of cholera had gained any significant support. However, his book on cholera (which cost him £200 to publish and which sold only 56 copies) slowly gained acceptance after his death. In subsequent epidemics water supplies were scrutinised and water boiled according to Snow's recommendations and these measures saved thousands of lives.

By the time of the last major outbreak of cholera in Europe (Hamburg, Germany in 1892), Snow's ideas and methods had been accepted (you can read a fascinating report about this epidemic in the British Medical Journal, Feb 18, 1893, p373-375). His statistical and mapping methods are now routine in the study of diseases.

Sources:

John Snow – a historical giant in epidemiology <http://www.ph.ucla.edu/epi/snow.html#FATHER>
 The Pleasures of Counting, Tom Körner, Cambridge University Press 1996, ISBN 0 521 56823 4

An Update from Emily Green-Armytage

I was at NMSS in 1991 and then again as an 'EG' in 1992. It was so much fun and really opened my eyes up to a really exciting side to Maths that I'd never experienced before. All my yr 12 subjects were heading me straight for engineering, but I was also doing music and studying piano and I decided to study music at uni just for fun for a year (I did take a unit of Maths in first year though!). Well, that year became 5, followed by 4 years in London and The Hague, then back to Perth to do my masters in performance. It seemed a bit late to go back to engineering at that point, and I was having far too much fun anyway! It's funny how things work out.

Now I find myself doing all kinds of freelance stuff. I play orchestral piano with the WA Symphony Orchestra, teach at one of our tertiary institutions, have a (salaried - gasp!) position as an accompanist at one of the

specialist music schools here in Perth, and do whatever other odd gigs come up. I've played in concert halls, pubs, private homes, cinemas, night clubs, gardens, churches, theatres and even an old quarry. I think that my interest in Maths has been really central to my particular interest now in contemporary classical music. My Master's research was in music that used various numerical processes to generate material. I have the fondest memories of 'maths camp'. Thanks Terry!





NMSS2009

During 2008 our brave and fearless leader Tezza AM announced that there would be a few changes at the 41st NMSS: new accommodation (for the first time in 40 years) and a new number theory lecturer (for the first time in almost as long!).

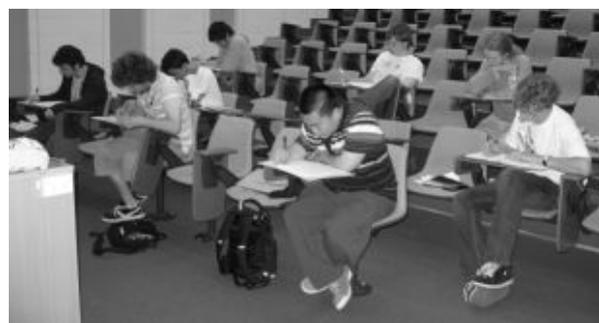
A new college! Would we cope? Would it be too far to walk to the lecture theatre? Would the food be as good? As it turned out, we stayed at John XXIII College, which is not far from the Bruce Hall, it's just down the road a bit, closer to the lake but further from the lecture theatre. Both the food and accommodation were fantastic.

Another change for 2009 was that Tezza did not give the number theory lectures. When I was at NMSS the number theory lectures were taken by Arnold Ross, and they were great. Then for many years Terry did the number theory lectures, and they were great. This year Robbie Gates did the number theory lectures, and they were great. Terry was of course there, talking number theory with anyone who was interested. There were other courses, some

new and some that have made an appearance at NMSS before: Chaos Theory with Leon Poladian, Quadratic numbers with James Borger, Discrete Harmonic Functions with Paul Norbury, Group Theory with David Easdown, Counting Measurement and Information with Steve Lack and The Road to Catalan with me. For James it was the first time at NMSS, and he enjoyed it.

So, how'd it go? The 41st NMSS was as good as always. John XXIII College was great. I'd say that this year's NMSS was an outstanding success mathematically and in very other way.

Leanne Rylands

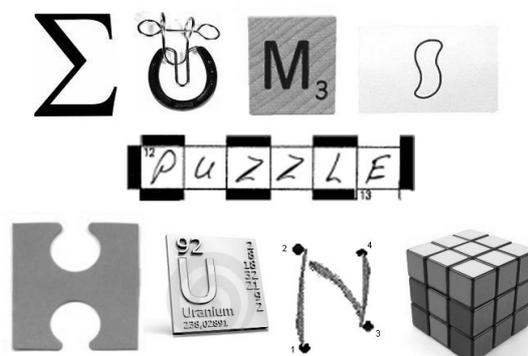


CAN YOU HELP?

As you are aware, the NMSS needs all the support that you can give. The school is now without a major sponsor and only remains viable because of the donations of past students and their parents.

I urge you to make a tax deductible donation if at all possible. Cheques should be made out to the Australian National University (NMSS) and sent to Professor T M Gagen, Director NMSS, School of Mathematics and Statistics, University of Sydney, NSW 2006.

Thank you for your continued support of NMSS.



20 puzzles.
5 days.
1 winner.

Starts August 2009 at:
<http://www.maths.usyd.edu.au>
(follow the link to SUMS)