JEAN MACNAMARA

FIGHTING FOR THE ENVIRONMENT

Jean Macnamara was a crusader for the environment, pushing for the introduction of myxomatosis to Australia.

Did you know myxomatosis, which was such a success in controlling Australia's rabbit population, almost didn't make it to Australia? Dame Jean Macnamara fought to have it investigated even after initial tests suggested that biological control of rabbits wouldn't work. As well as being the driving force behind the introduction of the myxoma virus to Australia, she also made her mark on science by conducting research into polio, a disease to which children were particularly susceptible.

After being introduced for hunting last century, rabbits spread across Australia. Their numbers sometimes grew to plague proportions.

Photo courtesy CSIRO Wildlife and Ecology

RAMPAGING RABBITS

Although European rabbits arrived in Australia with the First Fleet in 1788, it wasn't until about a dozen rabbits were brought from England in 1859 for hunting that they began to spread across the country. Within 30 years they had multiplied and spread as far as the Queensland border, and they arrived at the west coast early this century. All Australian rabbits are descendants of these first few rabbits. They devastate the land and native vegetation, causing soil erosion, and compete for food with native animals and domestic livestock.

Fences stretching for hundreds of kilometres and bounties paid for rabbit scalps didn't stop the advance of the rabbits. So in 1887 the New South Wales Government offered a £25 000 reward to anyone who could come up with a biological control. In France, Louis Pasteur heard about the prize and sent a team to Australia to see if the micro-organism responsible for chicken cholera would control rabbits. Authorities experimented with the disease on rabbit-infested Rodd Island at the western end of Sydney Harbour. The tests needed to prove that chicken cholera wouldn't harm native and domestic animals and that the disease would spread among rabbits under Australian conditions. The experiments showed that though the disease killed rabbits, it was not contagious enough to justify its release. Louis Pasteur's team returned to France, the prize was awarded to nobody, and Australia had to wait another 60 years for the first successful rabbit biological control: myxomatosis.

THE HISTORY OF MYXOMATOSIS

In 1896 in South America, European rabbits (*Oryctolagus cuniculus*) were wiped out by a highly infectious disease that didn't seem to harm the native rabbit population, other animals or humans. Researchers found it killed rabbits very quickly (usually five or six days after infection) and named it myxomatosis. But it was Dr H.B. Arago in Brazil who first thought of using the virus to control Australia's rabbit problem. In 1916 he brought rabbit myxoma disease to the attention of the Australian authorities and sent a Brazilian strain to Australia in 1919, but the over-cautious authorities didn't realise the disease's potential so did not continue the investigation.

Jean Macnamara was a young Australian polio researcher interested in both the polio virus and the care of paralysed patients. While visiting the United States, Canada and Britain on a Rockefeller Fellowship in 1931 she met Dr Richard Shope, who was studying myxomatosis in rabbits following an outbreak in California. Jean was unaware of Arago's attempts in 1919 and it occurred to her that myxomatosis could be the answer to Australia's rabbit problem because it only affected rabbits, not other species.

Jean began studying the problem — she travelled to Baltimore to find out more about the disease, looked into which species were susceptible, checked that the rabbits in Australia were Europeans and therefore should catch myxomatosis, and she looked up research that showed myxomatosis couldn't be caught by rats, mice, chickens, guinea pigs, monkeys, hamsters or humans. But Jean was concerned that the virus hadn't been tested in sheep, cattle, goats, horses, cats or Australian wild animals to ensure they were safe. So, in 1933 she sent a myxomatosis sample to Australia for testing, taking great care to ensure the virus arrived live. But the parcel was destroyed by quarantine because of concern it would be a danger to other animals!

Undaunted by this initial setback, Jean travelled to London in a cattle ship (the only way she could afford to travel on her scholarship) and handed over all the data she had collected to Charles Martin, a CSIR scientist. Charles began work on myxomatosis and within two years had shown the virus was virtually 100 per cent lethal to rabbits but harmless to humans and livestock. But the question still remained: could the virus be spread effectively among rabbits in their natural habitat?

Results looked promising when CSIR researcher Dr Lionel Bull tested the virus in the laboratory. His experiments showed that fleas could carry the disease between rabbits, and that there was no threat to native Australian animals. The experiment was expanded to Wardang Island, a dry and dusty rabbit-infested island off the coast of South Australia. But field trials showed the virus didn't seem to spread from one rabbit warren to another. Lionel was convinced the virus couldn't spread under field conditions in Australia, so from 1943 to 1950 no further work was done.

Lionel Bull releases rabbits on Wardang Island to see if myxomatosis would spread between rabbit warrens.

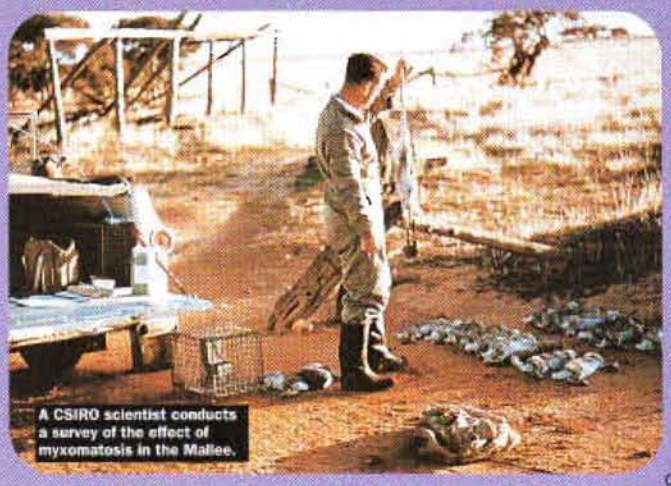
LET'S TRY AGAIN

In the years immediately following World War II Australia's rabbit population boomed because farmers hadn't been able to carry out the trapping, shooting and poisoning that usually kept rabbit numbers from growing to plague proportions. In some places bushes were stripped bare of their leaves, not a blade of grass remained and waterholes were surrounded by a seething carpet of brown fur. This increased the public's awareness of the rabbit problem, but there were two opposing views: on the one hand rabbits were seen as a pest that devastated pastures, increased soil erosion and bankrupted farmers; on the other hand they were seen as an asset whose skin was sold for fashion and whose meat was sold as food.

As well as some resistance to killing rabbits for financial reasons, some scientists were convinced that no further experimental work was justified following the failure on Wardang Island. Also, for health reasons, some people didn't like the idea of releasing a virus for large-scale trials. There were also administrative difficulties, such as the opinion that field trials should be the responsibility of the State Agriculture Departments rather than CSIRO.

But Jean pressed for further tests in wetter locations, where the virus might have a better chance of spreading. She wrote to the Melbourne Herald saying, "Few advances would have been made in medical research if work had been abandoned after such a pathetically limited enquiry." Her campaign focused on many fronts — she gave lectures, lobbied politicians, criticised CSIRO and persuaded the Chairman of CSIRO, Ian Clunies Ross, to convince the Officer in Charge of CSIRO's Wildlife Survey Section to direct research toward myxomatosis. Jean's lobbying didn't make her popular with some people, and she sometimes received death threats. Jean's daughter Merran remembers how her mother would receive threatening phone calls, to which she would respond with an hour-long lecture about the fragility of the soil!

The Victorian Government became involved through a friend of Jean's, Dame Valerie Austin. Dame Valerie was a Victorian Liberal Party Member and had married into the Austin family that had imported rabbits in 1859. As a result of the pressure from Jean, CSIRO agreed to try again by the end of 1949. Graziers were suffering from a plague of rabbits so were very keen to be involved in trials. Four trials began in early 1950 at Gunbower Estate in northern Victoria, near the Murray River. Disappointingly, all four trials appeared to fail. The virus just wouldn't spread.



A CSIRO scientist conducts a survey of the effect of myxomatosis in the Mallee.

Images courtesy CSIRO Archives

Suddenly, the virus seemed to be working. In December 1950 the owner of a property near the Murray river rang CSIRO to say he'd seen large numbers of sick and dying rabbits. There'd been heavy rains further north, which allowed mosquitoes and other insects to spread the virus rapidly along rivers for more than a thousand miles in all directions. By the middle of 1953, rabbit populations in southeast Australia were a fifth of what they had been in 1950. The income from wool increased by 30 million pounds thanks to the ability for more sheep to graze on pastures formerly devastated by rabbits. This was a great achievement for Jean Macnamara and also for CSIRO. Farmers gave Jean a clock, a cheque for 80 pounds and a handbag as thanks. But more importantly, she could see that after 20 years of pushing for the virus to be tried, her efforts had finally paid off.

CONTINUED CONCERNS

In the recorded history of myxomatosis there had never been a case of human infection. But some anxiety arose due to a coincidental outbreak of encephalitis in people in the Murray Valley at the same time and place as myxomatosis (the first appearance of this disease for many years). So Frank Macfarlane Burnet (the director of the Walter and Eliza Hall Institute), Frank Fenner (Professor of Microbiology at John Curtin School of Medical Research at ANU) and Ian Clunies Ross all injected themselves with the virus and of course suffered no ill effects. This reassured the public that there was no link between myxomatosis and illness in humans.

Meanwhile, Jean was concerned that a small number of immune rabbits would multiply and develop resistance. She continued to press for more support, more research and more funding. She pointed out that everyone paid for the effects of rabbits, which increased the cost of lamb, butter, milk, cheese and any other products coming from animals on the land devastated by rabbits. She felt this increase in the cost of foodstuffs was affecting the physique of the population. "The end of that pest will surely make way for a greater and better Australia — bigger and finer Australians," she said. "That has been my aim with myxomatosis."

Dame Jean Macnamara with two of the rabbits she campaigned so hard to defeat. Thanks mainly to her efforts, myxomatosis trials were continued and eventually proved a success.

A NEW VIRUS

Australia still has outbreaks of myxomatosis, and the virus has meant rabbit numbers have not reached the plague proportions before the virus was released. If you have a pet rabbit you should cover its hutch with fly wire to keep out mosquitoes that carry the virus (we now know that fleas, ticks, mites and lice can

WIRED TO THE RABBIT WEB

WEB SITES FOR FURTHER INFORMATION

- **A short story about Jean's life can be found at the Bright Sparcs Web site (www.asap.unimelb.edu.au/bsparcs/exhib/journal/as_macna.htm).**
- **The Bright Sparcs Web site (www.asap.unimelb.edu.au/bsparcs/bsparcshome.htm) contains many biographies of famous Australian scientists, including Jean Macnamara (www.asap.unimelb.edu.au/bsparcs/biogs/P001288b.htm).**
- **CSIRO news about Rabbit Calicivirus Disease (RCD) can be found at the Rabbit Calicivirus News page (www.csiro.au/communication/rabbits/rabbits.htm).**
- **www.burrill.demon.co.uk/meddoc/myxo.htm is a good myxomatosis essay describing the history of the virus.**
- **Introduction to the Viruses (www.ucmp.berkeley.edu/alllife/virus.html) provides information about how viruses work.**
- **Cells Alive! (www.cellsalive.com) has information about cells and viruses, including great colour images.**

MAKE YOUR OWN VIRUS PARTICLE

Viruses are very small, simple organisms made of genetic material (either DNA or RNA) wrapped in a protein coat. A single virus particle is called a virion. Due to its small size, a virion can produce only a few types of protein because it only has room for a small amount of genetic material. This means the protein coat has to be built out of one type of sub-unit, used over and over again. The sub-units are arranged symmetrically so that each is in the same environment on the viral surface. A virus can be shaped like a helix, an icosahedron, or some other more complicated shape. The herpes virus that causes chicken pox is one of the most common icosahedral viruses.

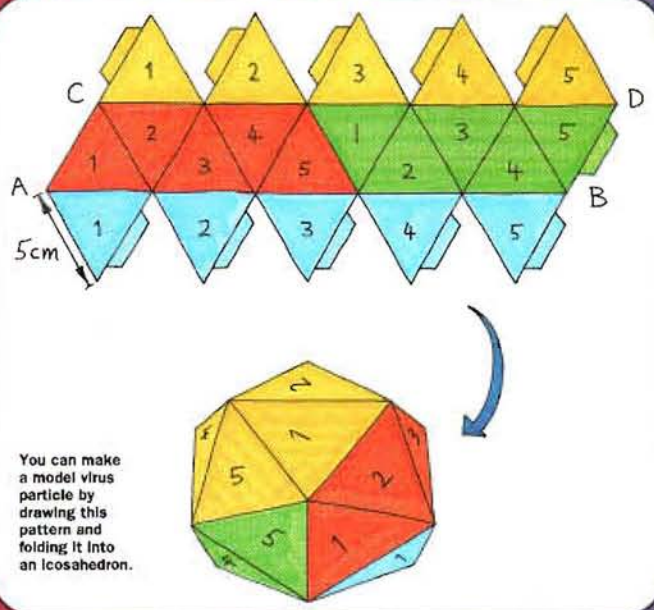
An icosahedron has 20 identical faces, each one an equilateral triangle. To make an icosahedron you'll need:

- two sheets of A4 paper
- ruler
- scissors
- coloured pens or pencils
- glue.

Draw an equilateral triangle with 5cm sides on one sheet of paper, then cut it out to use as a triangle template. Next, take the second sheet of paper and draw a line 25cm long, about 7cm in from the long edge of the paper (line A to B on the diagram). Make a mark every 5cm along the line and use your triangle template to draw 5 triangles above the line and five triangles below it. Now draw a line along the tops of the upper triangles, 25cm long, starting from the top of the left hand triangle (line C to D on the diagram). Join up points B and D, and draw five more triangles on the top of line C to D.

Colour the triangles in four different colours following the pattern on the diagram (this makes it easier to stick the icosahedron together). Draw in the tabs in the positions shown on the diagram. Cut out the pattern and fold along all the lines, including the tabs, by folding the white (inside) edges of the paper towards each other.

Now glue triangle 1N to 2N, 2N to 3N and so on until all the yellow triangles are stuck together, forming a five-sided pyramid. Glue triangle 5E to 1W to form the centre of the icosahedron. Then glue triangle 1S to 2S, 2S to 3S and so on to complete the icosahedron. And there you have it: a model virus particle, guaranteed not to be contagious!



You can make a model virus particle by drawing this pattern and folding it into an icosahedron.

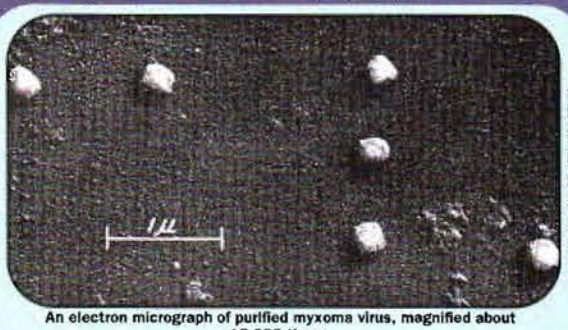


Image courtesy CSIRO Animals

An electron micrograph of purified myxoma virus, magnified about 15 000 times

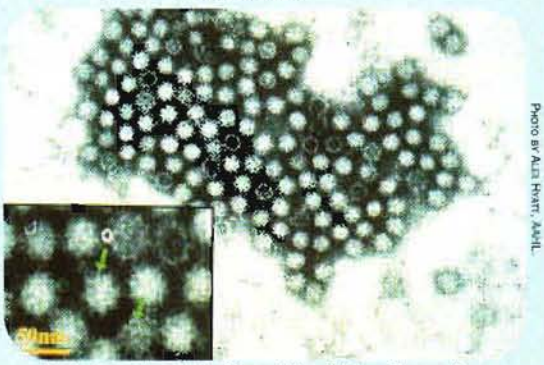


Photo by Alan Hyatt, AAHL

An electron micrograph of the rabbit calicivirus. The cup-like projections on the surface of the virus (see inset) give the virus its name, which comes from the Latin word calyx, meaning cup.

also spread the disease). Researchers are also looking at modifying the myxoma virus to include genes that will stop the rabbits reproducing, so those which catch myxomatosis and survive will not be able to produce more rabbits resistant to the disease.

Researchers are also monitoring the effects of another virus, called rabbit calicivirus disease (RCD). RCD first appeared in China in 1984 and quickly spread to Europe and Mexico. After testing it in Australian labs, CSIRO researchers again headed to Wardang Island for field trials. In 1995 the virus escaped quarantine and spread quickly through large areas of South Australia, killing enormous numbers of rabbits. While its escape wasn't planned, the decline in rabbit numbers gave many native plants and animals an opportunity to thrive, and gave farms and grazing properties gains in productivity. In some areas rabbit numbers have been reduced by up to 90 per cent, though in high rainfall regions the new virus seems not to have taken hold. Research is continuing into the viruses and other methods to control Australia's most devastating pest.

Photo by Dean Nicolle, SA Dept of Environment and Natural Resources

Thanks to RCD this burrow is empty. With fewer rabbits, native plants such as the bullock bush are regenerating.

WHO WAS JEAN MACNAMARA?

Jean was born on the 1 April 1899 in Beechworth in northeastern Victoria, the second daughter of Australian parents John (of Irish descent) and Annie (of Scottish descent). The family moved to Melbourne in 1907 and Jean won a scholarship to attend Presbyterian Ladies' College, where she was editor of the school magazine and won the prize for general excellence.

Her childhood in rural Victoria, as well as farm holidays with her mother's large family, gave her a strong affection for the land. She went rabbiting as a child and saw the effects of rabbits and drought on the land. Living through the war as a young person also affected her outlook on life. It motivated her to study medicine, which was made possible when she won a scholarship to attend medical school at the University of Melbourne. She graduated the same year as Frank Macfarlane Burnet, who went on to win theNobel Prize for medicine.

Her first job began at a time when women didn't often have careers outside the home. Jean ignored that culture and at the age of 22 became resident medical officer at the Children's Hospital in Melbourne, which had never appointed a woman to that position before. While working in the hospital she saw many patients with polio, particularly during the 1925 epidemic in Victoria. She helped many children with polio recover with minimal disability, providing personal care to families and holding clinics in rural areas, often working unpaid hours into the evening and night.

This led to an interest in early diagnosis and vaccination for polio. Jean developed a technique of using serum from those who had recovered from polio in the treatment of patients with early polio (before paralysis). This practice wasn't accepted by other scientists — it was a difficult technique to carry out — but she continued to use it.

Jean (left) with her family in Beechworth, Victoria.

In 1966 Jean became the first woman to have an Honourary Doctorate of Laws conferred by Melbourne University.

Jean with her two daughters, Joan and Merran.

Jean (far left) with other Children's Hospital medical staff. She was the first female resident medical officer at the hospital.

Her major work on polio led her to work with Frank Macfarlane Burnet and together they discovered that the strain of polio virus in Australia differed from the one in the United States. This was the first evidence there was more than one type of polio, which was important for vaccine development — a vaccine needs to be active against all types to be effective. Jean also worked on other viruses, such as psittacosis (a disease of parrots).

Jean caught polio herself in her 60s during the last polio epidemic in Victoria. She was a heavy smoker and in 1968 she died of heart disease, which she had experienced for years.

She had a happy marriage, having met Dr Ivan Connor on a ship as they both travelled to a conference in New Zealand. Ivan was a medical researcher at the Walter and Eliza Hall Institute. They had two daughters, Joan and Merran, and Jean received strong support from her family during her years fighting for the introduction of myxomatosis.

Being short and female in those days, Jean found it hard to be taken seriously — she felt the best thing about being made a Dame at 35 was that people couldn't throw her out of their office! She was energetic, determined, honest and considerate. She was concerned with people, not with appearances, and would sometimes change into party clothes (which she'd brought with her to work, wrapped in brown paper and tied up with string) and go straight from her clinic. She was always very busy, putting her patients' welfare before her own, and was physically very active in the care of disabled children. Jean believed that if you saw wrongs that needed to be righted, and it was within your power to do something about it, you should do it. She was passionate about children's health, their future, and the land, which she called 'the children's inheritance'.

A TALL POPPY

As part of the centenary celebrations of Jean Macnamara's birth, this Special Feature is brought to you by Janssen-Cilag; the Commonwealth Department of Health and Aged Care; the Victorian Department of Human Services; the Australian Institute of Political Science (as part of its Tall Poppies Campaign); and CSIRO's Double Helix Science Club. The Tall Poppy is a metaphor for excellence and achievement in all fields. The Australian Institute of Political Science is trying to foster an awareness by Australians of the achievements of Tall Poppies such as Dame Jean, and hopes that younger Australians will follow in their footsteps. The Tall Poppy Campaign and *The Helix* have previously honoured other Tall Poppies including Howard Florey (who won the Nobel Prize for developing the drug penicillin), Frank Macfarlane Burnet (who won the Nobel Prize for research into how the body fights foreign invaders) and Ian Clunies Ross (who was the first Chairman of CSIRO and a great spokesman for Australian science). These legendary scientists are tall poppies who stand above the crowd.

This article was prepared with the assistance of Hilary Cadman.