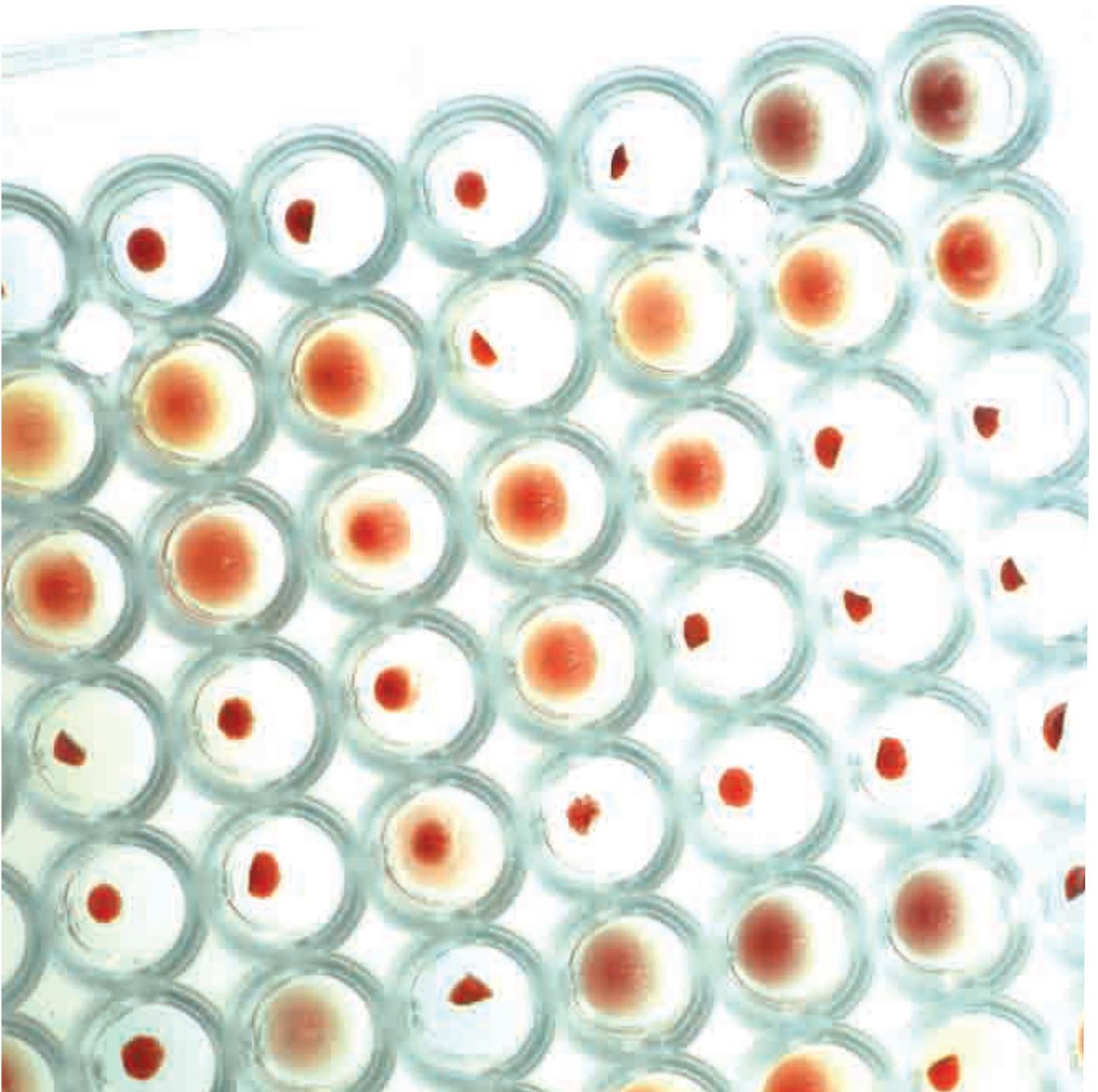


Fighting the bugs that call us home

THIRTY YEARS AGO, MANY THOUGHT INFECTIOUS DISEASES WERE ON THE VERGE OF BEING CONTROLLED. INSTEAD, THREATS SUCH AS AIDS, SARS AND BIRD FLU HAVE ENSURED THAT MICROBIOLOGY REMAINS ONE OF THE MOST IMPORTANT BRANCHES OF MEDICINE, WRITES **MATT JOHNSON**.



Great Moments In Microbiology

- 1670** Dutchman Antony van Leeuwenhoek's skill at grinding lenses allows him to improve the microscope and cast open the micro-world.
- 1864** Louis Pasteur disproves the theory of spontaneous generation (that living organisms can arise spontaneously from putrefying matter), and shows that heating liquids can sterilise them.
- 1875** Pasteur's development of the germ theory of diseases and the use of vaccines to prevent them.
- 1880s** Robert Lister supports the germ theory by pioneering the use of antiseptics during surgery.
- 1882** Elie Metchnikoff discovers the cells of the immune system.
- 1928** Alexander Fleming discovers that a strain of penicillium mould exudes a substance that kills certain bacteria.
- 1952** Joshua Lederberg identifies the structure of bacteria which assisted in cracking the DNA code in 1959 by Watson and Crick, the whole basis of genetics and molecular pathology today.
- 1958** Cora Downs, professor of microbiology, discovers a fluorescent dye to trace bacteria and viruses. Makes it possible to safely, quickly and cheaply diagnose disease organisms in hours instead of days.



Photographer: Marina Neil

Clinical Microbiologist Professor Peter Collignon likes to call microorganisms 'promiscuous buggers'.

When an epidemic of Asiatic cholera hit England in late 1831, "miasma in the atmosphere" was held to blame. Twenty-three-years later, when an horrific outbreak tore through London's Soho district, medical knowledge about the disease had not changed.

Cholera had broken out four times in England between 1831 and 1854, causing thousands of deaths, and the regular epidemics were thought to be beyond human control.

Another epidemic had arisen in South London in mid 1854, but it was the sudden and violent outbreak in Soho on the night of August 31 - described by a local anaesthesiologist as "the most terrible outbreak of cholera which ever occurred in the kingdom" - that would provide Dr John Snow with the key to identifying the disease's cause.

Snow challenged convention, having earlier written a report speculating that it was not the mysterious "miasma" that sparked cholera, but that the disease came from contaminated drinking water.

He had noted cholera "always commences with disturbances of the functions of the alimentary canal", and even thought he had traced a previous outbreak to a particular water company. His report, however, was widely condemned by the water providers and the local authorities.

So when 127 people living in or around a single Soho street near to Snow's home died in just three days, he set out find the source of the polluted water that he was certain was to blame. Snow interviewed families of the victims and found himself pointed towards a communal water pump on the corner of Broad and Cambridge streets.

He later wrote that nearly all the deaths had taken place within a short distance of the pump. His theory also explained why only five of 530 workers in a nearby factory had become infected - the factory had its own well - and, similarly, the 73 workers in the district's brewery were unaffected because their daily beer ration made going to the well rather redundant.

By the time Snow looked at a sample of water from the pump under his microscope and found it bursting with "white, flocculent particles", three-quarters of the district's residents had fled their homes.

On September 7, eight days after the outbreak began, and now convinced of the source of infection, Snow took his findings to the authorities responsible for the pump. Although reluctant to believe him, they removed the pump handle and the spread of cholera dramatically slowed.

In just 10 days 500 had died - a Soho death rate of nearly 13 per cent. But still no one believed Snow, and a report by the Board of Health a few months later

dismissed his results, concluding, "We see no reason to adopt this belief."

Snow's spark of inspiration, his use of scientific method to find proof, and his persistence in the face of scorn and established attitudes eventually led to his ideas being accepted. His work has continued to have an impact on microbiology long after his death.

A worryingly large number of micro-organisms - bacteria, viruses, fungi and parasites - find the human body a hospitable site to set up house. In some cases a mutually beneficial relationship exists, but at other times the association leads to disease. In the case of cholera, bacteria are to blame.

Microbiologists study the interaction between man and micro-organisms, seeking to determine types of organism, where they are found, how they spread and gain entry and how they reproduce. It is a detective story but one with the potential to save not only individuals but entire populations from disease.

And despite a world supposedly enlightened by 150 years of experience since John Snow, microbiologists continue to search for infectious agents for diseases that the rest of the community blames on environmental causes, some little more factual than the "miasma".

Just 30 years ago many medical practitioners thought infectious diseases

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were on the verge of being controlled. Public health initiatives, vaccinations and antibiotics had eradicated smallpox and reduced measles, tuberculosis and polio cases to small numbers.

But then the trend reversed, and deaths from infections steadily increased. Even in the Western world they are the third highest cause of death after heart disease and cancer.

The emergence of drug-resistant forms of old diseases contributed to part of this growth, but new infectious diseases have also taken their toll. Since 1973, 29 previously unknown infections have been discovered, including Lyme disease, Ebola virus, legionnaires disease, toxic shock syndrome, AIDS, the hepatitis C and E viruses, and the *Helicobacter pylori* bacterium (which can lead to ulcers), which was discovered in 1981 by Dr Robin Warren, a Fellow of the Royal College of Pathologists of Australasia. In the past few years, SARS and avian flu have emerged as serious health threats.

From a time when the role of microbiology could have been thought to be diminishing, it has re-emerged as one of the most important and dynamic branches of medicine.

For Dr Raymond Chan, staff specialist in microbiology and infectious diseases at the Sydney Southwest Area Pathology Service, the attraction of microbiology is that it is “the only medical discipline where we consider how the human body interacts with other organisms.” It requires “not just an understanding of us but of other organisms, their feeding, reproductive and life cycles”, he says.

Clinical microbiologist Professor Peter Collignon, of the Canberra Clinical School and Canberra Hospital, shares the view, albeit in less formal language.

“Micro-organisms are promiscuous buggers, and in this age they can jump on a 747 and be spread around the world in 24 hours. It's our role to identify them, chase them back to their sources, and to help find a way to treat them.”

For both men, microbiology makes demands that other medical specialties do not: “You need a degree of creativity and imagination. To be good at microbiology you need to be able to think outside the square,” says Professor Collignon, “You need to be a scientist but you have to be able to think without being bound by what is currently held as fact.”

Photographer: Paul Jones



Dr Raymond Chan says microbiology is the only medical discipline to study how our bodies interact with other organisms

He cannot hide his enthusiasm at the chance of finding new infections to link with old diseases. “Imagine if we found more common cancers were caused by infectious agents,” he says. “Given the profound benefits, even a one in 10 hit rate would make an enormous difference to so many people.

It is worth noting that in the last decade cervical cancer has been directly linked with certain strains of the Human Papilloma virus and trials are underway to develop a vaccine to prevent such cancers.

“An infectious agent may not even be the direct cause, but it may contribute to the disease becoming established. It sounds fanciful but it has happened so many times. Identifying an infectious agent could open the door to a vaccine or some other way to stop transmission.”

Microbiology requires strong communication skills if infections are to be effectively controlled. “A microbiologist has to be able to interact with an enormous range of people, and you have to be able to communicate effectively,” Professor Collignon says. “You can find yourself working with vets, food manufacturers, cooks, engineers, maintenance workers,

cleaning staff, managers and bureaucrats, many of who have no medical training. Much more than other areas of pathology, you need to interact with people outside your profession.”

He has long held that a microbiologist's performance can be measured by how many people in an organisation know their name.

Raymond Chan enjoys the communication challenges that microbiology presents. “Dealing with humans can be more difficult than dealing with bugs and it can't be neglected. After you have identified the bug, to manage and control it effectively you have to deal with humans.”

Effective infection control requires educating the community about the disease so that, even in healthy individuals, it doesn't inflict a social cost, he says.

“Look at SARS, people became hysterical, wearing masks, overwhelming hospitals and services because they were scared. People with HIV were highly stigmatised by the social reaction to the infection. We have to appreciate and deal with the question, ‘Can I get it?’”

Being good communicators and managers means many microbiologists end up expanding their roles beyond what they expected when they joined the profession. Professor Collignon still sounds pleasantly surprised when he describes his role with the World Health Organisation and international food projects. "It's not something I would have thought about 10

years ago, but I find it a great challenge to potentially make a difference on a very big scale."

Similarly a large number of microbiologists have taken charge of hospitals and departments. Dr Gary Lum is director of the Northern Territory Government Pathology Service but at the

time of the Bali bombings he was the head of the Royal Darwin Hospital and had to oversee the arrival, treatment and transport of patients in circumstances that had never before been experienced.

"I didn't anticipate moving up the ladder, but it was microbiology that gave me the skills," he says.

Picking up the pieces

WITH HEALTH SERVICES IN EARTHQUAKE AND TSUNAMI-HIT ACEH DESPERATELY IN NEED OF HELP IN THEIR OWN RIGHT, MICROBIOLOGIST PETER MCMINN WAS ASKED TO JOIN THE INTERNATIONAL AID EFFORT. HE RECOUNTS HIS EXPERIENCES FOR *PATHWAY*.

Last year's Boxing Day tsunami and the earthquake that triggered it caused devastation across all sections of society in Indonesia's Aceh province, including the medical sector.

Being close to the epicentre of the quake, which led to waves as high as 25 metres, and with most of its population of five million living in low-lying coastal areas, Aceh suffered huge losses. At least 126,000 people were killed and towns and villages were flattened.

As well as the emergency work of treating the injured and identifying the dead, there was an urgent need to begin rebuilding medical services across the province. Hospitals had been severely damaged and medical staff killed.

I was seconded to the World Health Organisation as a technical and clinical consultant within a team involved in setting up a public health microbiology lab for Aceh, which is on the northern tip of Sumatra.

Together with Professor Jane Cardoso from Malaysia, I run a program in public health microbiology and infectious disease surveillance to help labs in developing countries in the Asia-Pacific region with areas such as training and technology transfer. It was based on its knowledge of this work that the WHO asked us to help in Aceh.

The existing public health laboratory, in the provincial capital, Banda Aceh, had been rendered inoperative. The building housing it was badly damaged and most of the equipment and records had been destroyed. Thirty per cent of the staff had

been killed and many others had lost close relatives or their homes.

Hundreds of thousands of Acehnese were made homeless by the disaster and forced to live in crowded and damp camps. There was a high risk of epidemics, so the WHO decided to develop a microbiology lab to support infectious disease surveillance within the camps, checking for diseases including cholera, tuberculosis, dengue fever and malaria.

Given the damage in Banda Aceh, the new laboratory was located at the general hospital in Meulaboh, the province's second-largest city (population 60,000). About 20 per cent of the population in Meulaboh had been killed and much of the central city area had been destroyed.

But Meulaboh General Hospital was on high ground, sparing it from being

inundated with mud and seawater. Furthermore, the hospital's laboratory staff had been relatively lightly affected by the disaster.

The first laboratory relief team, led by Professor Cardoso, travelled to Meulaboh on January 7. She had supervised the purchase in Malaysia of a large supply of the goods and equipment needed to set up the lab.

The first team spent the rest of its assignment getting the laboratory established and starting to train local staff, none of whom had any experience in microbiology laboratory techniques.

I replaced Professor Cardoso on January 30 and worked in Meulaboh until February 28, continuing to train local staff and ensuring their competency in basic microbiology techniques.



The aid effort included working closely with local medical staff

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The fact I could speak Bahasa Indonesia fluently, having learned it at secondary school in NSW 30 years ago, was a considerable help. I have long had an interest in Indonesian language and culture and have made frequent visits there for holidays and professional reasons.

The laboratory was up and running in six weeks. In addition to training staff, I provided a clinical consultative service to the Meulaboh General Hospital and to humanitarian workers from medical agencies helping those living in the camps.

I used this as an opportunity to develop a network of hospital and primary health-care workers who provided a regular flow of specimens to the laboratory, which was necessary for microbiological surveillance and building up the experience of the local technical staff.

I was assisted in staff training by two clinical microbiology scientists (Dr Azian Hurun and Ms Rosliza Abdul Rahmann) from Kota Bahru in Malaysia, both of whom spoke Bahasa Malayu and could converse freely with the Indonesian staff.

By the time I left, the laboratory was being operated solely by Acehnese technical staff and it is now functioning in a basic but competent capacity. Professor Cardoso and I are finalising plans for further in-service training and support for the laboratory in the coming months and years.

Once public buildings have been reconstructed in Banda Aceh, we plan to move the public health laboratory back to there. I am confident that the people of Aceh will receive a long-term health benefit from our work.

My experience in Aceh was overwhelming and one that I will never forget. I am deeply grateful to Dr Haris Saputra, medical director at Meulaboh General Hospital, for the honour and privilege of working with him and his staff and particularly grateful to pathologist Dr Lily Kalalo and to chief technologist Ibu Darmi for so graciously accepting me as part of their team.

It was a joy and privilege to work with the people of Indonesia, whose friendliness and resilience during a time of national tragedy was deeply moving and inspiring. 🔥

Professor Peter McMinn is a clinical microbiologist with the Women's and Children's Health Service based at Princess Margaret Hospital for Children in Perth, WA. He is also a Clinical Associate Professor in the University of Western Australia's department of microbiology.

How to join the profession

There are a number of different career paths available for those interested in Microbiology.

Medical Microbiologist

Medical microbiologists are specialist pathologists who supervise specimens coming into the lab for diagnosis of infection. They ensure appropriate methods are followed and that the answers are correct and meaningful. Ultimately they give direct advice on the management of the disease. They are also involved in public health issues such as infection control, immunisation and how to make food and water safer.

To become a medical microbiologist you must first complete a medical degree and then undertake further training with the Royal College of Pathologists of Australasia. The College accepts applications from registered medical practitioners with a minimum of one year's post-graduate experience. Applicants must be employed in an accredited laboratory before seeking registration with the College. Pathology training takes a minimum of five years and includes a series of examinations.

For more information visit the www.rcpa.edu.au

Microbiology Scientists and Laboratory Technicians

Microbiology scientists undertake a 3 to 4 year undergraduate degree in science through various universities. Many scientists undertake further training such Masters and PHD degrees after their basic degree. Laboratory Technicians are required to undertake at least a Diploma in Applied Science.

For information for training as a medical laboratory scientist visit www.aims.org.au

Research Assistants

Research assistants support researchers by providing technical assistance in the collection, processing, and co-ordination of data, samples, and specimens. Work will involve conducting routine tests, experiments and procedures relevant to the field of study. Research assistants need at least a Bachelor of Science.



Professor McMinn treating patients in Aceh