

The Broad Street Pump

Medical Entomology in Australia: *past, present and future concerns*

A festschrift to honour the career of Professor
Richard Russell

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Haematophagous (blood sucking) arthropods are the cause of considerable human morbidity. While the bites from mosquitoes, bed bugs, ticks and other biting insects are just plain irritating, many of these little blood-suckers spread life-threatening diseases that kill millions of people annually worldwide.

Knowledge of vector and pathogen biology, the development of highly-organised government based health promotion and control programs, and the intelligent application of insecticides and use of repellents, have all helped to minimise the potential for vector borne diseases. However, the risk has certainly not been eliminated as evidenced by the 5,000 cases of mosquito-borne disease within Australia every year.

Additionally, there are a number of potential threats that make the future of these insects and their diseases uncertain. These include; potential funding cuts to government health and mosquito management programs, the decline of entomology teaching at the tertiary level (and the retirement of key researchers), reduced insecticide availability, changes in land use patterns that increase human exposure to vectors, growing world travel and international trade that can aid in the spread of exotic vectors and viruses and the potential impact of climate change on vector distribution and disease activity.

In some cases, the pest potential of an insect may not be realised until too late. The classic example of this is the recent global resurgence of bed bugs, an insect thought to be relegated to history and, until recently, only collectively remembered through a children's night time nursery rhyme ('night, night, don't let the bed bugs bite'). Fortunately bed bugs do not transmit agents of disease, however the economic impact associated with this pest has cost the world's economy billions; an unwanted burden in this age of fiscal restraint.

In fact, such unexpected happenings are not isolated events. In 2011, Kunjin virus, a mosquito borne virus that historically only occurred in inland regions of Australia, crossed the massive geological barrier of the Great Dividing Range. This virus infected hundreds of horses along eastern coastal Australia killing a significant number of those infected.

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Will we see the related virus, Murray Valley Encephalitis virus, which is far more pathogenic to humans, cross the same barrier in the future, resulting in epidemics in the most populated region of Australia? Or will we see other exotic viruses enter the country as happened with West Nile virus in the USA? Time will tell. The fact is that humans are in constant interaction with, and dependence on, the world around us and we are often humbled by some of the smallest creatures in it. Yet we must be in a position to meet these challenges.

The symposium 'Medical Entomology in Australia: Past, Present & Future Concerns' held at Westmead Hospital on 29th June 2012, reviewed many of the historical and current issues relating to arthropods that impinge on human health, and examined the threats of tomorrow. We were fortunate, arguably, to have assembled the greatest gathering of internationally recognized Australian scientists in the field of Medical Entomology for a one day event. This was reflected in the excellent attendance, with close to 140 registrants from varying fields of expertise.

However, the symposium was not just about arthropods and their diseases. It was held to honour one of the leading figures in the fight against these public health pests. Richard Russell, Professor of Medical Entomology, Centre for Infectious Diseases and Microbiology, University of Sydney, and CIDM Laboratory Services, ICPMR, Westmead, has worked on medically important arthropods for over 40 years and retired the day of the symposium. He is the author of numerous books on mosquitoes and mosquito-borne disease, and has published over 200 scientific papers. He has been involved with a multitude of national and international organisations and committees, and is one of the most highly respected figures in the world of medical entomology today. His retirement is seen by all as a great loss, and we will miss his expertise.

Yet Richard's work will carry on. In the 25 years of being based on the Westmead Hospital campus, the Department has steadily grown in both size and in the breadth of its research programs. Richard has set up a legacy, which most other organisations can only admire. No other medical entomology facility in the country (and possibly the world) has researched such a diverse range of arthropods of medical importance. Currently the Department is engaged in a broad range of projects including; the provision of disinfected larvae for maggot debridement therapy (the only such service in the nation), efficacy evaluation of insecticides and repellents, the development of industry standards and guidelines for bed bug management (which have been adopted by other nations), and projects relating to mosquito management and biology, to name but a few. Additionally, the core functions that Richard established in 1987 of teaching, arbovirus surveillance, insect identification and insect provision, will continue. For all this, Richard can be rightly proud.

The following is a short biography outlining Russell's rich career and enviable achievements, followed by a selection of abstracts of work that was presented at the symposium.

We wish Richard all the best in his retirement and thank him for his valuable contributions to the study and practice of medical entomology.



Professor Richard Charles Russell

Richard Charles Russell B.Sc., M.Sc., Ph.D., is Professor of Medical Entomology at The University of Sydney (Department of Medicine and the School of Public Health), and is Founding Director of the Department of Medical Entomology, in the Centre for Infectious Diseases and Microbiology, Institute for Clinical Pathology & Medical Research at Westmead Hospital, Sydney. He was previously with the School of Public Health and Tropical Medicine at the University of Sydney from 1970 until its closure in 1987, whereupon he established the Department of Medical Entomology at Westmead.

In 1984 he initiated the state-wide New South Wales Mosquito and Arbovirus Surveillance Program for the NSW Ministry of Health, and has experience with all aspects of medical and public health entomology. His research has been primarily on mosquito biology and ecology, the role of mosquitoes as pests, and vectors of arboviruses and other pathogens (malaria and filariae). Prof. Russell has also worked with biting midges ('sand-flies'), ticks and mites.

Prof. Russell is the author of the monographs "Mosquitoes and Mosquito-Borne Disease in South-eastern Australia" (1993), and "A Colour Photo Atlas of Mosquitoes of South-eastern Australia" (1996). He is co-author of the 12 volume monograph series "The Culicidae of the Australasian Region" (1980-1989). He has published more than 200 scientific papers on medical entomology topics, more than 150

survey and commercial reports, and has presented more than 100 papers at local and international scientific meetings.

In his professional capacity, he has travelled widely on all continents, visiting universities, research institutes and field control programs, and has been the Australian delegate to the Board of Trustees of the International Federation for Tropical Medicine. Prof. Russell has worked as a consultant in mosquito-borne disease and mosquito control in all states of Australia, in 18 countries in the Asian and Pacific regions, and South America. He has provided instruction on the principles and practice of mosquito population management, including methodologies for surveillance and control, to personnel associated with mosquito pest and vector control programs for international authorities in many countries, and for federal and state government and local authorities in all states and territories of Australia. He is advisor on arbovirus disease control and to the NSW and Commonwealth Departments of Health, has worked as a consultant on mosquito management for a number of state government and municipal authorities, catchment management trusts, and various industry and private enterprises.



Bed Bugs; the modern night time accessory

Stephen L. Doggett

Senior Hospital Scientist and Section Manager

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Currently the world is in the grip of a bed bug pandemic and Australia has not been excluded. A survey in 2006 of professional pest managers revealed that infestations had increased across the nation by an astonishing 4,500% since the start of the millennium.

Factors for the resurgence include: insecticide resistance, globalisation and increased world travel, changes in pest management practices and, for Australia, the recent introduction and establishment of the Tropical bed bug, *Cimex hemipterus*, which means that the whole country is now receptive to bed bugs.

Bed bugs are a public health pest because of their nuisance biting, and dermatological allergic reactions can be severe. However, the major impact of bed bugs is the financial impost upon the accommodation industry, which has lost tens of millions of dollars due to this insect.

Unfortunately, there are no new specific control solutions on the horizon, and with the 'ostrich' mentality of many accommodation associations who are in denial, it is likely that the pandemic will only get much worse, as indicated by the increasing number and diversity of infestations.

In response, a multi-disciplinary approach to combat the rise of this public health pest was implemented in Australia, which involved the coordinated efforts of several organizations. The key components of the strategy included the introduction of a pest management standard 'A Code of Practice for the Control of Bed Bug Infestations in Australia' that defines and promotes 'best practice' in bed bug eradication, the development of a policy and procedural guide for accommodation providers, education of stakeholders in best management practices, and research.



Murray Valley Encephalitis and Kunjin viruses in Eastern Australia - curiouser and curiouser!

Linda Hueston

Principal Hospital Scientist

Arbovirus Emerging Diseases Unit, Centre for Infectious Diseases and Microbiology Services, Institute of Clinical Pathology and Medical Research, Westmead Hospital, Westmead

The earliest medical description of probable MVE infection was in 1917 when Litchfield described a case from Bourke, NSW. He named the illness "Mysterious Disease" after a newspaper caption from the time. Outbreaks of acute encephalomyelitis in 1917 and 1918 saw a name change for the disease to Australian X Disease, which only increased the mystery and intrigue. Further outbreaks took place in the 1920's and 1950's and then the largest outbreak in 1974. This occurred in all mainland states and the Northern Territory. By this time it had been discovered that two viruses were involved MVE and Kunjin. But the mystery and intrigue continued, why the long periods between outbreaks? As these outbreaks often coincided with large flood events a theory was developed that heavy rainfall was necessary for the reappearance of these viruses in eastern Australia. In this century evidence emerged that these viruses exist in low density endemicity, which may only be detectable under certain climatic conditions but involved vast areas of NSW, Victoria and South Australia.

Clearly these two viruses have impacted the populations of these states in more ways than just the obvious health problems. The effects of the 1974 outbreak on crop production and tourism alone were so great that it remains in the collective memory more than 30 years later. However when considering the potential impact of the spread of these viruses we need to consider factors in addition to climate, namely, how humans have changed land and water use and the effect this has had on the environment that both facilitates and negates viral spread.



Constructed Wetlands; the instant mosquito habitat

Dr. Cameron Webb

Hospital Scientist
Department of Medical Entomology, Centre for Infectious Diseases and Microbiology Laboratory
ICPMR, Westmead Hospital, Westmead

Mosquito-borne disease management in coastal Australia faces many challenges. Increasing urbanisation is bringing the community closer to productive mosquito habitats but environmental management of local wetlands is often in conflict with effective mosquito control strategies. Broad scale mosquito control activities are restricted, resulting in annually abundant pest and vector mosquito populations, and large-scale estuarine wetland rehabilitation projects are increasing the availability of productive mosquito habitats. Balancing the desire for environmental conservation with the need to protect the health of human communities requires integrated urban design strategies combined with targeted research. Constructed wetlands are a common component of Water Sensitive Urban Design strategies intended to increase water conservation through above- and below-ground water treatment and storage, and to provide of wildlife refuges. Prof Russell has played a key role in raising awareness of the issues surrounding mosquito risk and constructed wetlands in Australia. Issues of “mosquito risk” associated with constructed and rehabilitated wetlands were discussed and illustrated by local case studies from the past 15 years.



The Inconvenient Truth about Climate Change and Mosquito-borne Diseases

Dr Craig Williams

School of Pharmacy & Medical Sciences
University of South Australia, Adelaide

The potential impacts of climate change on ecosystems have been the focus of study for several decades. Such study has included mosquito-borne diseases, which is not surprising given the strong links between climate, weather and mosquitoes. In recent years the political will to acknowledge the role of humans in climate change has surged, which has in turn motivated study of both climate change mitigation and adaptation strategies. One driver of this political will was Al Gore's film, *An Inconvenient Truth*, which helped to firmly entrench the idea in the broader public that human activity accelerates climate change. This film demonstrated not only the extent of climate change, but went on to explain how many things, including mosquito-borne diseases, were bound to become worse. However, strong evidence that a changing climate will impact such diseases can be hard to find. So for those making claims that climate change will make mosquito-borne disease worse, the truth about a lack of evidence is inconvenient. In this talk I will explain the current understanding about how climate-change will impact mosquito-borne diseases and provide an update on current research on climate change and dengue.



Veterinary Diseases; Implications for Human Health

Dr Deborah Finlaison

Virology Laboratory, Elizabeth Macarthur Agricultural Institute, Virology Laboratory
NSW Department of Primary Industries, Menangle

During the past two decades over 75% of emerging infectious diseases in particular interest and concern have emerged including Australian Bat Lyssavirus (ABLV), Hendra virus and the virulent strain of Kunjin (NSW2011) that resulted in disease in horses during 2011. ABLV was first reported in 1996 in bats in eastern Australia and has caused the death of two people. To date there have been 33 outbreaks of Hendra disease in horses since 1994, 18 of these occurred during June to October 2011. Horse to human transmission occurred during 5 of these outbreaks resulting in 7 human infections with 4 deaths. During late summer and autumn of 2011, an unprecedented outbreak of encephalitis in horses was reported in NSW. Most cases were caused by a variant of the Kunjin strain of West Nile virus (WNVNSW2011). Mouse models showed this strain to be more neuro-invasive than the prototype WNVKUN strain, with its apparent increase in virulence correlated with at least 2 known markers of WNV virulence. This presentation will review the history, clinical signs and epidemiology of diseases due to these three viruses.



Ross River and Barmah Forest viruses; uniquely Australian arbovirus challenges

Dr Michael Lindsay

Managing Scientist
Environmental Health Hazards, Environmental Health Directorate, Public Health and Clinical Services
Division
Department of Health WA, Perth

Ross River virus (RRV) and Barmah Forest virus (BFV) are undeniably the most common cause of mosquito-borne illness in Australian communities. Next year it will be 50 years since Ralph Doherty and his team isolated RRV from mosquitoes and linked it to 'epidemic polyarthrititis'. A remarkable body of work has accumulated since then, defining the virus-, vector-, host-, environmental- and human-related predictors of RRV activity and risk. Along the way, another alphavirus, BFV, was also discovered and has been well investigated. Prof Richard Russell and his colleagues have been at the centre of much of the investigation into both viruses.

The versatility and complex ecologies of RRV and BFV are key themes arising from research to date, and in turn pose new questions and challenges about how to (and even whether to) manage human exposure to these viruses. Despite contemporary models and surveillance that can forecast outbreaks, management of RRV and BFV is still largely linked to demand for control of nuisance mosquito populations. Land-use pressures, changing climate and influences of human activities on vector, host and human interactions will ensure that RRV and BFV continue to impact on public health in Australia until new approaches or technologies are developed.



Lyme Borreliosis: a diagnostic controversy?

David Dickeson

Centre for Infectious Diseases and Microbiology Laboratory Services, Institute of Clinical Pathology & Medical Research, Westmead Hospital, Westmead

Since the discovery of *Borrelia* in ticks and humans in 1975 in Lyme, Connecticut, USA, much has been written about Lyme Borreliosis (LB). After importing the causative organism, *B. burgdorferi sensu stricto*, in 1988, I started serology tests using IFAT and later ELISA. In 1990 Professors Richard Russell and Rosemary Munro employed

Stephen Doggett on a NHMRC grant to collect ticks in coastal NSW. That study included 12,000 ticks collected with no evidence of *Borrelia*. From 1994 serology changed to a commercial screening ELISA from USA then testing positives by in-house Western immunoblots for both *B. burgdorferi* and *B. afzelii* following the CDC two-tier testing convention. Since 1994 we have screened over 23,000 human sera detecting over 900 so-called "positive" reactions. Of these and another 1,000 samples screened by other laboratories, only 80 (4%) clearly positive tests have been reported (with the required 5 or more specific IgG bands). Of these patients, all were bitten by ticks in northern hemisphere countries except for two with no history of travel. If the diagnostic conventions are changed will we obtain more false positives or will the use of recombinant antigens improve the specificity of these tests? Except for actually growing the organism from human tissue samples, no test can be considered to be perfect. Recent controversy over test results from overseas laboratories highlights the problems of using invalidated testing strategies.

For more abstracts and presentations from the day, please visit: <http://sydney.edu.au/seib/news/2012/richardrussell.php>

Upcoming Symposia

ANNUAL SEIB COLLOQUIUM

October 11-12, 2012
The University of Sydney
The Quad Lecture Theatre, The Quadrangle - Main Campus (Oct 11)
and
Nursing Lecture Theatre - 88 Mallett Street, Camperdown (Oct 12)

This free colloquium is open to anyone with an interest in the areas of emerging/re-emerging infectious diseases and biosecurity, with a particular emphasis on the Asia-Pacific region.

Now in its third year, the SEIB annual colloquium will bring together members of the medical community for a special two-day event.

The first day will focus on microbial ecology and antimicrobial resistance and day 2 will discuss social networks and communications in addition to food security and safety.

Full programme and register online at: www.sydney.edu.au/seib

ANNUAL IAN BEVERIDGE MEMORIAL LECTURE

October 12, 2012
The University of Sydney
Webster Lecture Theatre
Veterinary Science Conference Centre

The annual Beveridge Lecture will also be held on October 12, 2012, following the SEIB Colloquium.

The theme this year is *Rabies Control in Indonesia: what's the threat to Australia?* The lecture will be given by Dr. Helen Scott-Orr.

Cocktails will be served from 5:45pm and the lecture will commence at 6:45pm.

Register online at:
<http://whatson.sydney.edu.au/events/published/the-ian-beveridge-memorial-lecture>

Staff Profiles



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Stephen Doggett is Australia's Mr Bed Bug. He is a Senior Hospital Scientist with the Department of Medical Entomology at Westmead Hospital in Sydney and manager of the NSW Health funded Mosquito Monitoring and Arbovirus Surveillance Program. His research background is extremely broad having worked on various arthropods of medical importance notably ticks, mosquitoes and bed bugs.

Since the beginning of the modern bed bug resurgence, Stephen has been at the forefront of documenting the rise and impact of these public health pests within Australia, and has produced over 80 articles for industry and scientific journals, and given over 100 presentations on bed bugs and their control. He is widely consulted both locally and internationally on bed bugs and their control by the pest management and the accommodation industries, as well as the media. He is also consulted on bed bugs by the medical profession having recently completed a large clinical review on bed bugs, which was published in 2012 in the high impact factor journal, *Clinical Microbiological Reviews*.

Over the last seven years, Stephen has worked with a distinguished team of Australian pest controllers in producing the world's first industry standard on bed bug management; 'A Code of Practice for the Control of Bed Bugs in Australia', and Stephen is the principal author. The Code is now up to its draft 4th edition (and seventh version) and has been adopted by other pest control organisations around the world, notably the European pest management industry. More recently to assist the Hospitality industry and other accommodation providers in achieving 'best practice' in bed bug eradication, Stephen developed 'A Bed Bug Management Policy and Procedural Guide for Accommodation Providers'. Both the Code of Practice and the Management Policy are available for free from www.bedbug.org.au. Stephen is also an internationally award winning insect photographer with his images appearing in numerous books, journals and other publications. At the Federation of Asian and Oceania Pest Managers Association 2012 conference in July, Stephen received the inaugural 'Award for Excellence' for services to the pest control industry.



Dr. Cameron E. Webb

Position: Hospital Scientist and Clinical Lecturer in Medical Entomology

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Dr Cameron Webb is a Clinical Lecturer with the University of Sydney and Hospital Scientist with the Department of Medical Entomology at Westmead Hospital. Cameron's primary focus is on understanding the role of environmental management and urban development in reducing the risks of mosquito-borne disease caused by Murray Valley encephalitis virus, Ross River virus and Barmah Forest virus. However, he has also been called on to provide expert advice on a range of medically

important arthropods, such as ticks, mites, biting midges, bed bugs and flies, to local, state and federal government agencies. Key to his research is an understanding of the ecological role of mosquitoes and how wetland conservation, construction and rehabilitation projects may influence regional mosquito-borne disease risk together with changes in the local environment resulting from climate change, potential introductions of exotic mosquito species and personal protection strategies (e.g. insect repellents).

Contact Us

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