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The Dorothea Sandars Fellowship for the study of medical and veterinary parasitology

"A horrid thing called mal'aria (bad air) that comes to Rome every summer and kills one"
Horace Walpole 1740

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Signed:
(Rogan Lee)

Date:
22nd July 2004

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TITLE:

Diagnosis of parasitic diseases of medical importance: a global perspective.

SUMMARY:

On a global scale, parasites still cause high levels of morbidity and mortality in humans who live in rural areas of developing countries. The fact that Malaria is still a major killer of over 1 million children per year in Africa and other parasitic diseases such as Trypanosomiasis, Leishmaniasis and Schistosomiasis are increasing in incidence means that those who travel to these regions have a higher chance of contact with these parasites. Political instability has exasperated the problem because normal control measures of parasites are abandoned and mass migration of refugees encourages the spread of parasites to new areas. In regions closer to Australia such as South East Asia, Malaria infections are still high in remote rural areas and levels of drug resistance are increasing very rapidly. Regional institutions, which I was fortunate enough to visit, such as the Faculty of Tropical Medicine at Mahidol University, Department of Parasitology at the University of Khon Kaen, Institute of Medical Research at the Kuala Lumpur Hospital and the Eijkman Institute in Jakarta dedicate their research and training to control of parasitic diseases in Asia. In addition to Malaria, more specific parasitic diseases such as the human liver fluke in North East Thailand, Filariasis infection in Southern Thailand, Malaysia and Indonesia and Gnathostomiasis in Thailand still have high morbidity often leading to chronic disease. My visit to these institutions has laid the foundation from which strong collaborative links will be forged. This exchange will enhance our capacity as a parasitology laboratory to be more effective in diagnosing parasitic diseases in Australians who have migrated, travelled or worked in countries where parasites remain a serious threat to human health.

ACKNOWLEDGEMENTS:

The experience and knowledge gained could not have occurred without the support of:

The Churchill Memorial Trust which provided not only the financial support but also an introduction to past and present Churchill Fellows with whom I can share my adventure tales.

The Western Sydney Area Health Services, which has allowed my travel tour to go ahead. It is fortunate that the senior members of the hospital have the foresight to see the long-term benefits of my study tour.

The Directors of the Centre for Infectious Diseases and Medical Laboratory Services and Parasitology who supported my application from infancy to its completion.

My wife, Mary and children, Aron and Lauren whom I miss so much but feel their love from afar.

FELLOWSHIP TRAVEL PROGRAM (8TH March to 9th May 2004)

DATES	LOCATIONS	INSTITUTIONS
Mon 8/3/04	Atlanta, USA	Travel to the USA
Tue 9/03/04 to Fri 12/03/04	Atlanta, USA	Ms Marianna Wilson, Centre for Disease Control, Parasitology Program Group.
Sat 13/03/04 to Sun 14/03/04	Atlanta to Philadelphia, USA	Travel to Philadelphia
Mon 15/03/04 to Wed 17/03/04	Philadelphia, USA	Dr David Abraham Thomas Jefferson University
Thur 18/03/04 to Fri 19/03/04	Philadelphia, USA	Professor Gerhard Schad University of Pennsylvania
Sat 20/03/04 to Sun 21/03/04	Philadelphia, USA to London, UK	Travel to London
Mon 22/03/04 to Thur 01/04/04	London, UK	John Williams & Dr Colin Sutherland London School of Hygiene and Tropical Medicine. Dr Vaughan Southgate Natural History Museum
Fri 02/04/04 to Sat 03/04/04	Paris, France	Dr Georges Snounou, Natural History Museum
Sun 04/04/04	Paris to Chester, UK	Travel to Chester and Conference registration
Mon 05/04/04 Wed 07/04/04	Chester, UK	Professor Michael Doenhoff, University of Wales. British Parasitology Meeting
Thur 8/04/04	Chester to London, UK	Travel to London
Fri 09/04/04 to Sun 11/04/04	London to Bangkok, Thailand	Travel to Bangkok
Mon 12/04/04 to Fri 16/04/04	Bangkok, Thailand	Drs Wichit & Paron, Department of Helminthology, Faculty of Tropical Medicine, Mahidol University
Tue 13/04/04	Bangkok, Thailand	Dr Sathaporn Jitrapalpong, Veterinary Parasitology, Kasetsart University
Sat 17/04/04 to Sun 18/04/04	Bangkok to Khon Kaen, Thailand	Travel to Khon Kaen
Mon 19/04/04	Khon Kaen, Thailand	Dr Wanchai, Northern Region Vet Research and Development, Khon Kaen University
Tue 20/04/04 to Wed 21/04/04	Khon Kaen, Thailand	Dr Chawalit, Department of Pathology, Khon Kaen University
Thur 22/04/04 to Fri 23/04/04	Khon Kaen, Thailand	Dr Paiboon, Department of Parasitology, Khon Kaen University
Sat 24/04/04 to Sun 25/04/04	Khon Kaen to Kuala Lumpur via Bangkok	Travel to Kuala Lumpur via Bangkok
Mon 26/04/04 to Fri 30/04/04	Kuala Lumpur, Malaysia	Professor Mak Joon Wah, International Medical University Professor Khairul and Dr Lokman Hakim University of Malaya Dr Rahmah Noordin, Universiti Sains Malaysia
Sat 01/05/04 to Sun 02/05/04	Kuala Lumpur to Jakarta, Indonesia	Travel to Jakarta
Mon 3/05/04	Bogor, Indonesia	Dr Sri Muharsini, Department of Parasitology, BALITVET
Tue 04/05/04	Jakarta, Indonesia	Dr Jason Maguire, Naval Army Malaria Research Unit
Wed 05/04/04	Jakarta, Indonesia	Dr Syafruddin, Eijkman Institute
Thurs 06/04/04	Bogor, Indonesia	Dr Sri Muharsini, Department of Parasitology, BALITVET
Fri 07/05/04	Bandung, Indonesia	Dr Sukanto, BioFarma
Sat 08/05/04 to Sun 09/05/04	Jakarta to Sydney to Brisbane	Travel to Australia

INTRODUCTION:

Parasite infections in human populations in developed countries are found in select community groups. Australia is surrounded by oceans and seas which act as a natural barrier preventing the introduction of many diseases found in neighbouring countries of South East Asia and the Pacific. However with more movement of people and animals between countries by air and sea transport, we can no longer rely upon this barrier to protect Australia against introduction of exotic diseases. Furthermore, parasitic diseases acquired abroad by Australians can go undetected for many years until chronic changes have developed and irreparable damage to human health has occurred. There must be a knowledge base within Australia where by Clinicians turn to for advice on exotic parasitic disease. The aim of my visit to laboratories in USA, Europe and South East Asia was to: seek out new techniques for the diagnosis of parasitic infection; acquire knowledge on parasitic disease problems affecting those countries; and establish a network of Parasitologists with whom future collaboration can be achieved.

HIGHLIGHTS:

Visit to the Parasitology Diagnostic Program Group, at the Centre for Control Disease (CDC), Atlanta. ¹The laboratory does similar diagnostic work as my laboratory at Westmead but they have more available resources and function more in outbreak situations rather than support as a routine diagnostic laboratory to a hospital. We have a long working relationship with this group and have regularly sent samples for analysis. I met several Parasitologists who have a wealth of experience and are willing to share their knowledge with me. I believe our collaborative ties have strengthened with my visit and continual testing of parasitological specimens will be maintained. CDC publishes case studies on their DPDx website:

<http://www.dpd.cdc.gov/dpdx/HTML/Training.htm>

This site is constantly up dated and monthly parasite images are posted to check our diagnostic competence.

My visit to Philadelphia put me in touch with two well known Parasitologists Professor Schad and Dr Abraham who have research projects in *Strongyloides stercoralis*, a parasitic worm which is present in Australia and has been a serious complication in patients undergoing treatment for cancer and organ transplantation. Discussions took place for future collaboration and the supply of this parasitic worm for our use was also agreed upon during my meeting with Professor Schad.

The visit to the London School of Hygiene and Tropical Medicine provided me with the opportunity to learn new molecular procedures, which will be implemented in my laboratory over the course of the year. Malaria still causes about 12-16 deaths in travellers each year in the UK despite good medical facilities and sound travel advice published by the School of Hygiene and Tropical Medicine (LSHTM). Future correspondence by email will be made so that new molecular methods detection of parasitic infections can be developed between LSHTM and our laboratory.

¹ Contrary to my perception, the laboratories were very modest and comprised of several army huts built during World War II. More recently they have modern laboratories which were built as a direct consequence of the threat of bioterrorism.

Attended the British Parasitology Society Conference, main topics were drug resistance in Malaria is becoming a big problem in Africa. A number of interesting papers were presented at the meeting showing how the symbiont in filaria worms are important in the disease development in patients infected with this worm. *Plasmodium knowlesi* a malarial parasite of monkeys, infects humans in Malaysia and the parasite is morphologically very similar to *Plasmodium malariae*.

Parasitologists in Bangkok have the experience and expertise in Gnathostomiasis. Locally the parasite is found in high levels in eels in local fish ponds (up to 40% carry the parasite) This high level continues to be a threat to humans. Future testing for this parasite in Australia may require that the specimens be sent to The Department of Helminthology in Bangkok.

Dr Paiboon is one of the senior members of the Centre for Cholangiosarcoma due to the human Liver fluke *Opisthorchis viverrine*. They are actively researching the cause of this disease and the host-pathogen interaction that leads to tumour development in patients infect with this worm. Future collaboration with Dr Paiboon will depend on funding success.

Eijkman Institute is molecular biology research facility with internationally educated scientists. However, the Institution needs new sources of funding to grow into an international leader of scientific research. Our laboratory may be able to provide experimental material for genetic testing and resistance studies being done at the Institute.

US Navy Malaria Research Unit in Jakarta is an important research unit that monitors emerging diseases such as avian influenza, and provides expert advice to the Indonesian Department of Health in epidemiology of malaria and drug resistance. Future help in microscopic examination of rare parasitic infections may be sought at NAMRU.

BALITVET is the National Veterinary Research Institute. Collaboration with research scientists in parasitic zoonosis will provide an opportunity to study about regional parasitic diseases in Indonesia.

PROGRAM DETAIL:

The detail of the report will follow in chronological order as shown by the program table.

United States of America

The first leg of the trip was to USA, visiting the Centre for Disease Control (CDC), the Thomas Jefferson University and the University of Pennsylvania. CDC is located in Atlanta Georgia. My laboratory at Westmead Hospital has collaborative links with the Parasitology Diagnostic Program Group, headed by Ms Marianna Wilson. She acted as my host during my visit to the laboratory. The laboratory is located on Bufford Highway next to a busy airport, which services light planes. This part of CDC is across the city from the Main Headquarters, which was currently being fortified to protect against potential terrorist attack. I was shown how the laboratory functioned and the routine tests carried out. Many of the activities were similar to our activities but they had more facilities and staff. The prime objective of CDC is to respond quickly and concisely to disease outbreaks. They have well trained epidemiologists and diagnosticians who work together to identify the disease and instigate action to minimise spread. I met several staff members who specialise in parasitic infections. These people and their area of speciality are listed:

Name	Training	Specialty Interest
Ms Marianna Wilson	Laboratory Diagnostician	Toxoplasmosis
Dr Peter Shantz	Epidemiologist	Hydatid Disease
Dr Alexandre J. Da Silva	Molecular Biologist	Malaria
Dr Patrick Lammie	Diagnostician/Epidemiologist	Filaria Disease
Dr Govinda Visvesvara	Diagnostician	Amoebic disease
Dr Norman Pieniazek	Molecular Biologist	Malaria
Dr Frank Steurer	Laboratory Diagnostician	Leishmaniasis

I spoke to each of these people at CDC and they were very keen to assist if I needed help in diagnosis of parasitic diseases that were in their area of expertise. I have obtained their email addresses and can send enquires when required. All scientists were eager to share in their experience and exchange laboratory specimens when required.

My discussion with Dr Patrick Lammie also focused on developing a single multiplex method to diagnose parasitic disease. Beads labelled to different fluorescent colours will be used to identify a range of parasitic infections depending of the colour of fluorescence that develops in the test. This is currently being conceptualised because clinicians frequently request a broad range of serological tests to help identify parasitic infections in their patients. We also discussed improved testing for Filariasis in serum of patients by measuring antibody subclasses as a means of determining whether exposure to the parasitic worm is current or a past infection. Reactivity levels of antibody classes IgG1 and IgG4 will indicate the patient's exposure history to filarial parasite. The use of antibody subclasses in our filarial test will be investigated as a result of my discussions with Dr Lammie.

I left CDC feeling confident that my visit had strengthened our ties for years to come and I had fresh ideas to improve my laboratory's diagnostic performance.

In the second week of my visit to the USA, I met Dr David Abraham at The Thomas Jefferson University, Philadelphia. We talked about collaboration and how current diagnostic tests for parasites needed modernising. We had a common interest in a small parasitic worm, *Strongyloides stercoralis* and discussed ways that we can collaborate. His main focus of research was in vaccine development to *S. stercoralis*. Follow up discussion was to occur upon my return from Fellowship tour.

Professor Gerhard Schad is a well known parasitologist who specialises in laboratory cultures in *S. stercoralis* and dog hookworm at the University of Pennsylvania. He is currently funded to study the nervous system of parasitic worms and at mapping the various neurones that control motility of these worms. The long-term point of his studies is to understand the mechanisms of parasite mobility, so that chemicals can be used to target essential neurones for control of these parasites. He is eager to visit us in Australia and present his research at the annual meeting for the Australian Society of Parasitology. I had promised that I would nominate him as a possible invited speaker to the Society's executive. I also asked Professor Schad whether he was willing to supply us with *S. stercoralis* antigen to be used in for diagnosing this infection in humans in Australia. The costs and difficulties in maintaining this parasite in the laboratory have prevented culture of this parasite in Australia. Therefore I was very pleased to get his commitment to provide our laboratory with *S. stercoralis* antigen. This will allow us to use a test (Western blot), which will be more specific than the currently used ELISA assay.

United Kingdom and Paris

The second leg of my tour was to United Kingdom and Europe where I spent the majority of my time at the London School of Hygiene and Tropical Health (LSHTM). My host, John Williams manages a reference laboratory for diagnosis of parasitic diseases. His laboratory also provides a diagnostic service to zoological gardens in England. The main activities of this group are to provide educational services to postgraduate medical and nursing students specialising in Tropical Health and providing a reference to diagnosis of parasitic infection, particularly malaria. The results of 33,000 malaria cases confirmed by the laboratory are kept in a database, which is used to provide advice in travel medicine. Despite this service being available, there are about 12-16 deaths due to malaria every year in the UK. The activities of the laboratory are similar to those of my laboratory and we exchanged ideas in parasitic diagnosis. I learnt of new molecular tests that are not currently being used in our laboratory. One test can be easily adopted in my laboratory while other tests need more research and development. This test is for the diagnosis of Amoebiasis in faecal specimens, which combines molecular detection and an enzyme reaction. The assay can be read by measuring the colour change reaction over a set time period. John Williams is willing to help establish this test in my laboratory.

Dr Colin Sutherland has recently been appointed to LSHTM to develop molecular methods for the diagnosis of parasitic diseases in humans. He has funding from the Gates Foundation to help reduce the mortalities caused by malaria in Africa. He has a specific interest in providing practical approaches to implementing methods to control malaria in Africa and monitoring the development of drug resistance to new drug

combinations. Currently the new combination of sulfadoxine and pyrimethamine (SP, Fansidar) introduced as a result of the broad resistance of malaria to chloroquine is showing rapid resistance in East Africa. His studies using a new combination of artemether and lumefantrine drastically reduced the transmission of drug resistant falciparum malaria in Gambian children. Ms Rosie Ord, a postgraduate student of Dr Sutherland, is studying the genetic variation in vivax malaria within isolated amazonian villages. They have expressed an interest to analysing genetic variation of these isolates to those from Asia. Our laboratory may be a source of material for future studies in this project.

During my visit to LSHTM, I had the opportunity to meet the group, headed by Dr Simon Croft, specialising in Leishmaniasis. Both genetic and culture methods were used to analyse drug resistance and they have provided advice to methods in culture of the organism and molecular diagnosis. Dr Vanessa Yardley has been in contact with our laboratory and will provide analysis for drug resistant of leishmania organisms. Her help provides a service, which is not available in our laboratory because of limited resources.

Dr Georges Snounou has recently located from the Pasteur Institute to the Natural History Museum in Paris. I managed to pay him a short visit and we discussed molecular methods in diagnosis of malaria and future genetic studies of malaria. Dr Snounou developed the molecular test for malaria and this test is used widely by laboratories around the world. We discussed methods of analysing drug resistance using genetic markers, however drug resistance may not involve a single gene and there is still a lot of research required to find suitable markers to be used in a diagnostic laboratory.

I returned from Paris to attend the Spring Meeting of the British Parasitology Society Meeting in Chester, UK. I had an opportunity to meet Professor Michael Doenhoff who supplies the antigen used in our tests for Schistosomiasis (Bilharzia). This parasite enters by borrowing through the skin of people swimming in infected waters in Africa. Our laboratory frequently detects this parasite in young Australians who travel through Africa. Professor Doenhoff and I discussed the various types of antigen that he produces to improve currently available tests but he was concerned about difficulty in gaining funding to continue his research. I had suggested that we approach an Australian company to help commercialise a test for Schistosomiasis using his laboratory as the supplier of antigen. Funding options to help develop these tests need to be investigated soon after my fellowship tour. The meeting covered all areas of parasitology, to my delight there were three keynote speakers from Australia. I managed to listen to talks given by Professors Michael Good and Ian Clarke who spoke on malaria control by vaccination and the pathological mechanisms caused by malaria. Another topic of the meeting that interested me was the studies on the symbiotic relationship of the filaria worm and the bacteria Wolbachia that lives inside these worms. Experiments have shown that worm survival is reduced after giving antibiotics to remove the bacteria. However, it is becoming apparent that the bacteria stimulate adverse inflammatory responses in humans when released from the worm. Studies show that the prior use of antibiotics to remove the bacteria, Wolbachia, reduces adverse inflammatory effects of patients being treated for filarial worm. Future studies in this disease may lead to new approaches to treatment of people who suffer from elephantiasis caused by these worms.

The Natural History Museum of London is a beautiful historic building located in South Kensington. The parasitologists located in the museum concentrate in genetic diversity of parasites and are actively contributing to making full genomic maps of parasitic worms. Dr Vaughan Southgate, my host, showed me the activities of the parasitology group. He studies host-parasite interactions with schistosome worms. He has shown that these worms survive in the host for many years and possibly for the life of the host. Interaction of different species of this parasite occurs within their host and the dominant species is more likely to do better than other species. These parasites lay hundreds of eggs per day and are released in to the circulation of their human host. Some eggs make there way out of the blood vessels into the gut or bladder where they are passed in faeces or urine, respectively. Those eggs that remain gradually block the small blood vessels of the intestine and lodge in the liver eventually causing liver damage. My visit was short but I was impressed by the quality of the scientific research coming from the museum. It was however unfortunate to learn that Dr Southgate will be retiring from his position with the museum this year.

Thailand

My visit to Europe and UK went quickly and I find myself making my way to Thailand over Easter. Through the help of Dr Wichit Rojekittikhun, I managed to meet with senior academics from the Faculty of Tropical Medicine, Mahidol University. The faculty has a staff of 85, offer 5 courses in Tropical Medicine and is linked to 261-bed hospital. Below is a list of academics who gave me a brief over view of their research interest.

Name	Training	Specialty Interest
Dr Piyarat Butraporn	Epidemiologist	Malaria & Dengue Fever
Dr Wichit Rojekittikhun	Helminthologist	Gnathostomiasis
Dr Yaowalark Sukthana	Protozoologist	Toxoplasmosis
Dr Manas Chongsa-Nguan	Epidemiologist/Sociologist	Social effects of disease
Dr Emsri Pongponratn	Pathologist	Malaria

After the initial meeting with senior members of the Faculty of Tropical Medicine, I was taken to visit Professor Wanpen Chaicumpa who had left the Faculty of Tropical Medicine to head a research group at Thammasat University. She is one Thailand's eminent scientists and has received a number of national awards in recognition of her work. Currently, she is developing new tests to identify parasitic infections in humans and has 16 postgraduate students working with her. Perhaps we will be using her tests in our laboratory in future. It was good to learn that Australia had helped launch Professor Chaicumpa into a successful career in parasitology as she did her postgraduate training at the University of Adelaide.

Most of time in Bangkok was spent with Dr Paron Dekumyoy who manages diagnostic tests for human parasites. He receives requests from laboratories from all parts of the world to help diagnose rare parasitic infections. All the tests carried out rely on obtaining parasites from the wild to make antigens for the immunoassays. A whole worm extract is produced and prepared for Western blot analysis. Specific molecules highlighted by this technique allow scientist to identify the parasite. This technique is applied to a number of uncommon parasitic infections such as Paragonimiasis, Gnathostomiasis, Angiostrongyliasis, and Trichinosis. All of these parasites use animals as their main hosts but humans can become accidentally infected. On occasions our laboratory is

asked to test for these parasites but in most cases, apart from *Angiostrongylus*, we do not have access to these parasitic worms to carry out the test. Dr Dekumyoy was willing to run these tests if requested from me. Gnathostomiasis is a disease frequently diagnosed in their laboratory but rarely found in Australia. We discussed the disease symptoms caused by this tiny worm less than 1 centimetre in length. Adult worms normally infect dogs and cats, which eat raw fish infected with juvenile stages of this parasite. If humans eat infect raw fish, the larval parasite burrows through the gut wall and moves about under the skin causing pain and swelling. It is believed that one worm is sufficient to cause painful symptoms.

I was invited to visit the Department of Parasitology in the Faculty of Veterinary Medicine at Kasetsart University by Dr Sathaporn Jittapalapong. The campus is located close to the Bangkok International Airport. We met to discuss the development of vaccines to ticks, which are a major problem for dairy cattle from Australia and USA. Dr Jittapalapong was well aware of the first tick vaccine developed for cattle in Australia and wanted to develop a recombinant vaccine for cattle in Thailand. The higher milk producing European breeds of cattle are most prone to ticks in tropical countries. Although I no longer do research in vaccines to cattle, I did commit to contacting relevant people in CSIRO who may be able to offer assistance.

My second week in Thailand was spent in Khon Kaen meeting with academic staff at the University of Khon Kaen. The University has a medical school linked with Srinagarind Hospital on campus. The Department of Parasitology is a preclinical Department, which helps train medical and postgraduate students, provide diagnostic services to the hospital and conduct research in medical parasitology. The Department has 14 academic staff many of who are involved with the Liver Fluke and Cholangiocarcinoma Research Centre (LFCRC). This Centre of research excellence in Thailand concentrates on studies with the liver fluke, *Opisthorchis viverrini*. This fluke uses the local freshwater fish as the intermediate host and transmission to humans occurs when raw fish is consumed. Unfortunately, apart from liver disease caused by damage to the biliary network in the liver, this fluke also acts as a trigger in the development of Cholangiocarcinoma (bile duct cancer). Patients do not realise they have this cancer until advanced stages where it can occupy a large portion of the liver. I spoke to several of the key scientists in the Faculty of medicine who are funded by LFCRC. The scientists are listed below with the topics we discussed.

Name	Training	Specialty Interest
Dr Banchob Sripa	Pathobiology	Human Liver Fluke
Dr Paiboon Sithithaworn	Parasitology	Human Liver Fluke
Dr Sasithorn Kaewkes	Parasitology	Taxonomy of Flukes
Dr Chawalit	Pathobiology	Human Liver Fluke

Other academic staff, that I meet and discussed regional diseases are listed below. These academics were from the Veterinary School and Department of Animal Science in Khon Kaen University.

Name	Training	Specialty Interest
Dr Somboon Sangmaneedet	Parasitology	minute intestinal flukes
Dr Kate Kanistanon	Epidemiology	minute intestinal flukes

Dr Sirikachorn Tangkawattana	Pathobiology	Human Liver Fluke
Dr Chainarong Navanukraw	Animal Scientist	Avian Influenza
Dr Terdsak Khammeng	Animal Scientist	Avian Influenza

Although the liver fluke is a more serious infection in humans, the minute intestinal flukes comprise of a group of 10 species of flukes that invade the small intestine causing diarrhoea. Eggs from minute intestinal flukes are morphologically very similar to that of the liver fluke and it is important to differentiate between the two infections.

During my visit to Khon Kaen, I had the opportunity to visit the Northern Regional Veterinary Laboratory. I discussed regional diseases with the Parasitologist, Dr Manvikap Pholpark and her husband Dr Satis Pholpark who is the Regional Veterinary Officer. The main veterinary disease problems in North Eastern Thailand are Avian Influenza in chicken, liver fluke (*Fasciola gigantica*) in buffalo and cattle, *Trypanosoma evansi* in livestock, worms (*Haemonchus contortus*) in goats and sheep, Foot and Mouth Disease in livestock and avian malaria in poultry. Much of the laboratory resources have been channelled to diagnosis of avian influenza, which swept through South East Asia during 2003.

Thailand has many tropical diseases that are not present in Australia. The specific habits of communities and location of vectors and reservoir hosts influence the prevalence of parasites through Thailand. These contacts that I have made in Bangkok and Khon Kaen were willing to share in their experience and were interested in continued interaction in study of parasites of interest in Australia and Thailand. It will be necessary to develop collaborative projects between Institutions to strengthen ties.

Malaysia

I arrived in Kuala Lumpur late Sunday night and met Parasitologists at three major institutions during the following week. My host was Professor Mak Joon Wah who was the previous Director for the Institute for Medical Research. He has now retired from this position and now teaches medical Parasitology and is the Deputy Director of the Research and Consultancy Centre at the International Medical University (IMU) of Malaysia. The IMU is a private University and has 24 partner medical schools located in Australia, Canada, New Zealand, United Kingdom and Ireland. We discussed about parasites of medical importance in Malaysia and Professor Mak presented me with his recently published book on Medical Parasites. I asked about the problem of malaria in Malaysia. It is not a problem on the Malaysian Peninsular but more malaria is in Sabah and Sarawak. The malaria found in monkeys is also being transmitted to humans living at the edge of the forests. Professor Mak feels that further investigation was necessary to say for certain that this malaria in humans is from monkeys.

We also discussed the filarial worm, *Brugia malayi*, which causes elephantiasis in Malaysian rubber workers. This parasite's natural hosts are leaf monkeys, which eat rubber seeds and are most active around dawn. This is also the time when the mosquito vector is most active and when the rubber plantation workers harvest the latex. A filariasis program is under way to reduce the disease in these workers. Since the leaf monkeys are protected animals, strategies to reduce infection in these primates need to be developed.

Professor Mak introduced me to the Parasitologists in the Institute for Medical Research (IMR) who are listed below.

Name	Training	Specialty Interest
Dr Patricia Lim	Molecular Pathology	Malaria/drug resistance
Dr Noorrain	Parasitologist	Malaria/drug discovery
Dr Shamilah Hisam	Parasitologist	Malaria/drug resistance
Dr Lokman Hakim	Parasitologist	Filariasis

The IMR provides a pathology service to the Kuala Lumpur General Hospital. The research emphasis at the Department of Parasitology in IMR is to find new drugs for malaria and understanding the genetic mechanisms to drug resistance. Drug resistance in malaria is wide spread in Malaysia and discovery of new drugs from natural herbal remedies for malaria is vital. The Department of Parasitology is also the WHO Centre for Filariasis.

The Department of Parasitology at the University of Malaya was a third institution that I visited in Kuala Lumpur. I met the Head of Department Dr Rohela Mahmud and we discussed the medical curriculum and the level of parasitology taught. Unfortunately, Australian medical students are taught very little parasitology compared to their Malaysian counter parts who get 50 hours of formal lectures in their course. The Department has recently established a reference laboratory, Parasites: South East Asian Diagnostic Laboratory (Para:SEAD). This new laboratory is accredited by the Clinical Pathology Association of the United Kingdom. The laboratory aims to provide a diagnostic and reference service for Malaysia and South East Asia. Regional development of Parasitic diagnosis in SE Asia has improved markedly over the last decade.

The last person who I met in Kuala Lumpur was Professor Rahmah Noordin. She is a molecular parasitologist at the Universiti Sains Malaysia who recently released her diagnostic kit for the detection of the filarial worm *Brugia malayi*. The kit is being used through out Malaysia and neighbouring countries. We have had previous collaborations with her development of the test kit but we met to discuss other tests that could be use in this context. Toxocariasis and Strongyloidiasis were two parasites that needed up dating for a more specific and sensitive assay. I hope that we will be able to work together on these parasites but future planning will need to be done through email.

Indonesia

The last week of my tour was in Indonesia and as with all the other host countries, the people were warm and enthusiastic about future work together. I met the Director of the National Veterinary Research Institute (BALITVET), Dr Darminto. The Institute has been heavily involved in the diagnosis of avian influenza that has swept through SE Asia in the last 12 months and will be involved in the continued monitoring of the disease in future. Many of the staff of BALITVET are past graduates of James Cook University in Queensland and I have met Dr Darminto during our student years. Dr Darminto was kind enough to lend me a vehicle to use on my visits to other institutions in Jakarta and Bandung. The Head of the Department of Parasitology at BALITVET, Dr Sri Muharsini, and I discussed parasitic disease problems in Indonesia but the economic crisis in the

early 2000 has restricted funds available for parasitic research. Dr Muharsini also acted as my guide and she helped me locate the other institution in Jakarta.

The US Navy Medical Research Unit (NAMRU) and the Eijkman Institute are located in Jakarta. NAMRU collaborates closely with the Ministry of Health in Indonesia and either funds or conducts research that would be of benefit Indonesia. A group of local scientists work in their laboratories and they provide the scientific expertise in monitoring malaria and other parasitic diseases in Indonesia. Its main activity is to provide an early recognition of disease outbreak conditions in Indonesia so that early steps to contain the emerging disease is instigated. Dr Jason Maguire, the Director of the Parasitic Disease Program in NAMRU and I discussed the malaria problem in Indonesia and its resistance to available drugs. I was surprised that there was extensive resistance in all four species of malaria throughout the Indonesian archipelago. However, malaria is a major problem on certain islands (such as Kalimantan, Sumatra and Irian Jaya) and has only a small number of cases in the most populous island of Java. There has been a resurgence of malaria in Indonesia because of the down turn in the economy followed by stopping of mosquito control programs and the transmigration of people from Java to other less populous islands.

I met Dr Purnomo Projodipuro who is a member of staff at NAMRU. He is the recognised expert in diagnosis of parasites by microscopy in Indonesia. We discussed the problem of filariasis in Indonesia and he fears that the disease is spreading because of the movement of people and the spreading of mosquito vectors.

The Dutch scientist, Christian Eijkman who was awarded a Noble Prize for showing the link between beri-beri and Vitamin B1 deficiency, founded the Eijkman Institute. The Institute now focuses on molecular and cell biological techniques in the treatment and prevention of human diseases. Dr Syafruddin heads the group on molecular studies aimed at showing genetic susceptibility to severe malaria in patients and drug resistance to the malaria parasite. We discussed various malaria genes associated with resistance to chloroquine. It is apparent that vector biology is not very well studied in Indonesia. There are about 22 species of anopheline mosquito that can transmit malaria. The distinct difference between mosquito populations on islands of the Indonesian archipelago determines the level of malaria, but population movements and changes in human activities have encouraged outbreaks of malaria. Dr Syafruddin is currently applying for more funding to support his research in Indonesia and I said I would try to contact scientists in the UK to help his success in gaining funding through the Wellcome Trust Funding.

I made a short visit to the Institute Pertanian Bogor (IPB), which is the Agricultural University of Bogor. I met Dr Koesharto at the Entomology Laboratory in the Department of Parasitology and Pathology within the Veterinary School. We had more detail talk on control of the mosquito and it was suggested that resistance to synthetic pyrethrins is emerging in Indonesia. The need for new chemicals to control the mosquito is therefore urgently required. Otherwise the mosquito vectors for both malaria and filariasis will be difficult to control and lead to resurgence of these diseases in SE Asia.

Biofarma originated in Jakarta by the Dutch East India Company, which started the manufacture of vaccines and sera for human use in 1890. At the turn of the century, the company moved to Bandung and has evolved to a facility that supplies vaccines to third world countries and is sponsored by WHO. Dr Sukanto showed me the facilities of the

company and their good manufacturing practice. The company is the equivalent of Commonwealth Serum Laboratories (CSL) in Australia before it was privatised, but Biofarma remains fully government sponsored. The company makes human vaccines, antivenenes and some diagnostic products, which are getting global recognition evident by the International Arch awards received in 2002 and 2003. My final visit was to the animal facilities of Biofarma located on top of a mountain peak towering above the city. This was a fitting end to my study tour as I sipped tea and gazed at the fertile scenery of three volcanic peaks surrounding the city of Bandung.

CONCLUSIONS & RECOMMENDATIONS:

The parasitologists that I visited were busy but they made time for me. The recognised parasitologists in many countries are ageing and their skill can not be so readily acquired in modern times. There needs to be a network of recognised experts locally and globally so that parasitic diseases can be quickly diagnosed and appropriate treatment given. An official register can be organised so specialised tests and Parasitologists with specialist skills can be identified with the individual laboratories. Recognised accreditation of these laboratories will also need to be included in this register.

The control of parasites in most countries relies heavily on chemical application to either kill the intermediate hosts or vectors but emergence of chemical resistance will eventually lead to resurgence in parasitic numbers. Malaria remains the major parasite in Africa, South America and SE Asia. However, drug resistance in malaria will lead to underdeveloped countries not being able provide safe, cheap and effective medication for patients. Practical methods in monitoring drug resistance in malaria needs to be develop so that the correct medication can be given at the outset. Exploration for new anti-malarial drugs is essential.

There is a need to cultivate intellectual exchange between Institutions so that a high level of training in diagnosis of parasitic diseases in Australia is maintained. Training is necessary in Australia as well as training of students in developing countries so that these trainees can go back and identify the parasitic diseases affecting their country. A group of specialists is required so that travellers and migrants that enter Australia can be diagnosed for parasitic infection. Currently established specialists are slowly disappearing and need to be replaced by trained personnel. A proportion of the overseas aid should be allocated to training medical or scientific staff from underdeveloped countries to work in Australia and learn the skills necessary to be effective diagnosticians back in their country. This contact will also provide a resource from which Australian parasitologists can learn more of parasitic diseases exotic to Australia. Collaborative research projects should be encouraged to help identify problems in developing countries and provide a resources for Australian scientists to learn more about parasites in foreign countries.

I have initiated contact with scientists in USA, UK, Thailand, Malaysia and Indonesia but this initial contact will need to be followed up with research proposals and funding. All overseas groups are keen to develop collaborative research projects with my laboratory. Difficulty in gaining funding for practical parasitological problems will stifle this network as continued contact and collaboration will keep this network alive. Knowledge and skills on parasites outside Australia can only be achieved with scientific exchange.