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Kangaroo blindness and some other new viral diseases in Australia

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Two articles[1,2] within this issue describe the work that showed the cause of the massive 1994 to 1996 outbreak of blindness in kangaroos. The actual elucidation started long before the epidemic occurred. The ensuing work demonstrated the values of gathering basic information, seemingly unimportant at the time, and of multidisciplinary and multilaboratory research.

In the 1970s, CSIRO and a number of other institutions commenced a surveillance program for viruses, particularly those that are arthropod-borne. The program included widespread trapping of insects and taking blood samples from a variety of animal species. As result of this work bluetongue virus was isolated. Because of bluetongue's economic importance, the sampling was expanded during the late 70s and early 80s. One of the findings was to be important in later work with kangaroo blindness: two orbiviruses of the Wallal and Warrego serogroups, named after the sites of their isolations in Queensland, were isolated from kangaroos.

Much later, in early 1994, staff of the NSW National Parks and Wildlife Service noticed many apparently blind kangaroos at Kinchega National Park in far-west New South Wales. Similar reports were received from neighbouring graziers and kangaroo shooters. There were similar situations over the borders in South Australia and Victoria, and later, in 1995, in Western Australia. Widespread investigations were started in the three States by task forces comprising veterinary officers, wildlife officers and the public. These studies confirmed a massive outbreak of disease involving mostly grey and red kangaroos, the dominant macropods in the areas. Strangely, once systematic studies were made, it became clear that the only a small minority of kangaroos were affected. To a casual observer there seemed to be multitudes of blind animals, easily visible because of their reluctance to move to the obscurity of timbered areas.

The laboratory investigations started with the dispatch of numerous organ samples, eyes, brains, blood and others, to regional veterinary laboratories and to the CSIRO Australian Animal Health Laboratory (AAHL). Each laboratory isolated Wallal and Warrego orbiviruses and these isolates were forwarded to AAHL. Because of the earlier work, reagents were available to confirm the identity of the viruses, and then show that the Wallal virus, at least, was present in high concentrations in the damaged retinas of blind kangaroos. Koch's postulates were satisfied by experimental reproduction. Molecular techniques were able to show that the incriminated Wallal virus was a variant of the earlier isolate and was present in certain species of mosquitoes. These techniques also showed retrospectively that there had been, years before, at least one earlier case of a blindness in kangaroo caused by the newly recognised variant of Wallal virus. Various skills were brought to bear on the problem. In the field, wildlife scientists, veterinary officers and the general public combined to provide epidemiological data, clinical observations and a large number of specimens to the laboratories. It remained for multidisciplinary laboratories to show that, at least one of the viruses isolated, an orbivirus of the Wallal serogroup, had been the aetiological agent. The final result was surprising because of the specific localisation of the Wallal virus in the retina was unusual for any infective agent, let alone an orbivirus. Orbiviruses such those causing bluetongue and African horse sickness tend to cause generalised disease with diffuse actions on blood vessels.

The discovery of the cause of the blindness in kangaroos has only been one in a remarkable series of newly discovered viruses and the so-called emerging diseases. About 20 years ago there was a belief that infectious diseases were being conquered and would be of no account by the turn of the century. The emergence of HIV/AIDS is one good example of the reversing of these perceptions.

Some of the prominent new viruses have appeared in Australia. Perhaps the most dramatic discovery has been the role of fruit bats (or flying foxes, *Pteropus* spp) in

hosting a number of viruses. Serendipity, the faculty of making desirable but unsought-for discoveries, has played a big role in this discovery. These new viruses are especially important because each has been shown to be zoonotic, and thence a danger to man.

Serendipity was at work in Queensland in 1994. If a Hendra racehorse trainer had not had such a close association with his horses, there may not have been the spectacular outbreak of disease that led to the discovery of the new paramyxovirus, Hendra virus (HeV, previously called equine morbillivirus). Because many horses were fatally affected at the one time, full resources of governments and their laboratories were brought in to assist private practitioners, resulting in the discovery of HeV and confirming it as the lethal agent. Later, the Queensland researchers hunting for a source of infection demonstrated that fruit bats were a carrier of HeV.

In 1995 another human died of HeV. This time the disease was manifested by encephalitis. As fruit bats had already been incriminated as carriers of HeV, there was interest in a bat with encephalitis, which then was tested for HeV, but with negative results. Alternative differential diagnoses were considered, particularly rabies, a disease commonly seen in various families of bats overseas but not thought to be in Australia. It is now history that the search for HeV ultimately led to the identification of Australian bat lyssavirus (ABL), a close relative of rabies, in four species of Australian fruit bats and in a totally unrelated microbat.

The third of this sequence of viral discoveries occurred in 1997 when a disease broke out in a large piggery in New South Wales. The disease was characterised by the appearance of numerous stillborn or live piglets with congenital abnormalities, and severe influenza-like signs in two humans. A paramyxovirus was isolated as the causative agent and was called Menangle virus. As there was a large colony of fruit bats nearby, and an awareness of the dangers of fruit bats after the experiences with HeV and ABL, stored sera from these animals were tested for antibody for the Menangle virus, with positive results. The incentive to check the bats came from the recent experience of detecting two other viral diseases in bats.

The fourth of the sequence of viral discoveries was early in 1999. Many pig farmers were sickening and dying with encephalitis in Malaysia. An initial diagnosis of Japanese encephalitis was changed when a paramyxovirus was isolated from the brain of a person. The virus was quickly noted to resemble HeV. It was subsequently confirmed in the farmers' pigs, and also in dogs, cats and horses. This Nipah virus was found to differ from HeV, yet genetically and serologically to be of the closest detected relationship to it. The close serological relationship meant that tests developed for HeV could be used for Nipah virus that facilitated the diagnosis of the disease in the domestic animals. From an epidemiological point of view the similarity helped in searching the reservoir of the Nipah virus, possibly fruit bats again.

There are many other zoonoses that affect wildlife as well as domestic animals. An unwelcome addition to Australia is Japanese encephalitis. The causative virus occurs in wading birds and mosquitoes and is amplified in pigs. It was formally thought to be confined to animals west of the Wallace line. This line, passing in a north-south direction between the Indonesian islands of Bali and Lombok, separates the fauna and flora characteristic of Asia to the west from those inhabiting Australasia and Oceania to the east. It was hoped that the geographical and thence biological separation would protect Australia from the viruses west of Wallace line, as they might only infect susceptible wild animals in Asia. The advent of Japanese encephalitis to north Australia has effectively disproved this theory. It is now clear that the virus can infect a broad spectrum of species, perhaps even Australian wildlife.

It is becoming obvious that infectious diseases in humans continue to become more important as populations grow and our environment is encroached by man and his intensively reared livestock. New viruses, normally safely contained within their host species, are emerging, even within Australia. Many are lethal to a number of species including man. Australia must continue to be alert. The sequence described above is probably unique in terms of the number of new dangerous viruses emerging in a short time. It must be of concern to Australian veterinarians that Australia is centrally involved. There would not have been such prompt resolution of most of these cases without the basic work that had been done before. The prior preparation of reagents such as antisera, and the collection and the study of viruses at times when there are no apparent epidemics, are of great value in future diagnostic and epidemiological work. Basic science including the acquisition of seemingly unimportant data can provide the tools for important discoveries.

1. Hooper PT, Lunt RA, Gould AR et al. Epidemic of blindness in kangaroos – evidence of a viral aetiology. *Aust Vet J* 1999;77:529-536.
2. Reddacliff L, Kirkland P, Philbey A et al. Experimental reproduction of viral chorioretinitis in kangaroos. *Aust Vet J* 1999;77:522-528.