

Special feature

From a BAT out of HELL

Juliet Gellatley, founder and director of Viva!, explores the animal origins of coronavirus

Coronavirus. One of the smallest and simplest life forms to ever exist and yet it has killed 1.2 million people so far and spread fear and economic chaos across the world. SARS-CoV-2 is the name of the virus that causes Covid-19 and it is actually just one of hundreds of different coronaviruses that have an ancient viral ancestry. They evolved tens of millions of years ago and their natural (original) hosts are bats and birds.

Over time coronaviruses have come to infect a wide array of other mammals and birds – hedgehogs, beluga whales, bottlenose dolphins, pigs, cows, geese, ducks, moorhens, night herons and many other species including, of course, us!

Coronaviruses were first discovered in chickens in the 1930s. It wasn't until the 1960s that human coronaviruses were detected. To date, seven coronaviruses have been identified that cause disease in humans. Four are endemic and usually cause mild disease – accounting for 15 to 30 per cent of common colds. But three can cause much more serious and fatal disease – Severe Acute Respiratory Syndrome (SARS), Middle Eastern Respiratory Syndrome (MERS) and Covid-19.

All seven human coronaviruses are zoonotic. That means the viruses originally evolved in animals and jumped the species barrier to us. This is common. Three in four of all newly emerging infectious diseases are zoonotic – hence the name of Viva!'s campaign; 3 in 4. The scary thing is, the incidence of new diseases is increasing because of the way we exploit and kill animals. Not only are we decimating natural habitats to clear the way for more factory farmed animals, we are incarcerating ever-increasing numbers of animals in dirty, crowded sheds and trading wild animals – all for traditional medicines that don't work and meat that we don't need. Invading and disrupting ecosystems inevitably shakes loose viruses from their natural hosts, just as factory farms give the ideal conditions for viruses to mutate to become more deadly and able to jump to humans.

Coronaviruses mainly infect the respiratory and gastrointestinal tract of their host. Although individual virus species mostly appear to be restricted to a narrow host range comprising a single animal species, genome sequencing and phylogenetic analyses testify that coronaviruses have crossed the species barrier frequently. Over the past 30 years, before Covid-19, there have been several coronavirus cross-species transmission events, involving cows, pigs, humans, bats, cats and dogs. Of the seven human coronaviruses five originated in bats and two in rodents, but they all transmitted to us through an intermediate host – always animals we exploit. It is therefore inevitable that similar zoonotic infections will occur in the future, unless we stop abusing animals. ►

WARNING BELLS

And it's not as if we weren't warned about this. Almost 20 years ago, a virus appeared in wildlife markets in southern China, and it was unlike any the world had seen. It was winter 2003, and sufferers complained of fever, chills, headache and dry coughs – all symptoms you would expect during cold and flu season.

But this condition progressed into a lethal form of pneumonia, one that left honeycomb-shaped holes in people's lungs and generated severe respiratory failure in a quarter of patients. While most infections only spread to three additional people, some of the afflicted became 'super-spreaders' – unwittingly transmitting the disease to dozens at a time. By the time the epidemic of SARS ended seven months later, more than 8,000 cases and 800 deaths stretched across 32 countries.

SARS originated in bats but passed to people through civets – sold in wet markets. Professor Yuen, a microbiologist at the University of Hong Kong, who screened large numbers of civets said it was likely the virus jumped host while the live animal was being handled. One of China's first confirmed SARS patients, worked as a cook in a Shenzhen restaurant; another was an animal handler and the first 'super-spreader' worked in a wet market.

Professor Yuen said: "If you cannot control further jumping of such viruses from animals to humans, the same epidemic can occur again – so it is very important that we have ways of controlling the rearing, the slaughtering and the selling of these wild game animals." There were many more warnings from scientists. "The presence of a large reservoir of SARS-like coronaviruses in... bats, together with the culture of eating exotic mammals in southern China, is a time bomb." A time bomb that just went off.

But even sooner than the emergence of Covid-19, MERS (Middle Eastern Respiratory Syndrome) emerged in 2012 – another coronavirus had mutated, enabling it to jump from bats to camels. This was bad news. Camels are exploited for their milk, meat, wool and for transport and racing. Owing to substantial government support, camel farming and racing expanded hugely, exacerbating desertification. This led to the banning of free grazing of camels in 2005. Consequently, camels are often confined in barns alongside workers. And so the virus that now infected camels (but fortunately only causes mild disease in them), changed its clothes again, only this time infecting people and becoming exceptionally deadly – killing one third of the people it invaded. Between 2012 and 2019, there were around 2,500 cases of MERS and over 900 deaths. The only reason it did not spread further is that MERS is not very contagious.

And so just seven years later, at the end of 2019, another coronavirus raised its ugly head. Sars-CoV-2 was born probably in a wet market in Wuhan city in Hubei province, China. In December 2019, two thirds of the first 41 people hospitalised with Covid-19 had walked through that market.

WHAT IS A WET MARKET?

Like farmers' markets around the world, wet markets are collections of open-air stalls selling fresh seafood, meat, fruits, and vegetables. Some wet markets sell and slaughter live animals on site – usually chickens, fish and shellfish. More rarely, wet markets also sell wild animals. The Huanan market, for example, had a wild animal section where live and slaughtered animals of 75



species were for sale, including snakes, beavers, porcupines, wolf pups, badgers, bears, foxes and baby crocodiles, as well as dogs. The conditions of all these animals – wild and domestic – were absolutely pitiful. These poor creatures crammed in small cages were being chosen by customers and killed there and then. Wet markets are so called, partly because of the blood that permeates the ground.

The theory is that bat and pangolin viruses swapped genes to be able to form a deadly new enemy – SARS-CoV-2

The virus causing Covid-19 is 96 per cent genetically identical to a bat coronavirus. But crucially, the bat virus doesn't have the right genetic sequence to be able to enter our cells. Enter the pangolin. Although overall, the pangolin coronavirus is 77 per cent similar to the Covid-19 virus, at the site that enables the virus to enter the human cell, it is 99 per cent identical. The theory is that bat and pangolin viruses swapped genes to be able to form a deadly new enemy – Sars-CoV-2. That recombination could have taken place in the trafficked pangolin.

Also known as scaly anteaters, pangolins look like an artichoke with legs. It is elusive, nocturnal and barely understood. When frightened, pangolins curl up into a roly-poly ball. But between the demand for their meat as a delicacy and scales and blood for traditional Chinese medicine, pangolins are the most trafficked mammal in the world.

Although the Huanan market reportedly did not sell bats, others markets certainly did, and Huanan traded in pangolins. ►



BAT AND MAN

You may be thinking why are bats the natural hosts of so many coronaviruses and how come they do not get ill. There are over 1,400 species of bats and they are the only true flying mammal. They are more manoeuvrable than birds, flying with their very long spread-out digits covered with a thin membrane or patagium. But their strange immune systems that make them the reservoir species for certain viruses are what make them truly special.

The reason bat viruses are increasingly coming into contact with intermediate hosts – or us directly – is the fault of humans

Bats need three to five times more energy than other mammals their size. Their incredibly fast metabolic rate would normally mean a mammal of their size would live just a few years because of the extra cell-damaging free radicals, however they can live up to 40. They have evolved a set of physiological pathways that reduces stress to their bodies, repairs DNA damage and dampens inflammation. They also manage to produce high levels of interferon-alpha which signals to their cells to go into an anti-viral state, halting the progress of an infection. As a consequence, their strong immune responses, constantly primed to respond to viruses, can drive viruses to greater virulence. The increased virulence and infectivity wreak havoc when these viruses infect animals with tamer immune systems, like us.

The reason bat viruses are increasingly coming into contact with intermediate hosts – or us directly – is the fault of humans. A shocking 170 species of bats are hunted and eaten worldwide. Andrew Cunningham, Professor of Wildlife Epidemiology at the Zoological Society of London says: “The underlying causes of zoonotic spill over from bats, or from other wild species, have always been shown to be human behaviour.”

When a bat is being hunted, or its home is damaged by deforestation, its immune system is challenged and cannot cope with pathogens it otherwise took in its stride. “The impact of stress on bats would be very much as it would be on people,” said Cunningham. “It would allow infections to increase and to be shed.”

“If bats are being shipped or held in markets, in close proximity to other animals or humans,” he continued, “then there is a chance those viruses are being shed in large numbers.” He said the other animals in a market like that are also more vulnerable to infection as they too are stressed.

“We are increasing transport of animals -- for medicine, for pets, for food -- at a scale that we have never done before,” said Kate Jones, Chair of Ecology and Biodiversity at University College London, to CNN.

“We are also destroying their habitats into landscapes that are more human-dominated. Animals are mixing in weird ways that have never happened before. So in a wet market, you are going to have a load of animals in cages on top of each other.”

Whichever the animal was that had the mix of deadly viruses brewing inside him or her; that one meal, that one medicine, has made humanity pay the dearest of prices for its mindless greed and cruelty, for its complete disregard of the warnings and for its unabated destruction of animals and all of nature.

