John McDougal (00:00):

Well, good afternoon to find out late afternoon, ladies and gentlemen, welcome to the Adelaide Festival of ideas, or perhaps more appropriately welcome back to the Adelaide festival of ideas. I'm sure a lot of you have been to sessions this morning and yesterday. My name is John McDougal. I work with professor Alan Snyder at the center for the mine, which is a, a joint venture between the ANU and university of Sydney. And our speaker today is on our board. Most serendipitously it wasn't a prearranged that I should be cheering his session. But number two, most welcome privileged to be doing. So Peter was was born in Queensland. I was an avid reader and thought his own inner inclinations were tending towards literature and history. Until he was reading Sartre and Hemingway and Huxley and thought he should be a man of action and achieve something.

John McDougal (00:48):

And I think we can safely say he's done that. He was he was struck by this desire to do something useful and was interested in his cousins working epidemiology in in viruses. And he maintained that that interest and completed a a veterinary degree. And in fact, I think is still the only Nobel Laureate with her, such a qualification. He met Rolf Zinkernagel and together they did a lot of work and I believe he was able to form a friendship and relationship with Ralph primarily because he was the only one in the the institution who could bear to listen to Ralph's opera singing. They shared the Nobel prize in 1996 for their work on how the immune system recognizes virus infected cells. So most profound accomplishment and one of the few living Australian Nobel laureates, but of course as Adelaide would, well, no, not the only Nobel Laureate living in, in Australia.

John McDougal (01:46):

We had the south African JM quit Sayer in a residents in Adelaide. Peter was named Australian of the year, the following year in 1997. And so he's had a busy time in his life, changed dramatically since plugging along and doing profound research in our finds himself in attendance that thinking conferences in Melbourne in the last couple of days. And he'll be enjoying expanding his ideas on what can be done to to Adelaide's festival of ideas. He now contributes regularly to a scientific debate in Australia and across the globe really, and radio television and in the press. And he moves between Memphis. He spends a few months of the year in Memphis, it's a Jude's and the university of Melbourne. And he's going to discuss what there is to be done on influenza, aids, SARS and other scary monsters. Ladies and gentlemen, please. Welcome. [inaudible].

Peter Doherty (02:47):

Thank you very much, John. And and thank you for coming. Are you getting an echo on the audience or is it okay? Yeah, I guess is a better if I move away. No, that are here. Okay. Okay. Stay here. I'll be disciplined. Right. Okay. Yeah. So I'm going to talk about about some infectious diseases and some infectious diseases that really hit the headlines and are really quite scary monsters. And we'll all be aware of them at some level or another. Before I say that, I think I need to say something about the interaction between infection and human beings. And we are of course, large complex multicellular multiorgan systems. We're very complex organisms in the world of biology and in on us live many simpler life forms. Each of us, as we walk the streets is a type of walking ecosystem with lots of little organisms living on our surface membranes in our intestine and all the rest of it.

Peter Doherty (03:54):

And to keep those organisms from invading us from going further than the surface of the lung or the surface of the gut, we have a well-developed immune system. The immune system is there basically so that we can respond if organisms invade and we can get rid of them. And mostly the organisms that live with us all the time, the ones that walk around with us sit quite happily there and don't attempt to go any further. And we have the immune system damping them down. Now that can go wrong. It can go wrong with our immune system is destroyed. And some of the things that normally live happily with us will invade and cause disease. And of course though, that's not the normal mode of infection that most of us suffer. And that is when something comes in from outside and we get influenza or we get the croup or something like that, depending on how old we are.

Peter Doherty (04:51):

And then our immune system, again, turns on and deals with that. And the great protection that we have against infection is of course, the vaccine where we give our immune system and the immune system is capable of learning. We give the immune system and experience of say, polio virus by infecting the baby or the young child with a dumbed down version of polio virus, which is not very dangerous. And then the immune system gets primed up. It makes the antibodies and the T cells and all the rest of it that handled poliovirus infection. And so polio comes back again and it's fully virulent form. We handle it and get rid of it. So our great weapon against infectious disease is vaccination. And what I want to tell you about really is the threat posed by three major infectious diseases, the SARS epidemic, the aids epidemic, or the aids pandemic, and the influenza viruses.

Peter Doherty (05:46):

What I want to tell you about is how science has dealt with those the extent to which science can deal with them and what our limitations are and how also we've dealt with them or not dealt with them culturally, and how that influences the way that these disease process manifest in human populations. Now, the first I'll talk about is the aids epidemic. I came to him human consciousness in the early 1980s, when in the United States, we started to see gay men developing a very serious and fatal wasting disease. People couldn't work out what was causing it. There were all sorts of speculations that what was happening there was speculations about toxins various other things about what actually was causing aids. It was only when we actually isolated the virus that we started to understand what was really going on. And the isolation of that virus was quite a demanding exercise.

Peter Doherty (06:51):

It required a fairly high technology for the time and the fact that we were able to do it really reflected the stage two its science had developed at that time. If aids had come along 50 or 60 years earlier, we would not have been able to isolate that virus. And we would not have known how to handle it. And as a result of that, we would not have been able to put in place as effectively, the control mechanisms that were put in place. The actual science that was done that led to the detection of the aids virus really found its home in the development of molecular biology. After the second world war, the the work that went on in places like cold spring Harbor, and it very much found its home in the type of technology that was developed at the national cancer Institute in Washington, DC under the funding of Richard Nixon's war against cancer, the war against cancer has had various successes, but one of its successes really was to bring us to the stage in science, where we can handle that died now aids, where did it come from?

Peter Doherty (07:55):

What happened? And where's it going? Well, I now know from studies that have been done extensively in Africa, that the aids virus is essentially a chimpanzee virus, which has come across into humans. It is the case that viruses, let me just say what a virus is for a start. I'm talking about virus disease. A virus is a very simple organism that cannot replicate itself outside living cells. It can't like a bacteria grow independently in the soil or outside the body. It has to get within a cell and it uses the cellular mechanisms of say a lung cell, or it's an influenza virus or a lymphocyte of white blood cell, or that's the aids virus to actually replicate itself and then produce more virus particles, and then go on and infect more individuals. So these are very simple parasites we're talking about. And SARS aids influenza all caused by viruses.

Peter Doherty (08:50):

Okay? So the aids virus is a virus that's lived for a very long time chimpanzees. And what happens when a virus lives with a particular population over a very long time, is that the two co evolve so that they live with each other, the classic case in human beings is the virus Epstein BARR virus. This is the virus that cause infectious mononucleosis in adolescents. 99% of the people in the room here will be infected with Epstein BARR virus. If our immune systems were destroyed, Epstein, BARR, virus could cause cancer. It could cause lymphoma, but that's not what normally happens. Normally we don't die from Epstein-Barr virus infection. We outlive it. That has means we die from something else you realize, of course, that survival in medicine or long-term survival means you die from something else. So, so that's a virus which has very much evolved to live with us.

Peter Doherty (09:47):

And if you actually look at that virus Epstein virus, you can see that it's taken in bits of our immune systems to sort of fool the immune system, but not fully immune system, to the extent where the virus would actually go along and destroy us, because if it did that, it would actually destroy itself as well. So that's what we call a stable ecosystem. If you like, if you're thinking in in terms of the environment. So the aids virus is like that in chimpanzees, the chimpanzees are infected, they produce the virus, but it doesn't do them much damage and they live quite happily with it. How was it fine found that it was in chimpanzees, a young German scientist working in the United States started to look in primate populations in Africa to try and find correlates of the aids virus. And she, she was studying chimpanzee populations as she her job really was to chimpanzees, tend to sort of get into a sort of a nest in trees as I understand it.

Peter Doherty (10:45):

And when they're all together in the evening, they sort of pee out of the nest. I mean, that's the the big tent of the American Republican party. It's better to have them inside and out than outside and in George Bush is familiar with that. And and so she was actually standing outside and had a stick on the end of a tin. This is research for you. This is high quality, top level biomedical research. She had a stick on the end of a tin collecting the urine, and then hour, I went from that to isolate the chimpanzee viruses and to show that the chimpanzee virus is pretty much identical to the human virus so that it came across. We think into the human population because of the practice of killing bushmeat, what's been happening through the world over the last a hundred years or so is an enormous increase in population.

Peter Doherty (11:35):

You realize, of course, that the human population between 1900 and 2000 increased four fold, that is at 1900. If we were looking in this room, only that quarter would have been full. And now the whole room is full. So four fold increase in the human population as a result of that, because much of that increase in population has been going on in the developing world. The people have been pushing more and more into jungle areas and the food suppliers have become more and more stretched and we've had more and more incursions. And we've seen that incursion with not numerous infections actually coming across from the animal population or the humans. This has always happened, but it's been happening with increasing frequency. Another case is a bowl of virus infection, which I won't talk about today. But again comes in from a while. There's some Vedic reservoir into human populations sporadically, as it happens, what probably happened with aids was that someone was killing bushmeat.

Peter Doherty (12:34):

There's a practice of killing primates for food, and they probably were not killing the Chimp. They probably cut their hand and it probably got into their circulation. Then it was spread and it would spread very rapidly. And of course it spread through international air travel and it's spread in Africa. The spread of aids as the epidemic developed, could be traced very clearly to the truck routes goods come into Africa. They come into ports like Mombasa, and then if you're getting stuff into Uganda, most of that would go by truck and you could see the aids virus developing along those truck routes, being spread by the truck drivers, low-level prostitution and all the rest of it. Now dealing with aids. What do we have to deal with that? Well, we have very good drugs. Science has given us excellent antiviral drugs, and we have aids drugs that target three different pathways and someone in our communities who is suffering, who was unfortunate enough to have got a blood transfusion with the aids virus.

Peter Doherty (13:31):

And of course those people died early on. Of course it doesn't happen now because we can test the blood supply and the blood supply is safe in our type of community, or if they are indulging in risky activity and they contract aids, then now will be treated with drugs. And if they can tolerate the drugs and not everyone does most will have reasonably normal lives. It's not a good disease to have. It's still in the end can kill you, but many people can live reasonably normal with the aids virus. So that's one line where science has actually triumphed over ovaries. In one sense. The other thing we'd like to have though is a vaccine. The problem of course, with aids drugs, is that we can afford them in and asset types of societies. But if you're looking at Africa where it's a major problem, and you've got incidence rates up around 30 to 40% in some communities, the aids drugs are simply unaffordable.

Peter Doherty (14:23):

As you know, there's a big push to get aids drugs into Africa. The trouble is though you really need to monitor people who are on aids drugs. And if you got to be just treated with one drug rather than the three drugs, because the three drugs target three different types of mechanisms that the virus uses to multiply. If you just target one of those, it's easy for the virus to mutate because this virus has to be tight very quickly and you'll get drug resistance. So you've got to target the three different things because then the virus can't tricky enough to get past it. What we really need for Africa and the developing world is a vaccine. And I've been involved in vaccine research on this. It's not my major interest. My major interest is influenza immunity. I've been involved in vaccine research too, though. I've just in fact, two weeks ago, I was in Washington DC chairing a final session to hand up $300 million for night's vaccine project.

Peter Doherty (15:16):

There are a number of projects on at that level funded by the gates foundation funded by various other organizations. And so a lot of money is being spent, but we're not getting terribly far with an aids vaccine. And it's not really clear. We can make one because the virus is so tricky and so forth. That's what we would like to have for Africa. We don't have it. So how do you deal with aids if you don't have a vaccine? Well, the way we deal with an analysis, it of course, is that we warn people about it. We've told people what the risks are and people have modified their behavior accordingly. And so we don't have a massive aids problem. It's been very hard to get that message across in some of the developing countries. Thailand had an enormous problem with aids. They thought I wouldn't, but they did.

Peter Doherty (16:00):

But the ties are very well-organized and very smart people. They got the king who's major maker of opinion. They got the army, they got the religious groups and the priests and school teachers, and everyone organized to get out the message that risky behavior risk of getting condoms were made freely available. And they dropped off their aids epidemic like that. Senegal and Uganda were also very, very public about how to deal with the aids epidemic publicly, the, the Islamic memes in, in Senegal, read the Qur'an and interpreted as saying that it's quite okay to use condoms and therefore they didn't preach against them, which was very valuable. And so those countries have done roughly well in Africa. On the other hand, you've got other countries that have refused to acknowledge. We had a big problem in South Africa for a long time. One of the really unfortunate things that happened early on with aids is that even some of the scientific community were rushing around saying that the aids virus doesn't cause it, this became a sort of crazy thing in a sense, the aids virus doesn't cause aids.

Peter Doherty (17:00):

What it does is the aids virus destroys a key component of the immune system called the CD. T-Cell. If you destroy the CD four, T-cell you decrease your level of, of resistance to all sorts of other infections like tuberculosis, like some of the things that normally live in our gut and in our lungs and they kill you. So it's like, you know, saying, well, guns don't kill people. Bullets do. And it just makes just about as much sense. So but then that led to a lot of confusion, led to confusion and getting out the message that the sort of behavioral changes that need to be made. And it continues to be a major problem. So while the advanced will says, well, another problem that has happened, and this is again, a cultural problem, and this is not a cultural problem comes from Africa. This is a cultural problem that comes from the advanced world because of the extreme sensitivities in the American political system.

Peter Doherty (17:56):

At the moment to the values of the religious right funding for women's health has dropped massively in the developing world. The cause women's health clinics are identified as providing abortion. And so the type of funding that would have gone to women's health clinics and it's women who can control these issues much better than anyone else, of course. And it's the women that you have to educate that type of money has fallen off dramatically. So while on the one hand, president Bush is putting $300 million. This grant that I was helping to adjudicate was that a direct initiative of the president, he's putting $300 million in more into aids vaccine, and it's putting more into aids treatment, their administration at the same time, it's cutting the sort of very practical programs that that would help to curtail the outbreak. In fact, one of the recent things I heard from one of my colleagues had been in Africa, she'd come to the conclusion that actually the best way to stop the aids epidemic, the bribe, which doctors, because they have a lot yeah.

Peter Doherty (19:00):

Of influence. And if we gave the witchdoctors condoms that they could sell at one center each, and we gave them $10,000 a year to promote ABC that's ABC is abstinence be faithful. Or if you can't do that, use a condom. Then we probably have a very high success rate. So then you have a situation where we have an epidemic, which has come to some extent through various cultural effects, population effects, cultural effects, and it's come into come throughout the whole world. We have a situation where science has done very well in designing drugs and developing drugs and keeping ahead of the disease with drugs, because there are new drugs being described all the time. We have a situation though, where science is to some extent, at least at the moment, running up against a brick wall because we don't have know how to make a vaccine.

Peter Doherty (19:49):

And when I was looking at these $300 million grants, I couldn't identify a single original idea in them. And we're trying everything I can tell you. I mean, we really are trying everything. And it's, it's, it's one of the things where science at times hits a wall and we don't actually know whether we will get over that wall. Science is great, but it doesn't solve every problem. And then on the other hand, you have the cultural problem, the cultural problem of getting across to people, the right information, the people accepting that information and then acting on it. And there you have the whole mix of global infectious disease in this one disease aids what's doing at the moment. Of course, you've got the other problem with intravenous drug users, which is is, is, is a big problem in Russia. It's the, the problem in the American inner cities.

Peter Doherty (20:37):

And of course, it's the intravenous drug users, users that spelt spread the disease heterosexually at least initially. But of course in Africa, aids is a fully heterosexual disease. So, so we are with aids. Where, where, where do we stand? 3 million people will die this year of aids and 3 million people die next year. And it's anything it's ramping up. And and that's that's the current state until we change really people's behavior. No, sorry. I was on the other hand was a totally different story. SAS again, it's scenes. And it took us a while to work this out. Not very long. SAS came along about the beginning of 2003. Initially people thought people are dying of this terrible respiratory infection. People thought this is influenza. We'd had an earlier outbreak of an, a bird influenza getting across into humans in Hong Kong. And people were dying in that part of the world.

Peter Doherty (21:32):

And we first saw a lot of this in, in Hong Kong. And with, with initially it was sort of influenza. They did the tests as non-influenza and suddenly people say, what are we facing here is something. And we don't know what it is. And it's killing people and it's killing people quickly. And it seems to be very infectious, very dangerous situation. And it looks as though it's a respiratory disease, which is even more dangerous. You know, you can change your behavior. [inaudible] With respect to aids and hopefully not get aids unless you're unlucky and in a traffic accident. And you happened to be in Africa and you get bad blood or something, but you can't change your behavior and stop yourself getting a respiratory infection. There's nothing we can do about it. We're totally vulnerable to respiratory viruses. We can walk around with masks. They're not very effective and all the rest of it.

Peter Doherty (22:16):

So it is scary. So SARS was frightening because we didn't know what it was. It was killing people and spreading rapidly. We reacted very strongly and very quickly, all sorts of controls on travel were put in place. We had temperature sensors in the airport trying to tell where the people had a fever or not. I was flying through Singapore airport at that stage and everyone's rushing around with masks on Toronto essentially shut down the disease, got to Toronto in the end, the disease cost. I don't know how many billion dollars. I think it's something like 30 or $40 billion in economic loss to various countries. What was it? Well, in three months we had the virus out. It really was remarkably quick. And the reason that it was so quick is that we were working in a well-established global network. When I say we, I wasn't personally involved, but the scientists were working in a well-established global network, which is the influenza network, which operates globally.

Peter Doherty (23:13):

It's it's, it's, it's injured. Its headquarters are in Geneva with the world health organization. And we have regional influenza centers throughout the world. There was one in Hong Kong, which had been monitoring influenza viruses coming out of China. And I'll tell you about that a bit later for some considerable time. And it was that influenza network that reacted very quickly or very good scientists right throughout the world. It turns out the virus was got out first in Hong Kong, but it was a race between Hong Kong and the Netherlands, the CDC in Atlanta and a group in Canada as well. And so everyone was onto it. Within a couple of months, we had the virus out, we knew what it was. It was a new virus. It's a virus that's known as a Corona virus. These viruses do cause respiratory infections generally very mild. They cause a disease called infectious bronchitis in chickens, a respiratory disease type disease.

Peter Doherty (24:02):

And here was coming across into humans. Where did it come from? Well, that was worked out very quickly to once the virus was sequenced, they found exactly the same virus in the Gwangju province, in Southern China, in Himalayan civet cats. Now Chinese culture over the years has tended to at least some of their columnary culture has focused on taking animals from the wild and preparing them for the table. And one of the things they eat is the civet cats, which are carnival, obviously. And when I compared the virus within humans with the virus that they got out of the civic cats in the live animal market, in that, in that town, they found that the civet cat virus is exactly identical, except it's a little bit longer. So what had happened was when the virus went across from civet cats, into humans, a bit of the virus genome dropped out and it hadn't gone the other way because otherwise this suspicion might've been well, we transferred it to the civic cats, but as, because a bit is lost, it means it must have gone that way.

Peter Doherty (25:07):

Okay. So somebody at one of those markets or, or one of the restaurants or something got infected with this virus just as a, as a chance thing, and that may have been happening for years, but it may not have spread very far because it turns out that the, the SARS virus is not that infectious. What really made it transmit so rapidly though, what happened was that coincided with the Chinese new year. And so there were massive numbers of people going home to visit their relatives and so forth, because this is the big family thing. It's like Thanksgiving in the U S or Christmas in Australia, and that spread it. And then the seem to be something that we still don't understand. There were a few, what we call super spreaders. One person seemed to spread it through at Hong Kong hotel in a way that was truly extraordinary.

Peter Doherty (25:52):

We still don't understand that fully. And that's how it got to Canada. But once we knew what the virus was and we started to understand it, and we started to understand how much it was, it was put out in the environment and when it's put out and we could get a test for it, then we found we could the public health people were able to deal with it quickly. By that time, a number of people had died, but not the enormous numbers of people that died that might've happened if it had just kept going. And if we didn't have the science to deal with it, and of course it was spread by rapid air travel. It went to Canada, it came down into Saigon and so forth from, from China. At first, the Chinese authorities weren't as open as they should have been about it, but later they handled it quite well.

Peter Doherty (26:31):

A nice set up massive hospitals, the quarantine people, we had massive quarantine. And what we'd always wondered is if a really serious disease came along in this part of the 20th century at the, of the 20th century, when people are so much more concerned with individual Liberty and individual self-determination, whether they would really accept the type of quarantine advice and so forth that would have had, would have had much more traction say in 1920 or something, right. People were living, you still living in a more distant and way in a sense. And people did. And the P the reason that people, it was because it was frightening and because people were scared. And so it was really the classical human fight and flight response. You're like, we reacted very, very quickly because we are a very immediate threat and everyone could see it, and everyone was frightened of it.

Peter Doherty (27:21):

The disease hasn't come back, it's a, we it's being watched, it's being monitored to see whether it will come back into the human population again. So far. It hasn't, it could, if it does, we'll deal with it much more quickly than the previous time what was unusual about it while everyone was thinking of it as a respiratory infection, but actually it wasn't being spread so much by the respiratory route as by oral fecal contamination, but hand to mouth spread. And it, and the virus survives for a very long time on surfaces. So if it was on a railing, for instance or, or, or whole railing or something like that, the virus will survive. And it's also, you get a lot of virus pushed out fairly late in the infection, like influenza, where it gets pushed out early on. And, and people with influence are very infectious early with SARS.

Peter Doherty (28:08):

They were infectious quite late. And a lot of the people that actually died from sizable medical professionals, because by the time they got into hospital from this infection, people were actually putting out a lot of virus and infecting a lot of other people. And so we've learned about the biology of the virus. And I think it really is a triumph of modern science and modern medicine, modern epidemiology, and so forth that we dealt with SaaS really in a matter of months, rather than a matter of years now, let's go on to that other grade in respiratory infection, which is influenza now influenza at the end of the first world, war influenza kills somewhere between 20 and 40 million people. It killed many more people than the first world war. And it was an absolutely catastrophic outbreak. Went all around the world. Australia did reasonably well out of it and got reasonably, got it reasonably late, but it killed a lot of Pacific Islanders.

Peter Doherty (28:58):

It killed people everywhere. It killed quite a lot of Australians, but not as badly as in some other places, the virus we knew it was influenza. We knew it was infectious. We tried all the quarantine things to stop

it. They didn't work except where the U S Navy had control of the quarantine, I think in Western Samoa. And they shut it up just the way the military would. And they actually did keep it out, but the democratic societies didn't do well with it. It spread. And we didn't even isolate the virus for another. I think it was another 14 years when it was transmitted the ferrets in, in England. And we first isolated the influenza virus. In fact, the great Australian biologist immunologists McFarland Burnett happened to be in the Institute where the experiment was done. And he, he remained, he describes his autobiography.

Peter Doherty (29:42):

One of the scientists rushing down the corridor, they transmitted the ferrets and, and the is rushed down the corridor, sharing out the ferrets, knees, the ferrets, and that was it. They transmitted the ferrets and then it went from there. They still actually study influencer and ferrets. It's still closer to human influencer than anything else. And so influenza massive problem, massive threat. As you know, it changes all the time. It changes because our immune systems put selective pressure on it and it changes it mutates to avoid our immune system. So the influence of virus, most of us have been contracting over the last 30 to 45 years is what's called a variant of the Hong Kong flu. Now, where did the Hong Kong influenza virus come from? It came from darks and it came across in the humans from ducks. So we've been suffering from duck flu for the last 30 years.

Peter Doherty (30:30):

Okay. And this is the big threat because now we have this, these very virulent H five, you will have heard H is just one of the spikes on the surface of the virus. The virus has two spikes, one called hemagglutinin one neuraminidase. These are what the antibodies would react against because they have to react against the surface structure of the virus to do any good. And the H five is just a description of the avian flu virus, which is highly lethal, kills birds in enormous numbers being widely spread by ducks. It's very high Tillys and ducks killing a lot of wild birds. When it does transmit to humans, it can be highly lethal in humans, but it hasn't started to transmit horizontally between humans. It's just been going from birds to humans, very little evidence that it's spreading between humans. What we're scared of is because of the way the influenza virus genome, because of the way its genetic materials organized.

Peter Doherty (31:24):

It's organized in eight separate little bits. And what we're scared of is that a human being is going to get infected with a human influence of ours or pig will get infected with the human influence of ours. And at the same time, I get infected with the bird influenza virus and those eight bits from those two viruses will reassort in various ways. And we get a virus now, which grows well in humans that has this H five characteristic of the bird virus. Then we could have a high spreading virus that would could devastate human populations if it retains the type of lethality that it has in birds. And so that's the big threat out there. So what do we do about it? Well, science again, we understand exactly what's happening. We can follow these viruses as they emerge exactly in terms of their changes in sequence and so forth.

Peter Doherty (32:10):

And so we've got very good monitoring, very good international situation, making a vaccine influenza vaccines work well, as long as you have the right vaccine, the trouble is the virus is changing all the time. We couldn't initially make that vaccine. The difficulty was the influence of virus. Vaccines are grown in embryonated Hinz eggs. It seems primitive, but that's the way they grow to the highest concentration. And the problem was the virus was, was so lethal that they killing the hands eggs before they made more virus. And that of course wouldn't work for a vaccine, what we can do now, and that the vaccine is

currently going through phase three trials. That's the final stage of trials in the United States is to make a vaccine whereby what we call reverse genetics. It's really a genetically modified organism and GMO where we can simply take one of the standard lab, vaccine strains, pop out one of its genes, pop in the bird, flu gene and make a new vaccine.

Peter Doherty (33:05):

The reason it has to be tested extensively is because it is a genetically modified organism and it will be the first such viral vaccine. It is. So we have a vaccine, whether we can get the right vaccines. The other question, we also have an antiviral drug, a drug called Tamiflu, which was they developed as a result of research that was done initially in in Melbourne it's it's targeting, it gets neuraminidase molecule. And it's what, one of the first examples of what we call rational drug design. It was solved by x-ray crystallography, or if we were doing it now, we'd use the synchrotron. The thing you may have heard of the Australia, the Victorian government is trying to get enough money out of the feds to finish it. The Victorian government is not loved by the federal government and they would rather just see it go down the tube and not have a synchrotron, but well, Adelaide probably doesn't love the Victorian government on there, but and anyway, well they're both labor governments.

Peter Doherty (34:00):

So so we do have, we do have a drug against the thing. Now the question is, is now as a logistics, if we had a mess of influence or outbreak influenza, unlike SAS spreads with enormous speed, modern air travel. And so with would spread it very, very rapidly indeed. And it'd go everywhere very fast. And if it's highly lethal virus we'll have, we'll have a lot of mortality and the vaccine, maybe the vaccine would be the right one. Maybe we'll have to make a slightly different one, but the problem will be getting enough vaccine out there quickly. That's a logistic problem and an economic problem as it is countries like Vietnam, Cambodia and so forth are not using the human vaccines anyway, which is one of the reasons why this virus might come out of that region. So vaccines are problem drug. Yes, we can buy the drug.

Peter Doherty (34:47):

And the Australian government has actually stockpile, quite a lot of drug. We don't know how much they won't talk about it. But that certainly it would certainly, it would probably cover the medical professionals. We don't know how much, how many more could be covered. The risk though is it's a single drug. The virus might be a tight and the drug may no longer work. So we don't know. So here we have a problem that we understand extremely well, scientifically. We understand extremely well, culturally everyone's aware of it, but in the end analysis, the problems are economic and logistic. And that's what we face with infectious disease. This is a constant battle. These are the three most prominent diseases over the last few years, new infectious diseases will come along. They do come along. New threats will come along, but that's something a little, a little at least about some of the scary monsters out there. I haven't, haven't scared you too much. Thank you. [inaudible]

Speaker 3 (35:53):

Thanks,

John McDougal (35:54):

Barry. If you put a new slate on my IVC every time I think about that now,

Peter Doherty (36:01):

IBC, abstinence be faithful. Use a condom. The other side says acknowledge human sexuality. Be realistic, use a condom.

John McDougal (36:13):

Okay. We've got just under 10 minutes left now with we'd like to take some questions for Peter, there's a microphone in the middle of the auditorium here, and one upstairs in the middle there people would put their hands up and move up to the microphone. We prepare questions and statements. I think you can stand or your local microphone.

Peter Doherty (36:35):

I think this works better than, okay. Yeah. Thanks.

John McDougal (36:38):

When you began your paper. So you spoke about the symbiosis that developed in the chimpanzee population between the aids virus and the chimpanzees over what sort of period does that symbiosis develop? It's obviously a Darwinian thing. Is it something that is foreseeable in humans and these are being hindered by the medical aid that's given to people? Well, I acknowledge that I would want treatment if I

Peter Doherty (37:01):

Had it. It's true. I mean that if we left it go long enough we could see that that evolution, I mean, we know that there are certain, there are some human beings that lack some of the receptors for the aids virus. And so they won't be infected. In fact, we had cases really early on where people who were in contact with who should have gotten it just didn't get aids. So it would be true that that selective effect would work, but you might lose 90% of the human population. And most people wouldn't think that was acceptable, but I mean, that's what would have happened over evolutionary time. And in fact various components of our immune response system over evolutionary time have certainly been shaped by infection. For instance, in the middle ages you can read of a third to a half the population of Europe dying by dying a play. And so that probably has shaped various components are very immune system. Unfortunately we don't know what they were like before, you know, it scientists would always like to have the control. We would have liked to have the people who were on Mars or something, but we don't have them.

Speaker 4 (38:15):

Okay. I'm mighty. I came from China and you were mentioning [inaudible] assess heavy, heavy the FEVS and USA. Some Chinese scientists, scientists said that leads a disease came came from enema. And can you tell why didn't the scientist, they find the clear evidence or is it disease as it is my first first question. And the other question is that most FITO fatal disease can come from anymore. So SSI scientist what we should reconsider the relationship between the human being and the animal is a two.

Peter Doherty (39:12):

Thank you. I, I'm not sure. I totally got your question that the Chinese scientists had, you know, there was some political problems in speaking out as freely as they might've initially, but I mean, the Chinese work was published and it was good work and there is a sophisticated increasingly sophisticated, epidemiological and scientific culture in China. In fact, you know, I've just been to China and you sort of

wonder whether the rest of us not going to be blown away in 20 years by what's happening in China. The second part of the question is the contact between animals and humans. Well, the animals that we've lived with for a long time, they, they can transmit infections to us. Toxoplasma worms, high data, and that sort of thing we're, we're aware of that. And the medical profession is variously aware of it and of course, deals with it.

Peter Doherty (40:04):

I mean, there are risks in, in, in this one of the risks that people worry about for instance is that people, we don't have enough organs for transplantation. So there's a very big, basic science effort going on, particularly in Boston, in fact, to to see if we can't engineer piggies. So that pig organs would actually be acceptable in humans. There are various reasons why they are not apart from any philosophical viewpoint or religious reservations you might have, but there are, there are good biological reasons. So one of the concerns is that we might get some hidden virus coming across from pigs into humans, which might be like, so as bad as aids. And so that's, that's a problem in the main we live reasonably well without animal things, but, but what happens usually is when people suddenly come into an area where they haven't been, I mean, another case of, of, of sort of human practice changing, if you like within the Korean war where there's a set of diseases called the hand of viruses, they're also in the Southern United States and in the Korean war where you suddenly had a lot of Caucasians sort of sleeping out and the Korean hillsides, they were breathing in what was really powdered excreta from the small mice that were carrying this virus.

Peter Doherty (41:20):

And you've got what we call Korean hemorrhagic fever. So this has been happening for many, many years and it is one of the problems. And for instance, one of the solutions in Thailand that they've used to try and minimize the risk of getting the H five virus across in humans is to get rid of the infected ducks. One of the things I've done in China is to shut down the live bird markets, which were also a very big risk. So we need to, to change our cultural practices at times to counter these infections also, you know, there are many infections out there where we could make vaccines and we don't for economic reasons. One is Murray valley encephalitis virus, which sometimes comes down into Victoria, carried by birds. And then my mosquitoes, we could make a vaccine against that, but the numbers of cases is so small that we haven't done that.

Speaker 4 (42:13):

Yeah. can I I was very interested to hear you say that viruses can't live very long in the atmosphere at large, but they can survive much longer if they can rest on a surface, such as a railing.

Peter Doherty (42:32):

It depends often the virus, sorry, often the virus is not surviving just as a, an isolated naked virus particle. It's often either within cells that have been shed or it's in mucus and so forth. And so that provides a sort of protection for it. Some viruses are much more resilient than others. Influenza virus is not particularly resilient, but say foot and mouth disease virus is. And so often though it's surviving in tissues or in some sort of extruded material they can't replicate that they can survive that it varies a lot for different viruses. And of course we will disinfect and so forth. Yeah.

Speaker 5 (43:12):

One more, one more question. Thank you. Do you, do you think that global warming, like the warming of the Earth's atmosphere and so forth will bring forth more viruses as we've seen with the bowl are coming when they environment is damaged or invited, it comes out from its natural environment.

Peter Doherty (43:35):

I think what you're bringing up is one of the things that we really face in the 21st century, I think we're starting to deal with much more effective than we have, and that's the idea of very complex systems. And so part of the global warming thing could be an increase in infectious disease of various types. One of the reasons for that would be so as, as things as if the world gets warmer, then we will get a lot more mosquito-borne disease moving out of the tropics into the subtropical areas. And that's sort of the, sort of, there are border lines. For instance, Queensland gets a times, gets dinghy outbreaks, these mosquito borne infections. But if things get a lot warmer than that would move south, and what we'd also Matt start to see is hemorrhagic Dangy, which is a multiple daily infection in the north of Australia, which we've never seen.

Peter Doherty (44:26):

So this is a very real concern that we will actually change the balance of it, of course, a classical case of of a mosquito borne virus getting suddenly appearing in human populations was the west Navarez that suddenly appeared in the United States. And as now a major virus infection in the United States, and it came in from somewhere. I don't think we really know where a bird born mosquito born carried in birds transmitted by mosquitoes. Yeah. So I think mosquito insect borne viruses will certainly move out of the tropics as the tropics move out of the tropics.

Speaker 5 (45:00):

And do you see beauty in virus, like in particular aids far the way it can hide itself?

Peter Doherty (45:12):

It's a very tricky virus. I mean, you know, the way a lot of viruses we're talking about are what are called RNA viruses and they have very poor fidelity of copying. And so they can, they can mutate and change very, very rapidly. And so they're, they're very extremely dangerous. I mean, if it, no, if some, in some people deny the reality of evolution, you can never deny the reality of evolution within say viruses Ms. Influenza and so forth because they changed that fast because most people who are upset about evolution and upset about that, they're upset about, about the thoughts about human evolution. Thank you very much, Peter.

Speaker 3 (46:13):

[Inaudible]

John McDougal (46:13):

Peter, Peter's very shy, but he might mention that in August or late August, September, he has a book coming out the beginner's guide to winning a Nobel prize. So I suspect there's a several hundred Nobel prize. That's going to be coming out of this later. Thank you very much, professor [inaudible].