DAAN VERWOERD

AWARDS, HONOURS AND ACHIEVEMENTS

- MT Steyn Award from the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (2004)
- Honorary Doctorate from the University of Pretoria (UP) (2000)
- Gold Medal of the South African Veterinary Association (1985)

DEFINING MOMENT

Spending time in Germany in order to bring back to South Africa the scientific tool now known as biotechnology. "I think it is extremely important to go to international laboratories because of the contact you have with other scientists, and the increased exposure to new ideas."

WHAT PEOPLE MIGHT NOT KNOW

He is a recognised orchid grower. "My favourite orchid is the Phalaenopsis or moth orchid. I have a small collection; I still grow them and still love them. I try to grow South African orchids too."

SOLVING SOUTH AFRICA'S FIRST MOLECULAR MYSTERIES

In the 1800s, South African sheep farmers observed a strange shortness of breath in their animals, as if they had been in a chase. They called the condition *jaagsiekte* (chasing illness), and over the next century veterinarians noted that it was a type of contagious lung cancer. When Daan Verwoerd came across this piece of history in the 1980s, he realised the cause of the disease was still a mystery. He suspected it could be a virus and made it his mission to prove as much.

"It was known at that time that viruses caused some types of cancers, but only in mice, rats and poultry. I wanted to know if there were models for larger animals, like sheep, that were economically important," recalls Verwoerd, the man who established South Africa's first molecular biology research group at the famous Onderstepoort Veterinary Institute in 1963.

All attempts to isolate the virus in laboratory cell cultures failed, so his group had to use infected sheep for this purpose. Many of the known cancers in smaller animals at the time were caused by a retrovirus (a virus that uses ribonucleic acid, RNA, as genetic material rather than DNA), and Verwoerd's group was able to isolate a retrovirus from the lungs of the infected sheep. They also injected material from the lungs of adult sheep who showed signs of the disease into newborn lambs and other adult sheep.

"We realised the sheep were only susceptible to infection when they were very young – 100% transmission of the disease was observed in newborns. This told us older sheep may be protected by the immune system, which is not yet fully developed in newborns," he explains.

But even in infected adult sheep, his team could not find an immune response in the form of antibodies against the virus – again very strange. The answer came when they were able to sequence the full genome of the retrovirus. "We made the astonishing discovery that 70% of the viral sequence was also found in the genomes of normal sheep," says Verwoerd. This was the first time a full genome sequence was achieved for any organism in South Africa.

"We started testing sheep all over the place, in Europe, Africa and Australia, which didn't even have the disease, but all the material proved the same thing. All sheep cells contain an abbreviated copy of the viral genome." This explained why there was no immune response – the sheep's immune system does not recognise the virus as a foreign invader, because it looks like its own DNA. "This was bad news for the goal of developing a vaccine, and today the recommended advice to farmers is still to isolate newborn lambs for the first couple of months to prevent infection while their immune systems develop," he says.

CHOOSING FOR THE SAKE OF SCIENCE

Being able to solve such mysteries using basic science was the reason Verwoerd chose veterinary science as a young adult. "It wasn't because of a passion for animals or disease; I wasn't really interested in the clinical side or in diagnostics, but in the science behind it. In today's terms, I was interested in what we'd call microbiology or biochemistry."

Verwoerd joined Onderstepoort as a researcher in 1955 after qualifying as a veterinarian at the UP. He soon realised his training was not specific enough for the research he wanted to do, so he completed an MSc in biochemistry

at the same university. During this time one of his seniors had asked for his help in preparing for a talk on the discovery of the DNA double helix. "That started me off on the structure and function of DNA. I realised this really is the future," he says.

Verwoerd left for Germany, to learn what he could from biochemistry institutes that were home to Nobel Prize winners and other pioneers in the field. "I had to do something applicable to veterinary science, so I thought it would be best to focus on viruses," he says. "I needed a practical approach to make this work acceptable to authorities in South Africa." Viruses indeed proved very important in animal diseases in South Africa, and Verwoerd was able to set up his basic science research group to support the clinical expertise at Onderstepoort.

The very first mystery solved by the group was why a vaccine against bluetongue, a disease that had been causing losses in the sheep and wool industry, sometimes worked and other times not. Verwoerd's team successfully isolated the virus, and in doing so were one of the first teams in the word to isolate a virus with double-stranded RNA. "It was known that some viruses had RNA while others had DNA, but at that time RNA viruses were considered to only have a single strand," explains Verwoerd.

When they looked deeper into the structure of the RNA, they found that each of ten segments coded for a protein – something quite uncommon and unique. But the key to unlocking the mystery of why the primitive vaccine didn't always work was that bluetongue is not caused by a single virus strain but rather by a population of different strains. "The vaccine was for only one strain," explains Verwoerd, "so it would not protect against the other strains. This opened up a totally new approach to vaccines."

Verwoerd's work supported the development of combination vaccines by genetically identifying the various viral strains present, and the very same science was applied to help combat African horse sickness. It was after solving the bluetongue puzzle that Verwoerd tackled the *jaagsiekte* conundrum, all the while working his way up to becoming the Director of Onderstepoort through most of the 1990s. In 1994, he was also one of the founding Members of the Academy of Science of South Africa (ASSAf).

In 2002, he was recalled from a brief retirement to serve where his academic career began: the Faculty of Veterinary Science at UP. "The faculty had to improve its research output under difficult conditions, and they felt they didn't have the expertise," says Verwoerd, "so they asked me if I would join them as research coordinator, to boost research capacity separate from the student training."

Under his leadership the faculty acquired substantial funding, research output went up and new infrastructure was established. "It is difficult to measure, but I do think I made a positive contribution," he humbly admits. But he confidently asserts that he was never worried about the gamble he took to bring molecular biology to South Africa: "I always knew that basic research would yield great results."

Academy of Science of South Africa (ASSAf)

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