HONORARY GRADUATE

Aaron Klug

Aaron Klug was born in Zelvas, Lithuania on 11 August 1926. Some of his family had been settled in South Africa since the turn of the century, and he came with his parents to this country as a child of two. He was educated at Durban High School, where the standards were so high that many of their better pupils found their way to our own university. The young man's interest had already been turned towards medicine by reading Paul de Kruif's fine piece of popular science, *Microbe Hunters*. He entered our medical faculty in 1942, but in his second year did not acquire the enthusiasm for gross anatomy which Raymond Dart instilled into so many bright medical students. His interest in biology on the microscopic scale led him to transfer to the Faculty of Science, in which he graduated in 1945 with three majors, mathematics, physics and chemistry. The leading physicist in South Africa was R W James of the University of Cape Town, and so Aaron Klug moved to Cape Town in 1946. He seems to have escaped the tiresome formality of taking an honours degree, and graduated MSc of the University of Cape Town at the end of the same year. He had as a fellow student in Cape Town a future Nobel Laureate in Physiology or Medicine, Allan Cormack. James was a great teacher, and an administrator who later acted as Vice-Chancellor of his university, but he was best known as a distinguished crystallographer, a pupil of Sir Lawrence Bragg's. It was in Cape Town that James completed his classical book, *The Optical Principles of the Diffraction of X-rays*. The young Klug helped James check the proofs of this book, and so laid the foundations of his own later contributions to diffraction theory.

Klug taught physics in the University of Cape Town for a couple of years; then, in 1949, supported by two South African degrees and a South African wife, he went to Cambridge to take a PhD. Here he suffered what at the time must have seemed a setback. The small but very distinguished Medical Research Council Unit in which he hoped to work with Perutz and Kendrew had no vacancies. Now Aaron Klug is joint head of one of its divisions, and its director is another of our graduates, Sydney Brenner. Even Klug's second choice, to work with Bragg on the crystallography of alloys, was not available. He found himself working under D R Hartree, a pioneer of computing, and, in his own words, 'I learned a good deal in this period, particularly in computing and solid state physics'. After taking his PhD in 1952, he spent a year applying the mathematical methods he had learned to a problem in biophysics. Only at the end of 1952, when he was 27 years old, did Aaron Klug manage to join a group working on what had been his latent interest for so long, the microstructure of biological objects. He joined J D Bernal's laboratory in Birkbeck College, London, and soon found himself working alongside Rosalind Franklin on the structure of tobacco mosaic virus.

Only a specialist would know why it should be profitable to study tobacco mosaic virus rather than bushy stunt virus, Coxsackie B virus or the dreaded polio virus on which Dr Klug did in fact make important observations, but this particular virus occupied most of his time from 1953 until the late 1970s. It is a long rodlike helical staircase of protein into which a thin strand of genetic material is cunningly threaded. When the helical staircase is broken down and then reassembled, the assembly may go all the way to the long staircase, or may stop at the stage of a set of two-turn helices which Klug calls lock-washers. Disturbingly, instead of two turns of staircase, one sometimes finds flat two-layer discs, and these two-layer discs may stack to form a sort of factory chimney without a staircase. A less determined man would have dis-

missed these structures as aberrations. Klug and his colleagues showed that they played an essential role in the assembly of the active virus. Looking back on this work, he has said: 'A most intricate structural mechanism has been evolved to give the assembly an efficiency and purposefulness whose basis we now understand. The general moral of all this is that not merely does nature once again confound our obvious preconceptions, but it has left enough clues for us to be able to puzzle out finally what is happening.'

At the same time as the work on tobacco mosaic virus was going on, Klug was studying other viruses. A major problem was that when one looks at a hollow tubular virus in the electron microscope one sees right through it, the image of the far side being superposed on that of the near side. Using the optical principles of diffraction which he had learned from James and developed further, Klug was able to select either of the images at will. Later, he devised a method for reconstructing the whole structure of a transparent three-dimensional object from a set of projections. It is essentially the same method as is used in the CAT scanner which is based on Cormack's work at the University of Cape Town, but Klug added many ingenious devices in which he exploited the symmetry of the viruses he was studying.

Dr Klug's latest contribution - and one suspects that history will decide it to be his greatest - has been his elucidation of the structure of the genetic material of higher organisms. The programme of our life is written on tapes several centimetres long. One can imagine that if these tapes lay loose in the nucleus of each cell they would become inextricably tangled. Instead, each one is neatly packaged into a necklace in which the beads are set alternately on one side and the other of the string. Each bead is a little ball of protein around which is wrapped a length of tape carrying 166 pieces of genetic information; the string itself is a chain of molecules of another protein. It is given to few men to combine the knowledge of physics, chemistry and biology which was necessary to solve this problem, and to add to these a great tenacity of purpose. Withal, Aaron Klug is the most modest of men.

Aaron Klug has received many distinctions. Among them has been his election as a Fellow of the Royal Society of London in 1969. He has been awarded several honorary degrees.

It is fitting to conclude by quoting the words which Dr Klug addressed to the King and Queen of Sweden when he received the Nobel Prize for Chemistry in 1982: 'In these days, when there are constant calls for research devoted to particular ends - and I do not wish to minimize the importance of these policies - yet there should always be left room for apparently unguided research on problems that seem to have no practical application at the time. One cannot plan for the unexpected. Human curiosity, the urge to know, is a powerful force and is perhaps the best secret weapon of all in the struggle to unravel the workings of the natural world.'

Aaron Klug is the first graduate of this university to receive a Nobel Prize. In seeking to honour a man of such distinction, with his superb breadth and depth of knowledge, his dedication and his inspiration, by the award of the degree of Doctor of Science, *honoris causa*, the University of the Witwatersrand feels a deep sense of pride and of honour to itself.