Growing up with David…

David J. Woodhams

It may come as a surprise to some people that I first met David at church. David, I take it for granted that now you would call yourself an atheist but I wanted to make the point that you are not *just* an atheist, you are a *Methodist* atheist, than which there are none better. We first met in March 1957at a function for first-year university students at the Durham Street Methodist Church in Christchurch, which we both attended.

Not only do we almost share a birthday (I turned 70 myself last Sunday) but we also share a biblical name, David, which seemed to be very popular in 1938. The biblical David had a reputation both as a shepherd and as a giant killer and, looking at David's flock gathered in the fold here this evening, I can see that his sheep-herding attributes are more than adequate. When I consider his classical 1982 paper applying Karl Popper's criteria to the theory of evolution, I know that, in confronting the creationist myth, like his biblical namesake, he has also confronted Goliath. The biblical David also had something of a reputation for running round with other people's wives but I have no evidence of David's proclivities in this arena. When I look at my own career I can also see traces of both the shepherd and the giant killer, although my giant, like David's, refuses to admit that it's dead.

Coincidentally, in our primary school years, at about 11 years old, both David and I headed our classes at our respective schools in scriptural knowledge. David has a framed certificate to show for it while somewhere in my library there is a book prize that recognises my achievement. Apparently we also shared the experience of delivering milk in 20 gallon cans to a Taranaki cheese factory by horse and dray and returning to feed the by-product cheese whey to the pigs

During our time together at Canterbury University (1957 to 1960), we saw each other often and double-dated on a number of occasions. As I recall we were members of both the Student Christian Movement, SCM, and the Socratic Society, or Soc Soc, a sort of SCM for atheists. The discussions and lines of argument in both groups were very similar and there was a substantial cross-over of membership between the two. Among our Soc Soc friends was the late Professor Beatrice Hill Tinsley, of whom more later.

In 1960, David left for Yale and I didn't see him again until 1966, the year I started postgraduate study at the University of Wisconsin. That first Easter, my wife Natalie Merle and I, with two small boys, drove to Toronto and on Good Friday we stopped off in Hamilton, Ontario, where David was doing post-doctoral work, to catch up with him and his new wife, Pauline. When we returned to Palmerston North in 1970 we found David and Pauline both teaching at Massey and renewed our acquaintance. Our children all went to College Street Normal School and, being much of an age, they knew each other well. Then, in 1975, when Natalie Merle and I moved to Dargaville, transferring new technology to the first dairy manufacturing site in the world to produce instant whole milk powder commercially, we sold our house to David and Pauline by private treaty. Over the next few years we visited them frequently, whenever we returned to Palmerston North for a dairy conference. The contact does not end there but I will return to it later.

David Woodhams is a retired process engineering consultant and food technologist, having previously worked for Fonterra, New Zealand's largest multinational dairy company. Dr Woodhams and his wife Merle are now in partnership in an export floriculture venture on the south Wairarapa coast.

So I have known David for just over 50 years. As I prepared for this talk I wondered if there was any other period of time in history in which I would have preferred to live – a big 'What If'? The only period that stood out as a possibility for me was 1870 to 1940. David, what if we had turned 70 in November 1938 rather than November 2008? We would have been at university in the late 1880s and, at age 46 in 1914, perhaps we would have been spared the Gallipoli landings and the trenches in France. What a time we would have seen! Surely this was the golden age of physics, chemistry and astronomy and the dawn of a golden age in the biological sciences. This was the time of some of the giants on whose shoulders we stand.

If we had been born in 1868, the preceding decade would have seen Charles Darwin publish *The Origin of Species* (1859), Louis Pasteur refute the theory of the spontaneous generation of life (1860), Gregor Mendel formulate the laws of inheritance (1865), Julius von Sachs reveal the role of chlorophyll in photosynthesis (1865), and August Kekulé determine the structural formula of benzene (1865).

By the time we graduated in 1889 we would have known that Dmitri Mendeleev had published the Periodic Table of the Elements (1869), Frederick Miescher had discovered DNA, although not its function (1869), Charles Darwin had published *The Descent of Man* (1872), James Clerk Maxwell had published his *Treatise on Electricity and Magnetism* (1873) and Michelson and Morley had demonstrated the constancy of the speed of light (1887).

During our working careers in the next 50 years we would have been aware when Joseph Thompson discovered the electron (1896), when Max Planck gave birth to quantum mechanics, the beginning of modern physics (1900), when Albert Einstein published on the photoelectric effect, the quantisation of the radiation field, and the special theory of relativity (1905), and the general theory of relativity (1916), when Ernest Rutherford discovered alpha and beta decay of radioactive substances (1898), demonstrated the existence of the atomic nucleus (1911) and transmuted nitrogen to oxygen (1917), when Henry Moseley gave the periodic table a firm foundation in atomic number rather than atomic weight (1913), when Harlow Shapley determined the size of our galaxy and placed the sun 50 000 light years from the galactic centre (1918), when Edwin Hubble determined that the Andromeda nebula was in fact outside our own galaxy (1924) and established Hubble's Law describing the expanding universe (1929). This tiny summary of the period omits the formidable contributions of Erwin Schrödinger, Louis de

Broglie, Wolfgang Pauli, Werner Heisenberg, James Chadwick and other outstanding scientists of the time. These were exciting times indeed for our grandparents' generation.

David, standing on the shoulders of these giants, what a marvellous time it has been for us during the last 70 years to be alive and to be scientists! I remember when I congratulated you on being awarded the Rutherford Medal you wryly recalled Rutherford's opinion that physics was the only true science and all the rest was stamp collecting, but even stamp collecting has its rewards.

Born as we were in late 1938, we got off to a bad start. Before we were a year old, the world was at war. When we were six, nuclear bombs were dropped on Hiroshima and Nagasaki and the nuclear age was born. But better was to come.

Cosmology, building on strong foundations laid in the 1920's, has progressed amazingly during our lifetime. In 1946, from the theoretical framework of the Big-Bang model, George Gamow predicted the existence of a thermal background radiation and estimated its temperature as 5°K. In 1965 Arno Penzias and Robert Wilson at Bell Labs detected a 3°K microwave signal that confirmed the Big-Bang theory of the origin of the expanding universe and consigned the Bondi/Gold/Hoyle Steady State theory to history. Given that, in the absence of evidence, I was inclined to prefer the Steady State theory on philosophical grounds, I remember vividly hearing the news on the car radio as I travelled between Hawera and Palmerston North. Nevertheless, I cannot recall having any difficulty with the paradigm shift once the evidence was in. It is interesting that, in attempting to provide the unsound Steady State hypothesis with a sound theoretical basis, Fred Hoyle was largely responsible for working out how the elements were synthesised in stars and in supernovae rather than in the initial cosmic egg. This is the work for which Hoyle is acknowledged most among professional cosmologists.

Once the genesis of the observable universe was resolved, the most important outstanding cosmological question was whether or not the universe was closed. Allan Sandage at Mt Wilson Observatory spent a lifetime trying to measure the distance to and recession velocity of more and more distant galaxies in order to resolve the question. In 1974, the New Zealand astrophysicist and our good friend Beatrice Hill Tinsley, with Jim Gunn, Richard Gott, and David Schramm, mustered a variety of arguments to suggest strongly that the density of the universe is no more than 10% of the value needed for closure; in other words they predicted that the universe will continue to expand forever against gravitational resistance. In a later paper, in 1975, Jim Gunn and Beatrice Tinsley predicted an accelerating universe; recent observations (1998) confirm this prediction.

The science of genetics has seen similar huge advances as theory and technology progressed in step. It was in 1953, when David and I were still in high school, that Frederick Sanger at Cambridge culminated eight years of work by publishing the amino acid sequence of the two chains of insulin, the first protein to be so defined. In the same year, James Watson and Francis Crick, with the assistance of Maurice Wilkins and the data of Rosalind Franklin, deduced and published the double helix structure of DNA. In 1956, Vernon Ingram identified the substitution of valine for glutamic acid at position 6 in the β-haemoglobin chain as the cause of sickle-cell anaemia, brought about by a single nucleotide mutation. Starting in 1961 with the work of Marshall Nirenberg, and ending in 1968, the year David and I turned 30, the amino acid equivalents of the three-nucleotide base codons on messenger RNA were finally determined. Mitochondrial DNA was discovered in 1966 but it wasn't until 1985 that Kary Mullis developed the polymerase chain reaction (PCR), the 'genetic equivalent of a printing press'.

I came to appreciate this technique myself in the last project I managed for the New Zealand Dairy Board, later Fonterra, where we were concerned with the various species and strains of thermophilic bacteria that grow in milk evaporators at temperatures between 45° and 75°C. We were intrigued to find that the four strains of *Bacillus* isolated from canned milk powder which had been abandoned in Antarctica after Shackleton's 1908 expedition, were apparently genetically identical to four of the seven strains that were found to be endemic in both New Zealand and Australian milk powder factories in the late 1990s and early 2000s. I feel sure the PCR technique has vastly simplified experimental work in phylogenetics.

Nevertheless, it was in 1982, three years earlier, that David and his co-workers, relying on DNA base sequences derived from amino acid sequences, published their classic paper testing predictions from Darwinian theory. While it is a quarter of a century ago now, and I'm sure that David has achieved many goals since then, that paper in *Nature* appeared to me as a peak performance.

I have had a couple of firsts myself, but hardly on the scale exhibited by my good friends, David Penny and Beatrice Tinsley. In 1970, by being in the right place at the right time, I was instrumental in bringing the new process of ultrafiltration to New Zealand. This is a membrane process that permits the separation, on a commercial scale, of proteins from sugars and minerals on the basis of molecular size. Now applied throughout the country, it has deprived the pigs of the whey that David and I once fed them and now returns several hundred million dollars annually to the dairy industry.

Whenever I am tempted to take pride in my own intelligence, I can always be humbled by remembering the attainments of those two student friends, David Penny and Beatrice Hill Tinsley. David has had a good deal of attention today so I'd like to speak for just a moment about Beetle, as Beatrice was known to all her friends. Quoting from the most recent issue of the Canterbury University alumni magazine:

> *In her tragically short lifetime astronomer Beatrice Hill Tinsley (1941 to 1981) achieved extraordinary things. Her PhD thesis, Evolution of galaxies and its significance for cosmology, on the evolution of the stars and gas in galaxies, is acknowledged as one of the great scientific papers of the last century. ... After Ernest, Lord Rutherford, Tinsley is one of Canterbury's most distinguished science graduates. She is credited with opening up a new branch of science with her work on the origin of galaxies and the Universe. When at the age of 40 she died of cancer, she had already become a professor of astronomy at Yale University. ...Her life story is documented in the biography Bright Star, Beatrice Hill Tinsley, Astronomer (2006), by Christine Cole Catley*. (*Canterbury 5(2)*, Summer 2008, p. 28)

I thoroughly recommend that biography, to everyone present, but particularly to any women scientists. It was on Beetle's recommendation back in 1959 that I read Fred Hoyle's seminal text '*Frontiers of Astronomy*' (Heinemann, 1955) and gained a lifelong interest in astronomy and astrophysics. Whether this interest led to my son Michael taking up astrophysics or not cannot be determined; he is an uncontrolled experiment.

I recall a very pleasant weekend that David and I spent at the University Students Association's hut at Arthur's Pass as part of a Soc Soc weekend. Beetle, and Brian Tinsley her future husband, were also there. Beetle was on cooking on Sunday evening. A small accident with the Primus resulted in the peas being tainted with kerosene. Over the years it is the taste of the peas rather than the flavour of the discussions that remains in my memory!

Beetle and Brian moved to Dallas, Texas, and Beetle wrote her PhD thesis at the University of Texas in Austin. In her first academic appointment, in 1972, she worked for three months at Caltech in Pasadena, particularly with Jim Gunn who was a close friend and colleague to the end of her life. Later she was offered an 18-month appointment at the University of Maryland but took up only six months. It was during this period that she took on a graduate student, Jill Knapp, who later wrote of Beatrice: 'I think she was the first great person we students had ever seen in action'. Jill also remained a close friend throughout her life. In 1975, Beatrice was appointed Associate Professor in the Astronomy Department at Yale University, where she had a meteoric career, cut tragically short when she died of melanoma in 1981 at the age of 40.

In 1982, Jim Gunn and Jill Knapp married and both got positions in the Princeton Astrophysics Department. In 1989, my son Michael, having completed a Masters degree in physics at Auckland University, studying the supernova SN1987A, was admitted to the PhD programme in astrophysics at Princeton University. His thesis supervisor was Jill Knapp. To complete the circle, in 2003 Michael was appointed to a three-year post-doctoral fellowship at the Allan Wilson Centre, working for Beatrice's and my old and very good friend, David Penny.

David, as I wish you a happy birthday and many more to come, allow me to offer you some advice as a long-standing food technologist:

Forget about organics and all that stuff about fresh and natural foods: at our age we need all the preservatives we can get!