

CENTREFOLD



Bruce Weir

Bruce Weir is one of New Zealand's most valuable exports. Bruce is now William Neal Reynolds Distinguished Professor of Statistics and Genetics and Head of the Bioinformatics Research Center at North Carolina State University in Raleigh. In addition to an extensive and deserved reputation in the fields of genetics and statistics he has also made a central contribution to my own field of Forensic Science. His CV containing seven books, four named lectures, 19 PhD and 13 postdoctoral students, 143 refereed papers, nine editorial positions, 26 articles of correspondence, six encyclopedia entries, and a host of honours including being elected to an honorary FRSNZ in 1998 and a fellow of the American Statistical Society in 1999, does not do justice to his contribution to several fields of scientific endeavour. For non-statisticians, the OJ Simpson case is perhaps what Bruce is most famous for. However, it is but one highlight in Bruce's multifaceted career. What was his path from Christchurch New Zealand, to the Superior Court in the County of Los Angeles to testify in the Simpson case?

Bruce will be 60 on New Years Eve, 2003. It's always easy for me to remember his birthday. His slim frame is still fully capable of disarming a robber who went for his wallet and he's walked me into the ground more than once. We have travelled the world together lecturing and I'm always the first to fade while he is still teaching or working.

He is the eldest child of the late Gordon and Peg Weir. His mother, aged 83, two sisters and a brother all still live in New Zealand. He was a foundation pupil of Shirley Boys' High School and attributes some of his success to the headmaster, Charles Gallagher, who spotted his potential and encouraged him to pursue further study. He went to University of Canterbury, graduating with a BSc (with first class honours in Mathematics) in 1965. After stints working on rubbish trucks and painting walls in local hospitals he obtained a summer internship with the Applied Mathematics Division of the DSIR working with Brian Hayman. Prior to his internship Bruce had concentrated solely on mathematics and was completely ignorant of genetics. Recall that this is time in the history of genetics when greats like R.A. Fisher, S. Wright, J.B. Haldane, J. Crow and M. Kimura were active. Brian's asking him to read the book "Genetics" by H. Kalmus began the great synergy of mathematics and genetics that has shaped the rest of Bruce's career.

After graduation from Canterbury he worked for eight months at the DSIR in Wellington and then following Brian Hayman's suggestion went to North Carolina State University to pursue his PhD in statistics with a minor in genetics under Clark Cockerham. The chance to study with one of the greats of our time was an opportunity that Bruce did not waste, beginning a partnership that was to last 30 years ending only with Dr Cockerham's death. Bruce asserts that he has been blessed by being allowed to use his love of mathematics and statistics in an area that is endlessly fascinating.

After receiving his PhD Bruce spent a postdoctoral year followed at University of California, Davis working with Bob Allard. Bruce returned to New Zealand in 1970 as a senior lecturer and later reader at Massey. During this time Bruce or maybe his fancy car, a 1966 green-blue Mustang, caught Beth's eye, leading to marriage and a life long friendship that is still obvious to even the most casual observer. Beth is herself a respected academic with interests in the theory and practice of early reading teaching. Bruce and Beth's two children, Claudia Beth in 1973 and Henry Bruce in 1975 were born during the seven years the Weirs spent at Massey. Henry was a month old when the family returned to North Carolina in 1976 to continue Bruce's work with Clark Cockerham. New Zealand nearly lured Henry back with the promise of the outdoor life, but both children are now firmly ensconced in the United States.

Starting with his PhD thesis, Bruce's early work was mostly concerned with the formulation of the genetic relationship between individuals in diverse populations at multiple loci. Working with his mentor, Clark Cockerham,

he formulated identity by descent measures at two linked genes between individuals under many differing situations. These included a consideration of inbreeding, selection, and overlapping populations. He also considered sib-ships and other pedigrees, mixed self and random mating populations; and reciprocal crosses. This pioneering work laid the rigorous foundation to characterise the relationship and inheritance of multiple genes with linkage, inbreeding and selection in diverse populations.

“One of Bruce Weir’s enduring contributions to statistical genetics is his monumental work on the elaboration of descent measure theory. This theory provides the mathematical tools for following the transmission of genes and pairs of genes through multiple generations. These tools can then be applied to solving a wide variety of problems ranging from analysis of the dynamical behaviour of linkage disequilibria in mixed mating systems, to the estimation of effective recombination rates between genes based on population data, to the dissection of complex traits.” Michael Clegg, Presidential Chair and Distinguished Professor of Genetics, University of California at Riverside.

Bruce then shifted his attention to constructing statistical methodology to infer genetic relationship measures, such as linkage disequilibrium (LD). He provided the statistical framework for inferring the complete LD structure between two loci based on genotypic data and also examined the sampling properties of LD statistics. At this time he published a seminal in LD analysis. This line of work provided critical foundation theory for disease gene mapping research. Bruce Weir and his colleagues developed the statistical methodology to infer linkage between molecular markers and disease genes to test and estimate the genomic location of disease genes. These statistical methods have been widely used in the scientific community and directly applied by him and his collaborators to successfully locate cystic fibrosis genes and a longevity gene in humans.

“Bruce Weir has made central contributions to the statistical methodology for complex trait analysis through his painstaking work on the theoretical calculation of genetic variance components in the presence of genetic linkage and finite population size.” Michael Clegg.

“He [Bruce Weir] has pioneered the localization of human disease genes through new statistical procedures.” Major Goodman, William Neal Reynolds and Distinguished University, Professor of Crop Science, Statistics and Genetics, North Carolina State University.

Bruce Weir’s work on genetic relationship measures is closely related to the study of population genetic structures, i.e. the structure and level of differentiation and relatedness among individuals in structured populations. Sewall Wright in 1951 proposed a set of statistics, called F -statistics, to characterise population structures. It was Weir and Cockerham in 1984 who unified the statistical methods for estimating F -statistics. This paper is a citation classic in population genetics and forensic science with a staggering 1,676 citations—so far! Bruce’s papers include the two most authoritative reviews of research progress in the study of population structures in human and other species.

“Among his basic work he [Bruce Weir] has, in particular, developed methods which have been and continue to be widely used world-wide for studying the differentiation among populations, including groups and populations of animals and plants in nature, livestock breeds, and local populations of humans.” W.G. Hill, FRS, Professor of Animal Genetics, Formerly Dean of the Faculty of Science and Engineering, The University of Edinburgh.

Much of his research is summarised in his definitive book “Genetic Data Analysis” which has gone through two editions and has been translated into Russian and Chinese. The third edition is about to appear.

Bruce Weir’s contributions in the use of DNA profiling for personal identification in forensic science are many fold. He brought his sharp mind and a body of statistical and genetic knowledge to a field that had been overpopulated by diligent scientists without these backgrounds. He led the effort to correct the erroneous sections in the first National Research Council (NRC) report on DNA methods in forensic science, 1991. The second NRC report, 1996, shows the results of this effort and completely adopted his methods and views. The 1998 book, *Interpreting DNA evidence* jointly authored with Ian Evett (retired recently) from the United Kingdom Forensic Science Service, which is now considered the field text for forensic caseworkers, lawyers, judges and statisticians involved in DNA interpretation. He is truly a giant and guiding light in this field. I would consider him to have made the single largest contribution to this science of any person working in the last few decades. This is a view that would be shared by many other forensic scientists.

“Dr Weir has worked tirelessly to establish valid scientific foundations for assessment of forensic DNA evidence, and to educate forensic scientists and the wider community. In this controversial arena, he is almost unique in his steadfast adherence to the highest standards of scientific professionalism. He has established a unique position as a true expert in this field and has retained the respect of collaborators and adversaries alike.” Elizabeth Thompson, Professor of Statistics and Biostatistics, University of Washington.

So I come to the OJ Simpson case. At that time (1995) I was in the United States working for Bruce on general theoretical issues in forensic science. We had analysed some of the data in the trial but the real reason that Bruce was chosen as an expert witness was his reputation for scholarly impartiality and the fact that we were the only people in

the United States working on likelihood ratios for mixed DNA profiles. The 54 page report, the testimony and the result are all public record. Much can be said about the trial but I record my opinion that Bruce set a standard for scholarly interpretation of evidence that has yet to be equalled. More, however, he set a standard for the behaviour of witnesses that will be a lesson for forensic scientists for decades.

Bruce is an educator and visionary leader and one would suspect that his greatest achievements may yet to be seen as both he and his students continue the work. He is known throughout the world as not only a prolific researcher, but a generous and innovative educator as well. He has also established several highly successful research and training endeavours including the NCSU Summer Institute in Statistical Genetics and Web-based Courses.

“Dr Weir has also excelled as an educator. The statistical genetics group at N.C. State is one of the foremost groups of its kind in the world, and much of that is due to Dr Weir. ... One of the unique aspects of the statistical genetics program is the interaction with the Genetics department.” Norman Kaplan, Mathematical Statistician, National Institute of Environmental Health Sciences.

“Bruce was a very supportive supervisor, from the time I made enquiries, through choosing PhD committees, courses, thesis topic, to writing up and defending the thesis. In addition to course requirements, he also got me involved in critiquing scientific writing and being exposed to practical aspects of data analyses which have been invaluable in my career.” Ken Dodds, Agresearch, graduate student of Bruce Weir, 1984-1986.

These pages do not do justice to a career which I hope has yet to reach its zenith. But they are completely inadequate to describe the man. I have met a few great minds but in Bruce I have met both a great mind and a great man. I cannot begin to repay my own debt, both personal and intellectual, to him.

John Buckleton

Special thanks to James Curran, Ken Dodds, Chris Triggs, Zhao-Bang Zeng, and Beth Weir, who provided material