

CENTREFOLD

Robert Ernest Lee (Tank) Aldred

I have known 'Tank' for over 30 years now first as an undergraduate student, then as a graduate student and finally as a colleague and research collaborator. However, there is still a lot that I don't know about him. Or is it just that my age is now concealing what I once knew? Anyway, if his father was such an admirer of General Robert E Lee that he gave that start to Tanks name, why wasn't his second name Edward? While the Medium M3 Tank with U.S. pattern turrets was known as the 'General Lee Tank', I have it on good authority that this was not the inspiration for the epithet, 'Tank'. Unfortunately the origins of the name have now been buried in the mists of time.

Tank was keen on Herpetology from a young age, and his mother had to put up with Death Adders in the lounge room. However, there is a silver lining to this: his pythons did mean that the house never had any problems with mice.

Son of a medical father, Tank grew up in the Australian bush and was taught various things that might be of use in that surrounding. For instance, he could apply sutures to personal injuries, without anaesthetic should the need arise. Tank also learned much about farming that has made him more of a practical person than most academics. Some of these skills were used to acquire his first employment, though I'm sad to see that grave digging and polar bear shooting are not on his current cv. I hasten to add that the latter shooting was not with a gun but occurred while employed by a film crew on location in wildest Canada. But these early skills have no doubt been useful on his 'station' at Brighton, just outside Dunedin, where his horticultural abilities are continually employed and where his wife Karen, accidentally, and with great dismay, can sometimes be seen killing rabbits during the 2 hours or so it takes to cut the grass with the mower with the 50 inch cut. When will the creatures realise that ducking under the tall grass is no guarantee of safety?

His father's influence on Tank was considerable. One of these influences was the father's fascination with explosives that led to him producing his own bombs. Tank was given an early introduction to the joys of blowing things up when a family friend bought an old silver mine near Nariel, Victoria, complete with 50 pounds of gelignite. The uncertain stability of the product meant it was best not to use it for precise work in the mine but it needed to be disposed of somehow. A desire for a new dam made the decision easy; detonate the whole lot at once! The deafening blast, showers of earth clods and a massive crater left Tank with tunnel vision when it came to removing stubborn tree stumps. It needs to be said that, although he longs for the days when authorities were chemically more liberal, he has found other less exciting ways to remove tree stumps in Brighton.

As can be inferred from the above, Tank spent his school years in country Australia and moved to the University of Melbourne to complete his formal education. Since then he has had short term positions first at Otago and then Southern Illinois University. This latter position meant a move from New Zealand. It was a long and sad day for the then current head of the maths and stats department as Tank took with him to the States the then secretary of the department.

Tank came back to Otago in 1989 where he has held a position ever since, rising through the ranks to a very well deserved personal chair in 2010. During the last 20 years, Tank's research output and collaboration has been exceptional. In that time he has collaborated with some of the leading researchers in the world both in Otago and at Vanderbilt University, USA, the Technical University of Denmark, Silpakorn University, Thailand and Nihon University, Japan. Quite appropriately in 2006, Tank received both the New Zealand Mathematical Society Research Award and the Nihon University Medal.



Tank's work has covered many areas including Latin Squares, Combinatorial Designs, Association Schemes and Permutation Patterns but his main interest has always been with Graphs. In particular he is interested in determining bounds on the existence of special structures such as perfect matchings, 2-factors and cycles. As a result of his work in these areas, he has now written over 80 refereed papers, more than half of which are in journals rated A or A* by the ERA system.

On perfect matchings Tank has produced ground breaking work with Michael Plummer (Vanderbilt University), the co-author of the definitive and most widely cited research monograph on matchings. This collaboration has been extremely fruitful over many years and has recently established proximity thresholds for Matching Extensions that were unanticipated by others working in this field. Tank and Michael have shown that, in planar and projective planar triangulations, which cannot be more than 2-extendable, if the edges to be included are separated by a pairwise distance of at least 5, then any given number of edges can be specified and there will be a perfect matching including all of the specified edges. Other particularly interesting topological results include, for a fixed genus (orientable or non-orientable) there are only finitely many graphs of that genus which are 4-extendable.

On 2-factors, Tank has studied Forbidden Subgraph Characterizations of graphs admitting 2-factors in joint work with Professors Akira Saito (Nihon University) and Jun Fujisawa (Keio University). The Forbidden Subgraph characterizations are something like the famous Kuratowski characterisation of planarity where it is known that a graph is planar if and only if it avoids subdivisions of two subgraphs. In the 2-factor work Tank and his collaborators are determining sets of induced subgraphs which, if avoided, will guarantee the existence of a 2-factor. These have been widely studied and most forbidden sets involve a claw or star (a $K(1,n)$ for some n). Recently they have been able to determine forbidden subsets which contain no claws or stars. Besides novel structural considerations, this work also requires deft application of Tutte's f-factor theorem.

Tank has also made significant contributions to the determination of 2-factors of graphs with Unique Isomorphism Type in association with John Sheehan (University of Aberdeen) and Bill Jackson (Queen

Mary, University of London). This involved some quite sophisticated investigations of det-extremal graphs and Pfaffian orientations producing results for both bipartite and non-bipartite graphs.

On cycles, Tank has worked with three of the world's best graph theorists: Carsten Thomassen (Technical University of Denmark), the world's leading authority on structural graph theory, Brendan McKay (Australian National University, Canberra), one of the foremost exponents of the use of computers in graph theory (his program 'nauty' is widely used by researchers using computers to investigate graphs and combinatorics), and Nick Wormald (recently appointed as a Laureate Fellow at Monash University), a world leader in probabilistic methods in Graph Theory.

The collaboration with Carsten Thomassen has resulted in the complete resolution of two long-standing conjectures. The first showed that the minimum number of cycles in a 3-connected cubic graph on n vertices grows superpolynomially but subexponentially with n , resolving a conjecture of Barefoot, Clark and Entringer from 1980. The second presented a counterexample to a strong form of the Path Partition Conjecture posed by Mihok in around 1980. This also produced major progress in another conjecture that has stood for thirty years. This considered the maximum number of cycles in a graph with cyclotomic number r which was naively bounded by Entringer and Clark in 1981. Tank and Carsten resolved the problem entirely for planar graphs and brought about the first meaningful reduction in the upper bound (based on the dimension of the cycle space) for general graphs.

Also worth noting in this area is that, with Brendan McKay and Nick Wormald, Tank established the nonexistence of a hypohamiltonian graph on 17 vertices. This is noteworthy because it stood (for nearly twenty years) as the last order for which the existence of a hypohamiltonian graph remained unresolved.

During 2011 to 2014 Tank is co-leading a research project on graph structures with Carsten and Patrick Sol (a leading French Coding Theorist) at King Abdulaziz University, Jeddah, Saudi Arabia. This project, which consists of a series of workshops, is part of a Distinguished Scientists program aimed to assist local researchers to develop and sustain their own research programmes. The project involves eminent scholars from all over the world including two Fields Medallists. In the project, Tank, Carsten and Patrick are investigating some consequences of Tank's work bounding the numbers of cycles in graphs, bounding numbers of codewords of certain types and improving other matroid bounds related to both cycles and coding.

Tank is currently the Immediate Past President of the Combinatorial Mathematics Society of Australasia, Editor-in-chief of the Journal of Combinatorial Mathematics and Combinatorial Computing, Editor of the journal Transactions on Combinatorics, and Associate Editor (sharing Editor-in-chief's duties with Carsten Thomassen) of the Electronic Journal of Combinatorics.

Derek Holton