

## Obituary



Emeritus Professor Ernest Oliver (Ernie) Tuck  
1 June 1939 – 11 March 2009

Sadly, at 11 pm on 11 March 2009, a little short of his 70th birthday, Professor Ernest Oliver (Ernie) Tuck died from prostate cancer. His battle lasted almost two years from the time of diagnosis, but none of the treatments he underwent were able to successfully arrest its progress. Without doubt, Australia has lost one of its leading applied mathematicians and the world has lost a notable fluid mechanist.

Many will remember the last ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) conference Ernie attended, in Katoomba, February 2008, and the talk he gave there. It epitomised his love of mathematics and the joy he experienced in telling others about it. Early on in the conference, he was struck by great pain due to the spread of cancer to his bones. It was clear to those who knew him that he was very ill. But he still delivered his talk — on the Riemann zeta function (!) — at the scheduled time, with the usual enthusiasm, walking of the floor, gesticulations, and writing on the whiteboard, and he thoroughly enjoyed doing so. We suspect he did not feel any pain during that seminar, as he was totally engaged with the thrill of giving a mathematical talk! His enthusiasm was so infectious it has since led to a publication by a member of the audience, Sir Michael Berry of the University of Bristol (with P. Shukla): ‘Tuck’s incompressibility function: statistics of zeta zeros and eigenvalues’, *J. Phys. A* 41 (2008) 385202. Ernie was chuffed by the appearance of his name in that title. The title also amused him; to quote Ernie from December last year: ‘I am not entirely sure what Berry means by ‘incompressibility’; it certainly has nothing to do with fluids.’

Ernie loved both teaching and research in mathematics. He was an enthusiastic and passionate teacher, from first-year university calculus (he certainly did avoid linear algebra) through to specialised fourth-year courses on such

subjects as aerodynamics. He inspired his undergraduate students, as well as his higher-degree research students. He treated his research students as colleagues and friends, something they much appreciated. In addition, they soon learned to admire and value his insight. It wasn't always an easy road for his research students. There was a time when Ernie was Dean of the Faculty of Mathematical and Computer Sciences, with many administrative duties, in addition to his teaching and research, four PhD students and a research assistant. But through such circumstances he taught his students to stand on their own two feet and believe in their research, something which they have greatly appreciated since completing their PhDs.

### **A short history**

Ernie was born in Adelaide, South Australia. He and his younger brother were raised by their mother after his father, a World War II veteran, was killed in an automobile accident when Ernie was just six years old. This family tragedy had a happy consequence later, when Ernie met his future wife and often-acknowledged best friend, Helen, at a Legacy gathering for children of military veterans.

Ernie was an undergraduate student at the University of Adelaide from 1956–1959, and received his First Class Honours degree in mathematics in 1960, supervised and mentored by Professor Ren Potts. Ren's interests in operations research and statistics rubbed off on his student, and provided the topic of Ernie's first research paper, 'Stability of following in two dimensions', *Operations Research*, 9 (1961) 479–495. After completing his Honours degree, Ernie won a Legacy Scholarship that funded his postgraduate studies at the University of Cambridge. Ernie was both proud and grateful for this opportunity provided by Legacy, and remained strongly attached to Cambridge throughout his life. Thus at the close of 1960, having proposed to Helen the day before, he embarked by ship to the UK to study at the University of Cambridge. Helen followed Ernie to Cambridge after his first year, and they were married in the chapel of Trinity College in 1961.

Ernie's PhD supervisor was Professor Fritz Ursell, a major figure in British applied mathematics and, currently, Emeritus Professor at the University of Manchester. In addition to Ursell's influence, Ernie's subsequent focus on ship hydrodynamics and related fields may be attributed to his observations on the long voyage to England, and to a deep inquisitiveness in science, technology, and engineering applications. Another possible connection with the field of hydrodynamics is suggested by the fact that Sir Horace Lamb had been the first Professor of Mathematics at the University of Adelaide.

With guidance and encouragement from Ursell, Ernie focused his PhD research on one of the first applications of slender-body theory to ships. Ernie's approach was revolutionary, based on the method of matched asymptotic expansions, and applied to the prediction of the wave resistance of a ship moving in steady motion on the free surface. When Ursell moved to Manchester after Ernie's first year, an arrangement was made where Ernie spent his second

year at Cambridge and his third at Manchester. After his second year he participated in a small meeting held at Wageningen, Netherlands, which was organised primarily to discuss his research and the complementary work of Gerrit Vossers on the same topic. That meeting was supported by the US Office of Naval Research. In 1963 Ernie was awarded a PhD for his thesis entitled 'The steady motion of a slender ship'. Clearly Ernie was an early adopter of the three-year rule for PhD completions!

After Cambridge, Ernie moved to a position at the David Taylor Model Basin, a US Naval Laboratory, to work with Francis Ogilvie and Nick Newman. This facility is a major laboratory, with a number of towing and modelling tanks inside a most impressive building almost exactly one kilometre long. Ernie and Helen's first son, Warren, was born during this time. From there Ernie moved to the California Institute of Technology, to work with Ted Wu.

Then, in December 1967, the family returned to Australia where Ernie took up a Readership at the University of Adelaide. The story of his return to Adelaide is a little intriguing. Apparently a former colleague of Ernie at the David Taylor Model Basin received a request for a reference for Ernie from what he described as 'that other University in Adelaide' (in 1967 that of course was a unique specification). The requested reference was provided but another letter was sent to Ren Potts at the University of Adelaide asking the question, 'how could you let such a talented person' go elsewhere in Adelaide? Clearly Ren could not, and the rest is history.

After his return to Adelaide Ernie and Helen's second son, Geoff, was born.

In 1974, at the age of just 34, Ernie was promoted to a Personal Chair. On the retirement of Professor Ren Potts in 1990, Ernie then became the Chair of Applied Mathematics and also the Elder Professor of Applied Mathematics (named after Sir Thomas Elder, a renowned Australian pastoralist, businessman and benefactor of the University). Ernie held those positions until his retirement in June 2002. During his time in applied mathematics he frequently held the position of Head of Department and he was also Dean of the Faculty of Mathematical and Computer Sciences from 1993 to 1996.

On his retirement he was awarded the title of Professor Emeritus. He really did not retire from research at all but continued the work he loved — supervising research students, pursuing his research interests, collaborating with colleagues, writing papers and grant applications, attending conferences, organising the ICTAM 2008 conference, and more. Even near the very end he was fervently hoping to attend the February 2009 ANZIAM conference, and was bitterly disappointed that his health did not allow this. Ernie did however live to see his final research student, Leo Lazauskas, qualify for his PhD early this year.

#### **The man and his work**

Ernie's primary field of expertise was fluid mechanics. He worked on a wide variety of topics related to ship hydrodynamics, aerodynamics, acoustics, bio-

fluid mechanics, and numerical analysis. His contributions to these fields were based primarily on analytic methods, but early on in his career 'high-speed' mainframe computers were becoming useful to scientists and engineers on a broad scale and Ernie was quick to embrace the developing field of numerical computation. This enabled him to produce practical and illustrative results based on his theoretical analyses. One of his most exciting computations was for the nonlinear waves generated by a submerged two-dimensional dipole in steady motion (*J. Fluid Mech.*, 22 (1965) 401–414). The streamlines include jets emerging from the free surface, which generated much discussion; Helen embroidered a splendid wall hanging with images of the streamlines.

Ernie had great expertise as a modeller, and published over 170 articles, with the vast majority being in the top journals in fluid mechanics; his papers are clear, concise, and stimulating. He also had a personal interest in games theory, and published articles on both blackjack and backgammon. After retirement Ernie became interested in Riemann's Hypothesis and wrote three papers in this area. This is usually regarded as a rather 'Pure' mathematical area but Ernie realised that the analytical skills honed in his hydrodynamic research could find application here. We have already referred to a recent publication citing his work in this area. For a complete list of Ernie's publications, see [www.maths.adelaide.edu.au/ernie.tuck/](http://www.maths.adelaide.edu.au/ernie.tuck/).

Ernie's research is characterised by the recognition of new or unsolved problems, application of novel mathematical methods, and careful numerical analysis. He was particularly adept at solving complex problems with simple approximations, as in his applications of matched asymptotic expansions. When he first employed this method to analyse the wave resistance of slender ships it was relatively new, and unknown to most. Subsequently he found other problems to which the same method was applicable, including the 'squat' of ships in shallow water, various types of flow or wave transmission through small gaps, end effects on blunt slender bodies, and bodies moving near a plane wall or in close proximity to other bodies. Several other topics which recur throughout the list of his publications include the strip theory of ship motions, Michell's thin-ship theory of wave resistance, planing, bodies with zero wave resistance, nonlinear free-boundary problems, numerical solution of integral equations, low-Reynolds number flows, wave resistance of multihull vessels, and lifting-surface theory.

Ernie's work on 'squat' (or sinkage) of ships in shallow water is an interesting example of his international stature in the field of ship hydrodynamics. He was asked to work on this problem soon after he arrived at the David Taylor Model Basin, motivated by the grounding of an aircraft carrier in the Gulf of Mexico. His brilliant analysis, which combined slender-body theory with the governing equations for shallow-water waves, revealed the nonlinear effect of a ship's speed on squat, particularly in the vicinity of the critical Froude number. He first reported his results in discussion of a paper by German researchers, where he showed how his elegantly simple theory could explain their experimental results. Subsequently he published this seminal work in the *Journal of Fluid*

*Mechanics*, 26 (1966) 81–95. He also simplified the essential results in Navigation (*The Journal of the Australian Institute of Navigation*), 3 (1970) 321–324, for the benefit of ship operators. The importance of his work was recognised after a widely publicised accident: on 7 August 1992 the famous Cunard flagship Queen Elizabeth 2 struck a shoal after leaving Martha's Vineyard, enroute to New York. The ship was behind schedule, operating at high speed, and passed over a shoal area because neither the pilot nor the ship's officers understood how the speed affected the squat. Ernie took a great interest in this accident, and subsequently he contributed a lucid overview of squat to the Workshop on Ship Squat in Restricted Waters held in Washington, October 1995.

In 1988 Ernie was elected a Fellow of the Australian Academy of Science and, in 1996, a Fellow of the Australian Academy of Technological Sciences and Engineering. Being a Fellow of both academies is a rare distinction and a recognition of Ernie's success in both scientific work and in application. In 1999, Ernie was awarded the Thomas Ranken Lyle Medal from the Australian Academy of Science, which is awarded once every two years and recognises outstanding achievement by a scientist in Australia for research in mathematics or physics. In 1999 he was also awarded the ANZIAM Medal by the Australian and New Zealand Industrial and Applied Mathematics (ANZIAM) society, a division of the Australian Mathematical Society. This medal has been awarded every two years since 1995 for research achievements and contributions to Applied Mathematics and ANZIAM, and Ernie was the third recipient. It is worth noting that the first ANZIAM Medal was awarded to Ren Potts. This reflects the extraordinary strength of Adelaide Applied Mathematics in the era of Ren Potts and Ernie Tuck. Ernie was also the proud recipient of a Centenary Medal from the Federal Government at the time of our national centenary (2001).

An international award of which Ernie was proud was his selection as the Georg Weinblum Memorial Lecturer for 1990–1991. Named after an internationally famous ship hydrodynamicist the award required Ernie to deliver the Memorial Lecture firstly in Berlin (1990) and later in Washington in 1991.

In addition to frequent participation in ANZIAM conferences, Ernie made many longer trips to attend the (ONR) Symposia on Naval Hydrodynamics, IUTAM Congresses, the International Workshops on Water Waves and Floating Bodies (IWWWF), and more. He was particularly active in small informal meetings, stimulated no doubt by his early exposure to seminars at Cambridge, the ad hoc meeting in Wageningen, and his early membership of the Analytical Ship-Wave Panel (H-5) of the US Society of Naval Architects and Marine Engineers.

Ernie successfully supervised 25 PhD and 4 research Masters students during his time at the University of Adelaide. At his retirement symposium in January 2003, 16 of these students were able to attend, a number of whom travelled great distances for the occasion. This aptly demonstrates the very high esteem in which Ernie was held by his students. During the period in

the mid-1990s when Ernie was Dean and then on study leave, he gave his departmental office over to his research assistant and four postgraduates — including open access to his whole library. This provided a great (if crowded) atmosphere for the inhabitants, each of whom went on to write at least three papers with Ernie. At about the same time in the period between 1993 and 2001 Ernie's students were awarded best student paper at the annual ANZIAM conference on four separate occasions.

Ernie was very interested in promoting mathematics in general and particularly in motivating young people towards an interest in maths, both through his teaching and by other means. As part of this interest he and a long-time friend, Professor Neville de Mestre of Bond University, produced a book aimed at secondary school students, titled 'Computer Ecology and Chaos' and published in 1991.

Ernie was Chair of the ANZIAM Society for two years and Deputy Chair for three years. He was Editor of the main Australian Applied Maths Journal — now the ANZIAM Journal — for eight years from 1985–1992. He was an early advocate of LaTeX, and in 1992 he established TeXAdel, an organisation responsible for automating the production of the Australian Mathematical Society journals.

Very recently and, remarkably, while his health was already very much affected, Ernie was the President of the ICTAM (International Congress of Theoretical and Applied Mechanics) 2008, held in Adelaide in August last year. ICTAM is held every four years and attracts approximately 1000 delegates, so that this was a major contribution by Ernie to his discipline. Some may recall the pleasure he expressed during the conference opening that he was able to be there and participate as its President.

#### **Other interests**

Everyone who knew Ernie knew he had a warm and loving personality. He was shy as a young man, but never shy about maths, or his family. He loved Helen dearly, and their two sons Warren and Geoff. Later, after Warren and Geoff had grown up and married, their families were at the centre of his life. He doted on his young grandchildren, spending as much time as possible with them over the last few years. He loved playing rough and tumble games with his youngest granddaughter Samantha, and then he became the clown. He enjoyed seeing granddaughter Georgia bring her dog into the hospice in his last week, and was touched that another, eight-year-old Isabel, was saving her money for a plane ticket from Hobart to Adelaide so that she could come to see him. Just several days before his death, he was watching his oldest grandchild, Matthew, play cricket, as he had done on many other Saturdays. Ernie loved other sports also, including Australian Rules football, and basketball. He also loved playing backgammon, bridge, blackjack, ... though he could not resist analysing the games mathematically! Another simple activity that gave him much pleasure was going for long drives with Helen, on weekends, or on trips to interstate conferences. His father's

love of motorcycles possibly led to Ernie's love of cars; he frequently attended the Rowley Park Speedway before it closed. Again, mathematics came into this leisure activity: in his honours lectures on aerodynamics, he also talked about using spoilers to produce negative lift to keep sports cars glued to the road.

### **The Tuck Fellowship**

To honour Ernie and continue his legacy a new fellowship has been proposed — The Tuck Fellowship — to support the participation at conferences by students and younger research workers, something Ernie fostered throughout his lifetime. After consultation with Ernie to ascertain his preferences, it was decided to associate this fellowship with the International Workshop on Water Waves and Floating Bodies (or IWWWFB), an annual conference at the heart of his research interests and with an emphasis on participation of young researchers. One student or young researcher will be fully funded to attend this workshop each year, with applications accepted from eligible people across the globe. More information is available at [www.iwwwfb.org/tuck.htm](http://www.iwwwfb.org/tuck.htm). As suggested by Ernie, if sufficient funds are raised, a student or young researcher will also be sponsored to attend the ANZIAM conference. Ernie was delighted and very much moved when told that his suggestion had been adopted — he cared very much for the 'local' Applied Mathematics society. Donations to the University of Adelaide to establish this fellowship are currently being sought. Those who wish to honour Ernie in this way may obtain a donation form at [www.maths.adelaide.edu.au](http://www.maths.adelaide.edu.au) or at [www.iwwwfb.org/tuck.htm](http://www.iwwwfb.org/tuck.htm).

### **Closing remarks**

Ernie will be remembered as a brilliant Australian mathematician and a caring and fun-loving man. He will be missed by many. In closing we would like to express, on behalf of all, sympathy to Helen and her family at the untimely loss of Ernie, but also gratitude for the wonderful academic career we have had the privilege to observe and share.

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