

## A. J. M. Spencer FRS

Anthony James Merrill Spencer, Emeritus Professor of Theoretical Mechanics, University of Nottingham, was born in Edgbaston, Birmingham, in the county of Warwickshire on August 23rd 1929. His grandfather, on his father's side, had been a miner in the coalfields at Beighton, Derbyshire, while his mother's father had kept a small village shop in Swallownest, which is near to the city of Sheffield. His father was a graduate in Chemistry from Sheffield University, but during the depression played professional football for West Bromwich Albion. Throughout the Second World War, Tony attended Queen Mary's Grammar School in Walsall. During this period the majority of male teachers were absent, which left the remainder greatly overworked. However, as for many scientists, his mathematics and physics teacher, Mr. William A. Burn, who incidentally also doubled as the Commandant of the local Home Guard, inculcated a serious interest for Tony in these disciplines. His friends at school included Steve Hunter, who was later to become Professor of Applied Mathematics at Sheffield University, and Neil Denison, who is now His Honour Judge Denison QC and Common Sergeant in the City of London, the latter also acting as Tony's best man.

On leaving school in 1947, Tony effectively had the choice of either going immediately to Birmingham University, or spending two years in the Army and then going on to Cambridge University. He decided on the latter course of action, and spent most of his time in Austria, serving with an infantry battalion as a signaler. After some twenty months he was given a premature release from the Army along with an ex-service grant to attend Queens' College at Cambridge University. His tutor at Cambridge was Edwin A. Maxwell and during that period his lecturers at Cambridge were to include distinguished mathematicians such as George Batchelor, Hermann Bondi, John Burkill, Fred Hoyle, Raymond Lyttleton and Robert Rankine, although at the time none were Professors. Upon graduating from Cambridge he initially started his PhD under Frank Nabarro at Birmingham University, but after only ten months his supervisor left to take up the Chair of Physics at the University of Witwatersrand. He subsequently completed his PhD with Professor Ian Sneddon, who was then affiliated with the University of Keele. Professor Ian Sneddon remembers Tony's arrival in Keele, with his own problem, which he considered too tough to solve analytically and advised him to tackle it numerically; his abiding memory of Tony at Keele is of the long hours he spent working away with an electric desk calculator. Fellow research students at Keele were George Eason and Denis Berry. He completed his PhD in 1955, married Margaret (née Bosker), and left for Brown University in the same year.

The Division of Applied Mechanics at Brown, headed by Professor William Prager, was the hub of activity in applied mechanics in the USA, the Department comprising Professors Ronald Rivlin, Dan Drucker, Eli Sternberg, Harry Kolsky, Ras Lee, Dick Shield and Turan Onat, to name a few. This group attracted its fair share of visiting faculty including Professor Albert Green who was at that time with the University of Newcastle upon Tyne. With Ronald Rivlin and Albert Green, Tony Spencer embarked on his remarkable studies into the application of the theory of invariants and its role in the development of constitutive laws in continuum mechanics. These studies have now become a milestone in the history of the development of continuum mechanics. References to the collaborative work of Tony Spencer, Ronald Rivlin

and Albert Green are standard citations in treatises in modern continuum mechanics. As Tony himself once remarked: *'My debt to Rivlin in particular is huge, and I also owe a great deal to Albert Green, from whom I learned much'*.

On returning to England in 1957, Tony joined the Atomic Weapons Research Establishment at Aldermaston, where he was chiefly engaged in the effects and detection of underground explosions. A colleague at Aldermaston was Peter Chadwick; he also had close links with the solid-mechanics group at the Royal Armaments Research and Development Establishment at Fort Halstead.

In 1960, Nottingham University decided to establish within the then rapidly expanding Faculty of Applied Science a department to teach mathematics to engineering students. The initial nucleus for the newly formed Department of Theoretical Mechanics was Professor John Adkins, who himself was a disciple of Rivlin, and two new lecturers Tony Spencer and Tony Green. It was housed in a brand-new building, which by 1960 was very nearly complete. When Tony Spencer arrived in the new department, he was immediately thrown in at the deep end, because John Adkins promptly set off on a sabbatical leave to Brown University. However, this experience proved beneficial, because he was forced to learn a lot quickly about university politics in which the engineers, especially Rex Coates, ably assisted him. Arthur England joined in 1962 and one year later Tryfan Rogers arrived. In the years that followed Tryfan and Tony undertook many successful research collaborations, extending over many years and ending only with Tryfan's premature death in 1993. In 1963 Tony was promoted Reader and became Head of Department on 1st April 1965 following the untimely death of Professor John Adkins. In 1964 John Holden and Eric Varley joined the department, and in the general mood of expansion of universities in the latter sixties, the department added to its staff Denis Berry, Bob Faulkner, Derek Middleton and David Parker. For the great majority of the following thirty years, Tony Spencer ran an unusually harmonious department, inspiring and encouraging by his own example. In addition to his administrative and research commitments, he carried a teaching load as great as that of any of his colleagues, both in the department's honours and joint honours degrees and in teaching to a substantial proportion of the nearly ten thousand students of Applied Science and Engineering who received their engineering degrees from Nottingham University in that period.

At Nottingham he undertook a full share of research supervision at all levels. He has supervised or co-supervised thirty-five PhD students and a similar number of final year undergraduate projects. Researchers of Tony's caliber usually shun administrative work; proving the exception, Tony has served on a number of university, national and international committees on both teaching and research. His publication record summarizes his wide-ranging interests and his uncanny ability and gift to make seminal contributions to each topic that has had the good fortune of his attention. His research interests include fracture mechanics, tensor constitutive laws and plasticity theory and the mechanics of granular media, to which he has contributed the concept of the 'double-shearing' theory. However, Tony and the Nottingham group are perhaps best known for their contributions to the study of strongly anisotropic, fibre-reinforced, composite and laminated solids. This work was stimulated in part by collaboration with the Advanced Research Department of Rolls-Royce in Derby and resulted in key theoretical concepts dealing with the mechanics of such highly anisotropic materials for a wide range of constitutive responses. Tony's continued interest into the mechanics of composites led to the study of laminated plates. The three-dimensional exact solutions that he developed for laminates are an elegant example of his piercing insight to see beyond Michell's classical result. He has worked extensively on nonlinear elasticity and thermoelasticity, leading to his

recent research on the deformation and flow of thermoplastics. His outstanding contributions to these disciplines were recognized by his election in 1987 as a Fellow of the Royal Society. It was fitting that, on his retirement, Tony Spencer was made an Emeritus Professor of Nottingham University and he continues to this day an association with the department to which he has given unstinting service for its entire existence.

Since his ‘formal’ retirement in 1994 Tony continues to be active in research and promoting continuum mechanics on the international stage. He travels extensively throughout the world to collaborate with numerous colleagues, attending conferences to give keynote presentations and generally supporting the research enterprise in continuum mechanics. His rate of research productivity shows no signs of diminishing. In fact, to the contrary, since relinquishing his departmental responsibilities, he is possibly even more productive than ever. At a stage in life when many of his contemporaries, and even some of his much younger colleagues, are fading under the frustrations of ‘modernity’, Tony ‘presses on regardless’. In this way he is an inspiration to all of us, just as he inspired those around him when he headed a talented group of academics associated with the department at Nottingham. He has contributed in an immeasurable way to the development of theoretical solid mechanics in the UK and abroad. Much of the national and international reputation acquired by the Department of Theoretical Mechanics arose as a result of the steady flow of PhD students, post-doctoral appointees and overseas visitors, which has occurred throughout the department’s long history. Those of us in one of these categories understand the extent to which our lives have been influenced and enriched by our experiences in the department. This collection of articles is an expression of our deep appreciation of Tony Spencer as a distinguished academic, consummate researcher, mentor and colleague.

*Universtiy of Wollongong  
and McGill University*

J. M. HILL  
and  
A. P. S. SELVADURAI

## A. Scientific papers

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