ALAN G. THOMAS

Alan Thomas (1927 – 2019) was a physicist through and through, starting with a Physics degree from the University of Oxford and taking up a job in physics of rubber at the British Rubber Producer's Research Association in 1948, where he stayed until "retiring" in 1987 from a very distinguished career as leader of the Applied Physics Group. But he continued working part time for some years, and kept close ties with TARRC and former TARRC staff to his last days, collaborating in new research areas. From 1974 he contributed original ideas as a visiting Professor to rubber research at Queen Mary University of London, and thus to many successful PhD projects, until recently.

He had been attracted to the Rubber Research Association during his interview, finding its staff enthusiastically engaged in a great variety of research activities, happy to show him intriguing phenomena which they were striving to understand, eagerly following a broad and open remit. His first task was to check the proofs of L R G Treloar's *The Physics of Rubber Elasticity* (published 1949) which, he said, was the perfect grounding for his career. He was assigned to work on the strength of rubber under R S Rivlin, who suggested he could start by checking the applicability of the energetics approach, developed by Griffith for fracture of glass, to fracture of rubber. Contrary to Rivlin's expectation, it turned out that the energetics approach, known also as Fracture Mechanics, could be generalised and made applicable to rubber, providing a unifying measure of strength, independent of test piece geometry. The complexity of finite strain elasticity theory called for experimental determination of the energy release rate, except for a few ingeniously devised test pieces for which it could be calculated. This was published in a seminal paper, Rupture of Rubber Part I, *J Polym Sci*, 1953, **10,** 291-318. Many more related papers swiftly followed, all making significant original advances – whether new test pieces for which the energy release rate could be simply calculated, anticipation in Part 2 (1955) of the J-integral of Rice, or significant insights into material fracture behaviour in response to the magnitude or time-variation of the energy release rate. Many fracture mechanics authorities knew only of its application to infinitesimal strain elastic materials, and remained ignorant of Alan's early achievement for materials with finite elastic strain capability and hysteresis, some even asserting that this couldn't be done.

The success of the work on fracture was marked by a seminar on rubber fracture entitled "50 Not Out" in 2003 at TARRC, as BRPRA had become, organised by Dr Graham Lake and Dr Keith Fuller. Ronald Rivlin and Alan Thomas both gave presentations at this meeting, as also did many much younger people.

But Alan's interest and capability extended much wider than fracture, the subject for which he is best known. Other notable areas were mechanics of rubber-metal laminates (his work being a key contribution towards the winning by the Malaysian Rubber Research Association in 1990 of the Prince Philip Award for Polymers in the Service of Mankind, for its development and successful launch of rubber-steel laminated earthquake isolation bearings), abrasion, migration of soluble materials in rubber, non-linear and finite strain elasticity and viscoelasticity. He would become intrigued by any issue – not always within rubber science - that he felt might be amenable to a quantitative theoretical treatment, and could readily generate such theory, without recourse to checking literature for ideas on how to tackle the problem. His aim was to capture the essence of the phenomenon in a quantitative theory, and quickly proceed to comparison of theory and experiment, without becoming distracted by theoretical refinement or unjustified complexity as an end in itself, until it was clear that such might be needed to achieve agreement with experiment. This ensured that theory was quickly in place to guide experiments, and the two proceeded hand in hand, quickly delivering insight and practical design methodology.

He couldn't resist sketching out a theory as soon as the idea for it came to him, and plotting theory and experimental data on a graph for comparison as soon as he had both. Not surprisingly, this made work a great pleasure and led to many original advances, but could also sometimes lead to a minor disappointment when he discovered someone else had solved the same problem already. But his knowledge of the literature was also very good, and he was much valued by younger researchers as a walking encyclopaedia of physics and rubber science, ready to explain what was known and where the limitations in current understanding lay. He had an enviable ability to assess rapidly whether a paper provided any new insight or not.

He sought to recruit on the basis of curiosity, imagination, enthusiasm and ability rather than on qualifications, knowledge or experience, knowing that if the first three qualities are in place the others would naturally be acquired, whereas the converse was much less certain. He readily shared his ideas, and valued bouncing them off all he worked with. In the words of Will Mars, a much younger beneficiary of Alan's pearls of wisdom, he "changed the world monumentally, never lost his curiosity, always kept his penetrating insight, always pushed against the frontier of the unknown. He was so approachable to young scientists. He might easily have tired of interacting with so many of us who were just discovering the power in his ideas, and who were starting on journeys along the pathways he laid down. "

He won many awards for his work, including the Colwyn Medal, the Charles Goodyear Medal, the MRRDB Gold Medal and the KMN award from the Malaysian government in 1976.

Alan encouraged his staff in the Applied Physics Group to join the IOP, of which he was a long-standing member, and a founder-member of the Retired Members group. The latter became a major part of his social life after he lost Yvonne, his wife, and in the fullness of time was where he met Pat, who became his second wife, and sadly, ultimately his carer too. Despite being very pleased to have a son and three grandsons also active in physics, it should not be thought that he had no other interests: he was equally proud in his daughter being an artist, and he would probably have done well himself in whatever path he had followed.

Alan will be fondly remembered and sorely missed.