

In Memoriam: Jack R. Phillips

On January 11, 2009 my mentor, Dr. Jack Raymond Phillips, passed away quietly in the home in Birchgrove, Sydney, that he shared with his partner, Elayne Russell, after an extended illness. He is survived by his two daughters, Catherine and Odette.

Jack was 85 years old, having been born on July 18, 1923 in Geelong, a large town to the west of Melbourne in the state of Victoria, Australia. An article celebrating his 85th birthday was published in the August 2008 issue of the journal *Mechanism and Machine Theory*. Professor Gordon R. Pennock authored the article, which includes a comprehensive bibliography. Those interested in his technical contributions are referred to that article.

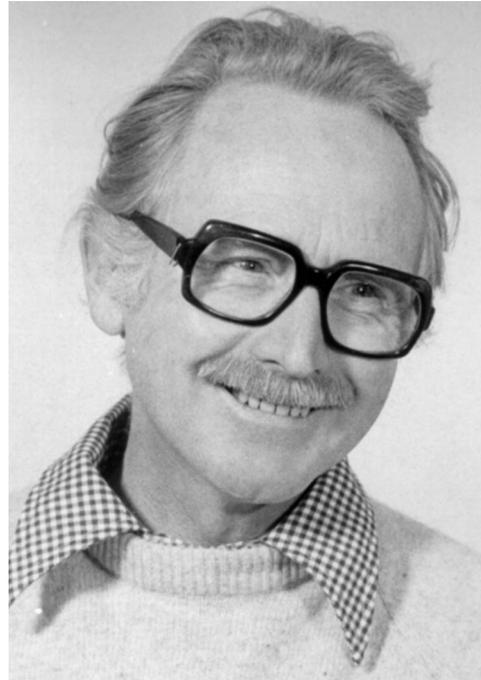
I first met Jack in 1964, shortly after he moved to the University of Sydney from the University of Western Australia. At the time I was a student enrolled in a new master's degree program that included a curriculum of courses, in contrast to the traditional program that was research only. Jack taught one of the courses I took, and I became interested in some of the unresolved research issues that he raised during the course. That led to my move to Stanford to complete my doctorate with Professor Bernie Roth.

Jack Phillips received his Ph.D. degree from the University of Melbourne in 1957. He took up his first academic position at the University of Western Australia shortly thereafter. However, there is a much deeper and darker story to his early career. Jack was an undergraduate at the University of Melbourne during the early part of the Second World War, and was then a lieutenant in the Australian army for two years. His army duties included maintenance of motor vehicles, and he became aware of the geometric and constraint issues of vehicle suspensions.

As told to me by Jack himself, he worked in a number of jobs after the war, including a stint of about three years with ICI Ltd. in Great Britain. However, he had become vocally involved in left wing political causes. It may seem strange to younger people in western countries, but at the time, early in the cold war there was intense paranoia against those who espoused left wing political causes. In the US this led to blacklisting of people, effectively excluding them from employment. In the UK and Australia the reaction was less overt, but the results were the same. Jack was offered a succession of attractive jobs that vanished either shortly before, or shortly after he started work. As I have noted, this may be alien to many in our community, but it should be remembered that there are countries in which political discrimination of this sort is still practiced.

Back in Australia, Jack found work as a technician at an agricultural research station in rural Victoria. His abilities soon caused him to be promoted to engineering work. It was fortuitous for us that this happened, because his work with multi-disk plough systems first caused him to grapple with the geometric equilibrium conditions of spatial force systems. One of the engineers associated with the research station was also affiliated with the Faculty of Engineering of the University of Melbourne. He suggested that Jack write up the work he had been doing on spatial force systems as a Ph.D. dissertation.

During his association with the University of Melbourne, Jack encountered Kenneth H. Hunt who had joined the university after



Dr. Jack Raymond Phillips
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the war as a senior lecturer. Hunt was working on problems of mechanism and geometry of motion. They came to realize that they were working on similar problems of geometrically composing spatial force and velocity systems. Thus began a long and productive collaboration. It continued despite Jack's move to the University of Western Australia, and subsequently to the University of Sydney, and Ken's move to become the founding Dean of Engineering at the new Monash University. It was not always a smooth relationship. The two men were very different in their backgrounds, personalities, and interests outside the technical sphere. Jack's work and his students were always his primary focus, whether at the university or at home. Ken grew up in relatively privileged circumstances in England and had an M.A. from Oxford. He was an accomplished musician, and remained deeply involved in the musical community throughout his life. Like Jack, he had served in the army during the war. Ken Hunt became an accomplished administrator, and very much part of the establishment, whereas Jack's rebellious streak never left him, and probably contributed to his prickly relationship with the leadership of his department, and the university administration during the latter part of his career at the University of Sydney. Thus, it is not surprising that there was often friction between Jack and Ken.

They did share a mutual respect for each other's work and a deep interest in similar technical problems.

Jack formally retired from the University of Sydney at the end of 1986. He continued to be associated with the university as an honorary research associate.

Jack had an extraordinary ability to visualize three-dimensional geometric systems, and to draw inferences from them. His approach to static and kinematic problems was to use purely geometric arguments. It was a source of frustration to him that the rest of the technical community could not see relationships that were perfectly obvious to him. Even Ken Hunt who was, himself, very good at visualizing spatial relationships would retreat into the language of projective geometry when trying to explicate results to the community. Jack's response to this problem was to try to draw the geometry in question. That is a difficult proposition for a spatial system, but it led to the remarkable illustrations he prepared for his books. When he felt that drawing was inadequate he would build models.

He and Ken Hunt rediscovered many of the results of Ball's instantaneous screw system calculus and applied them to modern mechanism problems. In so doing they created a substantial component of modern spatial mechanism theory. Back in the 1960s they could not know that what they were doing would be of fundamental importance to the emerging technology of robotics. Many properties that most of us regard as fundamental, such as the relationship of geometric singularity in a serial chain to the column dependence of its Jacobian matrix are results from screw system theory that have been recast into the language of algebraic geometry. There was a string of co-authored papers that laid out their results on screw system theory, followed by Ken Hunt's book *Kinematic Geometry of Mechanisms*, and by Jack's two volumes on *Freedom in Machinery*.

After his retirement, Jack applied his skills in spatial kinematics to the general problem of spatial gearing. He was able to elucidate a fully consistent theory of the generation and meshing requirements of conjugate action between gears turning on skew shafts.

This formulation was distinct from others and presents some attractive alternatives to systems in use that employ contact along curved lines. This work culminated in his third book *General Spatial Involute Gearing*.

Jack Phillips attended an international conference on mechanism and machines organized by Professor Mikhail S. Konstantinov at Varna, Bulgaria in 1965. This meeting is viewed as the first gathering of the community that within a few years became IFToMM, the International Federation for Promotion of Mechanism and Machine Science. Jack served on the Executive Council of IFToMM for two consecutive terms that spanned the period from 1971 to 1979. He was the founding chair of the Permanent Commission on History of Mechanism and Machine Theory. Jack enjoyed traveling and was a regular attendee of conferences in Eastern Europe in the 1960s and 1970s. He spoke fluent German and spent a sabbatical at the University of Karl Marx Stadt (now Chemnitz). One reason for this geographic orientation was that, at the time, travel to many western countries, and notably the US, was closed to him. He always enjoyed IFToMM World Congresses. I remember encountering Jack and Elayne while exploring the ruins of Granada with my wife a few days before the World Congress in Seville. Jack was made an Honorary Member of IFToMM at the Oulu Congress in 1999. Although infirm, he enjoyed attending the most recent conference in Besançon in 2007.

In many ways Jack Phillips was a transitional figure in our professional community. His ways of thinking about and understanding spatial relationships came from his technical background that preceded the use of a computer as a versatile tool. Notwithstanding that he later learned to use the computer as a powerful means of graphically representing three-dimensional systems. At the same time the problems he chose to work on laid the foundation for much of modern mechanism theory. It is with both deep regret and gratitude that we say goodbye to one of the founders of our professional community.

Kenneth J. Waldron