Theodore von Kármán – Rocket Scientist

Theodere von Kármán, the Hungarian born scientist, is best remembered for his seminal contributions to several areas of fluid and solid mechanics, as the first head of Guggenheim Aeronautical Laboratory at Caltech (GALCIT) who gave it a pre-eminent position in Aeronautics research, as a pioneer of rocket science in America and co-founder of the Jet Propulsion Laboratory (JPL), and as an ardent believer and organizer of international cooperation in science.

Theodore was born in Budapest on 11 May 1881 to Helen Kohn and Mor Kármán. His father, a leading educationist, had a major influence in Kármán's life and views. As a child, Kármán could mentally multiply large numbers. His father didn't like such mental feats and believed that the mind should be used for deeper thinking. Kármán himself felt that he was a slow thinker and for this reason he was opposed to methods which test speed and not the ability to engage in deep, solid, and creative thought. These remarks are particularly relevant today when we often gauge talent using multiple-choice tests and Britannia-child-genius type quiz contests.

Kármán studied at the Mint Gymnasium, a school founded by his father. He won the Eötvös Prize for the best student in Hungary in mathematics and science. Though Kármán's inclination was for mathematics, he joined the engineering course at the Palatine Joseph Polytechnic in Budapest, after completing which he worked for three years (1903-1906) at the same polytechnic as an assistant in hydraulics.

His career took a decisive turn when he joined Göttingen in Germany to work for his PhD under the famous German scientist-engineer Ludwig Prandtl (see *Resonance*, August 2000). Those were the days when Prandtl was revolutionizing the study of fluid mechanics, in particular with his discovery of boundary layers. Kármán's doctoral work, however, was on the theory of buckling of large structures. Apart from Prandtl, Kármán was greatly influenced by Felix Klein, the director of Göttingen, and the mathematician Hilbert. With Max Born he wrote a paper on vibrations of crystal lattices. Klein believed that an engineering graduate should have a strong theoretical background, and it is this philosophy of blending science and engineering that Kármán effectively implemented later at Aachen and GALCIT.

After his doctoral work, he joined Göttingen as Privatdozent (a candidate for the faculty) that marked his initiation into fluid mechanics research. He was involved in a project sponsored by the Zeppelin airship company which required the construction of a wind tunnel, an experience that would be useful many times later in his career. It

was at this time that he developed his famous theory for the double row of vortices (now known as the Kármán Vortex Street) often found in the wakes of bluff bodies. After four years of waiting as a Privatdozent he joined Sclmeczhanya, Hungary, but soon regretted the decision. Fortunately in 1913, the chair of aeronautics became vacant at the Technische Hochschule, Aachen. Kármán was to spend sixteen years at Aachen. He built an active research group. His contributions during this time include the Kármán momentum integral for boundary layers, his logarithmic law for skin friction and a similarity solution for flow induced by a rotating plate.

Because of the growing Nazism in Germany, but much against the wishes of his mother who believed "only misfits and family black sheep settled in America", in 1930, Kármán decided to take up the offer of directorship of the newly formed GALCIT. Caltech was young and rapidly growing (in stature) under the leadership of R Millikan. Kármán attracted a number of visitors to GALCIT. Among them were L Howarth, with whom Kármán derived the Kármán-Howarth equation for isotropic turbulence, and Sydney Goldstein. H W Liepmann joined GALCIT in 1939 and later ably succeeded Kármán as director of GALCIT. Kármán and his colleagues made fundamental contributions to turbulence theory, unsteady airfoil theory, transonic aerodynamics, shock-wave boundary layer interaction and proposed the slender body approximation in supersonic flow.

Another significant development was the initiation of the study of rocketry that eventually led to the formation of Aerojet, a company concerned with rocket propulsion, and starting of JPL, which has been at the forefront of space exploration. This activity was the result of the drive and enthusiasm of three young people – Malina a graduate student at Caltech, Parsons a self-taught chemist and Forman an amateur rocketeer – and the willingness of Kármán to support them.

Perhaps because of his deep involvement in both the World Wars, Kármán had a world view of things and strived to get scientists from different countries together. He started the International Congresses for Applied Mechanics and the Advisory Group for Aeronautical Research and Development (AGARD). Kármán had a large influence in strategic and technical planning for the US Air Force both during and after World War II. In 1963 Kármán received the National Science Medal from President Kennedy. A few months later, he died in Aachen on May 7, 1963.

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