

## THEODORE VON KÁRMÁN, Honorary Fellow

1881-1963

IN 1956 there was published the *Collected works of Theodore von Kármán*, in four volumes, under the editorship of Hugh L. Dryden, Director of the National Advisory Committee of Aeronautics. In his Preface to these astonishing records of von Kármán's work during the period 1902-1952, Dr. Dryden wrote, "They constitute the printed record of contributions to science and technology of great originality. His penetrating analysis of complex scientific and engineering problems to discern the important and essential elements, his success in subordinating mathematical technique to physical principles by the use of appropriate simple and rational solutions, and his skill in the presentation of the results in clear and logical form have made von Kármán the outstanding aeronautical scientist of our generation."

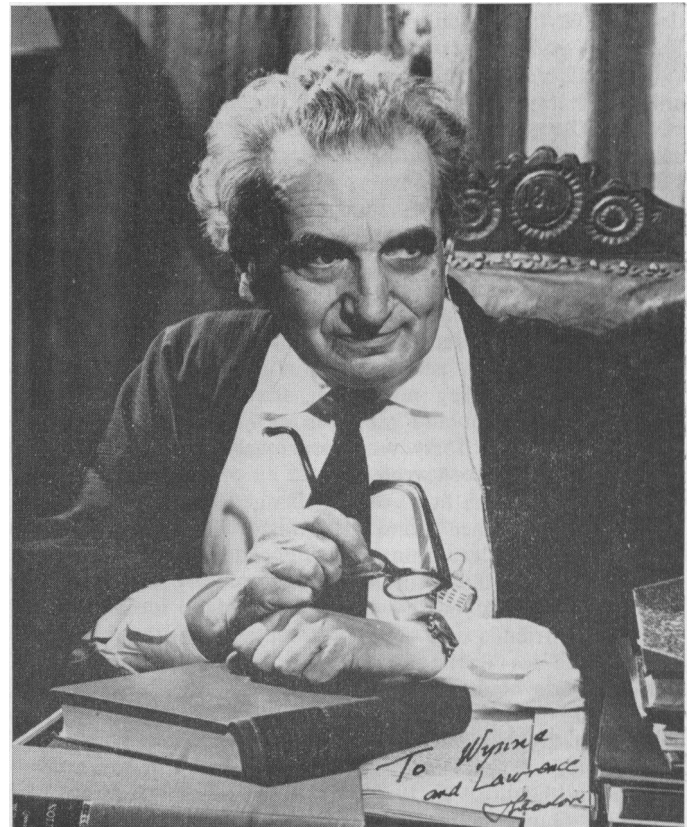
These volumes were originated by the desire of his associates to honour his seventieth birthday. A sixtieth anniversary volume contained an appreciation by his junior colleague, Professor C. B. Millikan, in which Millikan recorded that von Kármán had contributed to applied mathematics, stress analysis, theory of elasticity, especially elastic stability, monocoque structures, vibration, mechanics of ideal viscous and compressible fluids, turbulence, aerodynamics of aircraft, hydromechanics of planing surfaces and heat transfer.

Millikan wrote when von Kármán had still another twenty years to add to his grasp of the swiftly moving advances in science and technology.

Born in Budapest on 11th May 1881, Theodore von Kármán was the son of a leading Hungarian professor of philosophy, Dr. Maurice von Kármán, and of Helene Konn, a woman of great culture and understanding. Hugh Dryden, one of his closest friends, wrote, "From his early days he enjoyed the stimulating atmosphere of his home, an experience which coloured his entire life." In later years von Kármán paid moving tributes to his mother and sister, acknowledging what they had done to make him what he was as long as they were alive.

"He was trained as a mechanical engineer and took his degree with the highest honours at the Budapest Royal Mechanical University in 1902 and became a research engineer," added Dryden. "In 1906 he studied at Göttingen, mathematics, physics, and mechanics and became an assistant professor until 1912. He studied under that great man Ludwig Prandtl, who founded the school of aerodynamics and hydrodynamics. Von Kármán called him 'the father of modern aerodynamics', a term applied to himself in after years."

"How far Prandtl's work at Göttingen had been influenced by Lanchester's ideas in the development of his own theories was an often discussed question," recalled von Kármán in the First Lanchester Memorial Lecture delivered before the Society in 1957. "I was a graduate student at the University when Lanchester visited Göttingen for the first time. Lanchester had much closer relations with Carl Runge, Prandtl's colleague in applied mathematics, for the reason that Runge spoke perfect English." Prandtl himself, in his Wilbur Wright



Ben Olander, photographer, "Pasadena Star News"  
Dr. Theodore von Kármán. A photograph taken in his home in Pasadena, California in 1954.

Memorial Lecture in 1927 said, "In England you refer to it as the Lanchester-Prandtl theory, and quite rightly so, because Lanchester obtained independently an important part of the results." Von Kármán paid high tribute to Lanchester in his lecture, saying, "We (in Germany) were able to draw many useful ideas from his book."

Von Kármán read the Wilbur Wright Memorial Lecture himself in 1937 on Turbulence. Professor R. V. Southwell, proposing the vote of thanks, recalled that when in Ann Arbor in 1935 he saw von Kármán doing what he thought had never been done before in public, namely keeping a cigar and a cigarette going simultaneously at full blast and added, "I hope von Kármán would not think he was being treated disrespectfully, because so far as is consistent with affection I do really hold him in reverence."

Von Kármán could laugh at himself (a true test of a real sense of humour) and often told of occasions when there was nothing else to do but laugh. When he delivered the Lanchester lecture he began by saying, "It is a great pleasure

for me to recall my personal contacts with this great man," and he ended his lecture:

"Finally, a casual personal remembrance. After I met Lanchester several times in Göttingen in 1908, I saw him in Cambridge on the occasion of the Fifth International Congress for Mathematics, where I made a short contribution concerning the vortex trail, whose name I have the honour to bear. Lanchester made a point of showing me the sights not only in Cambridge but in the environs, for example the Cathedral of Ely. He drove an automobile with a speed which appeared to me excessive in view of the rather narrow winding country roads. We discussed aerodynamics. I was at that time more used to riding in one-horse buggy cars than in automobiles and meekly expressed my worry about his speed of driving. He looked at me and only said, "I am surprised. I thought your name was car-man."

In 1912 von Kármán was appointed professor of mechanics at the technical high school at Aachen, and while there became Director of Aerodynamics. At Aachen he and his assistants covered the entire field of applied mechanics and concentrated especially on aerodynamics. Von Kármán took an especial interest in turbulence. He was an outstanding teacher and one of the greatest interpreters between the mathematician and the engineer. Under his guidance Aachen gained an international reputation, due largely to his own contributions in the aeronautical sphere.

In 1955 the students and associates of von Kármán at Aachen published a tribute to him in the form of selected papers on engineering mechanics, first class papers written out of sheer delight and gratitude of having been taught so well by him, some forty years previously. In the preface to this tribute the editors wrote,

"Aachen was the first great challenge which Theodore von Kármán had to face alone. He was well equipped for the task; a crystal clear mind, equally adept at analysis and synthesis; a depth of intuition possessed by few men; an abundant generosity with which he passed on ideas and suggestions to friends and collaborators; and an amiability and an aptitude for dealing with his fellow men which earned him many devoted friends."

In 1924 he inaugurated the Congress of Applied Mathematics in Delft. That year Robert A. Millikan met von Kármán. Two years later he cabled asking him to come to America to lecture. In 1930 he was appointed the director of Caltech's Guggenheim Aeronautical Laboratory. In 1936 he became an American citizen and eight years later was advising the U.S. Air Force on jet propulsion, supersonic aerodynamics, electronics and so on. The following years the U.S. Air Force asked him to make a study of what the Air Force should be for future defence. His answers have made it the most powerful air force in the world. In 1952 he became head of the Advisory Group on Aeronautical Research and Development (AGARD) for NATO.

This is the barest outline of the spheres of von Kármán's activities. His published papers and lectures are themselves but an outline of his achievements. Some day when the Spectre of Secrecy ceases to raise its ugly head there will be released information of so much that von Kármán suggested and saw carried out on behalf of the defence of the West. It is because of that that the first recipient, in February 1963, of the newly founded U.S. National Medal of Science was von Kármán.

During his long career he received the highest honours from the great universities and educational establishments of the world and honours of the leading scientific and technical societies. He became an Honorary Fellow of the Society in 1948 and was awarded its Gold Medal in 1942.

His Wilbur Wright Memorial Lecture in 1937 on Tur-

bulence was one of the most remarkable lectures in the whole series of these lectures by the most eminent aeronautical research workers in aviation. I shall not forget him saying to the audience of engineers and scientists, "They should remember that if we meet a practical question in aeronautical design which we are unable to answer, the reason is almost certainly that it involves turbulence." It is almost as certain that von Kármán did more than most men to provide the answers. To this day the long succession of vortices from the wing of an aeroplane is known in England and America as Kármán's Vortex Street; in France as Avenue de Kármán; and in Germany as the Kármán Strasse.

Von Kármán did not claim to have discovered the vortices. "They were known before I was born," he wrote. "A French professor, Henri Bernard, did a great deal of work on the problem before I did. He was somewhat jealous because the vortex system was connected with my name and several times claimed priority for earlier observation of the phenomenon. In reply I once said, "I agree that what I did in Berlin and London is called the Kármán Street. In Paris it shall be called Avenue de Henri Bernard."

On his first visit to America in 1926 he lectured at a number of universities, including Caltech, Stanford and Massachusetts Institute of Technology. When he lectured at M.I.T. in the November of that year he was told there would be a dinner of thanksgiving. He recalled that he knew he had a considerable reputation in Europe, but he had hardly expected that he had achieved as high a fame in the United States. "To my chagrin," he said, "I learned on the following morning that Americans have this day of Thanksgiving every year!"

That first visit he recalled in another story. When the ship arrived he was interviewed by the New York press and asked by a reporter what was the real object of his visit, and replied, "To visit your country's laboratories." He recalled, "I happened to look at the reporter's notes and saw that he had written 'is visiting lavatories.' I told him that although this, too, was necessary, it was not the purpose of my trip. I did not speak so well then the English. I do not speak so good, now, but it is better, yes?"

He spoke and wrote English much better by 1955 when he paid a fine tribute to the work of the Royal Aircraft Establishment on the occasion of its 50th Anniversary.

"The year 1955 sees the Fiftieth Anniversary of Farnborough, an institution which has had far-reaching influence on the development of aviation, not only in Great Britain, but throughout the world," he began his tribute. He was then the Chairman of AGARD. He ended his tribute, "A few years ago as I arrived at London Airport shortly before the Farnborough Air Show, the Immigration Officer asked me about the purpose of my visit to England. I replied, 'I came to see whether the British airplanes are as good as they say they are.' 'That means you are going to Farnborough,' he said. After a pause of several seconds, he continued slowly, but in a tone of firm conviction, 'Of course they are,' and gave me back my passport. The fact that he was right is due to no small extent to the well-directed and highly competent work done at Farnborough."

Von Kármán was often a little difficult to follow, to say the least, and one was sometimes not fully aware of what he was saying in Hungarian, German, French, Spanish, Italian, English, or other languages which he spoke easily or was in the process of picking up. Much of his work in aeronautics involved visits not only to Europe and America, but Russia, China and Japan. Often when he was speaking rapidly he would use a foreign phrase as being more expressive than English, not being always aware of what he had said. Once, for example, when lecturing at Caltech he spoke for half an

hour before he realised he had been lecturing in German to the American engineering students!

Writing of Caltech reminds me that in 1955 von Kármán took the Chair when I lectured there, and what he said about me to the engineering students, who looked upon him as a kind of Delphic oracle, was such that they would listen to whatever I had to say, even if it were only an American version of the Greek alphabet! The following day I spoke at the University of California and von Kármán unexpectedly turned up from Pasadena and introduced me for a second time. I felt myself immensely honoured. But he was like that and gave so much to so many out of the kindness of his heart. Truly he could talk with first-class minds and yet imbue those with lesser abilities that they could be great on occasion.

Von Kármán was a unique phenomenon, not only as an engineer, a research worker in theory and practice in structures and fluid mechanics, but as a man of the world, at ease in any company, in any country. He was a master of the present and a prophet of the future in science and technology, and a well-grounded student in the history of progress in science and technology over the ages.

His fame was such that he was called in by the industrial giants to advise on how to solve some of their problems. When, for example, in 1940, the famous suspension bridge crashed into Washington's Tacoma Narrows, he was called in by the American Government to join the Committee to investigate the disaster, a Committee of leading bridge designers and engineers. "I only represent the wind," he declared, and pointed out that if the bridge was rebuilt in the same way, as it had been suggested, it would break up in the same way when there was a bad wind. He pointed out that the cause was the eddies of the wind caused by the way the bridge was designed. "I explained this years ago, but bridge builders did not believe they could break such a big thing as a bridge." He suggested the form of construction for the new bridge, and became known afterwards as "The Man who tamed the Wind!"

In his book *Aerodynamics*, from an historical development point of view, von Kármán pointed out that some branches of theoretical physics "lend themselves to speculation on the origin and true nature of the universe, others to the questioning of philosophical beliefs. We aerodynamicists were always more modest and did not attempt to change basic beliefs of the human mind or to interfere with the business of the good Lord or Divine Providence!"

He could make things sound easy of explanation, however difficult they were. "One can make a bird stall if one has some knowledge of aerodynamics," he once declared. "I have often tried to do this with seagulls on the shore of Lake Constance. I had bread in my hand and as the birds tried to get it I slowly withdrew my hand. Then the birds tried to reduce speed to get it, which required an increased lift coefficient. Several times, apparently, the birds exceeded the critical angle of their wings and stalled."

He noted also that the most evident thing in the history of flight during the past fifty years was mankind's yearning for speed. "We often hear of speed records but seldom hear anyone question why it is necessary to travel so fast. Who knows whether it is necessary to travel so fast or whether the world would not be happier without the great speeds at which we now move." He expressed the opinion during one of his lectures I was listening to in New York in 1955 that the noise of jet engines must be reduced, if not wiped out altogether.

Von Kármán's reply to a question on an aircraft spinning was as masterly as that of some politicians at question time in Parliament. "I once met the famous British aviatrix Amy Johnson at a so-called conversazione of the Royal Aeronautical Society, where the problem of spin was discussed by

British and American engineers and scientists. She came to me and asked 'Can you tell me in a few words what causes a spin and what is the mechanism of the thing?' 'Young lady,' I told her, 'a spin is like a love affair; you don't notice how you get into it and it is very hard to get out of it.'

The great tragedies of von Kármán's life were the deaths of his mother and his sister. He was devoted to both, as they were to him. His mother was exceptionally understanding and kind. His sister Josephine was highly intelligent and capable, and protected her brother constantly. When he published his book *Aerodynamics* he paid a loving tribute to her in his dedication: "To the memory of my sister Josephine de Kármán, whose devoted companionship secured for me the peace of mind necessary for scientific thinking."

She was as great a personality in her own right as her brother. They were the most remarkable and astonishing brother and sister in their devotion to each other whom I have ever met. She took a degree in the history of art at Vienna University and became an authority in Spanish painting and art. After her death in 1951 her brother paid for the publication of a series of volumes on the lives of great Spanish painters and sculptors, dedicated to her memory. In America she was for some time a lecturer in the French Department of the University of California and the author of a book on early Christian art.

I met her in London, in Paris and in New York. She was a daughter of the world's capitals. I was the stranger, but instantly there was a friend, voluble, alive, effervescent, responsive, intensely vital, interesting and interested to a degree which one could never forget when once experienced. And so was her brother. In any mixed company he was the centre of attraction to all the women, entertaining them with his reminiscences, his compliments and his challenges. So much of this he owed to his early bringing up in a household full of interest in everybody and everything. In the home of herself and her brother she brought back the atmosphere of the great salons of the past and made friends with many non-technical people for her brother's sake.

There are many great ladies in aviation. There are many great personalities. Josephine de Kármán was a great lady and a great personality who will be missed for many a long day and in many countries. . . . like her brother.

Once when asked to define a Hungarian, he replied, "He is a man who goes into a revolving door behind you and comes out ahead!"

He was very much ahead in so many ways that it will take another generation to catch up with him and for scientists and engineers to assess his achievements and suggestions in the spheres of mathematics and engineering. I have been fortunate to have known him for some thirty years and also to have been a close friend during those years of one of his brilliant pupils at Aachen. I have received many kindnesses from him. He was a man of the world, of women, wine and song in the best meaning of those words, for he understood human nature and social amenities to an extent which left all those who knew him well feeling better for having known him.

In reviewing the tribute by former students and associates of von Kármán at Aachen I wrote in the review, to pay my own tribute at the time to the man who "provides me with a perennial proof of the true philosophical content of the human mind. I use the word philosophy in the same sense as put on it by Bertrand Russell, as No Man's Land between those things amenable to scientific investigation and those apparently not."

And now he has gone and I shall not see his like again.

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