Memories of Kármán

The death of Theodore von Kármán in May came as a painful shock to his great host of friends. In the present age of rapid increase in our material resources and our technical knowledge, it becomes increasingly difficult for any one man to keep up with recent developments even in a comparatively small field of science. For a man to remain an inspiring leader of scientific thought and endeavour for 50 years or more, as Kármán did, is so remarkable that our editors have asked me to give a brief appreciation of his work.

Kármán was essentially an engineer whose thought extended over the whole range of engineering science. Though actively concerned with very large engineering projects he never ceased probing into the science which lay behind them or speculating on their future effects on mankind. If the word broadminded were not so frequently misused in describing well-intentioned people with extensive, but often shallow, knowledge I would describe Kármán as the most broadminded and the most deepminded engineer of his generation. His quality appears even in his earliest paper published in Hungary when he was still at the Technical College in Budapest. This was really a student's exercise and described the falling of a round-ended rod standing on a table. Most of us would think this a rather unpromising subject but Kármán extracted a surprising amount of interest from it, and made it a vehicle for some good mathematical analysis. After a few years with an engineering firm Kármán went to Göttingen in 1906 where he came under the influence of Prandtl and started working on both the main subjects of his early scientific interests, fluid dynamics and the mechanics of solid continua. In his first work on elasticity he showed how the engineer's rules for calculating the strength of slender columns is related to Euler's theory of the collapse of an idealized strut. This paper is interesting because it reveals so clearly Kármán's early engineering training in which empirical formulae played so prominent a part. Here he shows that the mathematician's idea is not so useless as some of his fellow engineers then believed, provided proper account is taken of the limitations which the theoretician is forced to accept. In the course of his life Kármán seemed to become more and more interested in ideal models from which practical detail had been omitted in order to expose the underlying physical principles involved. This seems to me to be one of the ways in which Kármán has exerted so great an influence on engineering science.

It was during his career in Göttingen that he developed his completely idealized 'Kármán Street' model of hydrodynamic resistance and showed how it is connected with what is observed in a water stream. In Göttingen also he collaborated with Max Born in calculating the vibrations of lattices and tracing their connexion with specific heat. During this period his natural mathematical ability developed into a powerful tool which he used so successfully for the rest of his life.

In 1912 Kármán went to Aachen where he started the Aeronautical Institute which rapidly became very famous and attracted students from all over the world. It was there I think that he developed his organizing ability. This did

not take the form of making him a good organization man. I do not believe he was ever particularly skilled at the details of organization, but he seemed to have an instinct for seeing what problems were likely to be important from the engineering point of view, which had intrinsic intellectual interest and which of his students were likely to make a success of them.

After service with the Austro–Hungarian Aviation Corps during World War I he returned to Aachen, but the enmities raised during the war had a profound effect on him and he spent much time and effort in promoting international co-operation in science. One of the first fruits of these efforts was the starting of the International Congresses for Applied Mechanics. After a preliminary private meeting at Innsbruck in 1922 the first Congress was held in Delft in 1924, Biezeno and Burgers being secretaries. These Congresses have had a most beneficial influence on applied mechanics as well as on the scientists attending them, particularly on scientists from countries whose political systems tended to isolate them from their colleagues.

At the Congress meetings Kármán always played an important role. As a Hungarian he was able to stand outside the national rivalries of French-, English- and German-speaking members, which sometimes arose, and with his ready wit and ability to point out absurdity and inconsistency in an argument without hurting the feelings of the man who produced it, he was an ideal chairman. In this I think he was helped by his skilful use of what he described as his bad English, which gave an international flavour to everything he said.

During the period 1920–30 most of his effort was devoted to his Aachen Institute and his pupils, but some striking results of his own were published. To this period belong his turbulent boundary-layer momentum equations and his logarithmic law for skin friction. The description of the laminar boundary layer on a rotating plate and of the mechanics of the rolling process in producing sheet metal were also published.

In 1930 Kármán became Director of the Guggenheim Aeronautical Laboratory at Pasadena, California. Among the earliest products of his work with American students was his paper with N. B. Moore on the resistance of slender bodies at supersonic speeds. This was a pioneering study and was followed by papers from aerodynamicists all over the world. In 1937, following my own simple studies of the statistical theory of turbulence, Kármán and Howarth showed how the theory could be much extended and in many papers written since World War II he has extended and expounded this work.

It was, I think, shortly after he went to California that Kármán's great prestige began to be recognized among people who were not mechanical scientists. He was exceedingly quick at seeing and replying to points raised in discussion of unscientific as well as scientific subjects, and he was able to express his thoughts on technical matters in an attractive way which non-technical people could understand once they had mastered the initial difficulty of interpreting his English. His advice began to be sought by government departments as well as by industrial concerns not only for its great scientific merit but also because they felt sure of its absolute integrity and because it was often expressed using apt illustrative analogies in a form which they could appreciate.

In California, I think less of his time must have been absorbed in administrative duties than it was in Aachen, for he obviously read very widely and the reviews which he published of the then existing state of knowledge were particularly valuable. They must have helped considerably in spreading his reputation.

Kármán was always an entertaining lecturer and sometimes he chose subjects of great general interest. One which he wrote with G. Gabrielli in 1950 had as its title 'What price speed?'. In it he compared all kinds of self-propelling objects from pedestrians to battleships using logarithmic diagrams representing horse-power per ton against speed. He found that there is a line with slope 2 to 1 above which all the curves lie and at their most efficient working the curves of the most efficient vehicles nearly touch this line.

Of Kármán's work for government agencies and industry I cannot write with authority, but the fact that he was chairman of the U.S. Air Force Scientific Advisory Board indicates the trust which the Government of his adopted country placed in him. He never retired from active work, and his later years were devoted more and more to international activities. He founded AGARD, the Advisory Group on Aeronautical Research and Development within NATO, and presided over its activities, spending most of the year at its headquarters in Paris. Though the word aeronautics appears in its title, its activities spread over a much wider field. It organized, for instance, scientific meetings on subjects which are developing rapidly; aerodynamic noise and combustion are examples. One of Kármán's last activities was to help in founding the International Academy of Astronautics of which he became Director.

It would require more literary skill than I possess to convey to those who did not know Kármán an impression of the delight and stimulation which his presence among us always called forth. We mourn the loss of an unselfish, wise and entertaining friend, and of a great citizen of the world.

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