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Red. 1956

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uitgesproken op 17 september 1956 ter gelegenheid van de erepromotie van

Dr. Th. von Kármán

door de promotor **Dr. C. B. Biezeno**



Dear Von Kármán,

Appointed by the Senate of our Technological University to address you in this ceremonious session to expound the reasons which led us to confer upon you the highest token of scientific esteem and respect of which we dispose, it is my first duty, – and a great personal pleasure – to bid you a most cordial welcome in Delft, no unknown territory to you, which has lodged for many decades – in fact since the beginning of your remarkable career – an ever increasing number of your admirers. By way of introduction to what I want to say this afternoon, I may start with the paradoxical remark, that the idea to honour you was accompanied by a serious doubt, whether our doctorate could be granted to you. If a testimony of this kind has to be pronounced at the end of an academic examination, the poor examinee, if not altogether deprived of self-esteem, will in his heart of hearts rather wish to fail, than to pass his exam in such a poor way (though in my experience such a wish has never been pronounced). It will be clear however to everyone present here, that considerations of quite a higher and different standard prevailed during the discussions about your honorary degree. The disadvantage of the doubt – if I may coin this new expression – as apposed to the „benefit” of the doubt, – did not lie with you, but with our Senate, whose judgment was seriously hampered by the doubt whether their „candidate” was not above their praise. No fewer than 15 honorary degrees had already been conferred on you, coming from America, Belgium, Germany, France, Israel and Turkey, and it might well be asked if a new one could possibly evoke any real satisfaction in the recipient, and would not – on the contrary – give rise to the reproach – though certainly never uttered by you – that with the offering of our homage we were lagging rather far behind others.

If we agree with La Rochefoucauld, whose maxim it was that „la racine de toute action humaine est l'égoïsme”, it cannot be denied, that every act of admiration contains at least an element of self-glorification. However well-meant the act may seem, it nevertheless finds its roots in the gratifying consciousness of being able to judge of the importance or greatness of an outstanding personage and in the self-assumed right to recognition of this judgment. Far from condemning these two traits of human character, which – kept within the bounds of reason and sentiment – can also be looked upon as contributions to human understanding and happiness, it nevertheless may be desirable to analyse in what measure they have influenced the decision of our Senate.

No bestowal of an honorary degree is in our opinion justifiable if not the University itself can point to self produced work, from which it may at least be hoped, that it has found some appreciation on the part of the recipient. From this point of view my task could not have been easier. Without doing an injustice to any of our colleagues working in the field of mechanics, I may restrict myself to drawing your attention to your life-long friend J. M. Burgers, whose work would have sufficed to make the University of Delft – confining myself for a moment to the mechanical field – a wellknown institute all over the world. Had not an unbridled desire for extensive knowledge and for a wider outlook on human relations deprived us of one of our prominent scientists, you would have enjoyed at this moment the speech of a far more competent promotor. The loss you are suffering by his no longer being a member of our Senate, is at least to some extent made good by his presence here, which I venture to say will be as highly appreciated by you as by his former colleagues. A glance at the list of honorary degrees, awarded since 1906, the year in which our University was raised to its present status suffices to show how sparingly and with what caution our Senate has made use of what

it regards to be its highest prerogative. The list records in all only 43 persons, no more than 16 of whom are still alive. The reading of their names revives our gratitude for what they were and what they did, and stimulates our pride that their names are lastingly connected with the name and let us hope the fame of our University. Nevertheless it seems strange, that – with only one exception – no foreign scientists are to be found in our list of honour, so that with some malevolence the remark might be made, that seemingly our scientific horizon is limited by our Dutch frontier. The broad point of view which our country as a whole has always taken in genuinely admiring foreign achievements, may be a warrant that our University too is well aware of the great debt it owes to foreign science and culture. Its natural shyness to bear witness of these feelings in an official manner could in no happier way be overcome than by paying high tribute to a man of universal and indisputable reputation in the field of a basic engineering science: the vast domain of theoretical and applied mechanics. It is gratifying that our appeal to you has been answered in a way too flattering for our University to be repeated here. It may find its fitting response in the assurance that it is we that feel ourselves honoured by the connection of your name with that of our Institute.

A complete survey of your work, your personality, and your relations with scientific, industrial, and governmental institutions would require considerably more time than is available in this session. Tempting as it would be to analyse parts of your scientific work, it is imperative that I restrict myself to a superficial review. May I ask you then to be the willing victim of this superficiality which in its essence is due to the fecundity of your activities. From a restricted point of view I could confine myself to your purely scientific work, but doing so, I should again be left with an insurmountable task even if I should only be permitted to read the

titles of your 130 publications. They cover a field of enormous extent and relate to all the various branches of applied mechanics. In their great majority they bear on fundamental questions, and excel in clearness and directness. In addition it must be stressed, that even the *earliest* publications are of a classic nature and evoke the admiration of everyone who reads them nowadays in their original wording. They also testify to the diversity of your interests, and suggest that from the beginning you wanted to claim the *whole* field of mechanics as your sphere of action. Three of them at least must be mentioned separately:

firstly your dissertation entitled: *Untersuchungen über Knickfestigkeit*, printed as nr. 81 in the „Mitteilungen über Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, ins besondere aus den Laboratorien der technischen Hochschulen, herausgegeben von dem Verein deutscher Ingenieure.” It answers (in the affirmative) the question whether the well-known formula of Euler, valid for columns, centrally loaded and buckling within the elastic range of the material can be used as well for buckling phenomena, occurring in the non-elastic range by replacing the modulus of elasticity by a well-defined substitute,

secondly the remarkable paper (written in collaboration with A. Haar) to be found in the „Nachrichten der Gesellschaft der Wissenschaften zu Göttingen 1909”, being a fundamental contribution „zur Theorie der Spannungszustände in plastischen und sandartigen Medien” to which reference is made in all treatises and books, on the theory of plasticity, thirdly the papers relating to „dem Mechanismus des Widerstandes, den ein bewegter Körper in einer Flüssigkeit erfährt”, published in the „Nachrichten der Gesellschaft der Wissenschaften zu Göttingen, 1911 and 1912 and in the „Physikalische Zeitschrift 1912” (the latter paper being written in collaboration with H. Rubach). The last mentioned papers put you at once in the limelight of the international scientific

amphitheatre and perhaps it will impress you even forty years after the event, that our greatest physicist, H. A. Lorentz with all the weight of his authority paid his tribute of appreciation for your work in a magisterial lecture on hydrodynamical topics delivered to the „Koninklijk Instituut van Ingenieurs”. This lecture, unique in its construction and its lucidity, characterised by a seeming simplicity and a winning charm which were Lorentz’ personal secrets, found its culmination in the description of what is now universally called the Kármán-street, bordered by two neatly arranged rows of vortices. The afternoon of 12 December 1914 has always remained a landmark in your promotor’s experiences and it marks the hour in which the desire to make your personal acquaintance began to force itself on him. Little did he think then how many times he was to meet you later on and to what inspiring influence he was to be subjected in pursuing, together with Burgers, an ideal of yours about which I shall speak within a few minutes. For the present however, I will continue my survey of your scientific production.

Without going into détail I must first of all give some attention to your papers on „die Bedingungen des Bruches und der plastischen Deformation, ins besondere bei quasi isotropen Körpern; Festigkeitsversuche unter allseitigem Druck; die mittragende Breite versteifter Platten, die Theorie des Walzvorganges, elastische Grenzzustände, die Berechnung freitragender Flügel, the strength of thin plates in compression, the buckling of spherical shells by external pressure, the influence of curvature on the buckling characteristics of structures, the buckling of thin cylindrical shells under axial compression, to mention only a few of those 40 papers which are devoted to elastic or plastic problems. Your two brilliant contributions to the „Encyclopädie der Mathematischen Wissenschaften” on „Festigkeitsprobleme im Maschinenbau” and „physikalische Grundlagen der Festigkeitslehre” have won you the gratitude of all your

colleagues, and your book, written in collaboration with Biot on Mathematical methods in Engineering translated as it has been into French, Spanish, Portuguese, Italian, Turkish and Japanese, is in the hands of all advanced students and young scientists in the field of mechanics. Your Willard Gibbs lecture delivered to the American Mathematical Society under the suggestive title „the Engineer grapples with non-linear problems” has had a most stimulating effect, and is an outstanding testimony of your pedagogical gifts.

And yet, all this valuable work has been surpassed by your numerous contributions to the field of hydro- and aerodynamics.

Going through their list one is at a complete loss, which of them to single out from the more than 60 papers which all relate to a most inhospitable domain of physical and mathematical difficulties. Here, even more so than in the other domains your specific gift comes to the fore, to isolate essential parts of a problem, to neglect all unessentials, to search, guided by a rare intuition, for approximate solutions and to set up at the end of the investigation control calculations with respect to initially neglected terms. Having been an assistant of Prandtl in your Göttinger-time it is not surprising, that you were tempted by his boundary-layer equations which you attacked in such a brilliant way. And of course you have time and again been challenged by that intricate problem, which intrigues all aerodynamists. Evidence of this is given by the numerous papers bearing on this subject, some few of which may be mentioned here: Über die Stabilität der Laminarströmung und die Theorie der Turbulenz (Proc. First Intern. Congr. Appl. Mech. Delft, 1924), Mechanische Ähnlichkeit und Turbulenz (Proc. Third Intern. Congr. Appl. Mech. Stockholm, 1938), Some aspects of the Turbulence Problem, (Proc. fourth Int. Congr. Appl. Mech. Cambridge Eng., 1944), On the Statistical Theory of Turbulence (Journal Aero. Sci. 1937), On the Statis-

tical Theory of Isotropic Turbulence (with Howarth) (Proc. Roy. Soc. Lond. 1938), Some remarks on the Statistical Theory of Turbulence (Proc. 5th Int. Congr. Appl. Mech. Cambridge Mass. 1938), On Laminar and Turbulent Friction (N.A.C.A. Techn. Mem. 1946), On the concept of Similarity in the theory of Isotropic Turbulence (with C. C. Linn) (Modern Physics 1949). Manifold other topics, however, have engaged your attention: Stability of aeroplanes, resistance problems of ships, windtunnel problems, problems of flow in compressible fluids, supersonic aerodynamics, and many others, some of which are of a specific physical nature. With unstinted generosity you contributed to anniversary books, dedicated to some of your colleagues, one of whom is highly in your debt for your article on the thermal theory of constant pressure deflagration, written in collaboration with G. Millan. Contributions in book-form were given by you in the Durand Edition under the title Perfect Fluids, in collaboration with J. M. Burgers, in „the Advances in Applied Mechanics” initiated by R. von Mises, and in the Selected Topics in the light of their historical development (New York 1954).

I now want to draw the attention of my audience to quite another activity of yours, the influence of which on our professional world can hardly be over-estimated. I allude to the Conference of Innsbrück in 1922, convened by you and your friend Levi-Civita, to enable a restricted number of scientists to compare in an unrestrained and quite informal way their results and general thoughts. Two still living participants present at that meeting, are in this room: Thijse and Burgers, and their thoughts, in unison with yours, will doubtless go back to those happy days, where, after the pestilence of world-war I, free intercourse became possible and international friendship and new idealism revived. – It is not astonishing that after the inspiring success of the Conference, your restless mind became preoccupied by the much broader scheme to call forth an inter-

national Congress which would not restrict itself to Aero and Hydrodynamics but would cover the whole field of applied mechanics. With a view to the still prevailing national controversies, delicate consideration was required as regards the place of gathering and no less the choice of an international Committee of sponsors that could be expected to find universal international confidence. Delft became the selected place and from that moment on a never failing cooperation, a never fading friendship arose between you and Burgers and myself. The success of the Congress, though guaranteed beforehand by the names of its sponsors: Ames, Bairstow, Bjerknes, Coker, Forchheimer, Griffith, von Kármán, Levi-Civita, von Mises, Oseen, Prandtl, Southwell, Stodola and Taylor, surpassed every expectation, and no higher tribute to your brilliant initiative can be paid than by a remembrance of the series of Congresses, which every fourth year were held in Zürich, Stockholm, Cambridge (England), Cambridge (U.S.A.), Paris, London, Istanbul, and but a week ago in Brussels, and which will regularly be continued.

Your great ability to solve intricate physical problems, your technical feeling, your organising power and your amiable personality have made you the vademecum of hundreds of persons, and the adviser of numerous institutions and governments. Once again I have to restrict myself to a mere summing up which, for all its simplicity will yet be impressive enough.

After having built between 1912 and 1930 the Aachen Institute into a world-renowned research institute and having interrupted your activities there by a visit to the Massachusetts Institute of Technology as a guest lecturer, and by a visit to Japan, where you designed the first wind-tunnel, you went, in 1930, to the U.S.A. for good and all, where your stimulating influence made itself at once noticeable in many directions. Already in that same year two of your co-workers Troller and Wattendorf

were indicated to design and supervise under your final responsibility the construction of the newly-authorized Daniel Guggenheim Airship Institute. In 1936 you were engaged in the design and supervision of the first two wind-tunnels in Peiping, China, where Dr. Wattendorf started the work in 1936 and where in 1937 this work had also your personal attention. In 1930 you were appointed Director of the newly established Guggenheim Aeronautical Laboratory, and in this function you have exerted great influence on the aeronautical sciences in the U.S.A. The Institute itself soon enjoyed a world-wide reputation, and attracted numbers of excellent scholars. In 1932 you were one of the founders of the American Institute of Aeronautical Sciences. In 1937 you were selected to give the Wilbur Wright Lecture, an honour which is only bestowed on prominent American scientists. In 1932 you advised the United States military forces to assign young officers to your Institute for advanced studies thereby greatly promoting the scientific development of these services.

In 1944 the Chief of the Army-Air-Forces invoked your help to advise him on future developments in the conquest of the air, and since then you have more and more occupied yourself with questions of primordial significance for mankind. From the excellent biography by Wattendorf recently published in the Zeitschrift für Flugwesen, we learn that a NATO conference, attended by a number of its leading NATO research Directors, appointed you as chairman of the Advisory Group for Aeronautical Research and Development, known as the A.G.A.R.D. The problems of international organization at which A.G.A.R.D. aims foreshadowed considerable difficulties, so that provisionally a trial basis of two years was fixed. As was to be expected your new experiment in international scientific cooperation has proved to be a great success, and earns, as we learn here from our colleague van der Maas universal appreciation. The

value, which our country attaches to your international work recently found its symbolic expression in the high order which it pleased our Majesty the Queen to confer upon you.

In the foregoing no mention has been made of peculiarities connected with your personal habits, your jokes or your witty remarks. They are not in keeping with the level on which you had to be considered *here*. Nevertheless I may revive one of your remarks, made at a banquet in Madrid, where to my good fortune we were both asked to lecture at the Institute of our mutual friend Terradas. It was after having heard several speeches in foreign languages, that you confessed you could follow an orator best, if he expressed himself in another idiom than his native tongue, exception being made of course for the Hungarian language; at any rate – you added – it was chiefly those parts of the Spanish conversation of that evening contributed by non Spaniards that had been understood by you. Remembering this remark – which was met with general laughter, because it stressed clearly enough the fact that a language can never be spoken quite correctly by a foreigner – and being no Hungarian – I thought it appropriate to address you in a language foreign to both of us. If lack of fluency in my address could be compensated by your capacity and readiness to detect the underlying admiration and friendship I would feel appeased and freed from the reproach that I did not speak to you in Dutch. Nevertheless I would do wrong to avoid this language altogether. Not only that this would mean underrating your well-known linguistic gifts – it is said that you understand no fewer than 7 languages – it would also invalidate the value and the dignity of our own language, in which everything worth saying *can* be said in quite a clear way, and which to renounce would affect the very roots of our national consciousness.

Therefore my last words may be spoken in my mothertongue:

Hooggeachte von Kármán: De betekenis van de onderscheiding, die U heden ten deel valt, moet stellig niet in de eerste plaats gezocht worden in het feit, dat Gij ze zo dadelijk zult ontvangen uit handen van een vriend, die Uwe wetenschappelijke en maatschappelijke levensgang in zijn geheel en met de grootste bewondering heeft gadegeslagen, doch in het feit dat het initiatief ertoe werd genomen door Uw vakgenoten in de gezamenlijke Afdelingen der Werktuigbouwkunde, Scheepsbouwkunde en Vliegtuigbouwkunde. Het is in de eerste plaats de *nieuwe* generatie, die haar eerbied voor Uw werk tot uitdrukking heeft willen brengen, in het scherpe bewustzijn van de betekenis die dit werk ook in de toekomst zal blijven behouden. Uw oude Delftse vrienden, Burgers en ikzelf, hopen door hun onderwijs en hun houding wellicht iets tot het ontstaan en de groei van die eerbied te hebben bijgedragen.

Bij het tot uiting brengen van bewondering voor een mens is het altijd moeilijk een grens te trekken tussen wat in zijn werk als een wonderlijke schikking van de natuur moet worden aangezien, en wat, voor zover wij daarover een oordeel kunnen uitspreken, als menselijke verdienste. Voor een man van statuur is het onmogelijk voldoening te putten uit een persoonsverheerlijking, voorbijgaande aan het feit, dat – om een man van betekenis te kunnen worden – de natuur vooraf een scheppende invloed moest doen gelden, waaraan hijzelf geen verdienste kan ontlenen. De lof, bewondering en dankbaarheid van anderen kan echter ten volle en met recht aanvaard worden door hem, die met inspanning van al zijn krachten de hem geschonken gaven tot ontplooiing heeft gebracht, en de resultaten van zijn rustloos streven ter beschikking van zijn medemens heeft gesteld.

Naar *die* maatstaf gemeten, wensen, allen hier aanwezig, U van hun hoogachting te getuigen, naar *die* maatstaf gemeten wordt Gij aan de hier aanwezige academische jeugd voorgehouden als een lichtend voor-

beeld, naar *die* maatstaf gemeten heeft de Senaat besloten U zijn hoge waardering voor Uw werk en Uw streven als volgt tot uiting te laten brengen door Uw door hem aangewezen promotor:

De Senaat van de Technische Hogeschool in zijn vergadering van 5 juli 1956, gebruik makend van de hem krachtens de Wet toegekende bevoegdheid, verleent U

Theodore von Kármán

het doctoraat in de technische wetenschap honoris causa met alle rechten door de Wet en gewoonte aan de doctorstitel verbonden op grond van Uw zeer uitstekende verdiensten op het gebied van de technische wetenschap in het algemeen en die op het terrein van de elasticiteitstheorie, de plasticiteitstheorie en de aero- en hydrodynamica in het bijzonder, alsmede op grond van de belangrijke bijdrage, die Gij geleverd hebt tot de internationale samenwerking op dit wetenschapsgebied.

Ik nodig U uit het diploma, door de Rector Magnificus en de Secretaris van de Senaat ondertekend, en met het grootzegel van de Senaat bekrachtigd, wel te willen aanvaarden.

De jongste Doctor heil!