In Memoriam
Warner Tjardus Koiter

2000:

This special issue of the International Journal of Solids and Structures is dedicated by friends, colleagues and former students to the memory of the internationally famous scientist and teacher, Warner Tjardus Koiter, Professor Emeritus at Delft University of Technology, who died after a long illness on 2 September 1997 at the age of 83.

The papers were invited and edited by an editorial committee consisting of Johann Arbocz, René de Borst and Erik van der Giessen, all from Delft University of Technology.

The wide range of topics, covered by the various contributions are representative of the breadth of scientific interest of Warner Koiter. The papers are also related, as they cover the various interacting aspects of the stability, strength and stiffness that one encounters when dealing with the theory describing the behavior of materials and structures.

Warner Tjardus Koiter was born in Amsterdam on 16 June 1914. He was raised in Zutphen and attended school there. After graduating from grammar school he enrolled at Delft Institute of Technology (as Delft University of Technology was called then) in 1931 and in 1936 he obtained his Mechanical Engineer's degree Cum Laude.

Initially, he worked at the National Research Institute (Rijks-Studiedienst voor Luchtvaart, the forerunner of NLR, the current National Aerospace Laboratory), where under Ari van der Neut he initiated his studies on the buckling behavior of thin-walled structures. This work later culminated in his famous Ph.D. thesis entitled "On the Stability of Elastic Equilibrium", published in Dutch in 1945, the year Koiter obtained his Ph.D. Cum Laude under C.B. Biezeno at the Delft Institute of Technology.

The story goes that the thesis was finished already in 1942, but Koiter refused to publish it in German, the only foreign language that was allowed under the occupation regime. Thus, it was only a decade and a half later, in the early 1960s, that the international scientific community became aware of Koiter's seminal contribution. A humorous incidence occurred at one of Koiter's initial presentations of his work at the Harvard University. His lecture was enthusiastically received, and among the many questions asked there was one inquiry whether the work could be published. Whereupon Koiter became somewhat indignant and answered that the work had already been published in 1945. The first English translation of Koiter's thesis appeared only in 1967.

There are few publications in engineering mechanics that have had such a profound impact on the work of a large part of the scientific community as Koiter's Ph.D, thesis. The thesis provided the stability investigation of elastic bodies with a solid mathematical foundation. Koiter's Imperfection Sensitivity Theory started a completely new branch of engineering analysis. His theory came at the time when the stability behavior of thin walled structures used for the launch vehicles of the military and space programs of the 1960s was a very hot topic. Koiter participated actively in the ongoing research activities and he continued as one of the most influential and leading scientists working on the stability of thin-walled shells for many years.

In 1949, Koiter was appointed Professor of Applied Mechanics at the Department of Mechanical Engineering, with a joint appointment at the Department of Aeronautics of Delft Institute of Technology. He served as Chairman of the Department of Mechanical Engineering 1959-1961. When in the early 1970s the student revolt movement reached Delft, and the established academic order was questioned Koiter left Delft and went abroad. He spent the 1973/74 academic year at the California Institute of Technology in Pasadena, California as a Sherman Fairchild Distinguished Scholar. Meanwhile his friends in the Netherlands, knowing that Koiter would

not return to Delft under the newly established order, succeeded in convincing the Undersecretary of Education and Science to create for Koiter a special Chair of Stress Analysis and Stability of Structures totally outside of the administrative hierarchy of the university. Koiter retired officially in June 1979 when he reached the mandatory retirement age of 65. As Emeritus Professor he continued his research work for many years at the office that he kept at the building of the Department of Mechanical Engineering.

Apart from his already mentioned pioneering work on the theory of elastic stability, Koiter also made important fundamental contributions to the theory of thin shells, fracture mechanics and plasticity theory. His excellent theoretical work and his imposing and absolutely honest personality were recognized nationally and internationally. He was elected member of the Royal Dutch Academy of Sciences (KNAW) in 1959. Koiter participated actively in the work of the International Union of Theoretical and Applied Mechanics (IUTAM), where he was elected successively Bureau Member (1956-1960), Treasurer (1960-1968), President (1968-1972) and Vice-President (1972-1976).

Many foreign academic and scientific associations honored Koiter for his life's work and achievements with a membership. Koiter received several Honorary Doctoral degrees, from the University of Glasgow (1978), Ruhr Universität Bochum (1978), Rijksuniversiteit Gent (1979) and Université de Liège (1986). Further, Koiter was elected honorary member of the Polish Society of Theoretical and Applied Mechanics (1969), foreign honorary member of the American Academy of Arts and Sciences (1974), Mitglied der Deutschen Akademie der Naturforscher zu Halle (1976), foreign associate of the National Academy of Engineering, Washington (1977), honorary member of the American Society of Mechanical Engineers (1980), associé étranger de l'academie des Sciences de l'Institut de France, Section des Sciences Mecanique (1981), foreign member of the Royal Society (1982), and socio straniero Accademia Nationale dei Lincei, Roma (1988).

Koiter was an excellent lecturer. He had the gift of presenting very complicated relationships and dependencies in a concise formulation. His many lectures as visiting scientist or professor at well-known universities such as Brown, Caltech, Harvard, Stanford, etc. will be remembered fondly by those who had the privilege to be present. In recognition of his many seminal scientific contributions, Koiter has been honored already during his lifetime by receiving several of the most prestigious prizes and medals such as the von Kármán medal of the American Society of Civil Engineers (1965) and the Timoshenko medal of the American Society of Mechanical Engineers (1968). Very recently, in July 1996, the American Society of Mechanical Engineers decided to introduce a new prize, the W.T. Koiter medal, to be awarded to a distinguished member of the Engineering Mechanics community. As a sign of great esteem, the society awarded Warner T. Koiter the first medal, which was personally presented to him on 22 January 1997 by Prof. J.W. Hutchinson of Harvard University in a stylish, small, closed ceremony among his family, friends and colleagues. At the end of the ceremony, the ones present could see the "old" Koiter vigorously taking the floor and, in a short speech, thanking everyone for the unexpected honor.

In remembrance of Koiter's work, the Governing Board of Delft University of Technology has created the Koiter Institute Delft, in which the solid mechanics groups of the Faculty of Aerospace Engineering, the Faculty of Civil Engineering and Geosciences and the Faculty of Mechanical Engineering cooperate.

Those of us who were fortunate enough to know Warner T. Koiter in his active days will always remember his skill in modeling complex physical phenomena by relatively simple mathematical equations, which in the end led to surprisingly simple answers. His passing away is undoubtedly a heavy loss for the worldwide Engineering Mechanics Community. - ***Johann Arbocz, René de Borst, Erik van der Giessen***

1999:

WARNER TJARDUS KOITER 16 June 1914 — 2 September 1997, Elected in 1982 as Foreign Member of the Royal Society

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On 2 September 1997, Warner Tjardus Koiter, Emeritus Professor in the theory of the stiffness, strength and stability of structures, died in Delft.

A teacher's son, Koiter was born in Amsterdam in 1914, but grew up and went to school in the town of Zutphen. From 1931 to 1936 he studied mechanical engineering at what was then the Technische Hogeschool Delft (now the Technische Universiteit Delft), where he graduated with honours. His first position was at the former Rijks-Studiedienst voor de luchtvaart (now the Nationaal Luchten Ruimtevaartlaboratorium), where he immersed himself further in applied mechanics and more especially its practical application to engineering under the guidance of A. van der Neut. Koiter spent his evenings working on his dissertation, which he defended shortly after the war, in November 1945—again with honours, with C.B. Biezeno being his supervisor. Koiter had actually finished the dissertation in 1942 but, not wanting to graduate from a university that required a pledge of loyalty to the occupying forces, he waited until 1945. It was published in Dutch because German had been the only foreign language permitted during the war. Another fifteen years would pass before the original text was translated into English, under the auspices of NASA in the USA. At Harvard University in the late 1950s, Koiter presented the results of his research, which were received enthusiastically. However, when an American colleague asked whether he could publish it, the Dutchman was rather indignant: it had already appeared in 1945, after all.

From 1949 to 1974 Koiter was Professor of Applied Mechanics in the Department of Mechanical Engineering at the Technische Hogeschool Delft. During this period he was also employed by the Department of Aeronautical Engineering. Koiter was so opposed to the democratization of the Dutch universities in the early 1970s that he announced his resignation in 1973 and decided to go abroad. With institutions such as universities, he believed a sound administration could not be formed democratically. Indeed he spent the academic year 1973– 74 as Sherman Fairchild Distinguished Scholar at the California Institute of Technology.

Thanks to a campaign launched by his colleagues, which found sympathy with G. Klein, the Secretary of Education and Sciences at the time, a chair was especially created for the theory of the stiffness, strength and stability of structures, which was well removed from the administration of the university. He held the post until his official retirement in June 1979 at the age of 65. When Koiter retired, friends and colleagues from all over the world came to Delft to honour him in a symposium entitled 'Trends in solid mechanics'. The contributions to this symposium, as well as the text of the lecture that he delivered on that occasion, were collected and published as a book. Even after his official departure, Koiter was for many years in his office every day in the Mechanical Engineering Building at the Technische Universiteit Delft.

Koiter's scientific qualities were quite remarkable. His pioneering dissertation 'On the stability of the elastic equilibrum' led to an entirely new approach to the stability of thin-walled constructions, the famous theory of the imperfection-sensitive buckling load. This theory is crucial to the safety and reliability of thin-walled structures in aeronautical and space technology, civil technology, mechanical engineering technology and

maritime technology. Koiter was brilliant at pointing the way to determining the sometimes inordinate influence of small irregularities in thin-walled structures, which can have disastrous consequences. During his active career he thus became the world's leading expert in the field.

At the same time Koiter made fundamental contributions in other, more or less related fields, such as the shell theory, fracture mechanics and the theory of plasticity, to say nothing of the countless other scientists that he inspired. Given his work and his authoritative personality, he was undoubtedly the most influential Dutch specialist in the field of applied mechanics of the twentieth century, and one of a select group of scientists in his field whose contributions will long be remembered.

There is no lack of evidence of Koiter's international stature. For instance, he was successively elected Bureau Member (1956–60), Treasurer (1960–68), President (1968–72) and Vice-President (1972–76) of the Board of the International Union of Theoretical and Applied Mechanics (IUTAM), the world's most prestigious association in the field. In 1959 he was made a Member of the Royal Netherlands Academy of Arts and Sciences (KNAW).

The institutions at which Koiter was invited to deliver guest lectures are legion. They include such renowned universities as Brown, Harvard, Stanford and California Institute of Technology, to mention only a few. If further evidence were needed of his global reputation, there are the numerous awards and honorary doctorates that he received during his lifetime. Particularly noteworthy are the Von Kármán Medal from the American Society of Civil Engineers (1965), the Timoshenko Medal from the American Society of Mechanical Engineers (1968), his honorary membership of the American Academy of Arts and Sciences (1974), his position as foreign associate of the National Academy of Engineering (1977), his honorary membership of the American Society of Mechanical Engineers (1980), his foreign membership of the Académie des Sciences de l'Institut de France (1981), the same in the Royal Society (1982), and his honorary doctorates from the universities of Leicester (1969), Glasgow (1987), Bochum (1978), Ghent (1979) and Liège (1986). Furthermore, from 1981 to 1983 Koiter was Rector of the distinguished Centre International des Sciences Mécaniques in Udine, Italy.

Characteristic of Koiter were his penchant for extremely careful formulation, in speech and print, and also his sense of humour. When, for example, in the 1960s, he was investigating the shell theory, and finally concluded that the best formulation had already been written by the English scientist A.E.H. Love, he gave a talk entitled 'All you need is Love'. Careful formulation also characterized Koiter's lectures: he never said too little or too much. This might explain why the students in his day introduced the lecture unit known as the 'milli-Koiter'. Other lectures were assessed by the students using the Koiter scale. Koiter was the sort of scientist who, in the course of preparing or delivering lectures, would develop new theories. It was in just such a context, for instance, that he showed how the error in the frequently used equations of L.H. Donnell for shallow shells can be reduced by slightly adjusting the equations, provided that the boundary conditions are adjusted accordingly. Koiter was so critical of his own formulations that, despite his numerous scientific publications and his involvement in many books, he never published a book in English. In 1972 he did publish a textbook in Dutch entitled Sterkte en Stijfheid I, Grondslagen. A new edition appeared in 1985, entitled Inleiding tot de Leer van Stijfheid en Sterkte. In 1976, under the motto 'From Delft to Delft', Koiter managed to bring to Delft for the second time the large international mechanics conference of the IUTAM, which takes place every four years and was first held in Delft in 1924.

Koiter was always in favour of consolidation in the field of applied mechanics in the Netherlands. For instance, he was the first to chair the Mechanics Department of the Koninklijk Nederlands Instituut van Ingenieurs, from

1956 to 1959. He was delighted to hear, just before his death, of the establishment of the national graduate School (research centre) of Engineering Mechanics, which has since been recognized by the KNAW. Those participating in this centre from the Technische Universiteit Delft have banded together in what they call the Koiter Institute Delft.

In July 1996 the American Society of Mechanical Engineers (ASME) decided to introduce a prestigious award in Koiter's honour, the Warner T. Koiter Medal. The medal, of the same status as the Timoshenko Medal, will be presented every year or two to a distinguished scientist in the field of solid mechanics who has demonstrated international leadership. Strikingly, the ASME decided to award the first Warner T. Koiter Medal to Koiter himself. It was presented to him in Delft by J.W. Hutchinson of Harvard University on 22 January 1997, during a splendid gathering of Koiter's colleagues and friends. The winner himself spoke on the occasion, almost as he had always done.

In Warner Tjardus Koiter the KNAW has lost a brilliant scientist of great renown and tremendous integrity, who will live on in the memory of his many friends.

Acknowledgement:

The photograph was taken by Klaas Koiter (son of Professor Koiter) in 1989 and is reproduced by courtesy of the Royal Netherlands Academy of Arts and Sciences.

2000:
Elastic Stability: From Euler to Koiter There Was None Like Koiter

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Here is a family announcement dated 2, September 1997: 'Verdrietig,maar opgelucht dat hem een langere lijdensweg bespaard is gebleven, delen wij u mede dat thuis is overleden Warner Tjardus Koiter Geboren 16 juni 1914 te Amsterdam'.

The giant of the modern theoretical and applied mechanics, and uniformly recognized father of the modern theory of stability is gone. We will not listen to his excellent lectures, we will not hear reports on his correspondences with contemporaries about their misconceptions, we will not be able to witness tough remarks like 'On your entire figure only one point is correct, belonging to the other author', or 'It will be no catastrophe if instead of the catastrophe theory you will research the chaos'. We will not have a privilege to have his razor-sharp questions, questions that can change the direction of one's research. We will not be able to hear about the uncompromising positions in the modern world where everyone, so it seems, is advised to keep quiet, and not to be judgmental. Many of his propositions were acceptable since they did not have a flavor of 'I told you so', but rather a desire to repair the scientific world, and the scientists themselves, as researchers and humans as well.

Warner Tjardus Koiter dealt with the subject of stability. We encounter this phenomenon in our everyday lives. Its ordinary, dictionary meaning is 'steadiness of firmness of character, resolution of purpose, constancy, steadfastness'. The meaning of the word stability underwent a transformation over the centuries. Its first

description occurs in the Bible, where the Tower of Babel lost its stability under its own weight, and the weight of too high esteem of people who decided to reach the unreachable. The term itself was introduced by Foscarini in his book under the title 'De Mobilitate Terrae et Stabilitate Solis' (in English 'On Motion of Earth and Immovability of the Sun') [25]. The Latin word stabilitate was used for denoting immovability. In the famous encyclopedia by Diderot and d'Alembert (1778), the word is used to denote the property of what is fixed, immobile: they say, unchangeability of the contract, character, spirit, views, etc. The concept was long associated with inertia. The tendency was to think of stability as an integral part of the notion of equilibrium of the material body. In his letter dated 11 February, 1605 to Fabricius, Johannes Kepler notes: 'Any material body is made so by the nature to rest in place, where it is located. Indeed, the rest, as darkness, is sort of the neutrality'. The concept of lack of stability is vividly illustrated in the short story 'A Sound of Thunder' (highly recommended all those who deal with mechanics) by a famous science-fiction writer Ray Bradbury [4]. The plot is set in the year 2055, immediately after the U.S. Presidential election has been won by the progressive candidate. 'Time Safari Inc.', an outfit specializing in guided tours of the past, has organized a hunting trip to a jungle 60 millions years back. Participants are warned to keep to a specially provided floating path and shoot only marked animals, but otherwise refrain from tampering in any way with the environment, as even the slightest error may multiply over the ages. For example, killing a mouse would mean no progeny, a fox would starve for want of mice; a lion would starve for want of foxes; and in some later era a man would starve for want of game with the attendant effect of future demography. Accordingly, the hunt is confined to animals preselected and marked in advance as 'safe', namely, Tyrannosaurus Rex destined to be killed anyway by a falling tree. The hero of the story, however, disobeys these instructions, steps off the path and inadvertently treads on butterfly. Back in the future, in the year 2055, he finds to his dismay that the 'anti-everything' candidate became a President, and, if this were not bad enough, the sign on the wall of 'Time Safari Inc' is grotesquely misspelt, since the spelling has been changed over the centuries, due to the different development humankind underwent due to the (small) butterfly effect! Thus a small disturbance leads to drastic consequences in the future development. This is lack of stability!

Mathematically the theory of stability was initiated by a Swiss mathematician, Leonhard Euler [9]. This theory found applications only from the 19th century, when the transportation revolution demanded light-weight structures, in the form of very thin plates or shells. Around 1910, Euler's theory was applied to thin shells (like the outer surface of an ordinary egg, or a bamboo stick) by the engineers in three different countries: Timoshenko [28, 29] from Russia, Southwell [26] from England, and Lorenz [23, 24] from Germany (see an unusually extensive review by Grigoliuk and Kabanov [10]). Since then there was a sort of a 'quarrel': who was the first amongst them? Yet, this question is a non-problem. The reason is very simple: their theoretical predictions were not substantiated by experiments. As we all know, His Excellency the Experiment is the final judge, and in Huxley's terminology, it is a 'tragedy of science: a beautiful theory killed by the ugly facts'. These shells were not needed in the kitchen for eggs or in the forest for the bamboos. Shells and plates are integral parts of the airplanes, cars, ships, space shuttles and what not. The theory of stability of columns, plates and shells are needed to design the vital elements of modern transportation. Engineers suggested a quite ingenious but still weird thing: since the experiment does not match the theory, make first theoretical calculations, then divide the result by some large correcting, knockdown factor, say, 5,6 or even 7, and utilize that number for the design.

At this crucial time young Koiter (1945) [11] presented to the Delft University of Technology his Ph.D. dissertation titled 'Over de stabiliteit van het elastisch evenwicht'. The thesis was done during the German occupation of the Netherlands. As Professor Koiter recalled at his retirement lecture (1979):
I have a vivid recollection of New Year's eve in December 1942 when my wife and I sat in front of a very

modest fire and discussed, in addition to the most acute war time problems, what would happen to my work which I considered to be significant but questioned whether it would be recognized as such'.
In September 1945 he presented the thesis to the Senate of the Delft University of Technology. In his work he explained why the 'ugly' experiments were not 'dancing' in accordance with the theory: shells possess unavoidable small imperfections , deviations from the desired ideal form. They, as small butterflies in Ray Bradbury's story, have a dramatic influence on the stability. This influence is so big, that it sometimes reduces the ideal theoretical results by a factor of 10, and thus previous results are totally invalidated.

The young educator of TH Delft did not extensively publish in the Forties the results of his Ph.D. dissertation in several scientific papers on this subject, as is so widely done nowadays when an idea is 'dissected' and then published and republished in numerous papers. He recalled:

". . . I considered I had already published my basic thinking on elastic stability, and that it would be improper to reiterate on the same topic, a curious mixture of modesty and immodesty, the latter because I took it for granted that my published work was accessible in principle to anyone actively interested in the field."

It took however two decades before the country that was uncovered by Christopher Columbus uncovered Koiter's work. Then this dissertation was enthusiastically translated two times, independently, into English, in 1967 [13], as a translation by NASA, and the second translation performed at Stanford University [15].

After that the stability research around the world flourished due to Koiter's breakthroughs, both in the West and in the East. Koiter's work was performed nearly 200 years after Euler's. We can safely say on the subject of stability: 'from Euler to Koiter there was none like Koiter'. Professor Koiter always paid attention to the mathematical part of the subject, but always stressed that engineers need to come up with just appropriate theoretical assumptions to catch the essence of the physical phenomenon. I recall that it was in 1966 when, as an upper-level undergraduate, I first met him in Moscow. At the scientific congress he said at the panel discussion on the future of shell research: 'We cannot excessively occupy ourselves with second order theoretical effects. We are engineers, and must come up with workable engineering solutions'.

In 1979/80 I and my family spent a sabbatical year at Delft as a guest of the Aerospace Department, through a kind invitation of Professor Johann Arbocz and Vakgroep C. At that time, I also had a privilege to get invitations from several other prestigious universities but chose to come to a compact, and scientifically and otherwise beautiful city of Dutch 'nuchtere burgers', (sober minded people). One scientist, whose University was not chosen, asked me: 'Why did you go to Delft? Where is it? What do they do?' My reply was simple: 'Delft is a city where Koiter is working'. Indeed, during that academic year, the already retired mastermind of stability gave no less than five scientific seminars on various topics.

Scientists live in this world and cannot and ought not escape from its problems. Professor Koiter actively expressed his worldly views. In 1976, during the International Mechanics Congress in Delft, the then Soviet Union did not allow some of its out-of-favor scientists to attend. Koiter stood firm; he announced from the podium, that he disagreed with such a treatment; that the time slots, allotted to these scientists would not be filled with other lectures: the empty room would serve as a reminder of the silent protest. Many were deeply impressed with this uncompromising stand. All, it so seemed, shared a human pride for this prominent scientist who did not yield to the pressure. Perhaps this was one of the highlights in the lives of the congress participants. Such moments fill one's heart with optimistic spirit and human pride that the truth would be eventually found. Was this because Hugo Grothius, prominent medieval human rights fighter, whose statue firmly stands in the

very center of Delft, somehow continues to inject part of himself in every Delftenaar? One of the ingredients of the chair Koiter occupied was 'stiffness'. He vividly illustrated this stiffness of human mind at the world congress. But he was flexible too. In his writings he would sometimes insert very flowery and elucidating statements. Here are two examples: (a) 'Flexible bodies like thin shells require a flexible method'. (b) 'Any two-dimensional theory of thin shells is necessarily an approximate character. An exact two-dimensional theory of shells cannot exist, because the actual body we have to deal with, thin as it may be, is always three-dimensional. We may perhaps illustrate this point in a somewhat facetious way: even if it appears to be the fashion for ladies to be as thin as possible, fortunately, in our view, they remain essentially three-dimensional'.

One personal experience of his tremendous influence on fellow scientists appears to be in order. Upon arrival in Delft in September 1979 in a week's time Ir. Dijkshoorn of the Aerospace Department approached me and said: 'You will give a course on probabilistic methods in engineering. But in a year's time you will be gone. We would like to have lecture notes written and typed in accordance with the TH Delft tradition'. I was very unenthusiastic, since I wanted totally to devote myself to research. Yet, the incomparable speed of typing by Mrs. Marijke Schillemans, and the unsurpassable quality of the draftsman Mr. Willem Spee, in addition to the warmest hospitability and Dutch courtesy extended to our family by families of Professors Arbocz, Koiter, van der Neut, Schijve, van Geer, van Ghesel Grothe and many others, gave me a tremendous motivation to do both research and prepare the requested lecture notes. These lecture notes appeared as a memorandum of the Aerospace Department, and were sent out to other departments, a great custom of disseminating the developments in one Department for the enlightenment of other divisions, a blessed tradition which is yet to be shared in other universities.

In March 1980 W. T. Koiter organized a European Colloquium on Stability. The conference participants were arriving to 'Centraal Hotel'. He asked me, since we lived nearby, if I could stay till the end of the reception and accompany him home, since physicians advised him to prefer walking to driving. He stayed till the last participant arrived, nearly midnight. While waiting, we had couple of jonge genevers. He told me: 'I received your memorandum. It is well and clearly written; you should make a book out of it!' I felt very happy to hear this advice. Starting the next day, my efforts were multiplied manyfold. My previous lack of excitement with this project evaporated. Since the world's Mr. Mechanics endorsed the project, one could not postpone work on it. In one year's time the manuscript was nearly completed, and it was later published by Wiley Publishers in New York. Yet, in the preface of the book I refrained from mentioning Professor Koiter's contribution, as I explained to him too, due to a huge hesitance: I did not want to use a name of the top scientist to promote my first big adventure – a monograph on the probabilistic theory of structures; what if the book is not warmly accepted? Happily the book was received positively and recently re-appeared in its second edition by the Dover Publications [7]. There I gave a full credit to Professor Koiter's warm encouragement and his injection of energy, without which the book would never have been started, and possibly neither would others follow.

He endorsed our developments of probabilistic analysis [5–8, 1] of initial imperfections pioneered earlier by Professor Bolotin [3] and encouraged several of stochastic studies. And, his deep grasp of every possible disadvantage of the theory of probability together with lucky meeting with several 'non-probabilistic uncertainty' scientists (Prof. Rudolf Drenick, Prof. Yakov Ben-Haim, Prof. Ezra Zeheb), led to an enrichment of my research scopes during a recent decade [2]. I know others who had such a blessing too. I was also very happy, several years ago, to cooperate with him on a scientific project posed by the NASA Langley Research Center. His hand-evaluated elegant analytical solutions, based on legendary physical insights, could only be matched and generalized by using the latest, suitably modified, symbolic computer packages [20, 21]. His last paper (see also his review, [18] that he planned to extend for the Applied Mechanics Reviews upon my

invitation; yet he could not complete this work due to illness) published in 1996, [19] will also have a lasting effect: it warns engineers about the dangers of using the concepts of unrealistic, fictitious, static 'follower' forces. We humbly submit that this admonition was timely, since many hundreds of papers were written up to now about Beck's column which could be only simulated but which neither could be directly reproduced experimentally, nor can be considered useful, since one can directly deal with the *real* phenomena themselves rather than with over-simplified models. These ideas are not shared, as anticipated, by all [27].

Perhaps now it is time to reveal that the undersigned had a courage, absolutely necessary in such circumstances, to propose the establishment of the W. T. Koiter medal by the ASME. The enthusiastic response by several colleagues, including Prof. J. Hutchinson, Prof. T. A. Cruse, Prof. C. T. Herakovich, Prof. Ir. J. Besseling, Prof. Ir. K. Wakker, and many others led the efforts to make this medal possible. The first medal was naturally presented to W. T. Koiter. Professor Koiter was very pleased by the honour and recognition.

His and Mevr. Lous' house in Delft always was a place for many foreign scientists who came to Delft to refine their understanding of stability. His research was about the effect of imperfections, and in life too, I recall him complaining once about the decline of the positive influences of religion on the modern society, and the attendant imperfections.

Mevr. Lous and Professor Koiter's hospitality was an invariable element of the Delft Atmosphere. I know of children of at least two foreign scientist for whom Mevr. Lous commemorated their birth in Delft by a hand-made embroidery. Professor Dr. Ir. Warner Tjardus Koiter left this world much more perfect than he found it, since only the identification of and the action upon both human and engineering imperfections can repair the world. One thing is above a disputation: from Euler to Koiter there was none like Koiter, in the field they both shared: 'theory of elastic stability'. It is our privilege that his monumental scientific work and most fond memories remain with us.

Acknowledgement
It was felt to submit the preliminary version of this paper to local newspaper in the city of Delft. Due to encouragement of several colleagues it was decided to submit for the publication in the scientific journal. Author is grateful to the anonymous referees, for several suggestions including adding the list of references.

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1998:
W.T. KOITER (1914–1997)

Born in Amsterdam on the 16th of June 1914, Warner Tjardus Koiter passed away in Delft on the 2nd of September 1997.

After obtaining a mechanical engineering degree, with distinction, at the Delft University of Technology, his first work experience was with the National Aeronautical Research Institute, where he participated in air-worthiness tests of aircraft structures and contributed to the stress analysis of cantilever two-spar wings with shear resisting skin. He then moved to the Government Patent Office and later to the Government Civil Aviation Office, where he became Director of the Engineering Division.

After the award of the degree of Doctor of Science from the Delft University of Technology on the basis of his much acclaimed thesis "On the Stability of the Elastic Equilibrium", in 1949 he was appointed Professor of Applied Mechanics in the same University. In 1973 he was appointed to the specially created chair of “Theory of Strength and Stability of Structures”, which he held until his retirement in 1979.

Koiter’s scientific stature is well known to everybody for his celebrated works on the theory of elasticity, plasticity, shell theory, and mainly for his fundamental work on the stability of elastic equilibrium of continuous media. He has served in various capacities on several learned Societies, including IUTAM, and was a member of the most prestigious international academies and of the editorial board of a number of international journals, including Meccanica.

In 1996 the ASME established the Warner T. Koiter Medal “to recognize distinguished contributions to the field of solid mechanics with emphasis on the effective blending of theoretic and applied elements” and awarded the first such medal to Koiter himself “for his fundamental work in nonlinear stability of structures, for his diligence in the effective application of these theories, his international leadership in mechanics, and his effectiveness as a teacher and a researcher”.

Much less known has been, and perhaps still is to many people, the unparalleled human figure which was hidden behind the scientific one. His impeccable moral integrity was incompatible with any deviating compromise. ‘Samurai in a world of Pharisees’, but at the same time he was cordial, generous and deprived of arrogance.

My personal knowledge of Professor Koiter dates back to the beginning of September 1972, when I went to Delft to carry out a research programme on stability which turned out to be lasting and fruitful, and resulted in a mutual friendship.

I like to remember an anecdote referring to the youth of Professor Koiter. The second world war had begun and Holland was firmly held in Nazi hands. Professor Flügge had been sent from Germany to Delft to cover the Rector Chair. According to the occupant law, Ph.D students who were willing to discuss their theses, were obliged to take an oath of allegiance to the Nazi government. Koiter’s thesis on the stability of elastic equilibrium was ready at that time, but the author, refusing this imposition, waited for the liberation of his country. The thesis thus appeared only in 1945.

Professor Koiter's interest in scientific problems remained very profound even when his disease was consuming his physical energies and even his ability to speak. The giant had slowly sunk. Everyone of us, especially his colleagues in the international scientific community, should look to him in bringing forward the road he has traced. - ***Marcello Pignataro***