NATIONAL ACADEMY OF SCIENCES

CARL RICHARD SODERBERG

1895—1979

A Biographical Memoir by

ASCHER H. SHAPIRO

Biographical Memoir

Courtesy of MIT Museum, Cambridge, Massachusetts

C. Richard Soderberg

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THE RICH INSPIRING life of C. Richard ("Dick") Soderberg, Institute Professor emeritus at the Massachusetts Institute of Technology came to an end at age eighty-four. With roots in the simple realities of a boyhood in a fishing family on a remote Swedish island in the Baltic Sea, his qualities of mind and character led him first into a distinguished industrial career as an engineer in his adopted country, the United States. He went on to an illustrious career in engineering education, with remarkable consulting activities on the side. His years were marked by an expansive and seemingly unlimited passion to learn, by a capacity to teach, by a superb intuitive sense of design and rightness, by an unflagging breadth of intellectual interest, by a deep understanding of the social and historical forces set in motion by technology, and by a warmth and nobility of spirit that endeared him to his colleagues and friends.

Three major phases in his professional life were especially notable. First, at the Westinghouse Electric & Manufacturing Company he was instrumental in solving the problems of steam turbines as these progressed to ever larger sizes and higher operating pressures and temperatures. Second, as a professor, department head, and dean of engineering at MIT, he was a leading figure in the extraordinary transformation of engineering education that followed World War II, as “engineering science” and graduate-level research and study blossomed. Thirdly, as a consultant to Pratt & Whitney (United Aircraft Corporation), he inspired and guided the conception and development of the J-57 gas turbine jet engine, which provided military superiority and, more importantly, revolutionized commercial air transport, thus leading to the ease of long-range travel that we now take for granted.

Born in the tiny town of Ulvöhamn, Sweden, one of eight children, Dick Soderberg grew up on the sea. He fished with his father and brothers, made and mended nets, and helped his father build up a seasonal canning business. Without plans, the family built their own boats. Aged ten years, young Dick became the technical expert who kept running the single-cylinder, four-cycle motorboat engine “of fearfully inept design.”

In his more mature years he became intensely interested in his roots. A series of essays he wrote constitute an extensive unpublished autobiographical work, which he thought of as being addressed to his grandchildren. In it he traced the history of his family and their ways of existence. Noting that his early years were not much different from the life of centuries earlier, he commented that “Medieval man was sustained by a rhythm of life which stemmed from tradition and which gave him security in his life’s work and also assurance of a just God watching over him.” And, referring to the fishing business, he said, “The technology was primitive, but primitive with a deep tradition; each major problem had its own solution.”

Young Dick studied with the one teacher of a small, one-room school, but the future pattern of his intellectual life and self-education was even then foreshadowed by his wide reading from books in the teacher's collection. These books, he wrote, "contained enough to feed me with dreams which have sustained me through life."

With assistance from his family and others, he was sent to the mainland for practical study in the Härnösand Teknisk Elementarskolan, although he would have preferred its humanistic counterpart, the Realgymnasium. In this period a friend and mentor at Uppsala was sending him "box after box" of books on mathematics, physics, and chemistry, as well as on history, geography, and literature. In later years, he ruminated, "I sometimes think that I might have derived more happiness and satisfaction if chance had led me to a deeper penetration in science and humanities," and he referred to his "life-long avocation of study in science, philosophy, and history."

After Härnösand, he worked for a time as a ship fitter and mechanic at the famous shipyard Götaverken in Göteborg, eventually becoming gang leader. After several months of required military service, and with the help of a loan, he enrolled at the Chalmers Institute of Technology in Göteborg to study shipbuilding. In 1919 he graduated with a degree in naval architecture.

In one of life's fateful turns, on a fellowship from the American Scandinavian Foundation, Soderberg in the fall of that year came to MIT, where he registered as a special student in the Department of Naval Architecture. He had hoped to mend the perceived shortcomings of Chalmers, but he was greatly disappointed, feeling that the courses he was taking lacked intellectual content and were little improvement upon Chalmers. (The writer of this memoir had similar reactions when he came to the Department of Mechanical Engineering at MIT as a transfer student in 1936; in retrospect, what Soderberg felt was actually a fairly accurate indicator of the state of engineering education in the

United States.) Early in 1920 he moved to the University of Michigan where he spent a short time doing towing tank research. Returning to MIT and completing a thesis on the optimal distribution of displacement for a merchant ship, he was awarded the degree of bachelor of science in naval architecture in June of 1920. He could not then imagine that eighteen years later he would return to MIT as a faculty member and be a major participant in the ferment that reconstructed engineering education and repaired the flaws he had observed as a student.

Since postwar economic conditions in the United States and Europe were bad, and even worse in Sweden, the American Scandinavian Foundation encouraged its fellows to stay in the United States if they could find work, rather than return home as originally planned. In the fall of 1920 Soderberg found a job as a draftsman in the shipfitting department of the New York Shipbuilding and Drydock Company. With this turn in the road, his life thereafter became centered in the United States; however, he never gave up close association with his homeland, to which he returned frequently.

In 1921 Dick Soderberg married Sigrid Kristina Löfstedt (Stina), a Bostonian whose parents had emigrated from Sweden. They would have three children: C. Richard, Jr., Lars O., and Barbro K.

On the very day when, because of the postwar drop in shipbuilding, he was laid off from New York Shipbuilding, he received a letter about a possible job at Westinghouse Electric and Manufacturing Company. He would learn later that a classmate at Chalmers, then working at the company as a design engineer, had suggested his name. The letter was accompanied by a set of engineering problems, very mature and complex. He was asked to study them and give comments as to a reasonable approach, not necessarily to solve them; however, after three weeks of steady effort, he returned the problems with solutions.

The response from Westinghouse was positive. Soderberg started at the company in 1922, and was assigned to the Heavy Traction Railway Department, which was concerned with railroad electrification and the design of electric motors, locomotives, and rail cars. During his first two years he concentrated on dynamical problems and gradually came to focus his attention on the very complex problem of vibrations, on a major development program on dynamic balancing, and on the problems surrounding commutators in large DC and AC machinery. He found that he could outdo experienced motor designers on such problems as mechanical vibrations, gear and axle drives, brushes, slip rings, and commutators. In 1924 he was transferred to the Power Engineering Department, where until 1928 he worked on mechanical and electrical problems of large power machinery, with emphasis on large steam turbine-driven electric generators.

The then major directions of development in power generation–much larger power output together with higher steam pressures and temperatures–made clear that the talents necessary for developing these new directions would have to be drawn from a wider segment of applied science than electrical engineering. Many of the main problems impeding progress were in mechanical engineering and in materials science: structural strength, fatigue, creep, vibrations, and control. This was a period of intellectual awakening, with a perception that more scientific treatments of practical problems were required in such areas as large rotating machinery, dynamics of the electric locomotive, cooling, and failure of insulation.

The new engineers coming into the company did not have the tools to cope with such problems; they were ill prepared scientifically by the type of education then prevalent in schools of engineering in the United States. The company organized an internal educational program, known eventually as the Westinghouse Design School, whose aim was to extend the undergraduate training (graduate studies in engineering were then rare) of a selected number of young starting engineers. This was staffed mainly by foreign-born young men in the company, who were also students in the school and for whom theoretical studies seemed natural. The intellectual leader was Stephen P. Timoshenko, a Russian émigré, already famous in the field of applied mechanics. He, with other young men who subsequently became prominent (Den Hartog, Jacobsen, Karelitz, Nadai, and Soderberg, among others), came to play important roles in American engineering education and industry. Dick Soderberg, arriving in 1922, participated as both pupil and teacher in the startup of the design school. This was a perfect opportunity for his intellectual appetites, and his studies extended beyond topics in mechanical engineering to such areas as modern physics. These experiences fed his attraction to the world of scholarship, which years later made it seem natural for him to join the Massachusetts Institute of Technology.

Although by then a naturalized U.S. citizen, Soderberg in 1928 accepted an offer from ASEA (the Swedish General Electric Company, not connected to the General Electric Company in the United States) to return to Sweden and head the development of a new line of large turbogenerators. This was a difficult decision for him, as Westinghouse wanted him to stay and America seemed to him bright and full of promise. Behind his move was a felt obligation to the American Scandinavian Foundation, as well as the desire shared with Stina to expose their children to Swedish culture. During his time with ASEA, he worked to rationalize the concept of working stresses in high-speed machinery and on the determination of the temperature distribution as part of the design process for electric generators.

After two years, feeling that ASEA's future plans were quite uncertain, he returned in 1930 to Westinghouse, where he was assigned to the Power Engineering Department in East Pittsburgh to work on large electric generators. This lasted only one year. The company and its customers had serious problems with its large steam turbines, and in consequence the South Philadelphia Works was restructured with new leadership. Soderberg was asked to move there, first to become chief engineer for large turbines, and later to serve as manager of the Turbine Division. With little specific experience in this field and little formal training in thermodynamics and fluid dynamics, he now faced the challenge of being responsible for the design of steam turbines. He also had to win back the confidence of doubtful customers, and to retain the loyalty and enthusiasm of some 300 engineers, draftsmen, and clerks.

Although now with heavy administrative duties, Soderberg continued technical work on such topics as the problem of moisture in condensing turbines; turbine speed control; stresses, fastenings, and vibrations of long turbine blades in the final turbine stages; and creep and plastic flow of high-temperature parts. The needed developments in turbine performance required a level of fundamental understanding lacking at South Philadelphia prior to 1931, a deficiency corrected under his leadership. He recognized that the steam turbine is a complex machine whose effective design entails all the many aspects of mechanical engineering. He made long-lasting contributions in two areas: the dynamics, vibrations, and balancing of rotating machinery, and the development of design criteria for safe working stresses under oscillatory applied loads. His broad experience with the steam turbine later became the foundation for his signal contributions to the development of the aircraft gas turbine.

Beyond his duties at Westinghouse, Soderberg was a very active member of the Applied Mechanics Division of the American Society of Mechanical Engineers. Through publications in the technical literature and many patents, he had by 1938 achieved a worldwide reputation in the fields of applied mechanics and turbine design.

By this time, too, a wave of reform had begun at MIT under the presidency of Karl T. Compton, and Soderberg was offered a faculty appointment in the Department of Mechanical Engineering. The decision to leave Westinghouse was not an easy one. In deciding to go to MIT, he was influenced on the one hand by pressure at Westinghouse toward more executive responsibility at the expense of technical effort, and on the other hand by his innate attraction to scholarship combined with the feeling that there was a great need to improve engineering education. At Westinghouse he had been engaged in revitalizing an engineering department that had fallen into decay, and the work of rejuvenation was nearing completion. MIT represented a new challenge and an environment that he would come to love. Reflective and philosophical by nature, he was glad to participate in the revolution in engineering education then beginning, and which, accelerated by the challenges that arose during World War II, dramatically changed engineering schools by the end of the 1950s.

At MIT Soderberg taught applied mechanics and gas turbine design. During the war years he became graduate registration officer of the Mechanical Engineering Department. Graduate studies had previously played an insignificant part in departments of mechanical engineering, including at MIT. This was about to change dramatically as the technological developments triggered by the war caused a burgeoning in engineering research and graduate study. In his role as graduate registration officer, Soderberg was responsible for admitting and guiding graduate students. Also, as a member of the Institute's Committee on the Graduate School, which formulated policy, he had a great opportunity to shape that future which resulted in the types of engineering departments now typical of research universities.

When Jerome C. Hunsaker, then head of the Departments of Mechanical Engineering and Aeronautical Engineering, became heavily occupied in Washington as chairman of the National Advisory Committee for Aeronautics, the predecessor of the National Aeronautics and Space Administration, Soderberg for all practical purposes ran Mechanical Engineering. In 1947 he succeeded Hunsaker formally as head of that department, and led it through the turbulent, critical years of postwar growth and development. This was a unique time. At the end of World War II, large numbers of mature students began to enroll for both undergraduate and graduate study. The department was just then emerging from a static period, although it had a nucleus of faculty as the base for a new era. Moreover, some of the most sophisticated advances in military technology had been brought about by physicists, chemists, and mathematicians, and it had become evident that engineering study would have to become more scientific in character in order to exploit new technological potentials. Especially because of, rather than despite, his experience with the practical problems of industry, this need was crystal clear to Soderberg. Under his hand the Mechanical Engineering Department reached a high level of excellence and developed a form and style that made it renowned the world over. Many of its graduate students fanned out and became leaders of engineering departments in top-level universities throughout the country.

Soderberg was a member of the blue-ribbon Committee on Educational Survey, appointed early in 1947 in recognition that the war years were a watershed. Where should MIT go and how? The committee report became a landmark, a vehicle for shaping MIT, and is still referred to today. Among other things, it led to the elevation of the humanities as an integral part of an MIT education.

In 1954 Soderberg was appointed dean of the School of Engineering, which removed him from the close contacts with young faculty and students that he had so enjoyed. He later remarked that "I had a hidden desire to be closer to the creative scientific work, and I came to see that the position of head of department at MIT is a very special one in the academic world." Every academic weary of the battles for turf in the way of space and curricular hours will empathize with his wry observation of "grim competitive power play between the department heads on one side and the top administration on the other."

Both as head of the department and as dean of the school, Soderberg encouraged revision of course content, development of newly emerging fields, and enrichment of instruction by challenging students to apply their basic knowledge to practical problems. He was concerned with the broader issues of engineering education–with general aims, with philosophical background, and with the development of character and professional style. He constantly stressed as a premise the dignity of useful work and the value of preparing for such a career. Though he emphasized fundamental science as opposed to mere vocational skill, he was deeply conscious of the importance of a professional background in which the development of critical judgment and a sense of responsibility were essential features. All who came into contact with him could not but be conscious of his breadth of mind and interest, his emphasis on fundamentals, his concern for the place and purpose of engineering in the society in which we live, the high meaning he ascribed to the word "profession." He was a statesman, a leader with broad vision.

With encroaching illness, he resigned as dean in 1959 and was appointed to the illustrious position of Institute Professor. A year later, at the age of sixty-five, he went on so-called half-time service. Actually he remained fully active, so much so indeed, that after mandatory full retirement at age seventy, he was recalled to serve for a half year as acting head of two departments: Mechanical Engineering, and Naval Architecture and Marine Engineering.

On the occasion of Soderberg's eightieth birthday in 1975, MIT announced the establishment of the Carl Richard Soderberg professorship of power engineering, a career development chair for a young faculty member. The first holder, John G. Kassakian, an Assistant Professor in Electrical Engineering, characterized Soderberg as "addressing socio-technical problems with the zeal and enthusiasm of a newly matriculated freshman . . . which leaves the uninitiated wondering whether this octogenarian is an apparition in their midst. His warmth of personality, genuine concern for the young, and ability to perceive and present contemporary challenges to technology in a disarmingly simple and straightforward manner have been an inspiration . . . ," and Kassakian observed an "absolute lack of energy spent in reminiscing . . . ."

Although in his autobiographical notes he described himself as shy, Soderberg's door at MIT was always open to students, and many a young colleague benefited from his interest, his concern, his experience, and on occasion, a reprimand. With Stina, he brought the students and faculty together at picnics and parties. One looked forward each Christmas season to Swedish glögg at their home in Weston, and later on Beacon Hill. From Dick and Stina, too, many a young faculty couple learned the social graces of academic life and the important part that warmth and generosity play in the total education of the student.

Soderberg's service coincided with the most creative period until then in the history of the Institute. The postwar years were a turning point for engineering education. The growth of graduate education and research in all fields, including engineering, was truly remarkable, and was responsible for MIT's future as a research university. When he arrived at MIT, there were two professors out of forty in Mechanical Engineering with doctorates, and faculty research was anything but the norm. But within a decade the departments of the School of Engineering became peopled by graduate scholars and researchers as well as by undergraduates, and the doctorate became a union card for appointment to the faculty. The research doctorate, usually funded in one way or another by government agencies, became an essential component of a community of learners at all levels, from novices to senior faculty. Growth at the graduate level reflected a deep influence on the character and quality of the undergraduate programs.

During the years of World War II and later, Soderberg, like many at MIT, served on numerous government advisory panels. He was a member of the Special Committee on Jet Propulsion (1941-43) of the National Advisory Committee for Aeronautics, which surveyed the general problem of jet propulsion for aircraft and formulated a program of experimental construction. Also for the National Advisory Committee for Aeronautics, he served on the Subcommittee on Turbines (1945-55) and the Panel on Power Plants for Aircraft (vice-chairman, 1955-58). He was chairman of the Panel on Fuels and Propulsion of the Scientific Advisory Board of the U.S. Air Force (1946-54) and was a member of the Department of Defense Technical Advisory Panel (1956-57). In 1948 he served on the Advisory Committee on Engineering Sciences for the Selective Service System. He was a member of several committees of the National Defense Research Committee on tank design and development and on gas turbine drives for ships, and as a consultant on torpedo power plants. In the early years of the Cold War, he was a consultant on nuclear-powered aircraft carried out at Oak Ridge, Tennessee, by the Fairchild Company.

Soderberg was also active on boards, panels, and committees of the National Academy of Sciences and the National Research Council. These are too numerous to list, but special mention should be made of the following: Editorial Board of the *Proceedings of the National Academy of Sciences* (1948-50); Academy representative to the Joint Board of the National Academy of Sciences and the National Academy of Engineering (1965-69); chairman of the Division of Engineering and Industrial Research of the National Research Council (1948-50); chairman of the Panel on Naval Vehicles of the Committee on Undersea Warfare (1959-61); and a member of the ad hoc Panel on Applied Research of the Committee on Science and Public Policy (1966-67).

A member of many professional societies (American Association for the Advancement of Science, American Institute of Aeronautics and Astronautics, American Society of Engineering Education, American Society of Swedish Engineers, British Institution of Mechanical Engineers, Society of Naval Architects and Marine Engineers, Svenska Teknologföreningen), Soderberg was particularly active in the American Society of Mechanical Engineers, of which he was a honorary member and for which he served on many committees and boards. He was a member (1933-38) of the Executive Committee of the Applied Mechanics Division and was chairman in 1938.

During his busy years at MIT, Soderberg maintained remarkable and fruitful associations with industry. In these, he accomplished what few consultants with limited time can. He was a catalyzing agent, and provided intellectual leadership for developments of far-reaching consequence.

On a summer-long trip to Sweden with his family in 1939, Soderberg renewed his contact with ASEA, becoming a consultant. He also established a consulting relationship with a subsidiary of ASEA, Stal-Laval Turbin AB, which manufactured power station steam turbines, industrial steam and gas turbines, and marine steam turbines. These became long-term connections, a most satisfying arrangement for Soderberg in that it allowed him to renew frequently his association with Swedish friends and culture. The characterization of Dick Soderberg as a man, as an engineer, and as a consultant is well expressed by Curt Nicolin:

> *For more than 30 years he was a consultant to ASEA's turbine company STAL on technical matters. He was a generation older than me and most of the people he was meeting in our company. He had an absolutely unique ability to create confidence with all our people. He was an extremely good listener. With these two qualities he played a very important role in the planning of the technical development of the company as well as reviewing its progress . . . He very seldom told them precisely what to do but he was able to lead the discussion so that people themselves formulated the ideas. I think this was an important ability behind his success. Needless to say, all of the above was based on a very solid and rich personality.*

As a consultant for the Elliot Company, Soderberg's efforts were directed toward the development of a gas turbine for ship propulsion. This project produced the first marine gas turbine power plant in the United States. He was senior author of two papers on this subject, one of which received a prize from the Society of Naval Architects and Marine Engineers.

By far his most dramatic and long-lasting contribution as a consultant was as an advisor to the Pratt & Whitney Company on the development of the J-57 gas turbine engine for jet propulsion of aircraft. One of the major suppliers for the allied powers during World War II, Pratt & Whitney produced rotary air-cooled reciprocating engines for the propeller-driven aircraft then in universal use. In the latter years of the war, both England and Germany were developing gas turbines for aircraft propulsion, but these early machines had high fuel consumption, due to the low pressure ratios employed. Jet aircraft, it was then generally thought, would be limited to short-range interceptors, for which high speed and light weight were the most important factors. Donald J. Jordan commented firsthand: "When P&W finally turned attention to turbine engines, the environment within the company was not propitious for such a venture. Reciprocating engines were built by the build 'em and bust 'em method. The engineering department was steeped in this lore and with the equipment and practices appropriate to such machinery."

Soderberg realized that an advanced aircraft gas turbine, by contrast, could be developed only with the help of careful and complete analysis together with a sophisticated experimental program, and that, lacking such, failure would ensue. Pratt & Whitney established in Boston a newly constituted team of young engineers, all with no prior turbine experience, to work under Soderberg's guidance. He was able to communicate with them on a technical level and then sit with top management to advise on the broad technical and management policies that were urgently needed. Moving easily between the youngsters and the oldsters, he earned the confidence and friendship of both. In this manner, a design system was developed, the first engine was designed, and an R&D program was planned. The two-spool engine design was daring and risky, but with a dual compressor system and high pressure ratio, it offered very low fuel consumption. Soderberg's knowledge of stresses, blade and rotor vibration, thermal creep, seals, and thermal expansion was critical to the development of a durable engine. By 1949 the engine had a first run; by 1951 it was in a test airplane, and soon it powered the B-52 long-range bomber and the first supersonic fighter. In the early sixties, as the commercial JT3, it was in the Boeing 707. With the successful development of the J-57, leadership in aircraft design shifted to the United States and Pratt & Whitney became the largest jet engine manufacturer in the world.

Soderberg was acutely aware of the deeper sociological and economic implications of the J-57 development. It, and other engines of its ilk, made high-speed, long-range commercial travel practical. Merely thinking of prewar travel underscores the profound changes in the ways we live, work, and play brought about by modern transport aircraft. Soderberg often noted that improvements in aircraft performance were directly keyed to advances in engine size and efficiency.

Many honors and awards were bestowed upon Dick Soderberg. He was elected to the National Academy of Sciences in 1947 and to the National Academy of Engineering in 1974. He was also a fellow of the American Academy of Arts and Sciences and the Royal Swedish Academy of Engineering Sciences. In 1958 he was made a knight of the Royal Order of the North Star by the King of Sweden and in 1968 a commander of the Royal Order of the North Star.

Soderberg's medals included the Gustav Dalen Medal of the Chalmers Institute of Technology (1970); the De Laval Medal of the Royal Academy of Engineering Sciences (1968);

the Gold Medal of the American Society of Mechanical Engineers (1960); and the John Ericsson Gold Medal of the American Society of Swedish Engineers (1952). He took pride in the fact that in 1951 he was the first graduate of the Chalmers Institute of Technology to receive an honorary doctorate from Chalmers. Tufts University awarded him the honorary degree of doctor of engineering in 1958.

Soderberg had a total of eighteen U.S. patents issued in the years from 1935 to 1950. All related to constructional features of turbines, including glands and seals, rotor construction, blade fastening, blade shrouding, blade mounting, and rotor cooling.

The biographical memoir of Stephen P. Timoshenko written by Soderberg for the National Academy of Sciences is delightful in style and notable for its insight. In speech, except for a slight accent, one might have thought that English was his native language. Soderberg recounts in his autobiography that when he came to secondary school in Härnösand, he was embarrassed by his rustic way of speech and manner. Fortunately, he had a somewhat cosmopolitan friend who helped him to polish his Swedish. But when he arrived in the United States at age twenty-four, it is unlikely that he was fluent in English. His wife Stina became his tutor, and to her he gave credit for his later skill in that language. When progress was slow, he felt that he was not "an educated man," but he persevered and became marvelously articulate in speech and writing.

Stina and Dick Soderberg had a close lifelong companionship. When Stina died in 1975, Dick felt severe loneliness during the four remaining years of his life. He had always written extensively in notebooks, and in these lonely years he found solace in completing his autobiographical essays, which more and more revolved about his life with Stina. Although he was fully acculturated and had a deep regard and admiration for the United States, his love and longing for his homeland was intense, as expressed in the following fragments of a poem appearing at the beginning of *My Life* by C. Richard Söderberg:

Still a child,
I left that land
Whose memories will never leave my soul . . .
But deep within me rested peacefully
Ängermanland, thy memory as a pearl . . .
The glory of thy memory will always illuminate my path
Thou, the land of my early years, the grave of my forbears.

His ashes and those of his wife lie in Sweden.

A personal note: When in 1938 Dick Soderberg started at MIT as a full professor, I started as a lowly lab assistant, fresh with a bachelor's degree. I regarded him with awe. It was my good luck to be close to him for forty years. He was my teacher, guide, friend, boss, and colleague, and he inspired me. Wonderfully well read, he was a pleasure to converse with, invariably stimulating. For this, his chronic insomnia may have been a blessing, for he read in the middle of the night. He was unfailingly attentive to and respectful of junior colleagues and students. I never knew him to have an enemy or heard that anyone felt unkindly or unfairly treated by him. A bear of a man, he sometimes blustered when pushed, but he was never less than open-minded. His simple, gusty sense of humor was a delight to witness. Filled with mature, philosophical wisdom, he had a sign in his office that read, "Ve get too soon old, and too late schmart."

In the 1976-77 edition of *Who's Who in America,* Soderberg took the opportunity to express deep, personal feelings about his life and career:

> *Grateful: to have been born before the end of the last century and to have been allowed to sense the rhythm of Medieval life and the innocence of the Victorian age; to have been allowed to sense the elation of, and also the despair about, the transition to science and technology as a cultural base, with its bewildering aspects in the USA; to have been allowed to live through two World Wars without personal tragedy; to have been forced to share in the anxiety of the modern world and to be allowed to witness the first faltering steps on the long road to a sensible compromise between man's power to create material means, his greed in exploiting them, and his limitations in mastering its social consequences; to have been allowed to participate in the education of young, gifted minds, and to share in their creative work, and thus to have been allowed to sense the only real source of faith in the future.*

SOURCES FOR THIS biographical memoir include Soderberg's autobiographical essays in *My Life*, from which are drawn all unattributed quotations herein; extensive documentation of his career prepared by J. A. Stratton and L. H. Mannix; and a brief biographical tribute by the present author published by the National Academy of Engineering. I wish to acknowledge the help of R. W. Mann in obtaining letters from Soderberg's friends and acquaintances, and of Ms. Mannix and S. H. Crandall in commenting on the manuscript.

SELECTED BIBLIOGRAPHY

1923

Recent developments in balancing machines. *Trans. Am. Soc. Mech. Eng.* pp. 111-34.

1924

Vibration absorbers for large single-phase machines. *Electr. J.* Aug.:383-87.

1928

On the practical application of the theory of vibrations to systems with several degrees of freedom. *Philos. Mag.* 5:47-66.

1930

Factor of safety and working stress. *Trans. Am. Soc. Mech. Eng.* APM-52-2.

1933

Working stresses. *Trans. Am. Soc. Mech. Eng.* APM--55-16.

1935

Recent developments in steam turbines. *Mech. Eng.* Mar.:165-73.
Working stresses. *J. Appl. Mech.* Sept.:A106.
Turbine-blade erosion. *Electr. J.* Dec.:533-36

1936

Scaling of turbine blading. *Power* Nov.:596-97
The interpretation of creep tests for machine design. *Trans. Am. Soc. Mech. Eng.* RP-58-15.

1938

Plasticity and creep in machine design. In *Timoshenko Commemorative Volume,* pp.197-210. New York: Macmillan.

1939

Problems incidental to the use of high pressures and temperatures in marine steam power plants. *Trans. Soc. Nav. Archit. Mar. Eng.* 47:21.

1941

Interpretation of creep tests on tubes. *Trans. Am. Soc. Mech. Eng.* 63:737-40.

1943

With R. B. Smith. The gas turbine as a possible marine prime mover. *Trans. Soc. Nav. Archit. Mar. Eng.* 51:115-30.

1945

With R. B. Smith and A. T. Scott. A marine gas turbine plant. *Trans. Soc. Nav. Archit. Mar. Eng.* 53:249-89.

1948

The gas turbine and its significance as a prime mover. *Proc. Natl. Acad. Sci. U. S. A.* 34(6):239-45.

1950

Working stresses. In *Handbook of Experimental Stress Analysis*, ed. M. I. Hetényi, chap. 10. New York: Wiley & Sons.

1955

Jet propulsion. In *Encyclopedia Britannica*, vol. 13, pp. 28-29.

1956

Mechanical properties in relation to design requirements. *Metall. Rev.* 1:31-61.

1960

With E. Orowan. Mechanics of materials for gas turbine applications. In *Design and Performance of Gas Turbine Power Plants*, vol. 11, eds. W. R. Hawthorne and W. T. Olson, pp. 353-424. Princeton: Princeton University Press.

1962

The trends in engineering education: Do they concern the power industry? *Proc. Am. Power Conf.* 24:135-46.

1968

Forty years of turbine power developments. The de Laval memorial lecture presented to the Royal Academy of Engineering Sciences, Stockholm, Sweden.