AIAA JOURNAL
Vol. 39, No. 1, January 2001

Book Reviews

Legacy of a Gentle Genius—The Life of A. M. O. Smith

Edited by Tuncer Cebeci, Horizons Publishing, Long Beach, CA, 1999, 235 pp., $50.00

This is a fascinating book. Apollo Milton Olin Smith ("AMO," with long vowels please) ran what must have been one of the last internationally recognized basic research groups in an airplane company, namely the Douglas Aircraft Company. Now Tuncer Cebeci, AMO's successor, has reprinted five key research papers of AMO's, preceded by some reminiscences by AMO himself, written in 1994. Each paper has an introduction by one of the group, giving a little of the background to the work at Douglas. This is an unusual format but a very effective one.

Perhaps A. M. O. Smith's most famous paper was "Wing Design and Analysis—Your Job." It is not reproduced here, possibly because it is—of course—a synthesis of AMO's more specialized papers on calculation of potential flow, boundary layers, and transition. It was published in another book edited by Dr. Cebeci, the conference proceedings *Numerical and Physical Aspects of Aerodynamic Flows II* (Springer, 1984). The papers that appear in this book range in date from 1956 to 1981 and are amazingly up to date in their thinking: this is not just a history book. AMO remarks that the "e^9" method of transition prediction (1956) is still going strong. Of course the Douglas Neumann potential-flow code (1963) could almost be claimed as the start of serious computational fluid dynamics, and this "panel method" is still the preferred technique for predicting incompressible or slightly compressible flows if boundary layers remain thin and only a limited number of "off-body" points is needed. AMO introduces the key integral equation for the source strength with "As is shown in any good treatise on potential theory...." The 1981 review "The Boundary Layer and I" contains what may be one of the last examples of a desk-calculator operator getting the better of a computer—actually an IBM card-programmed calculator—because the computation involved finding the eigenvalues of a nearly singular matrix and evidently the desk-calculator operator had a better feel for the problem than the computer programmers.

However, despite the fascination of rereading AMO's old papers, the main interest, particularly for older readers, will be in AMO's good-humored reminiscences, including minor gems like the fact that his nickname was given him by W. R. Sears on his first day at GALCIT (Graduate Aeronautical Laboratory, California Institute of Technology). AMO had a hand in the basic design of many famous Douglas aircraft during and soon after World War II, before moving over to aerodynamics research. He conceded that many of his recollections may not be completely accurate, but the only improbability this reviewer noticed was the description of the late James Lighthill as "not much of a talker." In the editor's introduction to "The Boundary Layer and I," Prof. Herbert B. Keller of Caltech is described as "a tamed [sic] and very gifted mathematician," but this may be a misprint.

The accurate definition of "gentleman" is "a person who does not need to work for his living." AMO was undoubtedly someone who would have worked at the job he loved even if he didn't have to. He describes himself as a bit of a loner, but this seems to refer to his preferred way of working at a problem, sitting quietly and thinking, rather than brainstorming. Clearly he was a very effective group leader.

The book is well produced and contains several characteristic photographs of AMO at various stages of his life. It is obviously a labor of love by AMO's old associates but should certainly be on the bookshelf of anybody concerned with aeronautical aerodynamics.

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Principles of Helicopter Aerodynamics

J. Gordon Leishman, Cambridge University Press, New York, 2000, 496 pp., $95.00

In the past 50 years, only a few books on the subject of helicopter aerodynamics have been published. Because the helicopter is such a complex flying machine, it requires multidisciplinary approaches to solve many conflicting requirements for helicopter engineering problems. As an example, the selection of a low-wave-drag airfoil for good transonic performance on the advancing side of the rotor will conflict with the requirement of delaying stall at the low speed on the retreating side. The second example is the rotor wakes. In contrast to fixed-wing aircraft, the wake vortex generated by the rotor blade interacts with the following blade as well as with the fuselage and tail rotor. The strength and location of the vortex affects performance, noise, and vibratory loads. Because of these difficulties the helicopter designer relies on simple theory, experience, and full-scale testing to design new helicopters. It is difficult to write a detailed treatise of helicopter aerodynamics to cover all different aspects. Professor Leishman took the challenge, and a well-written book is the result.

This book contains two parts, the first of which is in the spirit of Prof. Alfred Gessow's classic book on helicopter aerodynamics written almost 50 years ago. The first chapter discusses the history of vertical flight, including autogiros, helicopters, and other rotorcraft. The second chapter forms the basis for analyzing hover and forward flight performance using momentum theory. Chapter 3 extends the momentum theory to blade-element moment theory that is used extensively by the helicopter industry for preliminary design. Chapter 4 discusses how the aerodynamic forces affect the response of the rotor blades and the rotor trim. Rotor performance for hover and forward flight conditions is given in Chapter 5. This chapter also includes the analysis of climb, descent, and autorotation conditions. Chapter 6 shows how to combine the analytical methods from the preceding chapters in a rotor conceptual design.

The second part of the book is more like an assemblage research topic in helicopter aerodynamics. Indeed, Prof. Leishman has made substantial contributions, particularly to the research on rotor unsteady aerodynamics (Chapter 8) and rotor wakes (Chapter 10). Chapter 7 discusses the general requirements for a helicopter rotor airfoil, which are quite different from those for a fixed-wing airfoil. It is difficult to select one airfoil for all blade sections due to conflicting requirements. Chapter 8 addresses unsteady aerodynamics and covers classic techniques such as Theodorsen and Lowey's theory, as well as modern treatments, such as the indicial response method, and dynamic inflow. Chapter 9 discusses the more difficult problem for helicopter aerodynamics, namely, dynamic stall, which is one of the technical barriers to improved maneuverability for conventional helicopters. Different engineering methods to treat dynamic stall are discussed in detail. Chapter 10 discusses the most important aspect of helicopter aerodynamics, the rotor wakes, and covers topics such as tip vortex formation, the structure of tip vortices, and the basic geometry of the vortex wake.

Not only is this book a good text for the graduate student but it also is also a good book for practical engineers and researchers. The first six chapters review what is needed for basic helicopter aerodynamics, and the last four chapters address important research areas in the field. I hope the author will include two more chapters in future editions to cover interaction aerodynamics and computational fluid dynamics methods, neither of which are included in the present edition. This book is an excellent addition to a reference library.

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