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BOOK REVIEWS

H. L. EVANS, **Laminar Boundary-Layer Theory**, 229 pp. Addison-Wesley, Massachusetts (1968)

THE BOOK deals with one particular aspect of laminar boundary layer theory, namely the theory of two dimensional similar boundary layers. The literature abounds with papers on this topic and it is gratifying to have a nearly complete treatment of both two dimensional and axially symmetric similar boundary layer flows in one book. On classifying these similar solutions the author also shows how they may be employed to develop a practical method of prediction for non-similar boundary layer flows with heat transfer.

The book begins with a straight-forward account in physical terms of the laminar boundary layer equations for steady two-dimensional incompressible flow. However, basic mathematical concepts and inherent difficulties in formulating these equations are not discussed. There follows a chapter on the governing equations for two-dimensional similar boundary layers, namely that the main-stream velocity satisfies the equation $du/dx = cu^{2(\beta-1)/\beta}$, where c and β are constants.

Next comes an account of representative boundary layer length scales, definitions of heat transfer coefficients and etc. The next chapter gives an extremely useful and clear account of the potential flows which give rise to similar boundary layers and is followed by two chapters on actual numerical solutions of the velocity and thermal equations. These form the essential core of the book. It is evident that a detailed computer study of the velocity equation has been made to include a wide range of accelerated and retarded flows. The corresponding thermal profiles for isothermal wall condition are presented for Prandtl numbers ranging from 10^{-4} to 10^4 and nearly all of this data is new.

The above detailed information on two-dimensional similar solutions is then employed to discuss axially-symmetric flows. In particular, using Mangler's transformation, the boundary layer on a cone is discussed, together with details on the potential flow which are not readily available from the literature.

The final chapter deals with a method of prediction of viscous drag and heat transfer in non-similar boundary layers; the method was first developed by Meksyn and later extended by Merk to give heat transfer predictions. The account given by the author is in many ways unsatisfactory. For example, the dimensionless stream function satisfies the equation

$$f''' + ff'' + \beta(1 - f'^2) = \frac{d\beta}{d\chi}\left(f'\frac{\partial f'}{\partial \beta} - f''\frac{\partial f}{\partial \beta}\right)$$

and for a similar solution the pressure gradient parameter is constant, i.e. $d\beta/d\chi = 0$. If we assume that $d\beta/d\chi$ is small (i.e. we are not in the neighbourhood of a separation point) we read on page 153, 'We therefore treat $d\beta/d\chi$ as a perturbation parameter, which we assume to be small, and obtain a perturbation solution of the velocity and thermal energy equations', and then 'The series for the stream function has the form

$$f(\chi, \eta) = f_1(\beta, \eta) + \frac{d\beta}{d\chi} f_2(\beta, \eta) + \frac{1}{2}\left(\frac{d\beta}{d\chi}\right)^2 f_3(\beta, \eta) + \ldots).$$

Some ingenuity is required to correct this last expansion for it clearly must include terms in $d^2\beta/d\chi^2$, etc. Perhaps it is the above difficulty which might help to explain the author's conclusion, obtained by comparing his predictions with known numerical and experimental results, that the first term of the above expansion yields results which are usually superior to those obtained on employing two terms. Obviously some further research is needed in this connection.

In conclusion I feel that Evan's book will appeal most to those who rely on physical reasoning. Those who value mathematical reasoning may wish to see a different approach to the derivation of the basic equations and to the employment of modern techniques in the text. There is no doubt that we should all be grateful to the author for compiling this large body of numerical information on similar boundary layers and for the lucid presentation.

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