initial estimates of the unknown surface gradients, the effect of step size on the accuracy of the results, etc.

In referring to the results shown in Fig. 2 of Ref. 1, Wortman and Mills remark that solutions generated with simplified gas properties can exhibit incorrect trends—namely, the separation value of β generally increases with the Mach number parameter E for gases with realistic values of ω, whereas the converse is true for $\omega = 1.0$. However, a careful analysis of the results shown in Fig. 2 of Ref. 1 reveals that these "trends" are more likely attributable to mass transfer at the surface or real gas effects. In particular, Fig. 2 of Ref. 1 reveals that for no mass transfer at the surface, the separation value of β is essentially not a function of E, and that the values for $\omega = 0.5$, $Pr = 0.723$ and $\omega = 1.0$, $Pr = 1.0$ are quite close. In fact, it appears from the results shown in Fig. 2 of Ref. 1 that they may be correlated using an inverse square or cube root of the Prandtl number.

Wortman and Mills[1] also state that the arguments over accuracy entered into by Rogers[3] are quite academic, since the solutions resemble physical reality so poorly. Here Wortman and Mills[1] have misinterpreted the purpose of the accuracy arguments of Refs. 2 and 3. These arguments are directed towards establishing the numerical accuracy of the solutions and not the correspondence between the mathematical model and the physics of the problem. These are two separate questions. In the opinion of the present author, the accuracy of numerical solutions should always be established. Further, numerical solutions should be obtained and published to the highest practical accuracy in order to eliminate the necessity for subsequent investigators to repeat the calculations. Because the limitations of similar solutions in representing physical reality are generally well known, they are not normally discussed by current investigators. However, it should be noted that sufficient justification for investigating similar solutions, even with simplified physical property models, has been presented above.

References

[1] Wortman, A. and Mills, A. F., "Separating Self-Similar Laminar Boundary Layers," *AIAA Journal*, Vol. 9, No. 12, Dec. 1971, pp. 2449–2451.

[2] Rogers, D. F., "Reverse Flow Solutions for Compressible Laminar Boundary Layer Equations," *The Physics of Fluids*, Vol. 12, No. 3, March 1969, pp. 517–523.

[3] Rogers, D. F., "Comment on 'Separation Solutions for Laminar Boundary Layer,'" *AIAA Journal*, Vol. 8, No. 11, Nov. 1970, pp. 2107–2109.

[4] Fox, H. and Saland, H., "Separation Solutions for the Similar Laminar Boundary Layer," *AIAA Journal*, Vol. 8, No. 4, April 1970, pp. 780–788.

[5] Libby, P. A. and Liu, T. M., "Some Similar Laminar Flows Obtained by Quasilinearization," *AIAA Journal*, Vol. 6, No. 8, Aug. 1968, pp. 1541–1548.

[6] Wortman, A., "Mass Transfer in Self-Similar Boundary-Layer Flows," Ph.D. dissertation, 1969, School of Engineering and Applied Science, Univ. of Calif., Los Angeles, Calif.

[7] Dewey, C. F., Jr. and Gross, J. F., "Exact Similar Solutions of the Laminar Boundary-Layer Equations," *Advances in Heat-Transfer*, Vol. 4, Academic Press, New York, 1967.

[8] Cohen, C. B. and Reshotko, E., "Similar Solutions for Compressible Laminar Boundary-Layer with Heat-Transfer and Pressure Gradient," TR1293, 1956, NACA.

[9] Smith, A. M. O. and Clutter, D. W., "Machine Calculation of Compressible Lamilar Boundary-Layers," *AIAA Journal*, Vol. 3, No. 4, April 1965, pp. 639–647.

[10] Smith, A. M. O. and Jaffe, N. A., "General Method for Solving the Laminar Nonequilibrium Boundary-Layer Equations of a Dissociating Gas," *AIAA Journal*, Vol. 4, No. 4, April 1966, pp. 611–620.

[11] Sparrow, E. M., Quack, H. and Boerner, C. J., "Local Nonsimilarity Boundary-Layer Solutions," *AIAA Journal*, Vol. 8, No. 11, Nov. 1970, pp. 1936–1942.

Reply by Authors to D. F. Rogers

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In reply to Professor Rogers we offer the following rebuttal.

1) In Ref. 1 we simply argued that calculations of the separation pressure gradient parameter β using degenerate fluid properties were of doubtful value owing to an absence of a prescription for applying such results to real flows. Rogers' defense of self-similar calculations in general, seems irrelevant.

2) In Fig. 2 of Ref. 1 the zero suction values of β for real air show a variation of about 50% in the range of E considered, and for model air about 10%. Yet Rogers states that the figure reveals β to be "essentially not a function of E," demonstrating a difference in his and our thinking regarding the level of an acceptable approximation.

3) Rogers misrepresents Ref. 6 in asserting that the calculation method developed therein suffers from problems of choice of a finite η_{max}, integration step-size, and initial profile estimation. That the converse is true can be seen in Table 2-1 and Fig. 2.1 which summarizes the results of an extensive study and demonstrated the method to be insensitive to these factors.

4) We agree with Rogers that the accuracy of calculation methods should be carefully established, but find it difficult to be concerned with the 6th decimal place, and are of the opinion that such exercises should not be the main purpose of journal publications.

Received May 25, 1972.
Index category: Boundary Layers and Convecture Heat Transfer—Laminar.

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