Reply by Author to R.L. Simpson

Richard H. Pletcher*
Iowa State University, Ames, Iowa

THE author apologizes for not examining more carefully the criticisms of the Simpson data[1] given by Square[2] and Baker and Launder[3] (Refs. 11, 12, and 13 respectively of original paper). Apparently the question as to whether the von Karman "constant" remains constant or varies at low Reynolds numbers is still unsettled despite the recent analyses.[4,6] (Refs. 7, 9 of original paper) which suggest that κ does remain constant. The purpose of the paper was not to discredit Simpson's arguments[5] (Ref. 8 of original paper) about the variation of κ with Reynolds number in particular but to merely present the results from a turbulence model which was based on the assumption that κ does remain constant.

If Simpson's impermeable wall data were to be added to Fig. 1 of the paper[7] we would observe that the skin friction coefficient for the lowest Reynolds number, $Re_\theta = 627$, would like 14% above the predictions of Model 2B. Eight of the 10 remaining points would lie within 6% of prediction and two within 8%. The uncertainties cited by Simpson for his data would amount to 4-5%. The Simpson data indicate a trend in c_f generally higher (on the order of 5-6%) than that given by the data from the other three investigators shown in Fig. 1 of the paper or the predictions.

For completeness it would have been well to have included the Simpson data in Fig. 1 of the paper. On the other hand, since his c_f data does stand out as being higher at low Reynolds numbers than the concensus of data from three other investigators, it was easy to interpret the comments about the Simpson data in the papers by Squire[2] and Baker and Launder[3] as suggesting that a systematic error may have been present in Simpson's measurements or data reduction process. Until an infallible means to validate or invalidate experimental data becomes available, we should probably be cautious about disregarding any of it, since in scientific investigations as well as other endeavors the majority is not always right.

References

[1] Simpson, R.L., "The Turbulent Boundary Layer on a Porous Plate: An Experimental Study of the Fluid Dynamic with Injection and Suction," Ph.D. dissertation, Dept. of Mechanical Eng., Stanford Univ. Stanford, Calif., Dec. 1967.

[2] Squire, L.C., "The Constant Property Turbulent Boundary Layer with Injection; a Reanalysis of Some Experimental Results," *International Journal of Heat and Mass Transfer,* Vol. 13, May 1970, pp. 939-942.

[3] Baker, R.J. and Launder, B.E., "The Turbulent Boundary Layer with Foreign Gas Injection: I. Measurements in Zero Pressure Gradient." *International Journal of Heat and Mass Transfer,* Vol. 17, Feb. 1974, pp. 275-291.

[4] Cebeci, T., "Kinematic Eddy Viscosity at Low Reynolds Numbers," *AIAA Journal,* Vol. 11, Jan. 1973, pp. 102-104.

[5] Simpson, R.L., "Characteristics of Turbulent Boundary Layers at Low Reynolds Numbers with an Without Transpiration," *Journal of Fluid Mechanics,* Vol. 42, July 1970, pp. 769-802.

[6] Huffman, D.G. and Bradshaw, P., "A Note on von Karman's Constant in Low Reynolds Number Turbulent Flows," *Journal of Fluid Mechanics,* Vol. 53, May 1972, pp. 45-60.

[7] Pletcher, R.H., "Prediction of Turbulent Boundary Layers at Low Reynolds Numbers," *AIAA Journal,* Vol. 14, May 1976, pp. 696-698.

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Index category: Boundary Layers and Convective Heat Transfer-Turbulent.

*Professor of Mechanical Engineering. Member AIAA.

Errata

Unsteady Hypersonic Flow over Delta Wings with Detached Shock Waves*

W. H. Hui and H. T. Hemdan
University of Waterloo, Ontario, Canada

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THE following should be inserted immediately after Eq. (20)

$$g = V_0 - \cot\alpha[ik(h-x) - 1] \tag{20a}$$

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*The original paper was received June 12, 1975, not 1972.

Formulation of the Global Equations of Motion of a Deformable Body

Thomas B. McDonough
Aeronautical Research Associates of Princeton, Inc. Princeton, N. J.

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EQUATION (8) should read

$$\bar{\bar{D}} \equiv \frac{1}{2}\,(\bar{\nabla}\dot{\bar{p}} + \dot{\bar{p}}\bar{\nabla}) \tag{8}$$

Equations (10a) and (10b) should read

$$\dot{\bar{p}} = \dot{\bar{c}}(t) + \dot{\bar{p}}' = \dot{\bar{c}}(t) + \bar{\omega}\times\bar{p}' + \mathring{\bar{p}}' \tag{10a}$$

$$\ddot{\bar{p}} = \ddot{\bar{c}}(t) + \dot{\bar{\omega}}\times\bar{p}' + \bar{\omega}\times(\bar{\omega}\times\bar{p}') + 2\bar{\omega}\times\mathring{\bar{p}}' + \mathring{\mathring{\bar{p}}}' \tag{10b}$$

Equation (16b) should read

$$\dot{\bar{H}}^{[0]} = \dot{\bar{c}}\times\bar{P} - \ddot{\bar{c}}\times\int_V \bar{p}'\ dm + \dot{\bar{\omega}}\cdot\bar{\bar{I}} + \bar{\omega}\times(\bar{\omega}\cdot\bar{\bar{I}})$$
$$+\,\bar{\omega}\cdot\mathring{\bar{\bar{I}}} + \bar{\omega}\times\bar{H}'^{[0']} + \mathring{\bar{H}}'^{[0']} \tag{16b}$$

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