8) The table on p. 1217 should read as follows:

| First-order theories | Fig. no. |
|---|---|
| (1) Allen and Eggers | Fig. 3 |
| (2) Chapman | Fig. 3 |
| (3) Gazley | Fig. 4 |
| (4) Lees (Ting) | Figs. 7c, 7d |
| (5) Loh | Figs. 3, 7 |
| (6) Previous solution unavailable | Figs. 3, 4 |
| (7) Supercircular | Figs. 8a, 8b, 8c, 8d |

### II. Misprinting

1) The symbol $\zeta$ contained in Eqs. (14b, 21, and 23–25) should be the symbol $\rho$.

2) The numerator of the right-hand term of the first equation appearing on the right-hand side of p. 1215 should read $\theta_f - \theta$ instead of $\theta - \theta_f$.

3) The numerator of the right-hand term of the second equation appearing on the right-hand side of p. 1215 should read $(L/D)$ ln $\{1/[V^2/(gR_0)]\}$ instead of $(L/D)$ ln $\{1/[V_2/(gR_0)]\}$.

4) The Fig. 8 mentioned in the text on the right-hand side of p. 1216 should be Fig. 9, which is the figure contained in Ref. 2.

### III. Addendum

Since the submission of Ref. 1, Refs. 2 and 3 were written. References 2 and 3 show that the second-order solution also may be reduced analytically to the previous solutions given by Arthur and Karrenberg and Wang and Ting in Refs. 4 and 5. These references are in addition to the numerical checks presented in Ref. 1.


#### References

[1] Loh, W. H. T., "A second-order theory of entry mechanics into a planetary atmosphere," J. Aerospace Sci. **29**, 1210–1222 (1962).

[2] Loh, W. H. T., "On atmospheric entry with small $L/D$," J. Aerospace Sci. **29**, 1016 (1962).

[3] Loh, W. H. T., "Supercircular gliding entry," ARS J. **32**, 1398 (1962).

[4] Arthur, P. D. and Karrenberg, H. K. "Atmospheric entry with small $L/D$," J. Aerospace Sci. **28**, 351–352 (1961).

[5] Wang, K. and Ting, L., "An approximate analytic solution of re-entry trajectory with aerodynamic forces," ARS J. **30**, 565–566 (1960).


## Comments on "Calculation of Laminar Separation"


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In a recent paper, Morduchow and Reyle[1] reported a formula, due to Morduchow and Clarke,[2] by means of which the position of separation of a laminar boundary layer may be calculated in incompressible flow or in compressible flow with zero heat transfer. Calculated results were presented for two families of solutions as follows:

1) Compressible flow with zero heat transfer, $\sigma = 1$, $\mu \alpha T$, and $u_1 = u_\infty(1 - \xi)$, the values of $\xi$ at separation being calculated at various Mach numbers.

2) Incompressible flow, with $u_1 = u_\infty(1 - \xi^n)$, the values of $\xi$ at separation being calculated for various values of $n$.

The purpose of the present note is to indicate that the conclusions reached by Morduchow and Reyle are somewhat misleading. Begin with the case of compressible flow with zero heat transfer, where comparisons are made with the calculations of Stewartson,[3] showing remarkable agreement over a range of Mach numbers $M_\infty$ from 0 to 10. The implication that the proposed formula is thus exceedingly accurate is, however, fallacious. It does not appear to be very widely known that these early results of Stewartson show an error that increases with Mach number. In particular, when $M_\infty = 4$, the results tabulated by Morduchow and Reyle indicate that $\xi_s \,\underline{\Omega}\, 0.06(0)$, according to either their own method or Stewartson's. However, numerical solutions of the boundary layer equations for this problem by Mathematics Division, National Physical Laboratory, reported by Curle[4] show that $\xi_s \,\underline{\Omega}\, 0.04(5)$, with an error of under 10%. The values of $\xi_s$ given by Stewartson and by Morduchow and Reyle accordingly are alike in error by about 30 or 40%.

With regard to the case of incompressible flow, it may be remarked that a method exists which is both simpler to apply and more accurate in its predictions than the method under discussion. It was originally due to Stratford[5] and was simplified somewhat by Curle and Skan.[6] In its simplest form, the method gives the values of $\xi$ at separation by solution of the algebraic equation

$$C_p[\xi(dC_p/d\xi)]^2 = 0.0104$$

where $C_p = 1 - (u_1^2/u_\infty^2)$ is the pressure coefficient.

The simplicity is apparent, and the accuracy is indicated in Table 1.

It will be noted that the error is only 10% of that given by Morduchow and Reyle. The method of Stratford has been applied to the various other cases for which essentially exact solutions of the laminar boundary layer equations are available (Terrill[7] and Curle[8]) and the considerable accuracy verified.


#### References

[1] Morduchow, M. and Reyle, S. P., "On calculation of the laminar separation point, and results for certain flows," J. Aerospace Sci. **29**, 996 (1962).

[2] Morduchow, M. and Clarke, J. H., "Method for calculation of compressible laminar boundary-layer characteristics in axial pressure gradient with zero heat transfer," NACA TN 2784 (1952).

[3] Stewartson, K., "Correlated incompressible and compressible boundary layers," Proc. Roy. Soc. (London) **A200**, 84 (1949).

[4] Curle, N., "The steady compressible laminar boundary layers, with arbitrary pressure gradient and uniform wall temperature," Proc. Roy. Soc. (London) **A249**, 206 (1959).

[5] Stratford, B. S., "Flow in the laminar boundary layer near separation," A.R.C., R&M 3002 (1954).

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[7] Terrill, R. M., "Approximate methods of solving the laminar-boundary layer equations," Aeronaut. Quart. **13**, 285 (1962).

[8] Curle, N., "The laminar boundary layer equations," Oxford Mathematical Monographs (1962), Chap. 5.


**Table 1 Separation point for $u_1/u_\infty = 1 - \xi^n$, $M_\infty = 0$**

| $n$ | 1 | 2 | 4 | 8 |
|---|---|---|---|---|
| $\xi_s$ (Howarth and Tani) | 0.120 | 0.271 | 0.462 | 0.641 |
| $\xi_s$ (Morduchow and Reyle) | 0.122 | 0.268 | 0.452 | 0.625 |
| $\xi_s$ (Stratford) | 0.121 | 0.271 | 0.461 | 0.639 |

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