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Reply by Author to G. L. Mellor

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MELLOR'S comment cites wake results that indicate definite power law variations of centerline velocity decay and mixing region widths that tend to agree with the conventional eddy viscosity assumption.

However, it should be noted that conclusions regarding such power law results should be made with caution. Recently, Murphy and Dickinson[1] have shown that the determination of the power law variation for the wake growth is susceptible to considerable error, particularly in what can best be termed the "near-downstream" region. Furthermore, Zakkay[2] has recently obtained a voluminous amount of data for coaxial jets which indicate that the centerline decay of concentration appears to best fit an x^{-2} variation which contradicts the results cited by Mellor.

Nevertheless, Mellor raises a valid question regarding the fact that ϵ increases with x, whereas in all incompressible cases, asymptotic forms have either tended towards zero or approached a constant value. The answer here may well lie in the fact that the experiments for which ϵ were derived were centered in the near-downstream region. As a result, the zone of validity may at first appear to be excessively restrictive. However, it should be noted that it is within this apparently restricted region that approximately 90% of the velocity and concentration equalization takes place, and therefore, this region would ordinarily be the one of maximum interest.

Finally, Mellor seeks to attribute the mixing at $U_e \cong U_c$ to upstream turbulence or velocity distortions due to upstream boundary layers. If such quantities were indeed the principal instigators of the mixing process, one would expect that a perturbation of the upstream boundary layers or initial profiles should produce a significant effect on the downstream concentration distributions. In order to investigate this point the wind tunnel described in Ref. 3 was used for the following simple test. A 1-in. length of 0.022-in. thick sandpaper roughness was attached to the outer surface, downstream end, of the central jet in order to perturb the boundary layer of the external stream. The height of the roughness was of the same order as the boundary-layer thickness of the outer jet. Nevertheless, a comparison of the downstream concentration profiles at $x/r = 15$, taken with and without roughness, indicated no measureable differences. This result suggests that mixing at $U_e \cong U_c$ is not principally dependent on the nature of the upstream boundary layers.

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