It is perhaps best to conclude with another quote from Ref. 2: "We shall not editorialize further on the correlation, or lack thereof, ... but shall invite the reader to make his own judgment."

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Comment on "Structure of Turbulent Shear Flows: A New Look"

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THE probability density distributions reported for the first time in this paper by Roshko[1] for the nonuniform density mixing layer are of very great interest as they are of considerable importance in the theory of chemical reactions in turbulent flow.[2,3] The author remarks on the asymmetry of the distribution in the mixing layer with large density difference, a feature not nearly so marked in the constant-density layer. A large part of this asymmetry, however, appears to be associated with the choice of concentration in mole fraction as the variable of interest rather than mass fraction. Figure 1a shows the probability density distributions replotted using the mass fraction of helium, ξ, as the independent variable. The distributions now appear skewed the other way but this is mostly because the mean mass fractions turn out to be mainly on the N_2 side of 0.5. It would be interesting to see data for higher values of $\tilde{\xi}$.

Mass fractions are of more interest theoretically than mole fractions since the conservation equations for chemical species and mixture fraction are usually written in terms of mass fractions. In variable-density turbulent flows such equations are best written in Favre form[4,5] and these give rise to Favre probability density distribution functions[5] such as $\tilde{p}_\xi(\xi)$ where

$$\tilde{p}_\xi(\xi) \equiv \frac{1}{\bar{\rho}} \int_0^\infty \rho \, p_{\rho\xi}(\rho,\xi)\, d\rho$$

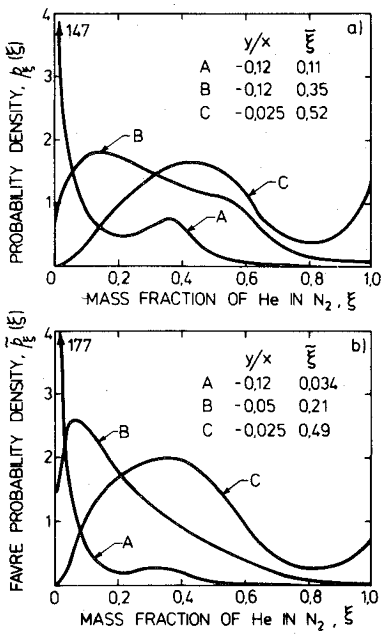

Fig. 1 Probability density distributions of mass fraction of helium in nitrogen in a mixing layer. Data of Roshko.[1] a) Probability density; b) Favre probability density.

In the present case where the density ρ is a function only of ξ the joint probability density function $p_{\xi\rho}(\rho,\xi)$ can be avoided so that

$$\tilde{p}_\xi(\xi) = (\rho/\bar{\rho})\, p_\xi(\xi)$$

A hypothesis[5] which is gaining support[6] is that it is $\tilde{p}_\xi(\xi)$ and not $p_\xi(\xi)$ which can be modeled in variable density flow in the same way as in uniform density flow. Figure 1b shows the mixing-layer data plotted in a Favre probability density form. These are also skewed to the N_2 side but now all the data is for Favre averages $\tilde{\xi} < 0.5$

$$\tilde{\xi} = \int_0^1 \xi \tilde{p}(\xi)\, d\xi = \overline{\rho\xi}/\bar{\rho}$$

It would be of interest to see some data for higher values of $\tilde{\xi}$ so that an evaluation of the aforementioned hypothesis can be made.

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