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LETTER TO THE EDITORS

COMMENTS ON "TURBULENT CONVECTIVE HEAT TRANSFER FROM ROUGH SURFACES"

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ONLY recently I have read the comment of Hall [1] referring to our paper [2] and to Lyall's comments on it [3]. As we auspicated in our rejoinder [4], the discussion had induced Hall to explain what he really meant in his original paper regarding the transformation of the temperature profile [5].

Hall states that the arbitrary constant to determine the transformed temperature profile should be chosen so as to make the bulk temperature in the transformed region coincide with the real bulk temperature in that region. "Consequently the wall temperature derived from the transformed temperature profile will not coincide with the measured wall temperature" [1]. Hall admits that Fig. 2 of his original paper [5] is not right [1] and this was the origin of our misinterpretation [2]. After Hall's clarification I can now admit that indeed the Hall method converts the measured temperature profile to the boundary condition $q = 0$ where $\tau = 0$, however, in doing so, Hall produces a new temperature profile where the wall temperature is changed. Now, the wall temperature is also a very important boundary condition, probably the most important. Lyall and Hall seem to think that only the temperature difference matters. This is not true, as shown for instance by many heat transfer experiments with gases in presence of large temperature differences: the wall temperature is important in itself, simply because many important things occur near the wall.

It seems to me that the present discussion shows that the Hall's transformation of temperature profiles breaks down in the same way as his transformation of velocity profiles, as shown for instance by the experiments of Kjellström and Hedberg [6] and of Wilkie *et al.* [7]. Essentially the breakdown of the Hall's transformation, for both heat transfer and friction, is due to:

(a) The difficulty in bringing to coincidence the two boundary conditions $\tau = 0$ and $q = 0$ in an annulus;
(b) the shift in the position of no shear in respect to the position of maximum velocity;
(c) the rather crude method of using the equivalent hydraulic diameter concept.

Our method suggested in [2] and based on velocity and temperature profiles is a real improvement on the method of the equivalent hydraulic diameter. However, our method is based on the assumption that the slope of these profiles is constant and equal to 2.5. There is experimental evidence [8–10] that this slope is a function of the roughness. Approaches based on this functional dependence would improve the situation even further.

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