LETTER TO THE EDITOR

On the estimation of vertical turbulent diffusion from thoron profiles

(Comment on a paper by Ikebe and Shimo)

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In a recent paper Ikebe & Shimo (1972) [I & S] reported results of their study on the estimation of vertical diffusivity from thoron profiles. They found that the apparent diffusivity from thoron profiles was 50 % larger than the apparent eddy viscosity derived from the wind profiles. The discussion in their paper concentrated on this discrepancy. I & S examine two possible explanations: (1) the departure from atmospheric stability, and (2) the error in their measurements. In their paper they did not mention that Israel (1966) found a seven fold difference between the apparent diffusivity from thoron and the eddy viscosity. It appears from that paper that something very essential is missing from the discussion of I & S.

In a paper of mine (Assaf, 1969) I gave a detailed analysis of the interrelation between the mean life of a radioisotope and the structure of atmospheric turbulence. The main conclusion was that the general condition for the validity of the K approximation is necessary but not sufficient to justify its application in the case of emanated products. For a meaningful application of the K approximation to emanated products there must be a gap in the power spectra of the eddy activity (this condition is necessary) and the mean life of the radioisotope must be long compared with those of the eddies whose action is integrated into the K approximation. However, the 52 sec half-life of thoron is comparable to that of atmospheric eddies. As was shown in my paper, in such a case the thoron concentration profile gives entirely different weight to different eddies and the apparent diffusivity depends upon the mean life of the radioisotope. In other words the K approximation is invalid and the evaluation of thoron concentration profiles should be made in accordance with the Beran & Assaf formulation (1970).

In the summary of their paper I & S indicate their plan to use radon concentration for measuring atmospheric diffusivity at higher altitudes. I would recommend that before they do this they should consider the separation principle of Richardson and the relation between advection and diffusion in the following papers: Assaf (1969), Huss et al. (1970) Beran & Assaf (1970) and Assaf (1971).

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