

## AUTHOR'S REPLY

Rangarajan (1972) has made valuable comments on the study reported by Satya Murty and Ramana Murty (1971) for which the latter express their sincere gratitude. From their study, Satya Murty and Ramana Murty have drawn the inference that transport downwards, from the stratosphere, of ice-forming aerosols is a strong possibility. The inference drawn has been based on the simultaneous consideration of the following four features : (1) date of occurrence of ice nuclei burst, (2) structure of the tropopause within the preceding five days of occurrence of the ice nuclei burst, (3) increase in the beta activity on the date of occurrence of the ice nuclei burst and (4) increase in ozone within the preceding five days of occurrence of the ice nuclei burst. As far as beta activity is concerned the periods considered are March 1962 to January 1963 and May 1965. For reasons pointed out by Rangarajan the periods April to December 1962 and June 1965 are not suitable for the study because the increase in the beta activity during those periods cannot be definitely attributed to increased stratospheric fallout. Considering that data, simultaneously, of ice nuclei and beta fallout are available for no other periods covering occasions of ice nuclei burst, the following may now be said.

The increases noticed in the beta activity during the above periods (March 1962 to January 1963 and May 1965), although cannot be definitely attributed to increased stratospheric fallout, cannot also be entirely attributed to tropospheric fallout. The increases could be attributed to a mixture of fallout of both the types. It is significant to note in this connection, as already stated in the paper, that of the 21 occasions of the ice nuclei burst noted during the above periods as many as 16 were associated with beta fallout increase of 10% and more. On 11 of those occasions the beta fallout increase noticed was 25% and more, as will be seen from Table 3 of the paper. However, these features alone now do not definitely suggest that stratospheric air rich with ice nuclei would have intruded into the troposphere on such occasions. But, consideration simultaneously of the tropopause features would help provide some clue. Of the 11 occasions referred to above which were associated with beta fallout increase of 25% and more (this percentage increase is now considered as against the 10% increase considered before because the accuracy of the beta fallout data itself, as pointed out by Rangarajan, may be of the order of  $\pm 10\%$  during periods of low activity), tropopause data which are required for examination are available for 6 occasions. These are 15 May (47% increase), 20 July

(131%), 12 October (33%) and 17 October (297%), in 1962; and 18 January (81%) and 21 January (62%) in 1963 (*vide* Tables 1 and 3 of the paper). Examination of the tropopause data indicate that on all the 6 occasions referred to above, as on most of the occasions of the ice nuclei burst, the tropopause structure had been favourable for downward mass transport to occur from the stratosphere (*vide* Table 1 of the paper).

The reason for the authors choosing the particular criterion stated for determining an increase in the beta fallout levels, unlike as in the case of ozone, is the assumption involved in the study,

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namely, that the ice nuclei from the stratosphere and the beta fallout have similar life times in the troposphere (*vide* IV on page 173 of the paper).

The tropopause data for Delhi only have been considered because the ice nuclei data available refer only to Delhi. The analysis could be usefully extended to other stations if ice nuclei data for those stations also are available.

Considerable light could be thrown on the origin of the ice-forming nuclei by undertaking studies in the manner suggested by Rangarajan. This is possible when data for longer periods and for more stations become available.

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#### REFERENCES

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| Rangarajan, C.                           | 1972 | <i>Indian J. Met. Geophys.</i> , 23, 3, pp. 423-425. |
| Satya Murty, P. and Ramana Murty, Bh. V. | 1971 | <i>Ibid.</i> , 22, 169-178.                          |