CAUSES OF ARIDITY AND INVERSION OVER THE DESERT AREAS OF WEST PAKISTAN AND NEIGHBOURHOOD DURING THE SOUTH-WEST MONSOON SEASON

BY B. N. DESAI, F.A.Sc.

(173, Swami Vivekananda Road, Vile Parle—West, Bombay—56)

Received February 21, 1968

ABSTRACT

Views of Flohn (1965, 1966) and of Ramage (1966) regarding the causes of aridity and inversion over the desert areas of West Pakistan and neighbourhood have been examined. It is shown on the basis of climatic features of the area that the inversion is due to air masses and not due to subsidence; the aridity of the region is due to absence usually of a mechanism which can break up the inversion and not due to the restricted depth of the moist current.

INTRODUCTION

It has hitherto been considered that the inversion over West Pakistan during the monsoon season is due to different air masses, deflected trades or moist monsoon air in the lower levels and warmer drier air from Baluchistan plateau side above (Desai, 1966—1, 2; 1967—1, 2); the aridity of the desert area has been taken as being due to inability of the convective clouds to penetrate the inversion.

Flohn (1965, 1966) has expressed the view that the aridity of the desert region is due to subsidence caused by divergence. Ramage (1966) has stated that the inversion over the desert area is due to large-scale subsidence which restricts the depth of the moist current and is responsible for scanty rainfall over that area.

It is proposed to examine in this paper the various facts of observations over the area with a view to decide which of the two causes—air masses considered valid up to 1963 or subsidence (Flohn and Ramage) is responsible for the inversion between about 1·0 and 2·0 km. and scanty rainfall over the desert area of West Pakistan and neighbourhood.
Climatic features.—It has been found on analysis of aeroplane ascents over Karachi (Hariharan, 1932) that during a typical monsoon month like July, an inversion usually occurs over Karachi at a height of about 1·0 km. and it is about 500 meter thick, the rise in temperature in the inversion being about 4° C. on an average. The lapse rate below the inversion was adiabatic and above it in the dry air about 6 to 8° C. per km. The winds over Karachi are moderate to strong and mainly from west upto 1·0 km., veer with height and at 3·0 km. are light to moderate between north and east, being somewhat stronger but from about the same direction at 6·0 km. Light rain occurs at times in the mornings from the stratiform clouds below the inversion, but the clouds dissipate as the insolation effect increases. It is also noticed that when above about 3·0 km. the north-easterly to easterly air is a continuation of the moist air from the east, the humidity increases (Hariharan, 1932; Mal and Desai, 1938; Desai and Mal, 1940), the convergence zone between the dry continental air (west to north-east veered to north-east) and the moist easterly air being also over the area.

View-point of Flohn.—Flohn (1965) has considered that the aridity of the desert region is due to the monsoon current becoming divergent as a result of the heat-low over West Pakistan and, therefore, subject to large-scale subsidence, reducing the vertical extent of the moist layer to about 1·5 to 2·0 km. In his comments on Desai’s paper (1966—2) Flohn (1966) has also stated that average vertical wind components at altitudes of 1·5 and 2·1 km. computed on the basis of low-level mass divergence, were evidently strongly correlated with the average rainfall map. The following remarks might be made regarding Flohn’s conclusions:

(a) While there will be divergence of the monsoon current under the influence of the heat-low resulting into subsidence, this effect will decrease with height as it (heat-low) is shallow (Ramage, 1966). Further, as a result of insolation vertical currents would be set up and these will considerably decrease the subsidence effect if not completely obliterate it in the lower levels upto about 2·0 km. if not more. The inversion occurs only between about 1·0 and 2·0 km. This would also show little effect of subsidence in the moist layer, i.e., below about 1·0 km. Computation of the divergence of the mean resultant winds at standard pressure levels over the eastern portion of the heat-low over Indo-Pakistan border area by Bellamy (1949) indicated net ascent below 700 mb. associated with the heat-low circulation and net descent above 700 mb. associated with the convergent easterlies (Ramage,