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DISTRIBUTION OF TEMPERATURE LAPSE RATE IN THE UPPER AIR OVER INDIA DURING DIFFERENT MONTHS.

1. *Introduction.*

In a previous paper the distribution of pressure and temperature over India and neighbourhood at different levels in the Upper Air has been studied especially with regard to their variation month by month. The daily radio-sonde data collected during the last two years at a number of stations had been used for the purpose. The lapse-rate of temperature in the atmosphere is another important element and statistics regarding its average monthly distribution at different layers in the atmosphere over a number of individual stations have been studied with the help of sounding balloon data.

For the preparation of daily constant pressure and other upper air charts based upon radio-sonde observation, the surface pressure and temperature data of hill stations are being put to increasing use thus augmenting the network of available stations. In India daily synoptic data from a large number of hill stations are available and these are being projected on to the nearest constant pressure and constant level charts. To reduce these values a knowledge of the average monthly temperature lapse-rates in the atmosphere over the station will be valuable. In addition, a study of the distribution of lapse-rates is also helpful in the determination of the air mass properties in different months. A brief account of the variation of lapse-rate with seasonal change will be given in this note, further details will be given in a paper to be published elsewhere.

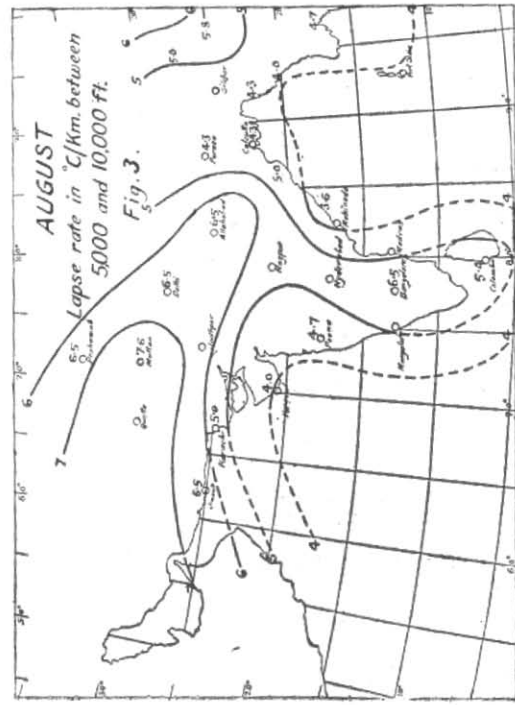
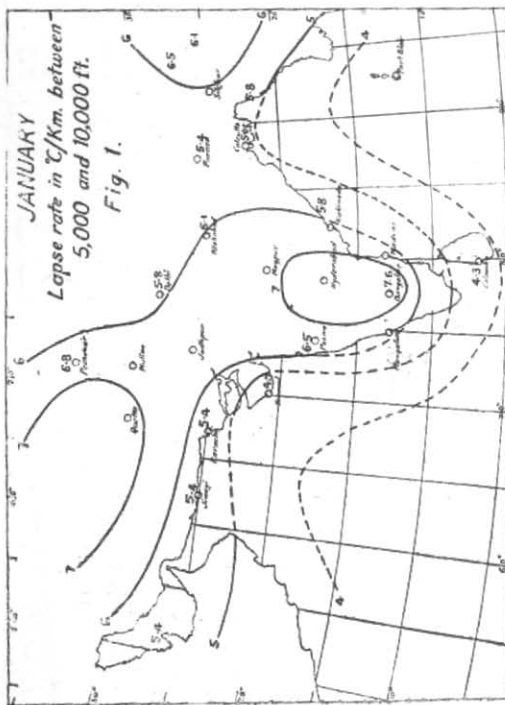
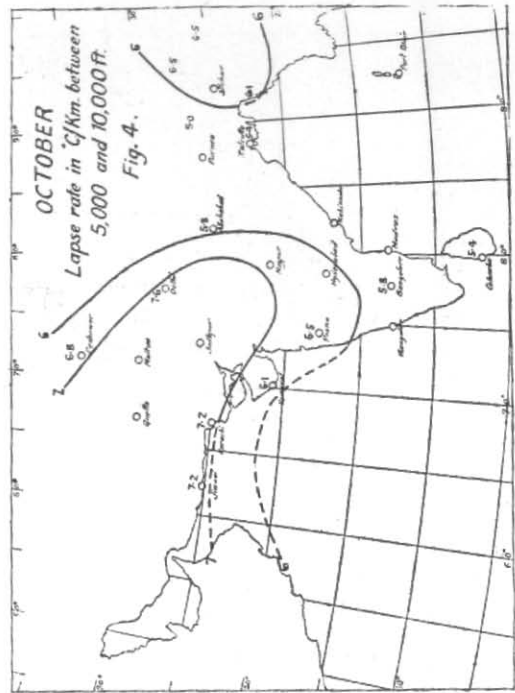
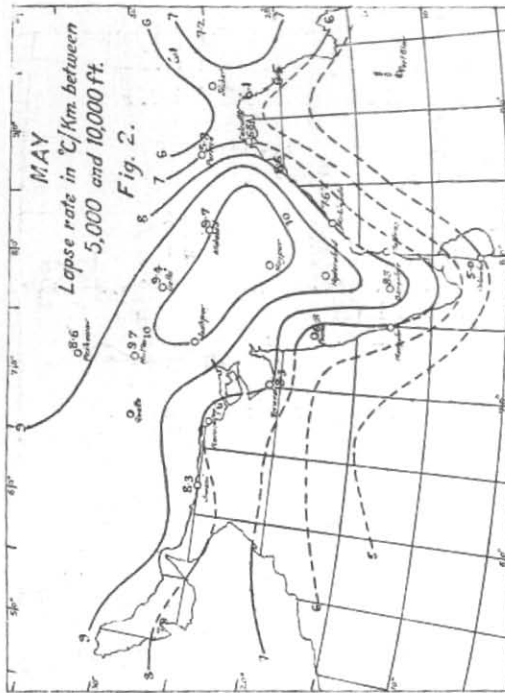
2. *Seasonal distribution of lapse-rates.*

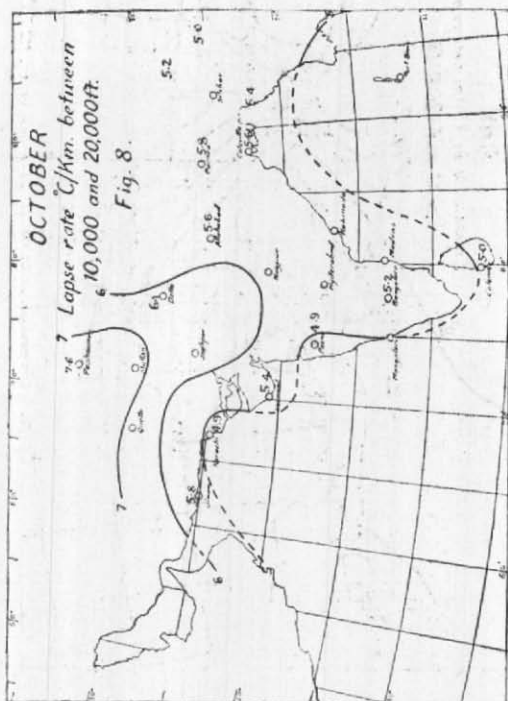
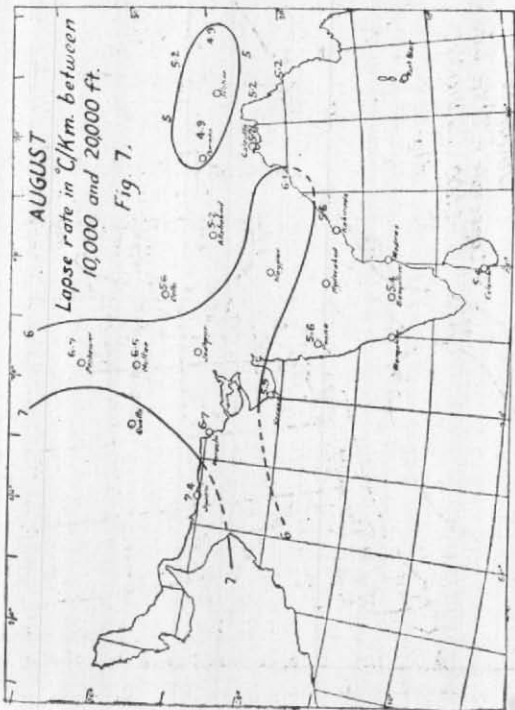
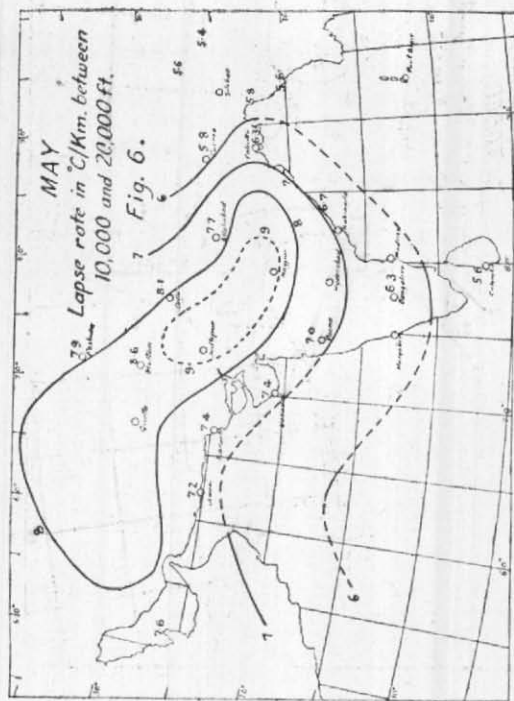
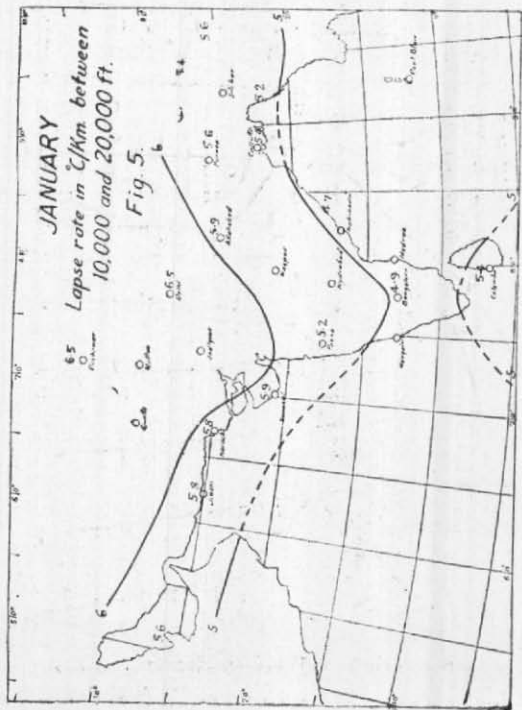
The two layers taken for study are the 5,000 to 10,000 ft. and 10,000 to 20,000 ft. The layer 'surface to 5,000 ft.' has not been taken into consideration due to its being affected by surface inversion. Figures 1—4 give the distribution of average monthly lapse-rates between 5,000 to 10,000 ft. in January, May, August and October over India and neighbourhood and figures 5—8 the corresponding figures for the 10 to 20 thousand feet layer.

The months have been chosen to be illustrative of conditions in winter, summer, monsoon and retreating monsoon respectively.

In January it may be seen that the lapse-rates are highest over the land areas varying from 5° to 7° C per km. over land and from 4° to 5° C over sea. The highest lapse-rates occur over northwest India, Central India and the Deccan upto 10,000 ft. and over northwest India at higher levels. The same tendency persists in the other winter months, but the lapse-rates increase in general. In March these range from 9° C per km. over Deccan and Central India to 5° C per km. at Colombo between 5,000 and 10,000 ft. and from 7° C per km. over northwest India to 5° C per km. at Colombo between 10 to 20,000 ft.

In summer (April—May) there is a rapid increase in lapse-rates all over the country but the increase is greater over the Indo-Gangetic plain than over Bengal and the extreme south. Between 5,000 and 10,000 ft. it is 9° C to 10° C per km. over the region extending from Baluchistan and Northwest Frontier to Hyderabad and Orissa and falls off rapidly to 5° to 6° C per km. in Bengal and Assam and along the Bay of Bengal coasts. Between 10,000 and 20,000 ft. it is about 7° C to 8° C per km. over the hotter parts of the country and 5° C to 6° C per km. over Bengal and Assam and along the coast.





In June, with the advance of the monsoon air, lapse-rates fall off along the west coast and Bengal and are still dry adiabatic 10°C per km. over northwest India and Rajputana between 5,000 and 10,000 ft. In higher levels, however, lapse-rates slightly decrease. In July to August lapse-rates over northwest India fall further due to the advance of monsoon air. In August when the maximum extension of the monsoon occurs lapse-rates vary from 6°C to 7°C per km. over northwest India to 4°C to 5°C per km elsewhere being almost moist adiabatic in the Peninsula and in Bengal and Assam.

With retreating monsoon lapse-rates again increase slightly in the drier air. In October they are about 6°C to 8°C per km. in northwest India and are generally 5°C to 6°C per km. in the sea areas and the neighbouring coasts.

3. Discussion of the results.

It will be seen from the foregoing that the highest lapse-rates equalling the dry adiabatic are reached over the north Indian plains only during the summer season (from April to June for these areas). During the winter, in spite of the extreme dryness of the air in north India, lapse-rates do not approach the dry adiabatic. This appears to be due to the fact that the air over this region is subject to subsidence due to the quasi stationary subtropical anticyclonic cells described in a previous paper.

Distribution of lapse-rates in summer brings about an interesting feature in contrasts between the lapse-rates over Bengal and Assam and over the region westwards. A gradient of lapse-rates may be observed over West Bengal and Chota Nagpur. In this season (Figures 2 and 6) varying from 10°C per km. over the east United Provinces and Chota Nagpur to 6°C per km. over Bengal. It may also be noticed that this gradient of lapse-rates persists in the 10,000—20,000 ft. layer. A perusal of the lapse-rate isopleths in May for the layers 5—10,000 ft. and 10—20,000 ft. suggests a uniformity in the air mass over Bengal and Assam even upto 20,000 ft. differentiated from the air to the west of it. This result is in contrast with the usual idea that dry continental air overruns moist Bay air over Bengal. The resultant reversal of temperature in the upper air due to this lapse-rate gradient and its concomitant results have been discussed in another paper.

During the monsoon, the main difference in lapse-rate is between the dry areas and the monsoon areas. But between the westerly and easterly moist streams there is very little difference in lapse-rates, both very nearly approaching the moist adiabatic. The withdrawal of the monsoon again brings in dry cool air from the Northwest and hence lapse-rates over the country generally increase, but not to the dry adiabatic rate due to the southward movement of the subtropical anticyclones and the subsidence of air in their fields of action.

In conclusion it may be mentioned that the slight differences which one can observe between the isopieths of lapse-rates in figures 1 to 4 of this paper and the lapse-rates from Temperature Indicator ascents and Dines Meteorograph ascents as published in Scientific Notes, Vol. IX, No. 106, by B. N. Sreenivasaiah are perhaps mainly due to the undermentioned factors :—

- (i) The times of ascents are different in the different types of observations ;
- (ii) The frequency of observations in the different types of ascents on the basis of which the averages have been arrived at is not large enough to eliminate altogether the characteristic conditions of the actual periods to which the different types of ascents refer, in the corresponding averages.

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