RECENT WORK ON THE MEASUREMENT OF ATMOSPHERIC OZONE AND ITS VERTICAL DISTRIBUTION IN INDIA

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1. Using a Dobson's photoelectric spectrophotometer belonging to the India Meteorological Department, and with recalibrated optical wedges, observations with direct sunlight were taken at Delhi during the period November 1945 to March 1947 to determine the daily values of ozone. The monthly mean values are given in Table 1. The observations generally refer to afternoon. The main maximum ozone values occur in April to June. The minimum seems to occur in November but there is a pronounced secondary minimum in August. Curves for Bombay and Kodaikanal and for Helwan and Zikawei show similar features. The values for the winter of 1946-47 were definitely higher than those for the winter of 1945-46. It is a moot point whether this increase in ozone amount was due to increased solar activity.

Table 1--Mean monthly values of ozone amount at Delhi (28°35'N)

Month	1945		1946		1947	
	No. of observations	Mean ozone amount in cm. N.T.P.	No. of observations	Mean ozone amount in cm	No. of observations	Mean ozone amount in cm
January			28	0.170	18	0.192
February			22	0.173	26	0.197
March			28	0.183	24	0.198
April			30	0.188		
May			29	0.187		
June			28	0.189		
July			21	0.179		
August			21	0.173		
September			28	0.176		
October			21	0.179		
November	19	0.169	29	0.175		
December	27	0.170	28	0.182		

Trans. IUGG Meeting, Oslo, 1948, Part V, 492-494, IATME Bulletin No. 13, 1950.

The daily ozone values at Delhi were plotted side by side with various meteorological factors. Out of these, minimum temperatures at Simla showed marked correlation with Delhi ozone values during the period October to April--except when Simla minimum temperatures were affected by föhn-effect or by rainfall.

The day-to-day changes in ozone amount were small in July-September but quite conspicuous during the period of western disturbances. In general, northerly air was found to be associated with high ozone amounts. Any association of changes of ozone amount with fronts has not yet been established. The depressing and stabilizing effect of the monsoon on the total ozone amount in the atmosphere suggests that water-vapor in the upper troposphere has a destructive action on ozone. During the monsoon, the tropopause in Northern India is almost always of Type I, beginning with a strong inversion at a height of 16-17 km.

2. Measurements of the intensity of the zenith-scattered light were taken on a number of clear days in different seasons for varying zenith-distances of the sun. The Umkehr-effect was observable without difficulty. From the curves of variation of the zenith-scattered light with the zenith-distance of the sun, the vertical distributions of ozone were calculated for the following values of total ozone: 0.155 cm., 0.175 cm., 0.200 cm., and 0.217 cm. Table 2 gives the average concentration of ozone expressed as cm at N.T.P. per km, in different atmospheric layers for different ozone amounts. The higher values of total ozone amount are associated with higher ozone-concentrations in the layers 9-18 km and 18-27 km. The center of gravity was found to be 26.5 km for 0.155 cm and 25.0 km for 0.217 cm. For the same ozone amount, the height of the center of gravity lowers as we go to higher latitudes. For example, for the ozone amount 0.217 cm, the height is 25 km at Delhi, 22.5 km at Arosa and 21 km at Tromsö. Greater precision in determining the boundaries of the layer in which the changes in ozone concentration occur would require a major improvement in method.

Table 2--Vertical distribution of ozone over Delhi (28°35'N)

Height of layer in km	Total ozone			
	0.155 cm	0.175 cm	0.200 cm	0.217 cm
Surface-9 km	0.0010 cm/km+	0.0010 cm/km+	0.0010 cm/km+	0.0010 cm/km+
9-18	0.0016 "	0.0020 "	0.0026 "	0.0030 "
18-27	0.0055 "	0.0070 "	0.0091 "	0.0104 "
27-36	0.0077 "	0.0080 "	0.0080 "	0.0080 "
36-45	0.0010 "	0.0010 "	0.0010 "	0.0012 "
45-54	0.0004 "	0.0004 "	0.0005 "	0.0005 "

+These are assumed values.

3. From the measurements of intensity of the direct radiation from the sun, the fraction of the incident radiation scattered by the large particles in the atmosphere can be deduced by subtracting the calculated attenuation due to molecular scattering from the total measured attenuation.

Daily values of $\delta' - \delta''$, where δ', δ'' are the net losses due to particle scattering at the wavelengths 3300 and 4450 A were tabulated. An unexpected new feature was the negative sign of $\delta' - \delta''$ (i.e., apparently greater loss due to scattering at 4450 Å than at 3300 Å) in the pre-monsoon period, particularly on days when there was widespread milky haze over the sky. This will be discussed in a separate paper elsewhere.

4. Arrangements are in progress for determining the vertical distribution of ozone over Poona (18°N) and Kodaikanal (10°N).

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DISCUSSION:

A la suite de cette communication, le Professeur Vassy remarque que c'est l'influence de la température qui conditionne la proportion d'ozone et qui peut ainsi expliquer les particularités signalées par le Professeur Ramanathan.
