Atmospheric Ozone and Its Relation to Meteorological Conditions

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Atmospheric ozone in Tokyo has been determined at the Meteorological Research Institute by Stair's method. The principal apparatus consisted of a cadmium phototube and a glass filter. The instrumental calibration for determining the total amount of ozone was made through simultaneous observations with Dobson's spectrophotometer. Using the observed data of the day-to-day variations in atmospheric ozone concentration, the relation of the ozone to the meteorological conditions at higher levels and to the location of jet streams was determined. The range of ozone concentration in Tokyo coincides closely with that observed in Washington, D. C., and other cities in the temperate zone.

The determination of atmospheric ozone in Tokyo has been carried on at the Meteorological Research Institute (35° 42'N, 139° 39'E) by using Stair's method (*5*). The principal apparatus consists of a cadmium phototube which is sensitive to the spectral ultraviolet of wave length shorter than 3250 A. and a glass filter which is transparent to radiant energy of wave lengths longer than 3000 A. (Figure 1). The sensitivity of the phototube has been checked several times with an incandescent electric lamp (in a quartz glass envelope) of known color temperature and three glass filters having different spectral transmittances. The spectral distribution of the transmittance of each filter has been examined repeatedly with a Beckman monochrometer. There was no appreciable change in the sensitivity of the phototube during the period of observation.

The total transmittance of the filter to the incident solar radiation changes according to the amount of ozone and the optical depth of the air mass. The instrumental calibration for determining the total amount of ozone was made through simultaneous observations with Dobson's spectrophotometer. The results of these calibrations are shown in Figure 2, in which the amount of ozone is expressed in 10^{-3} cm.

The total amount of ozone measured during the period from June 1953 to September 1955 is given in Figure 3. As shown in Figure 3, there is a maximum amount of ozone in the spring and a minimum amount in the fall. The range of ozone concentration in Tokyo obtained by Stair's method coincides closely with that observed in Washington, D. C., and other places in the temperate zone.

Recently, Normand (*3*) and the present authors (*2*) studied the relation between

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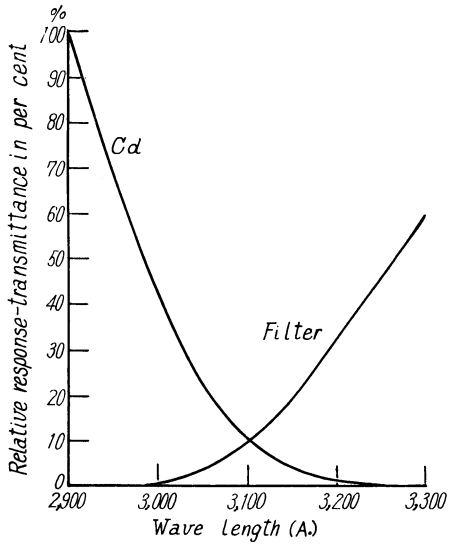

Figure 1. Sensitivity of experimental apparatus

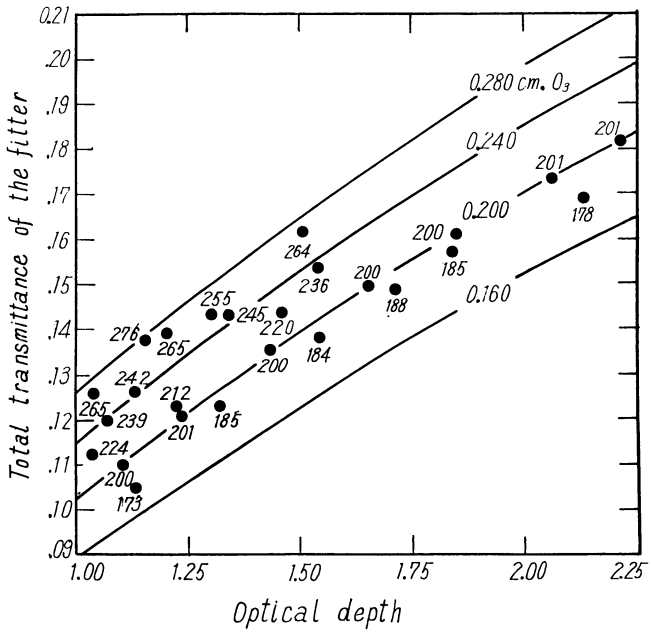

Figure 2. Total amount of ozone as determined by instrumental calibration

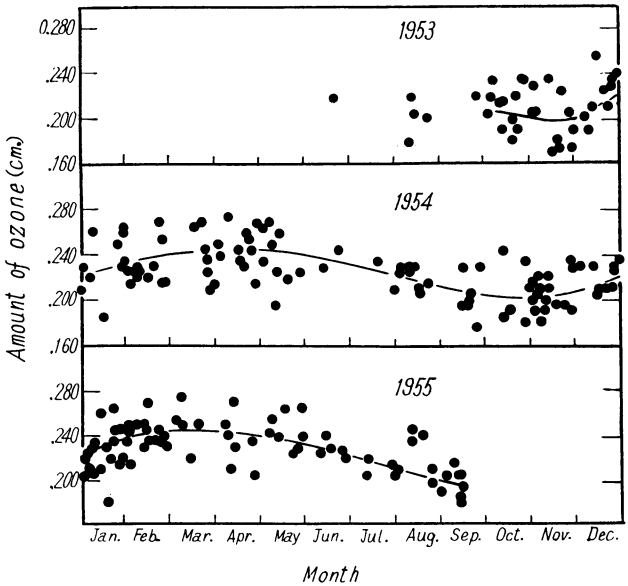

Figure 3. Total amount of ozone measured during period from June 1953 to September 1955

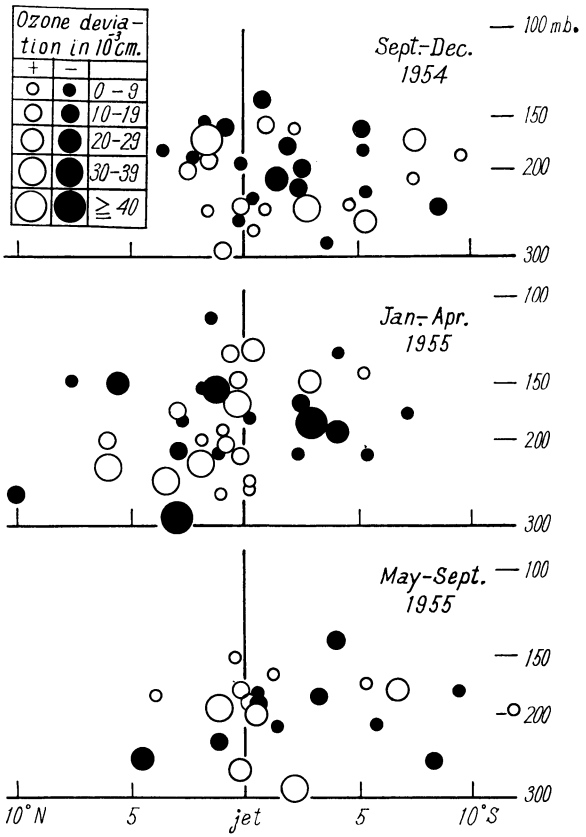

Figure 4. Relation between ozone and location of jet streams

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the day-to-day variation in ozone concentration and the meteorological conditions at higher levels. The ozone concentration increases when a trough in the upper layer passes over an observation point; it decreases by the passage of a ridge. Langlo (*1*) pointed out that a sudden change in ozone concentration often occurs between the latitudes 25° and 45°. Because the polar and tropical air masses are in contact in this zone, it is expected that the ozone concentration will be larger on the northern side of the polar front and smaller on its southern side. Ramanathan (*4*) suggested that the sudden change in concentration in this area might be related to the atmospheric jet stream.

Using the observed data of the day-to-day variations in the atmospheric ozone in Tokyo, the relation between the ozone and the location of jet streams was determined. The results showed that there is no correlation between the sense of variation in ozone concentration and the position of jet stream in relation to the observed point. However, great deviations in ozone concentrations occurred chiefly in the region below the axis of a jet stream (Figure 4).

Figure 5 shows the topographic relation between the ozone concentration which

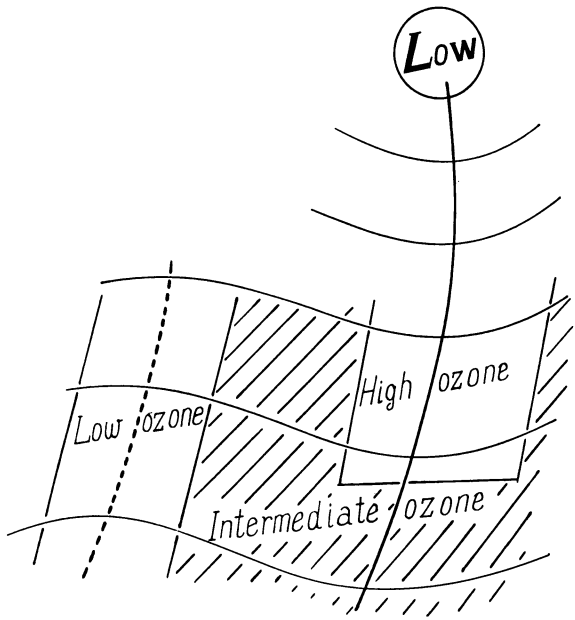

Figure 5. Topographic relation between ozone on ground and air pressure at 300 millibars

was observed on the ground and the air pressure at 300 millibars. Generally speaking, the maximum amount of ozone is observed near and south of the middle part of troughs; this may be attributed to the decline of the vertical movement in that region.

Literature Cited

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