been augmented by extensive mobile sampling by car and helicopter equipment and by full-scale atmospheric dispersion studies. Since most of the steam-electric plants in the TVA system are geographically located in areas remote from other significant sources of SO_2, it is felt that the test results are most closely representative of the flue gas distribution patterns of modern coal-fired power plants. The SO_2 concentrations in these tests refer to 30-minute average concentrations.

Frequency distribution of SO_2 concentrations. A logarithmic plot of frequency of SO_2 concentrations at fixed monitoring stations has consistently indicated a fairly straight line. Figure 11 shows this distribution as measured by an autometer situated where maximum concentrations occurred at ground level in the vicinity of a 4-unit plant, with two 500-foot-high stacks, and with a total generating capacity of 1050 MW. For the sampling period—approximately 19 months—the highest recorded concentration was about 0.6 ppm for three 30-minute periods. And SO_2 concentrations were 0.2 ppm or above for only eighty-four 30-minute periods, or approximately 0.40 percent of the time.

Similar data obtained from Public Health Service studies in Nashville, Tenn., are also plotted in Fig. 11. Although the maximum SO_2 concentration recorded was only about 0.3 ppm, the concentrations of this gas were 0.2 ppm or more 14.1 percent of the time. And the estimated SO_2 emissions in the urban area were less than half of that recorded at the power plant.

Although higher concentrations of pollution in urban areas tend to occur during periods of low wind velocity and temperature inversion, *the higher levels of pollution in the vicinity of large power plants tend to occur during moderate to high wind speeds and neutral atmospheric stability conditions.* Since none of the TVA plants are located in large urban areas, the data do not provide a direct quantitative measurement of the contribution of a large power plant to an urban pollution problem. But data analysis from an autometer located in a small town near one of the large plants indicated that SO_2 in detectable amounts was present 14 percent of the time.

Effect and influence of stack height. Monitoring data and data obtained from full-scale dispersion studies have been used in estimating stack height requirements for TVA plants. An example of estimates made by empirically derived formulas, based upon monitoring data, is shown in Fig. 12. The subject of this graphic plot was a two-unit, two-stack plant, with a generating capacity of 1800 MW, and an estimated SO_2 emission rate of 810 tons per day. This emission rate is calculated empirically from SO_2 monitoring data at plants with 250-, 300-, and 500-foot-high stacks. The curve for a 400-foot-high stack is interpolated, while the curves for the 600- and 800-foot-high stacks were extrapolated.

The electrostatic precipitator—TVA experience. The practical application of the electrostatic precipitator was first demonstrated by F. G. Cottrell in 1906. Essentially, it is a device that is used to remove liquid chemical mists or solid particulates from a gas in which they are suspended. Electrostatic precipitation is a two-stage process. In the first step, the gas containing the suspended particulates is passed through an electric, or corona, discharge area in which ionization of the gas occurs. The ions produced collide with the suspended particles and impart an electric charge to them. These charged particles then drift toward an electrode of opposite polarity, and they are deposited upon this electrode, where their electric charge is neutralized.

In its most elementary form, the precipitator configuration may consist merely of a vertical tube that contains an insulated concentric wire (see Fig. 13). When a dc potential of 10–100 kV is applied to the central wire, a corona discharge occurs in a small area surrounding the wire. The suspended particulates are ionized in the corona discharge and migrate to the tube wall. If the suspension is liquid, it will accumulate on the wall and coalesce into droplets that can be drained from the base of the tube. Suspended solid particulates can be removed from the tube wall by mechanical vibrators or scrapers, and then discharged into a cyclone or dust collector at the bottom of the apparatus.

In more complex configurations, the ionization may occur in one vessel and the deposition and precipitation in another. Figure 14 shows the plan view of a simplified two-chamber apparatus. In the first chamber, the particles become charged but are prevented from depositing

Fig. 15. Cutaway isometric view of an Opzel Plate Precipitator, a type manufactured by Research Cottrell, Inc.