average being 90 per cent. The results indicate that the two impingers in series were 10 per cent more efficient than the precipitator for fluoride fume. No attempt was made to determine what percentage of the fluorides existed in the gaseous phase, but, inasmuch as some of the fluoride was disseminated into the air by contact of ammonium bifluoride with hot sand molds and molten magnesium, it is reasonable to suppose that some of the fluoride existed as hydrogen fluoride gas. This gas, of course, would not be caught by the precipitator, but some would be caught by the impingers, thus increasing their efficiency ratio and indicating a falsely high collection efficiency, when compared with that of the precipitator.

This precipitator has been found satisfactory for collecting silica dust samples for quantification by counting.[41] Another electrostatic collector for dusts for light-field counting techniques was devised by Barnes.[42] This device consists of an aluminum cylinder 9 inches in diameter and 12 inches long holding about $^1/_2$ cu. ft. of air. The ends can be closed with micarta disks that support an ionizing wire axially through the center of the cylinder. A slide adapter in the side of the cylinder holds a special microscope slide with conducting surface. In use, the cylinder is opened and moved to the sample location, the ends are closed, the slide is uncovered, and the dust is deposited electrostatically in about 15 seconds. Several samples can be taken on the same slide if desired. It has been stated that the device is nearly 100 per cent efficient and that the slide receives a uniformly distributed proportionate share of the dust in the air in the cylinder at the time the current is turned on.

C. FILTRATION

Paper thimbles[43] have been used successfully for collecting various dusts, including explosives. They have a very high efficiency and at an air flow of 2 cu. ft. per minute have been found to collect nearly 100 per cent of most dusts and around 50 per cent of tobacco smoke. Filters made of salicylic acid,[44] sugar, or other material to be dissolved later in a liquid medium leaving the dust in suspension, have also been used. Filter-paper disks have been used for sampling the blackening of the paper, after a measured volume of air has been drawn through, may be compared with standards; or the samples obtained may be used for counting, with results comparable to results obtained by the impinger method.[45] Large filter-paper[46] cups, with inverted cones, have been used for rapid sampling of particulate matter from large air volumes. Molecular (membrane) filters are useful for the collection and examination of aerosols. They are highly efficient for

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[46] L. Silverman and C. R. Williams, *J. Ind. Hyg. Toxicol.*, **28**, 21 (1946).

particles in the 0.1-μ range.[47] A high-efficiency large-volume sampler that collects smog particles from air at the rate of 1000 c.f.m. has been constructed.[48]

D. THERMAL PRECIPITATION

Green and Watson[49] devised a thermal precipitator that draws air by water displacement at about 7 ml. per minute through a 0.051 × 0.95 cm. slot. A nichrome wire 0.025 cm. in diameter, heated to 100° C., is held centrally in the slot and the walls of the slot are cover slips backed by brass blocks for cooling. As the air passes between the hot wire and the cool surface of the cover glass any suspended dust particles are deposited upon the cover slips. The efficiency of the device is said to be 100 per cent. The deposit is suitable for microscopic examination. One technique includes counts and particle-size determinations with the electron microscope.[50]

E. SEDIMENTATION

The sedimentation cell, as devised by Green,[51] is a brass cylinder 6 cm. deep and 3.6 cm. in diameter closed at the top with a swivel lid and at the bottom by a brass slide mounting two $^1/_2$-inch cover slips. The cylinder is filled with atmosphere and then closed at the point where the sample is desired, and left to stand for 3 hours. Then the cover slips are removed and examined under a microscope of high resolving power. The method is suitable for determining the count and particle size of dusts down to 0.2 μ in diameter (3 hours settling time). The sedimentation cell is intended as a laboratory or research instrument and not for field

II. Evaluation of Dust Samples

The evaluation of a dust sample may be made on a weight basis, with or without the aid of chemical analyses, or it may be accomplished for all insoluble pneumoconioses-producing and nuisance dusts by determining the number of particles in a measured volume of air.

After dust particles from a known volume of air are collected, an aliquot portion must be counted in order to compute the number of particles suspended in a cubic foot of the atmosphere sampled, the cubic foot being the accepted unit for comparison in the United States.

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[48] G. C. Clayton, J. R. Arnold, and F. A. Patty, *Science*, **122**, 751 (1955), and *Am. Ind. Hyg. Assoc. Quart.*, **16**, 293 (1955).
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[50] H. L. Watson, *Can. J. Research*, **21**, 89 (1943).
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