In addition to the information obtained concerning air, light, and temperature control in the libraries visited, the following general observations of the condition of the material stored in these institutions were made, namely:

"Yellowing" was observed in hot, dry, and dusty places in the path of direct sunlight. Books stored in diffused light seemed to be little affected. "Brittling" was also observed under the same circumstances.

Dusty papers were frequently observed to be discolored and quite often brittle, but no general rule for the correlation of these facts could be formulated.

No damp places were observed at the time of this survey, but several spots were pointed out as being damp at other seasons. In these places, the papers examined seemed soft and "fuzzy," bearing a white powder which could readily be brushed off. They also show brown splotches known as "foxing."

Apparently, little difficulty was being experienced with pests, as is to be expected with the precautions taken to insure cleanliness and good ventilation.

IV. DISCUSSION OF RESULTS

An inspection of Table 1 shows that of the 13 libraries listed only 4 possessed the equipment necessary for the removal of dust from the incoming air of their ventilating systems. Oil filters were used in 3 of the 4 libraries attempting dust removal. The elimination of dust from library air is very important, for dust particles, in addition to their abrasive action upon the paper and bindings of stored material, act as nuclei for the condensation of acidic moisture.[22] Every library inspected attempted to reduce the amount of dust in the stacks and on the books by systematic dusting. In several instances small hand vacuum cleaners were extensively used.

If air containing sulphur dioxide is allowed to come into contact with cotton fabric, sulphuric acid is formed upon the surface of the substance.[23] A similar reaction would be expected in the case of papers, since both substances are composed essentially of cellulose. This acid is not volatile at ordinary temperatures and, hence, exerts a cumulative effect throughout the life of the paper. If the paper contains iron, as most commercial papers do, the rate of formation of sulphuric acid from sulphur dioxide is greatly accelerated by the catalytic effect of the iron.[24 25 26] If this acid is once formed upon the sheet, its concentration varies with the moisture content (relative humidity) of the surrounding atmosphere, the acid acting as a dehydrator in a very dry atmosphere, literally burning the paper, while in a moist atmosphere it functions as an agent of acidic hydrolysis. The problem of air pollution is most serious as indicated by

[22] Osborn Monnett, Smoke Abatement, U. S. Bureau of Mines Bull. No. 273.
[23] John B. Wilkie, U. S. Bureau of Standards, Research Paper No. 294.
[24] S. F. Cooke, Rôle of Certain Metallic Ions as Oxidation Catalysts, J. Biol. Chem., **10**, pp. 289–312; 1926.
[25] L. P. Wilson, Catalytic Action in the Oxidation of Cellulose, J. Soc. Chem. Ind., **39**, p. 177T; 1920.
[26] O. Baudisch and D. Davidson, Catalytic Oxidation by Means of Complex Iron Salts, J. Biol. Chem., **11**, p. 501; 1927.

Table 2, which shows the precipitation of sulphuric acid in tons per square mile per year in several European and American cities. A further illustration of the quantity of sulphur dioxide present in the atmosphere is the fact that the sulphur content (determined as SO_3) of filter oil used in a New York public library increases about 100 per cent over the original value of 0.46 per cent SO_3 during three weeks' use in an oil filter. When one considers that oil filters are very inefficient as a means of removing acidic pollutants from the air this increase assumes a position of paramount importance as an index of conditions already at hand. Every indication of the situation at present points toward increasingly polluted urban atmospheres and in consequence an increased effect unless immediate steps are taken to minimize the amount of polluted air in libraries and similar institutions. It is believed that such a minimization could be effected by the substitution of a mildly alkaline solution for the water now used in humidifying and purifying library air.

TABLE 2.—*Precipitation of sulphuric acid in cities*

City	Tons H_2SO_4 per square mile per year
Glasgow [1]	194.1
London [2]	180.2
Salt Lake City [1]	134.0
Manchester, England [3]	95.0
San Francisco [1]	83.1
Philadelphia [4]	83.1
Berlin [1]	16.2

[1] Osborn Monnett, G. St. J. Parrott, H. W. Clark, Smoke Abatement Investigation at Salt Lake City, Utah, U. S. Bureau of Mines Bulletin No. 254.
[2] Des Vœux and Owens, The Sootfall of London, The Lancet, p. 47; Jan. 6, 1912.
[3] Recent Progress in Smoke Abatement and Fuel Technology in Manchester, Mellon Institute, Smoke Investigation Bulletin No. 10.
[4] Data from University of Pennsylvania.

Six of the thirteen libraries included in this survey possessed machinery for humidity control, but in two cases the apparatus was not in use at all, and in a third instance the plant was effective only in cool weather owing to the lack of a refrigerator. An attempt was made, several years ago, to use the third-mentioned plant in the summer, but when the advent of a spell of cooler weather precipitated the moisture from the air in the stacks upon the books stored therein, resulting in extensive damage from molding, the attempt was abandoned. All of the equipment in full-time use was of the water-curtain type with no means of regulating the temperature of the water save in one instance where modern thermostatic control had just been installed. The average library using average equipment can not control the humidity of the air within its stacks very closely. Table 3 shows the variation of humidity in an institution which uses oil filters and a water spray for purifying and humidifying the incoming air.