TABLE 3.—*Variation of relative humidity within a library*

Day	Outside temperature	Outside humidity	Inside temperature	Inside humidity
	°F.	*Per cent*	°F.	*Per cent*
Feb. 24	50	42	59	38
Feb. 25	55	60	59	45
Mar. 5	40	57	60	30
Mar. 8	58	73	62	50

Inspection of Table 3 shows a pronounced fluctuation of relative humidity in this case, the lower limit of moisture content being below that considered desirable for the successful preservation of stored records. None of the libraries inspected made a definite attempt to reduce acidic pollution of the air, but those using oil filters and water curtains reduced the acidity materially during the process of air treatment for other purposes.

The situation regarding the protection of books from the action of daylight is considerably better than that dealing with the other phases of protection, for 10 of the 13 selected libraries minimize the effect of the actinic rays of light by the total elimination of windows in 3 cases, or by the use of thick glass in the remaining 7 examples. In only one instance is sunlight admitted freely to the stacks, and it may be noted that excessive deterioration is apparent in this case. Book stacks, in general, were found to be lighted by small, frosted incandescent bulbs which were switched on and off as required. This is a very commendable practice.

The results of the survey having shown the conditions which a book stored in an average library would encounter, a series of laboratory experiments was initiated to determine the extent of the effect of each individual "external" agent of paper deterioration and to ascertain means of minimizing its action.

Rosin and other materials used in the rosin sizing of paper have been subjected to the action of light with the result that all varieties of rosin, both bleached and unbleached, were found to be light sensitive, darkening in color under the influence of light.[27] The presence of ferrous iron was found to accelerate this color change materially. This is additional evidence that rosin sizing, as currently applied, is one cause of the yellowing of records with age. Furthermore, unpublished results obtained at the bureau by Rasch indicate that direct exposure of various types of record papers to sunlight, for a period of only 100 hours on each side, decreased their folding endurance from 25 to 63 per cent of the original. Both of these findings serve to emphasize the necessity of protecting records from the destructive effects of daylight. An investigation of the effect of air polluted with 5 to 10 parts sulphur dioxide per 1,000,000 on the various types of record papers is in progress, and results already obtained show that 10 days' exposure to such a polluted atmosphere causes losses in physical strength running as high as 40 percent and increases in acidity ranging from 90 to 400 per cent. If so short an exposure as 10 days will produce an effect of

[27] See footnote 11, p. 2.

this magnitude, one may well wonder that publications have survived as well as they have, and considering the constantly increasing acid pollution of the air, a long further life is problematic.

V. RECOMMENDATIONS

Taking into account present library conditions and the results of the laboratory work to date, the following recommendations as to library conditions may be made:

1. Daylight, particularly the actinic rays, should be rigorously excluded from bookstacks, either by the total elimination of windows or so far as possible by the use of thick glass. Any necessary illumination should be supplied by small, frosted, incandescent lamps, lighted as required.
2. Temperature and humidity should be automatically regulated within relatively narrow limits. A suggested range for temperature is 65° to 75° F., and for humidity, 45 to 55 per cent.
3. Incoming air should be purified to remove dust (oil filters) and acidic pollutants (alkaline-water wash in scrubbers).
4. When books or other records are stored in a purified atmosphere they should not be removed from it unnecessarily, as a short exposure to impure air may undo the preservative measures of many years' duration.

The machinery necessary to carry out recommendations 2 and 3 would be:

1. Oil filters of a type in which the oil coating is continually renewed.
2. Refrigerating apparatus to cool both incoming air (when necessary) and the solutions for the water curtains.
3. Water curtains, utilizing slightly alkaline solutions and having thermostatic control of temperature.
4. Apparatus to heat to desired temperature purified, cold air coming from water curtain.

In connection with air conditioning it is obvious that the installation and operation of costly apparatus is useless if members of the library staff and others are permitted to open windows, thereby allowing impure outside air free access to the library building. Some difficulty of this nature may be encountered at the outset, but if the operating conditions chosen are conducive to increased comfort, and it is believed that such is the case with the recommended conditions, these troubles should soon disappear. Conditioned air is coming to be used more extensively every day, not only in places of amusement but also in industrial plants and office buildings, with increased comfort and efficiency to all concerned.

VI. SUMMARY

1. Daylight, polluted air, variation of temperature and humidity, and pests, are "external" agents of paper deterioration.
2. The effects of light are well recognized and guarded against in most libraries, although one library, ultramodern in most respects, is without protection against light.