Spring Water and Paper Conservation
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Arriving at the New York State Archives Conservation Laboratory, I noticed two five gallon jugs of bottled spring water. Since the lab area had become a temporary storage area for some non-laboratory materials, I assumed the water would be removed at some point. However, it was later pointed out to me that the water was intended for lab use. Just what was meant by this coulnd't be clarified and I guessed that someone had probably tried to order distilled water and this was the result.

Having only unfiltered Albany tap water at my immediate disposal, I began to wonder about the suitability of spring water for lab use. It should be noted here that what is being discussed is not any product produced by reverse-osmosis, any carbonated product or any water other than that bottled as taken from a spring source.

My primary concern with using tap water was copper and iron contamination and the generally unpredictable quality of this water season to season. Thinking that bottled spring water would not travel through city water mains (picking up iron) or throughout the building in copper pipes (picking up copper ions), it seemed likely that it would be low in these contaminents and probably naturally high in calcium and magnesium.

When I had the opportunity to have the lab tap water tested, I also sent a sample of the bottled spring water. The results came back much as expected and in order to explore the possibility of spring water having these character-isitics in general, I arranged to have samples sent to me from different parts of the country.

Table I is the tabulated results of five samples from across the country and shows the general trend of bottled spring water in fact being high in calcium and magnesium while low in copper and iron. A county health officer suggested that manganese be monitored as well since in his experience, difficulty with high iron contamination in his area was always associated with high manganese levels. Accordingly, I included manganese in the analysis, although this paper will not discuss the role of manganese in either liberating iron ions or acting independently to degrade cellulose.

A concern in using spring water might be its variability season to season, year to year. Table II is the tabulation of pH and total hardness expressed as calcium carbonate over a seven year period for one spring and a four year period for another. Data relating to specific alkaline earth metals is not usually required by State or local health authorities and in light of the expense, bottlers do not voluntarily run such analyses.

Accordingly, it is not possible to retrospectively review levels of calcium and magnesium in bottled spring water samples. Hardness expressed as calcium carbonate is not a very accurate measure for our purposes, due to the relationship of alkalinity and hardness. Briefly, if alkaline constituents are present as salts of calcium and magnesium, alkalinity will equal hardness, but if alkalinity is greater than hardness, this generally means other metals are present, usually sodium and/or potassium. Data supplied by the Chippewa Springs Co. shows a sodium level of 6.2 mg/l in the 1983 sample and 5.6 mg/l in the 1982 sample. They did not test for sodium before 1982. Any follow-up to this study should probably include analysis for sodium and potassium.

While not conclusive, this first study suggests that bottled spring water may well have a place in the conservation lab or bindery, particularly the small or private practice which has only unfiltered, untested tap water at its disposal.

Practical considerations should not be ignored, however, and the problem of arranging for warmed or heated water baths might well, over time, exceed the purchase and maintenance costs of a water filtration system. Nevertheless, for specific or interim usage, bottled spring water might well be recommended over untreated tap water.

The author would like to express his appreciation to everyone who was kind enough to help in this project, particularly Carol Surash of the New York State Science Services Biological Survey who performed the analyses.

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TABLE I

Element	#1	#2	#3	#4	#5
Ca	18.375	85.438	8.375	11.250	25.812
Mg	4.625	25.500	3.000	4.625	9.750
Cu	0.020	0.010	0.150	ND	ND
Fe	0.064	ND	ND	ND	ND
Mn	0.020	0.030	ND	0.015	0.025

Results given in ppm.
ND is not detectable.

#1 purchased in Washington, D.C., source not given; (pH: 7.6).
#2 bottled in Plymouth, MI; (pH: 8.1).
#3 bottled in Chippewa Falls, WI; (pH: 6.8).
#4 bottled in Applegate, CA; (pH: 7.8).
#5 bottled in Willsboro, NY; (pH: 8.25).

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TABLE II

	Joy Springs, Inc. Old Forge, New York		Adirondack Aquifer Willsboro, New York	
year	pH	total hardness as $CaCO_3$ (mg/liter)	pH	total hardness as $CaCO_3$ (mg/liter)
1983	**7.6**	**29**	**N/A**	**N/A**
1982	**7.3**	**24**	**7.7**	**114**
1981	**7.4**	**28**	**6.3**	**108**
1980	**7.6**	**26**	**7.5**	**98**
1979	**N/A**	**N/A**	**7.6**	**103**
1978	**7.2**	**20**	**N/A**	**N/A**
1977	**7.5**	**28**	**N/A**	**N/A**

N/A is not available