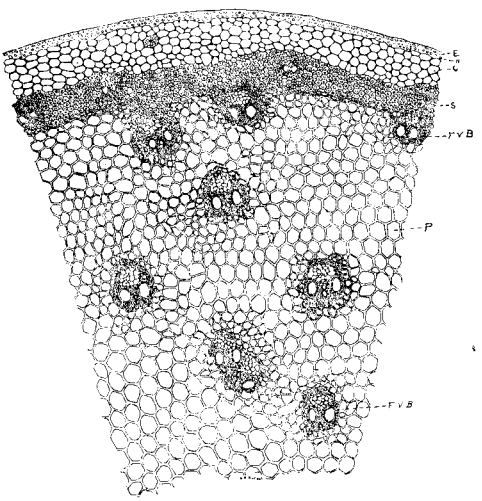
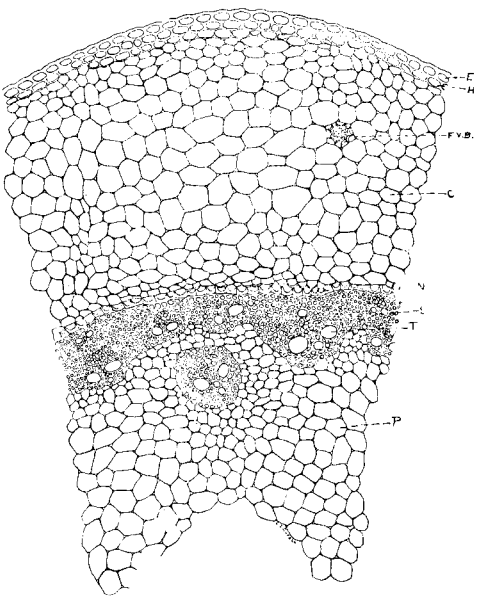
cum contains six or seven. Bermuda grass has no endodermis, while in Triticum this layer is quite prominent, with the inner and lateral walls much thickened. The circle of bundles and the individual bundles of the one are much like those of the other. The pith of the Bermuda grass is from four to five times as broad as that of Triticum, and the walls of the pith cells, as well as the walls of the cells in the cortical parenchyma, are decidedly thicker than those of Triticum.



Agropyron repens. Transverse section of rhizome: E, epidermis; H, hypodermis; C, cortex; S, sclerenchyma tissue; P, pith; F. V. B., fibro-vascular bundle.



Capriola Dactylon. Transverse section of rhizome: E, epidermis; H, hypodermis; F. V. B., fibro-vascular bundle; C, cortex; N, endodermis; S, sclerenchyma tissue; T, trachea; P, pith.

Scattered through the pith of Bermuda grass are from thirty to thirty-five fibro-vascular bundles, while in the pith of Triticum there are only ten or twelve, and these are attached to the circle of sclerenchymatous fibres and bundles. In Bermuda grass the central hollow area is twice as broad as that of Triticum.

The powdered Bermuda grass may be identified by the presence of a large amount of starch, the thick-walled parenchyma cells and the absence of endodermal cells with the peculiar thick walls.

LIME, LIME WATER, AND LIME WATER TABLETS.*

BY ROBERT WOOD TERRY.

Lime water is not usually regarded as an important pharmaceutical preparation, but after serious thought it is seen to be one of the most important in the pharmacopoeia. Lime water is used pharmaceutically in preparing black wash and yellow wash, in the preparation of carron oil and, formerly, for preserving mucilage of acacia. If lime water is very deficient in its content of calcium hy-

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droxide, which is not at all rare, serious injury may occur from the resulting yellow wash, as free mercuric chloride remains in the preparation.

Lime water is used internally as an antacid and to check nausea. Its principal use, however, is in infant feeding to modify the physical character of the paracasein curds from cows' milk, making the curds simulate the physical character of the paracasein curds of human milk. What pharmaceutical preparation should be purer than that which is given to infants in daily doses of from one to five ounces?

It is regrettable that lime water is so unstable and so little understood, since it is really so important. A few extracts from pharmaceutical literature will give a fair idea of the quality of lime water that is generally sold.

"Geo. E. Thum makes some practical observations on the preparation and preservation of lime water, operations which are usually conducted in the imperfect manner in which they have been conducted from time immemorial."[1]

"Pierce P. Bear, in view of the statement that not one sample in ten of lime water answers the pharmacopoeial requirements, examined fifteen samples obtained from different pharmacies. He found that not one of them answered all the requirements. Some were fairly good, but the majority were very poor, some containing scarcely any calcium hydrate and others considerable quantities of other soluble alkali. The results are shown in a table which may be consulted in the original paper."[2]

"Notwithstanding its cheapness and ease of preparation, much of the lime water dispensed by druggists is of inferior quality, due either to the use of a poor sample of lime or to insufficient care in preserving the liquid."[3]

The writer can see no objection to the use of lime water which has a small amount of calcium carbonate in it, the only difference being the formation of a small amount of carbon dioxide in the stomach. The practice of some druggists who dispense lime water containing undissolved calcium hydroxide is reprehensible and one that should be immediately stopped. Dispensing such lime water is chargeable to laziness, as lime water may rapidly be filtered. Small particles of calcium hydroxide are very liable to set up an irritation in baby's stomach. Calcium hydroxide is a caustic irritant.[4]

It is pleasing to note that in the last few years, since a high quality of lime has been marketed by certain manufacturers, the quality of lime water sold has improved. Unfortunately, not all druggists use this lime; some still cling to the old procedure of slaking builders' lime with ordinary tap water. This is so unethical and so great an injustice to the public that it need not be further discussed here. About twenty-five percent of the lime water sold to-day does not meet the pharmacopoeial requirements.

Lime water at its best is a poor pharmaceutical; its strength is seriously affected by temperature since it is a saturated solution. It is readily decomposed and reduced in strength by the action of air. It is a weak preparation, therefore, bulky.

TABLE A1.—COMMERCIAL AND PREPARED CALCIUM OXIDE.

No.	Directions.	Condition.	Carbonates.	Insoluble matter.	Chlorides.	Iron.
1	20 grammes to gallon	Good	Trace	Trace	None	Trace
2	.....[1]	Poor	Trace	Trace	None	Present
3	4 drachms to gallon	Good	None	Minute trace	None	None
4	Bulk CaO[2]	....	....	.....	....	....

[1] Sample No. 4 purified by U. S. P. IX process.

[2] Quicklime sold by wholesale druggist.

TABLE A2.—COMMERCIAL AND PREPARED CALCIUM OXIDE.—*Continued.*

No.	Heavy metals.	Arsenic.	Calcium oxide.	Alkalinity of 118 mils.[3]	Possible amt.[4]	Remarks.
1	None	Minute trace	99.28%	22.1 mils N/1 V. S.	585.7 mils	C. P. CaO
2	None	Minute trace	81.87%	18.3 mils N/1 V. S.	482.8 mils	
3	None	None	74.82%[5]	17.25 mils N/1 V. S.	346.3 mils	C. P. $Ca(OH)_2$
4	....	0.002%	.....	.....	.....	1 to 50,000 As_2O_3

Table "A1" shows results of a chemical analysis of two prepared limes, one bulk quicklime sold by a wholesale druggist for the preparation of lime water, and this same quicklime purified by the U. S. P. IX process. One of these prepared limes is a chemically pure calcium oxide, assaying 99.28 percent absolute CaO. The other is chemically pure calcium hydroxide assaying 99.83 percent absolute $Ca(OH)_2$. It seems more feasible to market these preparations in the form of hydroxide since, upon mixing with water, solution will be sure to be effected, as is not entirely the case if the oxide does not slake. Another argument is that of safety; it has been reported that one of these tubes, containing calcium oxide, exploded spontaneously, causing serious injury to the drug clerk who was handling it.

Chlorides and iron were tested for, not because they are toxic substances but they are an index to the degree of purity of the product and the care used in the manufacture. The quicklime sold by the wholesaler, Sample No 4, in Table A, contained 0.002 percent As_2O_3 or 1 part in 50,000 of lime, but fortunately the arsenic present is not in a water-soluble state. The prepared limes contained only minute traces of arsenic.

The manufacturer's directions as to the use of these tubes insure a saturated solution as they will theoretically make about five times the directed quantity. The bulk quicklime, Sample No. 4, purified by the U. S. P. IX process, after purification contained no arsenic and made a lime water slightly below standard, showing that the rapidity of solution is dependent on the fineness of the powder and upon the amount of lime used in excess. This shows that pharmacists following the U. S. P. IX process should be sure to titrate the finished product.

TABLE B.— LIME WATER FROM COMMERCIAL AND PREPARED CALCIUM OXIDE.

				50.0 mils expressed in mils N/10 V. S.					
No.	Foreign alk.	Chlorides.	Heat test.	18 Hrs.	36 Hrs.	54 Hrs.	72 Hrs.	$Ca(OH)_2$.	Remarks.
1	Trace	None	Cloudy	21.6	23.2	23.2	....	0.171%	U. S. P.
2	None	None	Cloudy	15.4	17.2	18.4	18.4	0.136%	Not U. S. P.
3	None	None	Cloudy	....	22.4	....	....	0.166%	U. S. P.
4	....	....	.....	....	....	....	....	.....	.....

The U. S. P. VIII directed that Calx be prepared from marble or the purest varieties of native calcium carbonate and to assay at least 90 percent CaO. The U. S. P. IX does not restrict the course but the lime should assay 95 percent CaO. Calx, from marble and oyster shells, are the purest varieties, being almost pure white and containing very little foreign alkalinity, while that from dolomites and limestones is gray in color, and contains iron, silica, aluminum, magnesium, occasionally manganese, and the foreign alkalinity sometimes is excessive.

The U. S. P. IX purification process under Liquor Calcis removes all the soluble objectionable substances, and those that do not dissolve in the purification process naturally will not dissolve in the lime water, insuring a pure product. An improvement in the procedure would be by several washings with cold water which would be imitating the conditions under which the lime water is to be made. One objection to the official purification process is, that each time lime water is to be

[3] Total alkalinity of quantity directed for 118 mils.

[4] Possible amount of 0.14% $Ca(OH)_2$ solution from quantity directed for 118 mils—ratio of excess.

[5] Equivalent to 99.83% $Ca(OH)_2$.

prepared the procedure must be gone through with. It would be far better to prepare a large quantity of the magma at one time as suggested by F. W. Nitardy,[5] or, still better, to dry the magma over a direct flame and then use the dry calcium hydroxide as needed.

Table B shows that the prepared limes make an official lime water on the first separation in about 18 hours.

TABLE C1.—LIME WATER TABLETS.

No.	Average weight.	Carbonates.	Chlorides.	Talcum.	Starch.	Sucrose.
1	0.722 gramme	Trace	None	0.0601 gramme	Present	None
2	0.320 gramme	Trace	None	0.0124 gramme	Present	None
3	0.419 gramme	Trace	None	0.0214 gramme	Present	None
4	0.442 gramme	Trace	None	0.003 gramme	None	0.134 gramme
5	0.755 gramme	Present	None	Present	Present	None

TABLE C2.—LIME WATER TABLETS.—*Continued.*

No.	Iron.	Heavy metals.	Arsenic as As_2O_3.	$Ca(OH)_2$.	Alkalinity of 118 mils.[1]	Possible amt.[2]
1	Present	None	0.0012%	0.477 gramme	12.9 mils N/1 V. S.	339.4 mils
2	Present	None	0.0010%	0.726 gramme	19.6 mils N/1 V. S.	515.8 mils
3	Present	None	Minute trace	0.670 gramme	18.1 mils N/1 V. S.	476.3 mils
4	Present	None	None	0.781 gramme	21.1 mils N/1 V. S.	555.2 mils
5	Present	Minute trace	None	0.566 gramme	15.25 mils N/1 V. S.	404.3 mils

Table C1 and C2 show the analyses of lime water tablets. Starch is present in four of the five tablets; it is present to assist the disintegration of the tablet so that a maximum surface of the lime is exposed to the solvent action of the water. One tablet contained sucrose to increase the solubility of the lime. This is a poor procedure here since the percentage of calcium hydroxide in solution fluctuates to quite a degree so that the lime water from these tablets is liable to a greater variation than the official lime water. One tablet contained 0.0012 percent As_2O_3 and one contained 0.001 percent As_2O_3. The ratio of the excess of calcium hydroxide to the required amount varies between three to five times.

The lime water prepared from these tablets meets the pharmacopoeial requirements, except the lime water from the tablet containing sucrose, which makes a lime water that is too strong. But, the lime waters do not meet the pharmacopoeial requirement as to strength as soon as the manufacturers state. These tablets are intended for the extemporaneous preparation of lime water but it requires, in most cases, fifty-four hours' contact to saturate the water; therefore, lime water prepared from the tablets should not be used for at least three days. One manufacturer advertises to the druggist that his tablets may be used in the prescription department to make lime water extemporaneously. That manufacturer's tablets are sample No. 3 in Table C1 and Table C2 and the lime water from these tablets is sample No. 3 in Table D1 and D2.

TABLE D1.—LIME WATER FROM LIME WATER TABLETS.

No.	Foreign alk.	Chlorides.	Starch.	Sucrose.	Heat test.	Heavy metals.	Arsenic.
1	None	None	None	None	Cloudy	None	None
2	Trace	None	None	None	Cloudy	....	....
3	Trace	None	None	None	Cloudy	....	....
4	None	None	None	Trace	Cloudy	....	....
5	None	None	None	None	Cloudy	....	....

TABLE D2.—LIME WATER FROM LIME WATER TABLETS.—*Continued.*

	50.0 mils expressed in mils N/10 V. S.						
No.	18 Hrs.	36 Hrs.	54 Hrs.	72 Hrs.	250 Hrs.	$Ca(OH)_2$.	Remarks.
1	12.2	19.0	19.4	....	....	0.143%	U. S. P.
2	12.4	18.2	19.2	....	....	0.142%	U. S. P.
3	13.4	17.2	20.2	....	....	0.150%	U. S. P.
4	19.0	28.6	25.6	....	....	0.211%	Not U. S. P.
5	7.0	11.2	14.8	....	22.4	0.166%	U. S. P.

[1] See footnote 3, Table A2.

[2] See footnote 4, Table A2.

Table E is the same as Table D[2], only the lime waters in this case were made one year after the lime waters in Table D[2]. The bottles containing the tablets were opened once a month and then recorked. This table shows that the older the tablets are, the slower will be the saturation of the water.

TABLE E.—SAME AS TABLE D[2], MADE ONE YEAR LATER.

	50.0 mils expressed in mils N/10 V. S.						
No.	18 Hrs.	36 Hrs.	54 Hrs.	72 Hrs.	250 Hrs.	$Ca(OH)_2$.	Remarks.
1	7.6	12.6	17.0	....	21.0	0.155%	U. S. P.
2	15.3	17.4	20.6	....	23.0	0.170%	U. S. P.
3	3.4	7.8	12.0	....	21.5	0.159%	U. S. P.
4	14.8	25.2	25.8	....	21.8	0.161%	Not U. S. P. (54 hrs.)
5	....	....	....	....	....	....	Not re-run

Table F shows analyses of four lime waters purchased from retail drug stores, three of which meet the pharmacopoeial requirements. This is a small number of samples from which to form any idea as to the general quality of lime water sold, but since these samples were obtained from the best drug stores the results may be considered as being the average of the best.

TABLE F.—LIME WATERS PURCHASED AT RETAIL.

No.	Foreign alk.	Sucrose.	Chlorides.	Heat tests.	Heavy metals.	Arsenic.	Titration 50.0 mils in N/10.	$Ca(OH)_2$.	Remarks.
1	None	None	None	Cloudy	None	None	22.2	0.164%	U. S. P.
2	None	None	None	Cloudy	None	....	22.6	0.167%	U. S. P.
3	None	None	None	Cloudy	None	....	18.3	0.135%	Not U. S. P.
4	None	None	None	Cloudy	None	....	22.7	0.168%	U. S. P.

There are several methods of dispensing lime water that are noteworthy. One is Nitardy's double siphon method,[6] which ensures a constant supply of lime water. The author modifies Nitardy's method by placing a test tube by the use of a one-hole rubber stopper over the delivery tip which prevents the formation of carbonate, thus preventing clouding the next portion of lime water drawn through. Another method is to use a tubulated bottle, drawing the lime water from directly above the lime. Another method is to have two stock bottles; the object is that while the lime water in one bottle is being allowed to settle, the lime water may be dispensed from the other bottle. One pharmacist filters lime water through a white filter into pint and quart bottles and then these are sold as required. Although this procedure is not countenanced by the Pharmacopoeia, it is not a bad method provided the lime water is sold before it begins to show traces of calcium carbonate. To determine how much lime was lost in standing after ten days off the lime, the following test was made:[4]

1. Filtered off lime and titrated — 44.85 mils = 0.1649 percent $Ca(OH)_2$ w/v.

2. Filtered off lime and titrated after ten days — 43.90 mils = 0.1614 percent $Ca(OH)_2$ w/v or a loss of 0.0035 gramme $Ca(OH)_2$ or 2.12 percent of the total amount present. The U. S. P. IX permits a variation of 17 percent of the total amount of calcium hydroxide merely through a change of temperature between 15 to 25 degrees C.

Rubber tubing on lime water siphons should be watched as the lime water will corrode the rubber tubing in about three months. Only pure gum tubing should be used, as the antimony in red rubber tubing is soluble in lime water.[7]

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COLUMBUS, OHIO,
August 10, 1918.

THE COMMERCIAL GROWING OF SOME EUROPEAN DRUGS IN MICHIGAN.*

BY E. L. WOODHAMS.[1]

In farming operations, as in other lines, the unusual attracts attention. People from other parts of the country who pass through our farms remark that "they didn't suppose peppermint was raised on a farm—they supposed it 'just grew' somewhere." Yet to the local resident, city man or farmer, there is nothing unusual in mint farms—he has seen or heard of them all his life. Climate and opportunity have united to make Southern Michigan and Northern Indiana the home of mint culture. Yet we receive many letters every year from farmers all over the country, inquiring about mint raising; the unusual evidently appeals to them, too.

We presume that it was partly for the same reason that we were favorably inclined toward commercial drug growing, when our Assistant Superintendent, who had had several years of experience growing drugs in England, imported some belladonna and henbane seed and urged that we attempt the culture of these European drugs. We began work in the spring of 1911, so that we had had four seasons' experience with their culture in the Michigan climate before a scarcity appeared and stimulated interest in the domestic growing of these heretofore imported drugs. This experience was invaluable.

There would be but little interest in a report of the culture of these drug plants if all were clear sailing. The cultivation of belladonna and henbane on a commercial scale is, however, new to this locality, and we have found that factors enter into their culture here in Michigan which are unknown in England. Hence it occurred to us that mention of some of the difficulties encountered might be of interest.

The first trouble appeared when we attempted to secure seed of high purity and germination. What little could be supplied by American seedsmen was almost without exception worthless as regarded germination. We decided to raise our own seed, and after two or three seasons' experimentation we found we were able to produce seed of 100 percent purity and over 90 percent germination. This involved the careful selection of parent seed plants and the subsequent propagation of these particular strains, but it was well worth the trouble.

Considering the plant in the order of growth, we fully agree with other investigators that belladonna and henbane are even more subject to the attack of the

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* Read before Scientific Section, A. Ph. A., Chicago Meeting, 1918.

[1] Superintendent "Mentha Plantation," A. M. Todd Company, Kalamazoo, Mich.