The phosphotungstic acid method of A. Heiduschka and L. Wolf (5) gave more uniform results in the determination of morphine and veratrine.

The extraction method was also tested to determine the smallest amount of morphine sulfate which could be extracted from a definite quantity of sheep stomach. The results are expressed in Table II and show that qualitative tests are possible when the ratio of morphine sulfate to tissue is as small as 1:500,000.

TABLE *II*.

| Morph. Sulf. | Sheep Stomach. | Proportion. | Lefort's. | Marquis. | Results. |
|---|---|---|---|---|---|
| 0.0 mg. | 250.0 Gm. | 00:00 | − | − | − |
| 10.0 mg. | 250.0 Gm. | 1:25,000 | + | + | + |
| 10.0 mg. | 250.0 Gm. | 1:25,000 | + | + | + |
| 10.0 mg. | 250.0 Gm. | 1:25,000 | + | + | + |
| 2.5 mg. | 250.0 Gm. | 1:100,000 | + | + | + |
| 2.5 mg. | 250.0 Gm. | 1:100,000 | + | + | + |
| 2.5 mg. | 250.0 Gm. | 1:100,000 | + | + | + |
| 1.0 mg. | 500.0 Gm. | 1:500,000 | + | + | + |
| 1.0 mg. | 500.0 Gm. | 1:500,000 | + | + | + |
| 1.0 mg. | 500.0 Gm. | 1:500,000 | + | + | + |
| .5 mg. | 500.0 Gm. | 1:1,000,000 | − | + | − |
| .5 mg. | 500.0 Gm. | 1:1,000,000 | − | − | − |

### SUMMARY.

1. A method was developed for extraction of morphine sulfate, codeine phosphate, narcotine sulfate, pilocarpine nitrate, sparteine sulfate and veratrine hydrochloride from animal tissue.
2. The delicacy of the procedure for qualitative extraction in the case of morphine sulfate was examined.

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# ON THE REDUCTION OF THE ALKALINITY OF HYPOCHLORITE SOLUTIONS WITH SODIUM BICARBONATE.*

BY ARTHUR OSOL[1] AND JOHN ROGER COX.[1]

In the commercial preparation of solution of sodium hypochlorite an excess of sodium hydroxide or sodium carbonate usually remains in the product. For many purposes such alkalinity is not disadvantageous but for application to wounds dilutions of this solution should be nearly neutral in reaction. To attain to this end the U. S. P. XI directs that in the preparation of diluted solution of sodium hypochlorite from the stronger solution, a sodium bicarbonate solution shall be added until no red color is produced with powdered phenolphthalein.

The mechanism of this neutralization of caustic alkalinity by the addition of sodium bicarbonate has been reported as consisting of the repression of ionization of sodium hydroxide in the solution by the added sodium ion, the law of mass action

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being cited as applying to the equilibrium involved (1), (2). If this were so, it should be possible to obtain the same reduction in alkalinity by adding any sodium salt—sodium chloride, for example. That the explanation offered does not apply is evident from the fact that the alkalinity of sodium hydroxide solution is not reduced upon addition of sodium chloride; furthermore, it is well known that the law of mass action is not applicable to sodium hydroxide solutions or to solutions of other strong bases or strong acids.

What, then, is the explanation of the reduction in alkalinity in this case? One would expect it to involve the well-known reaction

$$\mathrm{OH^- + HCO_3^- \rightleftarrows CO_3^= + H_2O}$$

with the equilibrium displaced sufficiently to the right by an excess of bicarbonate so that the degree of hydrolysis of the carbonate is insufficient to produce a red color with phenolphthalein powder under the conditions of the official test. This secondary rôle of bicarbonate ion in repressing the hydrolysis of carbonate ion also explains the reduction of the alkalinity of the latter in solutions where sodium carbonate is used in preparing the hypochlorite solution.

To demonstrate that sodium bicarbonate first reacts with sodium hydroxide, then represses hydrolysis of the resultant sodium carbonate may be shown by a comparison of the $p_H$ values of solutions of sodium hydroxide and of sodium carbonate to each of which is added sodium bicarbonate in varying quantities.

## EXPERIMENTAL.

The sodium bicarbonate and sodium carbonate used in preparing the solutions described in Tables I and II were of analytical reagent grade; the sodium hydroxide solution was prepared carbonate-free from a saturated solution of hydroxide. All solutions were prepared in boiled and cooled distilled water not more than 30 minutes before use, the temperature was adjusted to 25° C. and the electromotive force of a glass and saturated KCl-calomel electrode assembly measured by means of a Leeds and Northrup Potentiometer Electrometer. The results, corrected for asymmetry potential of the glass electrode, are set forth in Tables I and II as $p_H$ values of the solutions employed in this study.

TABLE I.—EFFECT OF SODIUM BICARBONATE UPON SODIUM HYDROXIDE SOLUTIONS.

Each Solution, Except No. 14, Prepared 0.0025 Molar With Respect to NaOH.

| Solution Number. | Added $NaHCO_3$ Molarity. | Molar Ratio* $HCO_3^-/CO_3^=$. | $p_H$. |
|---|---|---|---|
| 1 | 0 | .... | 11.50 |
| 2 | 0.00025 | .... | 11.46 |
| 3 | 0.00125 | .... | 11.18 |
| 4 | 0.00250 | .... | 10.61 |
| 5 | 0.00500 | 1.0 | 10.03 |
| 6 | 0.00875 | 2.5 | 9.70 |
| 7 | 0.01500 | 5.0 | 9.38 |
| 8 | 0.02125 | 7.5 | 9.19 |
| 9 | 0.02750 | 10.0 | 8.97 |
| 10** | 0.1275 | 50.0 | 8.34 |
| 11 | 0.2525 | 100.0 | 8.08 |
| 12 | 0.5025 | 200.0 | 7.87 |
| 13 | 1.0025 | 400.0 | 7.73 |
| 14 | Saturated—no NaOH | | 7.65 |

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* Calculation of this ratio based upon the assumption that $NaHCO_3$ first reacts to form $Na_2CO_3$, hence there is no excess of $NaHCO_3$ until solution 5 is reached.

** This solution is the first to show no pink color when tested with powdered phenolphthalein according to the official directions.

TABLE II.—EFFECT OF SODIUM BICARBONATE UPON SODIUM CARBONATE SOLUTIONS.

Each Solution Prepared 0.0025 Molar With Respect to $Na_2CO_3$.

| Solution Number. | Added $NaHCO_3$ Molarity. | Molar Ratio $HCO_3^-/CO_3^=$. | $p_H$. |
|---|---|---|---|
| 4A | 0 | .... | 10.59 |
| 5A | 0.00250 | 1.0 | 10.02 |
| 6A | 0.00625 | 2.5 | 9.69 |
| 7A | 0.01250 | 5.0 | 9.38 |
| 8A | 0.01875 | 7.5 | 9.17 |
| 9A | 0.02500 | 10.0 | 8.97 |
| 10A | 0.1250 | 50.0 | 8.33 |
| 11A | 0.2500 | 100.0 | 8.05 |
| 12A | 0.5000 | 200.0 | 7.89 |
| 13A | 1.0000 | 400.0 | 7.72 |

## DISCUSSION.

From inspection of the above data it may be seen that the first effect of sodium bicarbonate upon sodium hydroxide in solution is to convert the latter to sodium carbonate, this being evident from the similarity of the $p_H$ values of solutions 4 and 4A, the former representing an equimolecular mixture of hydroxide and carbonate which, according to the equation given earlier, should be identical with solution 4A. From this point on the effect of sodium bicarbonate upon both series of solutions is precisely the same as may be seen from a comparison of solutions 5 and 5A, 6 and 6A, etc.

The decrease in $p_H$ resulting from the addition of sodium bicarbonate to solutions 5 to 13 inclusive and 5A to 13A inclusive may be explained on the basis that sodium bicarbonate represses the hydrolysis of sodium carbonate by displacing to the left the point of equilibrium of the following reaction

$$CO_3^= + H_2O \rightleftarrows OH^- + HCO_3^-$$

thereby reducing the hydroxyl ion concentration.[1] When the latter is reduced to correspond to a $p_H$ of 8.3 or less the solution is no longer sufficiently alkaline to color powdered phenolphthalein under the conditions of the official test though all solutions, including even saturated sodium bicarbonate, produced at least a faint pink color with the excess of phenolphthalein test solution directed to be used in the official directions. This is interpreted to mean that with powdered phenolphthalein not enough of the indicator dissolves in the short time interval of the official test, to produce a color with solutions of $p_H$ 8.3 or less, whereas with an excess of phenolphthalein test solution a sufficiently high concentration of indicator is obtained to produce a color at a much lower $p_H$.

## SUMMARY.

From a comparison of the $p_H$ values of solutions containing sodium hydroxide and sodium carbonate with solutions containing sodium carbonate, with and without bicarbonate, it is shown that the neutralization of caustic alkalinity of hypochlorite solutions by sodium bicarbonate involves formation of sodium carbonate

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[1] It should be noted here that, to a degree, the hydrolysis of sodium carbonate may be repressed by the salt effect of sodium chloride. This, however, is not characteristic of sodium chloride or sodium salts, being exhibited also by other strong electrolytes.

rather than repression of the ionization of sodium hydroxide as has been reported in the literature.

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# A STUDY OF THE TOXIC PRINCIPLES OF RED SQUILL.*,[1]

BY FLOYD J. LEBLANC[2] AND C. O. LEE.[3]

It is estimated that rats do damage to the amount of many millions of dollars annually, and at times carry disease. For these reasons the extermination of rats is a big problem and one to which the government gives much attention.

For the past several years powdered red squill has been widely used as a raticide. Its popularity is due, perhaps, to the fact that it is acceptable to rats and relatively non-toxic to domestic animals. Its success in rat control work has led to much speculation as to the nature and character of its killing principles.

Our study of red squill was begun in 1931, the object being to isolate and identify the toxic constituent or constituents. A very extended number of extractions have been made using a large variety of solvents. The extracts which were obtained were all tested upon rats to determine their potency. The nature of the squill has made the isolation of its constituents a difficult task. While the chemical nature of the rat-killing principle of squill is as yet unsolved we are able to report that a highly toxic, reasonably stable non-crystallizable product has been obtained and will be briefly described under the experimental part of this paper.

*Red and White Squill.*—There are two varieties of squill, Urginea maritima, designated as red and white squill. White squill is official in the United States Pharmacopœia XI. The red squill is not official.

White squill is generally preferred for medicinal use although red squill has been used in some countries. There is, however, very little information to be had concerning the medicinal differences in these two drugs.

Red squill is native to those countries bordering on the Mediterranean. It is a perennial herb with fibrous roots proceeding from the base of a large, tunicated, pear-shaped bulb. The bulb is from four to six inches long, often weighing as much as four pounds and usually grows about half immersed in the sand.

Claremont (1) found no essential chemical differences between the red and white squills, but observed that the latter had no action on rats. Winton (2) says, "The cardiac glucoside and the rat killing principle in red squills are distinct substances. The former occurs in about equal amounts in red and white squills. The rat poisoning substance, however, is present in significant amounts in red squills only."

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