# TECHNICAL PAPERS

## Thermal Separation of Radiomercury From Radiosodium[1]

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A number of physiologic phenomena can be studied best by the simultaneous administration of two or more radioactive isotopes. If their half-lives differ sufficiently, no problems arise. In some instances it is feasible for the separation to be effected chemically, but such a procedure is beyond the realm of most clinical investigations. Physical methods employing counters capable of distinguishing beta from gamma radiation and high from low energy particles are often successful. A mass spectrometer may be used. This report is concerned with the description of a method which is practical for separating radioactive mercury[2] from radioactive sodium[3] ($Na^{22}$) and presumably from other elements with similar thermodynamic constants. The method utilizes the well-known intrinsic property of mercury— its volatility under conditions available in ordinary laboratories.

Mercury, one of the oldest of therapeutic agents, combines with other elements to form many compounds, usually organic, of definite biologic interest. Its organic combinations are characterized by instability. If they are decomposed and the consequent behavior of the Hg is used to advantage, it is possible to remove 99 percent or more of the Hg from a given compound under conditions which are quantitative and simple.

In the present studies the biologic relationship between a mercurial diuretic (Mercuhydrin[4]) and sodium chloride is under investigation. To study the pharmacodynamics of diuresis produced by a mercurial diuretic, it is desirable to use such a compound synthesized with radiomercury ($Hg^{203-205}$). Such a procedure is expensive and time-consuming. This isotope of mercury has a physical half-life of 51.5 days. Its "practical" half-life was found to vary considerably, depending on environmental and chemical conditions, making quantitative, separatory studies of isotope activity extremely difficult. The present experiment was prompted by this discovery.

Thirty samples of an aqueous radioactive Mercuhydrin preparation were accurately measured onto filter paper discs and allowed to dry at room temperature. Similarly, 30 such samples of a solution of radioactive sodium ($Na^{22}$) chloride were prepared, to which, after drying, was added a known amount of radioactive Mercuhydrin solution. The papers were fixed to tinned discs with rubber paper cement. The three series of preparations were counted by separate, thin mica window Geiger-Müller counters with different sensitivities (Table 1).

TABLE 1

VOLATILIZATION VALUES

| Specimen | Tube | Mean ± S.D. (%) Before heat (cpm) | Mean ± S.D. (%) After heat (cpm) | Amount remaining (%) | $\frac{Na^{22}}{Na^{22} + Hg^{203-205}} \times 100$ |
|---|---|---|---|---|---|
| $Hg^{203-205}$ | A | 3,918 ± 4.95 | 41.3 ± 35 | 1.05 | |
| $Na^{22}$ | A | 2,193 ± 4.73 | 2,242 ± 3.79 | 102 | |
| $Na^{22} + Hg^{203-205}$ | A | 5,620 ± 4.93 | 1,995 ± 6.43 | 35.4 | 35.8 |
| $Hg^{203-205}$ | B | 7,881 ± 6.81 | 60 ± 36 | 0.77 | |
| $Na^{22}$ | B | 3,788 ± 3.75 | 3,864 ± 3.95 | 102 | |
| $Na^{22}$ $Hg^{203-205}$ | B | 10,462 ± 5.63 | 3,400 ± 5.91 | 32.4 | 32.4 |

After being counted, all preparations were placed alternately in position on a sheet of aluminum measuring $18'' \times 12'' \times \frac{3}{16}''$ and heated in an oven to 250° C for one hour and twenty minutes. Upon removal and cooling they were again counted (Table 1). Interference by the rubber cement was shown to be nonexistent.

A mean of more than 99 percent of the mercury of a Mercuhydrin preparation was driven off by heat, whereas under identical conditions a sodium preparation did not change significantly. Naturally, stable mercurial salts or compounds would have to be rendered labile to heat to take advantage of vapor tension and boiling point differences. Further studies of a chemicophysical nature are in progress.

[1] Aided by a grant from the Life Insurance Medical Research Fund, the War Contract No. W-49-007-Md-389, the Helis Institute for Medical Research, and the Mrs. E. J. Caire Fund for Research in Heart Disease.

[2] Preparation item No. 47B, $Hg^{203-205}$, U. S. Atomic Energy Commission, Oak Ridge Laboratories.

[3] Secured through the courtesy of M. A. Tuve and Dean Cowie, Carnegie Institution of Washington, Department of Terrestrial Magnetism.

[4] Produced by Harold Krahnke, Edwin Sprengeler. and Darwin Kaestner, through the cooperation of Dr. H. L. Daiell of the Lakeside Laboratories, Milwaukee.