The data for the compressibility of beryllium are presented in Table VI.

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Summary

1. Coefficients of compressibility were measured by the "constant volume" method at 25° as follows: sodium, $\beta = 15.6 \times 10^{-6}$; barium, $\beta = 10.48 \times 10^{-6}$; strontium (preliminary) 7.22×10^{-6}; beryllium, $\beta = 0.93 \times 10^{-6}$.

2. The densities of the specimens used were for barium, 3.66; for strontium, 2.74; for beryllium, 1.85.

3. Special methods were developed for determining the weight and density of barium and strontium.

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NOTE

Use of the Hildebrand Hydrogen Electrode in Biological Solutions.—We have found that in certain biological solutions the ordinary Hildebrand[1] hydrogen electrode may attain equilibrium so slowly as to be entirely worthless. The Hildebrand type is obviously inferior to the enclosed electrode involving complete saturation of the solution with hydrogen, but the latter device greatly changes the P_H (as is well known) of mixtures containing reducible substances, or of mixtures partly buffered by hemoglobin or by volatile substances such as carbon dioxide and hydrogen sulfide.

We have put an ordinary rubber bulb from an "atomizer" into our hydrogen supply line so that the hydrogen flows through the bulb. By squeezing the bulb repeatedly the Hildebrand electrode is repeatedly saturated with hydrogen. Obviously, because of possible air leaks, the system should be operated so that at all times the pressure in the hydrogen supply line is slightly greater than atmospheric. It is very important that the solution level be periodically forced *entirely* below the bottom of the platinum, this being regulated by the rate of squeezing the bulb. In this way nearly constant readings are obtainable within five minutes with a small amount of hydrogen, while the usual arrangement sometimes did not give the right *sign* of e.m.f. even after an hour with a vigorous stream of hydrogen. This difference is strikingly observed by passing the hydrogen at first without touching the bulb, the e.m.f. being erratic and sometimes off by 0.5 volt. The correct reading is then quickly attained by pressing

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[1] J. H. Hildebrand, THIS JOURNAL, **35**, 349 (1913).

the bulb a few times. We claim no new principle,[2] but give this note for the benefit of those who may own an electrode of the Hildebrand type.

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THE CARBAZYLIC ACIDS: THE AMMONIA ANALOGS OF THE CARBOXYLIC ACIDS[1]

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The Ammonia System.—Liquid ammonia shows a striking similarity to water in many of its properties, particularly as an electrolytic solvent. This close correspondence purely as solvents has been extended so as to include similarities between derivatives of ammonia and the analogous water compounds. A system of acids, bases and salts related to ammonia as the aquo acids, bases and salts are related to water has been developed by Franklin.[2]

The Carbazylic Acids.—In this paper is given an account of the investigation of a class of ammono acids which are to be regarded as the ammonia or nitrogen analogs of the carboxylic acids. Just as aquo-acetic acid, for example, may be looked upon as being derived from a hypothetical ortho-acetic acid by the loss of a molecule of water, so a analogous ammono-acetic acid may be regarded as being derived from a hypothetical ortho-ammono-acetic acid by the loss of a molecule of ammonia, as represented by the parallel equations

$$2CH_3C(OH)_3 \longrightarrow 2CH_3COOH \longrightarrow (CH_3CO)_2O$$
$$CH_3C(NH_2)_3 \longrightarrow CH_3C(NH)NH_2 \longrightarrow CH_3CN$$

The acid amidines and the nitriles have come to be known as carbazylic acids and acid anammonides inasmuch as they represent the nitrogen analogs, respectively, of the carboxylic acids and acid anhydrides. In the following discussion, it will be shown that the carbazylic acids and their derivatives are identical in several of their reactions with the carboxylic acids or their derivatives.[3]

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[2] See Michaelis and Rona, *Biochem. Z.*, **18**, 317 (1909).

[1] The material in this paper is from a thesis submitted to the Department of Chemistry and the Committee on Graduate Study of Stanford University in partial fulfilment of the requirement for the degree of Doctor of Philosophy, 1926.

[2] Franklin, *Am. Chem. J.*, **47**, 285 (1912); Eighth Int. Cong. App. Chem., **6**, (1912); THIS JOURNAL, **46**, 2137 (1924).

[3] Franklin in his earlier papers [THIS JOURNAL, **27**, 800 (1905); *Am. Chem. J.*, **47**, 291 (1912)] mistakenly refers to acetamide and diacetamide as ammono-acetic acids,