

for its origin must have been acid from the presence of carbonic acid unbalanced by base. The present ratio between bicarbonates and carbonic acid in sea water has not been accurately estimated, but it is perhaps 50 : 1 or 100 : 1. The conditions are complicated by flora and fauna, and such influences have not yet been determined.

Turning to the acid-base equilibrium of blood and protoplasm, we encounter a subject which is better understood, though not more significant in the present discussion. The alkalinity of the blood is one of the familiar subjects of physiological investigation, and its clinical importance has long been clear. Not until the introduction of the ionization hypothesis, however, was it possible to explain the conditions. The outcome of these studies has been to assign to the equilibrium between carbonic acid and bicarbonates a first place in the regulation of the reaction of blood;<sup>1</sup> and since such substances are invariably constituents of all protoplasm, to make evident the universal biological importance of this equi-

<sup>1</sup> Friedenthal, "Archiv für Physiologie, Verhandlungen der Physiologischen Gesellschaft Berlin," May 8, 1903. Henderson, *American Journal of Physiology*, XV, 257, 1906, "Ergebnisse der Physiologie," VIII, 254-325, 1909 (the last a review of the equilibrium between acids and bases in the organism).