

a striking difference but it is easy of explanation. The proportion of magnesium in sea water is now slowly growing. In the pre-Cambrian oceans it must, therefore, have been very small, not perhaps as low as it is in blood plasma, for in the latter the magnesium would only represent the proportion of an earlier period than that in which the circulation became closed, as the tissues would only reproduce the proportion which had by long accommodation become fixed in them. Even the organisms which live in the sea to-day, whose ancestral forms have lived in the sea since the Cambrian, do not take up the magnesium from the sea water in the full proportion which it has in the latter.

III.—THE ORIGIN OF THE RELATION OF THE CHEMICAL ELEMENTS WITHIN PROTOPLASM ITSELF.

There is, therefore, so far as the circulatory fluid of Vertebrates is concerned, a reproduction of the proportions of the sodium, calcium, and potassium of the pre-Cambrian oceans. The problem which now arises is one whose solution involves greater difficulties. If organisms should reproduce in their own circulatory fluids the proportions of the elements in the early geological periods, what contributed to those remarkable proportions which obtain, not in the circulatory fluids, but in the living matter itself? These proportions are widely different from those found in the circulatory fluids, and one cannot bring oneself to regard the former as derived from the latter. In vegetable organisms the potassium and the calcium much exceed the sodium, and even the magnesium may be greater in amount than that of the latter. In animal organisms the proportions are difficult to ascertain owing to the presence of skeletal and other structures in which the calcium and sodium greatly preponderate, but even in these the potassium is nearly equal to the sodium, and in muscle it is greatly in excess, while the calcium and the magnesium are much less than the sodium. Thus, in the muscle of the dog the relative values for each are* :—

<i>Na.</i>	<i>K.</i>	<i>Ca.</i>	<i>Mg.</i>
100	354	7.26	25.1

These proportions may or may not represent approximately those found in unicellular organisms like an *Amœba*, or even a white blood corpuscle, but do they represent to any degree the proportions which obtained in the early pre-Cambrian seas when life was represented by unicellular organisms only, which accommodated themselves to the sodium, potassium, calcium, and magnesium in their habitat, just as the

* Julius Katz, *Pflüger's Arch.*, Vol. 53, p. 1, 1896.