

## II.—THE ORIGIN OF THE PHYSIOLOGICAL RELATION OF THE CHEMICAL ELEMENT IN BLOOD PLASMA.

I have thus dealt at some length upon the importance of the history of sea water, and with Joly's views and those of his critics, because all this leads up to a question which is of very great importance to the physiologist. The life of the globe in the earlier geological ages, so far as the strata reveal to us the past history of the earth, as already pointed out, was closely associated with the sea. It is indeed almost universally assumed that life began in the ocean and continued in association with it alone till the close of the Cambrian period, although the presence of graphite in Cambrian and older rocks seems to indicate that vegetable organisms were accommodating themselves to a land life. Even this may not be an exception, for these rocks must have been laid down under water, and therefore their organic remains would be those of the sea. If accordingly we could know what the composition of the sea water in the Cambrian and pre-Cambrian periods was, we would, in all probability, be able to determine some of the chemical and physical forces to which living matter was then subjected and thus explain the relations which obtain to-day in living matter between it and its salts. In a recent paper\* I have pointed out that the relative proportions of the elements, sodium, potassium, and calcium in the plasma of the blood are surprisingly very like those which are found in the ocean water of to-day, and that the differences which obtain between the two series of proportions of these elements may be explained on the ground that such proportions in the blood plasma are those that obtained in ancient sea water when the ancestral form of Vertebrates, in which sea water was the circulatory fluid, as it is in many marine forms to-day, acquired a closed circulatory system. That the ancient proportions are reproduced to-day in all forms, which have a closed circulation, I attribute to the influence of heredity, the cells of the organisms having for ages been associated with the sodium, potassium, and calcium in certain proportions, and having been accommodated to them, the relations ultimately became so fixed that living matter reproduces the ancient proportions in the fluids which bathe itself. There is one point in which the proportions in the circulatory fluid and those in sea water differ, and that is in respect to the magnesium. In the sea water of to-day there are 11.99 parts of magnesium for every 100 of sodium, while in plasma there are 0.8 parts of magnesium to 100 of sodium. This is

\* On the Inorganic Composition of the Meduse, *Aurelia flavidula* and *Cyanea Arctica*. Journ. of Physiol., Vol. 29, p. 213, 1903.