

tion at a given moment need not necessarily be proportionate to the conditions of existence prevailing. There may be after-effects of a previous set of conditions. Indeed it is possible to point to places totally destitute of vegetation, owing to former unfavourable circumstances having destroyed all germs, while new germs have not yet found their way there. Still this is the only reservation we need to make, when asserting the universality of this natural law.

The necessary nutritive substances which are most likely to occur "in minimum" in the sea are nitrogen, phosphoric acid, and, in the case of diatoms, silicic acid; all others occur even to superfluity. Brandt in his works on metabolism in the sea discusses at some length the importance of nitrogen, phosphoric acid, and silicic acid, and his assistants at Kiel have carried out a number of tests to ascertain the extent to which these substances are present in sea-water. Not only the nitrogenous compounds (organic compounds, ammonia, and nitrates), but also phosphoric acid and silicic acid, occur in extremely minute quantities, so that it is particularly difficult to get accurate values representing them. We have therefore, unfortunately, no proper conception as yet of the way in which these substances vary in different parts of the sea. According to Raben's latest investigations the total quantity of combined nitrogen (ammonia, nitrates, and nitrites) in true North Sea water varies between 0.110 mg. and 0.314 mg. per litre, of which 0.047 to 0.124 mg. is saline ammonia, the whole being reckoned as free nitrogen. Even if we assume that the quantity of nitrogen in the Atlantic is considerably less, these values are high compared with the quantity of nitrogen to be found combined in the cells of the plankton-algæ. It seems, therefore, hardly possible that the nitrogenous compounds are entirely consumed by the algæ. It is, however, quite conceivable that the variations in the total quantity of nitrogen, or in the quality of such compounds as are easiest to absorb, may hasten or retard the augmentation of the algæ. The same is the case with silicic acid, which Raben found to vary between 0.30 mg. and 1.03 mg. per litre in thirty samples from the North Sea. The quantity of phosphoric acid, according to Raben's investigations, is as a rule below 1 mg. per litre, though it slightly exceeds the quantity of nitrogen.

Raben.

Brandt starts by discussing the occurrence of nitrogenous compounds in the sea. He calculates that large quantities of combined nitrogen are carried out from the land by the