

rivers, as organic nitrogenous compounds, ammoniacal salts, and nitrates. The result would be a constant increase, until at last the sea became poisoned, were it not that it is continually being absorbed by living organisms, or else being restored in some form or other to the atmosphere. We now know that there is very little combined nitrogen in the sea, so that it must evidently be used up as fast as it arrives. The consumers of nitrogen are first and foremost the seaweeds growing along the coasts, and the floating algæ of the open sea, but besides them there are also bacteria, which exist in all sea-water, as shown by Fischer. Their competition with the algæ for the nitrogenous compounds is not of any great consequence, so long as they do not interfere with the circulation of nitrogen otherwise than by disintegrating organic compounds so as to form ammonia, or by binding ammonia and nitrates in their cells as albumen.

From the bacteria-life of the soil, however, we are acquainted with another kind of nitrogenous metamorphosis produced by bacteria. There are nitrifying species which oxidise ammonia into nitrites and nitrates, without requiring organic substance to enable them to live; there are further whole series of other species which can reduce nitrites and nitrates, and give off nitrogen in a free state. Their action drives out of the natural circulation larger or smaller quantities of this valuable nutritive substance, scarce enough already, which all plants generally utilise to the uttermost. How great the loss is, as compared with the metamorphosis in other respects, and under what conditions it takes place, are questions that require our most careful attention before considering anything else.

Baur, and others after him, succeeded in finding several kinds of these denitrifying bacteria in the sea, where they appeared to be widely distributed. It was found, too, that they produced free nitrogen with greater rapidity when the temperature was high (20° to 30° C.) than when it was low. Brandt, accordingly, put forward the hypothesis, that to the activity of these bacteria is due the fact that the abundance of plant life does not increase as we approach the tropics, but on the contrary very often decreases. This theory has now for some years been considered the only explanation of the irregular distribution of the plankton, but recent researches have shown that it is untenable.

The denitrifying bacteria require organic substance for their existence. If they are to give off free nitrogen, they must have