

nitrates or nitrites, though denitrification is as little a vital necessity for them as alcoholic fermentation is for the fermentation fungi. Feeding them with sugar and ammoniacal salts will result in their multiplying to an unlimited number of generations, without exhibiting their power of denitrification. They can attack nitrates whenever met with, utilise their oxygen, and give off nitrogen, but denitrification is not of any particular importance, provided the bacteria find sufficient free oxygen in their surroundings. It is only when this fails that they attack nitrates to any great extent. Given the requisite quantity of oxygen they will enter the regular circulation, and no nitrogen worth mentioning will be produced even where denitrifying bacteria are living and multiplying.

This is the case at any rate in the soil, where denitrification is of no importance, unless nitrates are brought into contact with considerable quantities of easily disintegrated organic substance. In the sea the quantity of organic substance is generally so small that a cubic centimetre of salt-water from the open sea rarely contains more than 50 to 100 living bacteria cells, while the nitrogenous compounds occur for the most part as ammonia or inorganic compounds, and not as nitrates or nitrites. It is more than likely that nitrates are not formed to any great extent in sea-water. Nitrifying bacteria are met with occasionally in the mud along the coasts, but they have not been proved to exist in the open sea ; in any case they have not the same importance there that they possess on land, where numbers of them are present in every single gram of cultivated earth. So it is probable that the small quantities of nitrates and nitrites in the sea-water are brought either from the land, or in a minor degree from the atmosphere as the result of electrical discharges. Most of the combined nitrogen of the sea occurs as organic compounds or as saline ammonia, neither of which can be reduced by denitrification. Supposing then that denitrification does play any noticeable part, it will only be in more or less enclosed bays and fjords, where there is a comparatively large amount of organic substance, a plentiful supply of nitrates from land, and so little circulation that there may be a lack of oxygen. In the open sea it is negligible.

Nathansohn.

We must look for other conditions to explain the apparent irregularities in the distribution of the plankton. Nathansohn was the first to notice that vertical currents are bound to exercise considerable influence. If it be true that one or