On the Oxidation of Ammonia in Sea Water.

By

G. P. Darnell-Smith, B.Sc., F.C.S.

Whilst working at the Laboratory this summer on the function of iodine in Algae, it was suggested to me by the Director that I should study the influence of Algae on the ammonia in sea water. I here tender my thanks to Mr. E. J. Bles for his kind advice and assistance.

Before commencing experiments with Algae the effect of keeping sea water in the light and in the dark was tried. Neither daylight nor darkness appears to have any effect on the amount of ammonia in the water. Thus—

Sea water containing

After standing in the dark twenty-four hours contained

After standing in the dark forty-eight hours contained

Sea water containing

After standing in the light eight hours contained

After standing in the light sixteen hours contained

After a few days, however, whether standing in daylight or darkness, ammonia is produced by the decomposition of organic matter.

In order to test the efficiency of Algae in oxidising the ammonia, sea water which had been in an inverted bell-jar seven days, with a fair quantity of Ulva, moderately illuminated, was analysed.

It contained

After being placed in the window twenty-four hours it contained

After being placed in the window forty-eight hours it contained
This rapid reduction of ammonia is probably due to the oxygen given off by the Ulva. To check this conclusion, water containing 0.008 grm. NH₃ per 100 litres was placed in a bell-jar in the dark and a quantity of Ulva placed in it.

After twenty hours it contained 0.008 grm. NH₃ per 100 litres.
After forty hours 0.008

Thus when assimilation was not proceeding the quantity of ammonia remained stationary. Decomposition then commenced, for—

After standing in the dark sixty-four hours it contained 0.012 grm. NH₃ per 100 litres.

After standing in the dark eighty-eight hours it contained 0.030

The jar was now placed in the window, and after standing there forty-eight hours it contained 0.007 grm. NH₃ per 100 litres. That the reduction of ammonia in sea water by Ulva depends upon the assimilation of the latter is further shown by the following experiments. Water, into which some Ulva had been put, had stood seven days in a position moderately illuminated.

It contained 0.037 grm. NH₃ per 100 litres.

After standing in the window twenty-four hours it contained 0.009

After standing in the window forty-eight hours it contained 0.010

After standing in the window seventy-two hours it contained 0.015

The available carbon dioxide had apparently been used up after the first twenty-four hours, and the plant was unable then to keep down the ammonia. A small quantity of carbon dioxide was now blown through the water, and after twelve hours it contained 0.009 grm. NH₃ per 100 litres. A further quantity of carbon dioxide was blown through overnight, and after standing seven hours in daylight the water contained 0.006 grm. NH₃ per 100 litres. That the reduction in the amount of ammonia was not due to the agitation of the water is shown by the following experiment. Water containing much ammonia was placed with Ulva in bright sunshine.

It contained at the commencement 0.009 grm. NH₃ per 100 litres;
" after five hours 0.003
" after forty-one hours 0.006

showing the same series of changes as in the previous experiment. Carbonic acid gas was now blown through it, and it was still found
to contain '006 grm. NH₃ per 100 litres. After standing one night and six hours in daylight, however, it contained '002 grm. NH₃ per 100 litres. The preceding experiments show that when Ulva is assimilating rapidly and oxygen is given off, the ammonia in sea water is very quickly reduced. The amount of carbonic acid gas, however, available for purposes of assimilation is not clear; from the "Challenger" Reports there does not appear to be any free carbonic acid gas in sea water, and Algae, therefore, must depend upon that which is in a state of "loose" chemical combination.

An experiment was now made to test the rapidity of action of a current of air blown through the water. A current of air at the rate of 400 c.c. per minute was blown through sea water which contained—

At the commencement '030 grm. NH₃ per 100 litres.
After five hours '023
After twenty-six hours '013
After fifty hours '008

A second experiment gave similar results, and it appears, therefore, that the oxygen given off by Algae is very much more efficacious than that of the atmosphere, which is probably due to its being in the nascent condition.