and proceeding towards the pole to colder and colder latitudes, the water will take in carbonic acid at a greater and greater rate, and tend to convert its surplus base into fully saturated bicarbonate, which stage of saturation is the more likely to be reached the nearer we come to either pole. The number of equivalents of carbonic acid present for every one equivalent of surplus base would, in fact, be a function of the temperature of the water, or approximately of the latitude. But the actual relations are far more complicated: the excess of carbonic acid taken up in the polar regions is constantly being conveyed to warmer latitudes by the polar currents, to make up for loss of carbonic acid constantly suffered by the water there. It may be pointed out that, assuming (as we have tacitly done so far) there were no other source of carbonic acid than the atmosphere, the sea water even in the Arctic and Antarctic Regions could not contain more than traces of actually free carbonic acid in addition to fully saturated bicarbonate. According to Bunsen, one volume of even pure water of 0° C., when shaken with excess of pure carbonic acid of 760 mms. dry gas pressure, absorbs only 1·8 volumes of the gas (measured dry at 0° C. and 760 mm.). Even in the polar regions, the temperature of liquid sea water never sinks by more than 2 or 3 degrees below 0° C., hence the maximum proportion of carbonic acid which such polar sea water could possibly take up from the atmosphere may be roughly estimated at 0·0003 × 1800, or to ·54 c.c., or about 1 milligramme per litre of water. And supposing at a given place a larger proportion were produced by an influx of gas from below, this excess of carbonic acid, over and above the 0·5 c.c., would speedily diffuse out into the atmosphere."

Besides making determinations of the carbonic acid, Mr. Buchanan boiled out the atmospheric gases, oxygen and nitrogen, with a portion of the carbonic acid, from a large number of samples of water, and preserved them till the Expedition came home, when a certain proportion of them were analysed by himself and the remainder by Professor Dittmar.

The atmosphere may be taken as consisting of 21 per cent. oxygen and 79 per cent. nitrogen. Professor Dittmar says[1]:—

"As the pressure of the atmosphere at the sea level does not differ very greatly from 760 mm., the two gases may be assumed everywhere to press on the ocean, the oxygen with a force equivalent to 0·21 times $(760-p)$, the nitrogen with a force equivalent to 0·79 times $(760-p)$ millimetres of mercury, where p stands for the tension of the vapour of water, which of course is very little in the polar regions, while in the tropics it may assume greater values up to some 33 mm. (the tension of steam saturated at 30° C.). According to the law of gas absorption, a given volume of sea water, when shaken up with a given volume of air at a given temperature, takes up both gases, the dissolved quantity of each being proportional to the product of its coefficient of absorption

[1] Phys. Chem. Chall. Exp., part i. p. 223, 1884.