

being a feeble acid, is combined chiefly with the weakest bases, and consequently chiefly with the magnesia, and in the second instance with the lime. So we should say, if the arrangement of the bases and acids into salts were a mere matter of tendency to form simple salts. But magnesium has a characteristic tendency to form double chlorides with potassium and sodium, and there is superabundance of chloride of sodium in sea water. Hence, probably, most of the magnesium is not there as carbonate but as double sodio-chloride, and the lime takes the greater share of the carbonic acid. The alkalinity in any case represents the potential, and may fairly be presumed to measure approximately the actual, carbonate of lime. This is the only answer to that often raised question about the presence of ready-formed carbonate of lime in sea water, which some chemists, who at the time must have deliberately shut their eyes to the established propositions of chemistry, have endeavoured to solve by direct experiment. Supposing actual carbonate of lime could be extracted from sea water without the co-operation of external matter (I greatly doubt whether this has ever been done), the weight of such extracted carbonate of lime could not reasonably be assumed to be equal to that which was originally present in the water. Sea water is alkaline, all the alkalinity must be owing to carbonates, and of these carbonate of lime must be one. This is, and for a time is likely to be, the sum total of our knowledge on this point."

At the time when the Challenger Expedition was decided on, and the nature of the work to be done in the different departments was being considered, the chemist's attention was principally directed to the gaseous contents of the water, understanding these to mean the oxygen, nitrogen, and carbonic acid.

Dr. Jacobsen, who had been engaged as chemist on board the German ship "Pommerania" in her cruise in the North Sea, had found that the method boiling *in vacuo*, which was sufficient for the extraction of the oxygen and nitrogen, was useless for extracting the carbonic acid. He found that, to obtain concordant results, it was necessary to distil the water sample almost to dryness and collect the carbonic acid which came away with the steam in baryta water or similar absorbent, and determine it thus directly. The amount of carbonic acid which Jacobsen thus found (about 88 mgrm. per litre) was enormously in excess of what pure water could hold in solution when exposed to the atmosphere under similar conditions. At the same time he was unable to find in the residue when the water was evaporated to dryness an amount of carbonate in any way sufficient to account for the retention of the carbonic acid as bicarbonate. Jacobsen was inclined to ascribe to the chloride of magnesium, which is present in large quantity in sea water, the property of retaining the carbonic acid. When the "Pommerania" touched at Leith on her homeward voyage in August 1872, Jacobsen very kindly communicated to Mr. Buchanan all the facts which he had observed, and his views as to their possible explanation.