Dr. Pettersson analysed a large number of samples of sea water ice and found the ratio $Cl : SO_3$ to vary from 100 : 12·8 to 100 : 76·6, the average proportion in sea water being 100 : 11·88.

In the act of freezing, sea water separates into ice which contains less salt and into brine which contains more salt than the parent sea water, and it may be assumed that both the ice and the brine have the same temperature (29° F.). The brine being denser than the surrounding water sinks into it and by mixing with it renders it more salt and at the same time lowers its temperature. The tendency is in a sea isolated from circulation to produce a uniform temperature of about 29° throughout its depth, and this is actually what is observed in the Arctic regions in the Norwegian Sea, which is separated from the Atlantic by a ridge with a maximum depth of 300 fathoms of water over it.

In the portion of the Antarctic Ocean traversed by the Challenger there is only a very slight and gradual shoaling of the water from the Indian Ocean towards the Antarctic Circle. Hence there is no impediment to the free circulation of the water between high and low latitudes. The effect of the winter cold in high latitudes is in one respect the same as that of heat in tropical regions, it removes water from the sea and thus produces concentration; in the tropics the water is removed as vapour; in the polar regions it is removed as ice, leaving a salter water at the freezing temperature of the ice, which sinks and cools the deeper water by convection. In summer, when the ice breaks up, some of it melts and forms a layer of less saltness but low temperature at the surface. This layer, along with the melting pack ice floating in it, is generally driven in part far to the northward of the place where it was formed. Its place must be supplied from below by water coming from lower latitudes, unless the supply of land ice from the Antarctic continent were sufficient to supply the deficiency, which is very unlikely. On the return of winter the surface water will still be less dense than that below, and the brine separated from it on freezing will also be less dense, and therefore have less power to penetrate the deep water.

Further, the covering of ice is a very powerful protection to the water below. The thickness of the ice formed round the "Vega" during the winter that she was frozen in, in the Siberian Sea, was 162 centimetres, and the water below it was no colder than it had been in summer. Pettersson has found the latent heat of freezing sea water to be less than that of fresh water; but even if it were identical with it, the formation of 162 centimetres (0·875 fathoms) of ice would only be thermally equivalent to the reduction of the temperature of 125 fathoms of water, by 1° F. Such an effect is much inferior to that produced by the moderate winters of temperate latitudes where no ice is produced. In order that the winter cold at the surface be freely transmitted to the deeper water, it is important that the salinity of the surface water be greater than that of the water below it. The importance of this factor in promoting convection downwards was pointed out by Mr. Buchanan in