

decreased from 4 or 5 parts per thousand to 1 or 2 parts per thousand.

A very interesting characteristic of the thin layers of salt water ice is their great mobility. It is entirely different in appearance to fresh water ice, being white and the top layers seemingly full of mechanically suspended salt. Extreme



Fig. 5.—Men cutting out the "Stanley."

brittleness, which characterizes the fresh water ice, is entirely wanting. A small wave set up in the water travels through it without breaking it, the thin layers rising and falling and exhibiting great plasticity.

It was clear that the chief factors in the ice conditions in the Straits are wind and tide. The temperature of the water remains very constant everywhere at 30° C. The severity of the air temperatures has an influence on the quantity of ice formed, but the greatest difficulties in ice-breaking were always experienced in the milder weather, especially after a period of intense cold. The frost appears to hold the shore ice, but this is afterwards set free by the milder weather and carried immense distances by wind and tide.

These "hard pans" of ice, as they are called, are carried by the wind through the Straits, and it sometimes happens that the ice formed in the Straits will be carried out by this means against the tide. If the tide is carrying in other floes, then the two meet, causing a tremendous ice jam. Should a ship be caught in such a jam, the squeezing and pinching is very great. In following a lead through the ice, see Fig. 2, a ship may be caught in this way, and is said to be "nipped." Fig. 3 shows two masses of ice coming together and piling up along the pressure ridge. Fig. 4 shows the ice pressing up on the ship and piling up, often on to the deck itself. As wonderful as the immense force of these jams is the quiet and silent way the ice disappears. When the tide turns, the ice is apparently drawn down and open water appears all around. One can hardly credit the vagaries played by the moving ice.

My assistant, Mr. J. B. Woodyatt, thus describes "his experiences on board the C.G.S. "Stanley" during one of these ice jams:—

"The wind was from the S.S.E., and the sky was clear when we started out. As usual, we did not have much trouble with ice until we passed Cape Bear. We could see the

'Minto' had drifted to a point about half way between Cape Bear and Cape St. George, and was stuck solid. We passed along through leads until we passed the east end of Pictou Island, and were working west, about a mile off the south shore of the Island. We were in open water, running at full speed, and were making for a narrow bridge of ice (about 150 feet through) which separated us from open water, and the bow ran up on the ice, but did not break it, nor could she back off. From where we were to shore was solid ice, and the bridge we were on was holding back another big field, which was being pressed in by the wind, consequently it was very solid. After several attempts to move, we 'burned down.' About 12:00 o'clock there was a slight slackening in the ice, and the men started to 'cut her down' with slice-bars (or chisel-bars)—see Fig. 5. This operation consists of cutting away the ice for about six feet along one side of her, starting at the stern, and shoving the ice as cut back into the pond of open water created by the screw. The ice was opening up ahead, so that her bow was in open water. The instant enough ice was cut away to clear her, she moved for the open water, but the ice started to run, and before she could cover the hundred feet or so, the ice on the east side came in to fill in where it had been cut away and nipped us tight. It would seem as if the ice gained considerable momentum in travelling the six feet that it did, for when it nipped us, it nipped hard, started plates, twisted bulkheads, broke ports, and sheared bolts. And it didn't stop there. The ice coming on behind started to climb over the ice on our side, and piled up until it was coming in over the decks. With great groaning, it piled and squeezed and the ship shook under the strain. We were not quite broadside to it, however, and it was gradually passing to our stern, so that after about an hour of the squeezing we got another chance to cut down the ice and got under way before it closed in again. From there to Pictou was easy sailing, as there was lots of open



Fig. 6.—The "Montcalm" stuck for 10 hours in the ice below the Richelieu Rapids. Observe the effect of the circulating water in removing the frazil.

water. The 'Minto' at that time was also stuck and drifted around for a number of hours."