the broken ice might be held in by strong winds. There is a current there of one mile per hour: through the channel, the lake would soon be emptied of ice if the channel were kept open. Thus, it appears from previous study of the river that there are three points where efforts would have to be made

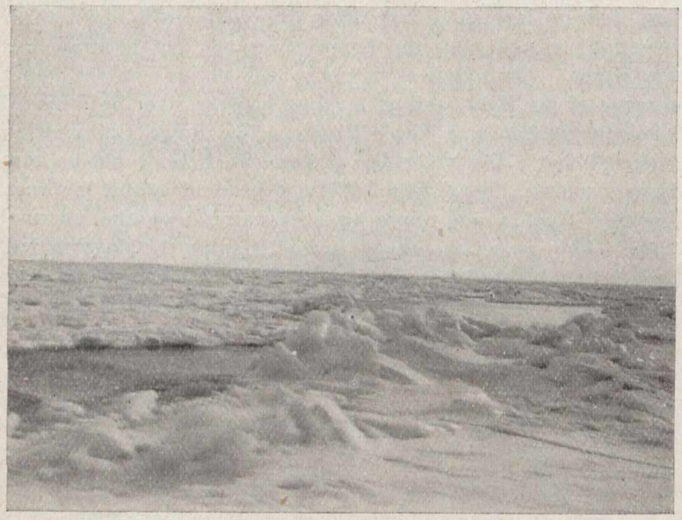

Fig. 2.—This shows a "Lead" in the ice in the Northumberland Straits, through which the ship tries to pass to avoid the ice crushing.

to prevent prolonged stoppage of ice. Cap Rouge, which has been successfully handled this year; Nicolet, at the base of Lake St. Peter; and at the Sorel Islands. With Lake St. Peter free of ice, we may safely predict a continuous open channel above that point. The river is continually struggling to free itself of its icy burden, and every attempt to assist at vital points will be found to be far more effective than we can, at the present time, sufficiently appreciate.

It is my intention further on to indicate one or two ways whereby, I believe, the problem of Lake St. Peter may be solved in a comparatively simple way.

Fig. 3.—Two floes coming together in opposite directions. Work at the Northumberland Straits.

Observations on the formation and action of salt water ice are of great interest. It is quite unlike fresh water ice, being so very variable in composition and different in appearance.

Prof. Otto Pettersson, of Stockholm, President of the International Commission for the Study of the Sea, has made an extended study of salt water ice. As a result of his inquiry, he finds that ocean water is divided on freezing, not into pure ice and a more or less concentrated solution of ordinary sea salt, but into two saliniferous parts, one liquid and one solid, which are of different chemical composition. It is found that the formation of sea ice is chemically a selective process. Some of the elements of the sea water are more fit than others to enter into the solid state by freezing: those that are rejected by the ice will preponderate in the brine, and vice versa. As a rule, the ice is richer in sulphates, the brine in chlorides. With time, the ice appears to give up more and more of its chlorides and to retain the sulphates. The general opinion has been that pure ice was formed on the freezing of sea water. The small impurities always present in sea ice were accounted for by adherent sea water, but it has been conclusively shown that the freezing of sea water

Fig. 4.—Nipped in the ice which has begun climbing up into the ship. Photo taken from the C.G.S. "Stanley."

involves a separation of its chemical constituents, of which one part enters into the composition of the solid, another into that part of the liquid water. The actual salinity of the ice is, of course, small, and was found to diminish with the age of the ice. Immediately after its formation, sea ice contains a noticeable quantity of salt—chlorides as well as sulphates, carbonates and other salts. Such ice is very different from fresh water ice in its physical properties. It melts below zero, and begins to show signs of melting by contraction of volume at temperature far below zero. Thus, ice which contained as much chlorine as 2.73 parts per thousand commenced to contract at -14° C. (6.8° F.), and continued to do so up to the melting point. Ice formed by freezing at low temperatures of Arctic sea water which contained 6.49 parts per thousand of chlorine began to contract its volume already at -18° C. (0° F.). This phenomenon is, however, a relative one, so far as any ice is concerned. Even fresh water ice contains small traces of impurities which cause a contraction of volume before the actual melting occurs. The purer the ice, the sharper is the change from solid to liquid differentiated. E. V. Drygalski has found, in his study of polar ice for the Berlin Geological Society, that the salinity of newly formed sea ice is from 4 to 5 parts of salt per thousand. He found, which is very important, that the salt is not confined, to the uppermost layer of the ice. The salt was found to be almost equally distributed in every layer of the sea ice, from the surface to 68.4 centimeters depth, where the salinity was 4 parts per thousand, but after two months the salinity in all layers