A Small Research Submarine in the Arctic

The two-man undersea work boat PISCES I (see cover picture) made a total of 15 dives during a six-week joint scientific enterprise in the Canadian Arctic Archipelago in 1968 (see Fig. 1). The Canadian Coast Guard icebreaker CCGS *Labrador* acted as a mother ship and was especially fitted out with a heated house having a removable roof to accommodate PISCES under the ship's boat crane. PISCES was flown from Vancouver by a C130 Hercules on 12 August to rendezvous with CCGS *Labrador* at Thule, Greenland. The return flight from Thule to Vancouver was made on 20 September.

Early in 1967, the Defence Research Establishment Pacific (DREP) proposed to extend the summer 1968 scientific program of *Labrador* by carrying the undersea work boat PISCES. The uses proposed for PISCES were: a) to determine the usefulness of a small submarine in an arctic summer environment, particularly with regard to the problems of diving near and under sea ice; b) to assist, if necessary, in the recovery of bottom mounted instruments, called RIP's, which were installed in the summer of 1967[1]; c) to make measurements on the acoustic scattering properties of sea ice; d) to explore the sea bottom visually with regard to living organisms and geological structure, and finally e) to attempt to observe the *in situ* habits of sea mammals in relationship to the character of the underwater sounds they make.

PISCES I weighs 15,000 lb. and normally operates to depths of 1800 feet. With its two outboard propulsion pods and its *sail* removed it fits easily into a C130 Hercules. Dives in ice-covered seas were made in Norwegian Bay and at the west end of Viscount Melville Sound. In other locations, open water generally dominated the scene. Although diving in ice-covered waters was limited to the availability of geometrically stable polynyas within the ice field, there were no problems in the launching and retrieval of PISCES from the icebreaker. Under these conditions, the absence of surface waves allowed dives to be made in poor weather. As a safety measure, all dives in ice-covered areas were made with a heavy polypropylene rope loosely connecting the PISCES to *Labrador*. The length of the rope (max. 4000 feet) ensured that underwater voice communications from PISCES to *Labrador* were always well within the maximum audible range. The rope was also used to navigate back to the polynya by following it visually, either through the view ports or by the use of underwater television. A back-up navigational system, consisting of a scanning sonar in PISCES which could home on a sonar *pinger* suspended from *Labrador* was also available.

In ice-free seas even a slight rolling of *Labrador* inhibited the launching of PISCES because of the pendulum action which could occur when it was lifted by the ship's crane. As a result of careful ship handling no problems arose in this connection and it was clear that the *Labrador* had sufficient manoeuverability to act as an effective retriever of submersibles. In the absence of special handling equipment on *Labrador*, diving operations with PISCES were suspended when the wave or swell height exceeded 3 feet.

Photographs of the bottom were taken at all dive locations, which included photo-

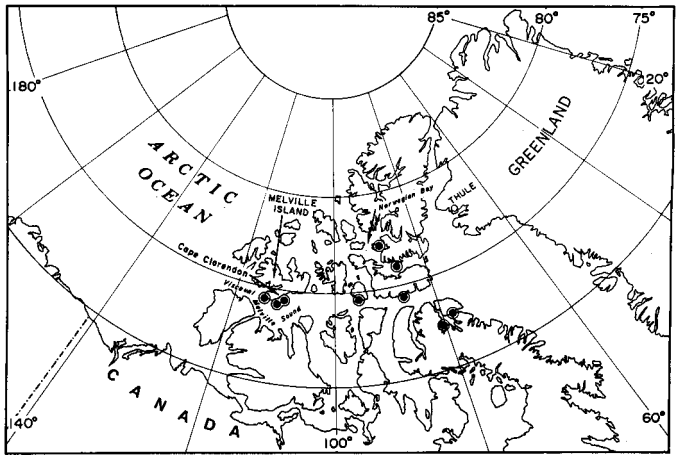

FIG. 1. Location of dives made by PISCES I.

graphs of an RIP as it had been sitting on the bottom for a year just south of Cape Clarendon, Melville Island. The exceptional clarity of the water permitted observations to be made by natural illumination to depths greater than 300 feet. In fact, off Melville Island, the external fixtures of PISCES could be clearly seen by natural illumination to a depth of 700 feet. Despite the transparency of the waters, the view of the underside of the sea ice proved to be disappointing. The view upward and forward presented a view of the ice as a background of patchy shades of grey, as a consequence of the ice acting as a secondary source of illumination. Against this background, the occasional seal could be seen, but at no time could the PISCES approach a seal, nor did any under-sea mammal exhibit sufficient curiosity to approach PISCES. As a result, the mammal investigations were more effectively carried out with the aid of the ship's helicopters.

It is a generally accepted hypothesis that *fail-safe* mechanisms in submersibles will result in a rapid rise to the surface. However, when operating near sea ice the possibility of being inadvertently perched under a floe is not small. The accidental loss of a manipulator arm from PISCES off Melville Island, although the loss occurred at the surface, produced a large increase in buoyancy. At this time the dive had been terminated by the impending intrusion of a large polar floe into the dive area. Although normal underwater communications existed, and procedures for control were followed, it is clear that homing and communication devices must be positioned on a submersible so as to remain effective while the submersible is pressed up under the sea ice. Rescue under these conditions could then be effected by the icebreaker mother ship. Under these circumstances, the release of a large volume of dye would be an effective way to indicate the location of the submersible relative to cracks produced by the icebreaker.

The operation of a small submarine in the summer sea ice was dependent on the correct choice of favourable conditions, which were in turn subject to the whims of ice movement and weather. PISCES proved to be a versatile, manoeuverable and well-instrumented work boat, and was effective in introducing the scientists to the undersea environment of the Arctic Archipelago.

ACKNOWLEDGEMENT

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[1]Milne, A. R. 1968. Noise Under Sea Ice is Studied. *Canadian Shipping and Marine Engineering News*, March, pp. 65-66.

Indians in Siberia

In the very centre of Siberia, on the vast snow-covered expanses that adjoin the great Siberian river of Yenisei where there are 62 square kilometres of land to every man, live Indian tribes that settled there many years ago. Little is known of the history of these Indians, called Evenks, before they were discovered by the Russians early in the seventeenth century.

The word "Evenk" means "he who runs swifter than a reindeer". One cannot imagine an Evenk without a reindeer (see frontispiece), just as one cannot picture a bedouin without a camel. The reindeer is an indispensable means of transportation in the snow-covered expanses of Siberia. Its hoofs are wide and it does not fall through the thickest snow. Out of reindeer skin the Evenks make clothes and footwear that are cold- and damp-resistant and are essential in this area of the world where the mercury sometimes drops to −60°C. They live in tents made of reindeer skin that very much resemble Indian wigwams. Their favourite food is cooked reindeer meat and finely cut pieces of raw frozen fish.

At present there are about 25,000 Evenks in the Soviet Union; they live mostly in Central Siberia where they inhabit the Evenk National Area. Once this land was overgrown with giant sequoias and was washed by the warm Fern Sea. Later volcanic eruptions covered it with an enormous amount of magma and now it has an unusual surface resembling that of the moon.

A fish called taimen (the salmon trout) is the symbol of this land. From ancient times the Evenks used to cut its image upon the trees as a sacred sign. According to the beliefs of the Evenks, the land itself is a raft