Arctic Field Equipment

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ABSTRACT. The equipment described allows normally chair-bound scientists to work and live in comfort on arctic field trips in the winter. Included are methods of inserting and recovering transducers through the sea ice, the design of a cargo sled, and the design of comfortable lightweight fabric shelters.

RÉSUMÉ. *Équipement de terrain dans l'Arctique.* L'équipement décrit ici permet aux "scientifiques de fauteuil" de travailler et de vivre confortablement lors d'expéditions hivernales dans l'Arctique. Il comprend des méthodes de déposition et de récupération de sondes à travers la glace de mer, l'étude d'un traineau à marchandises et l'étude d'abris de toile légers et confortables.

РЕЗЮМЕ. *Арктическое полевэе оборудование.* Описанное оборудование позволяет ученому, привыкшему к комфорту, работать и жить со всеми удобствами в Арктике во время зимних экспедиций. Описаны методы спуска и подъема трансдукторов через морской лед, конструкция грузовых саней, а также конструкция удобных и легких палаток.

The Defence Research Establishment Pacific has been making underwater acoustic measurements in the Arctic since 1959. A typical field party consists of four people camped on the sea ice for periods of up to a month. The design of our equipment was dictated by conditions in the Canadian Archipelago in the winter and the early spring.

The sea ice provides a "highway" and a stable working platform for ocean measurements. However, the sea ice, typically 5 to 7 feet thick on frozen leads, is a formidable barrier to insertion of transducers into the ocean beneath. Standard shaped explosive charges make very little impression on the tough sea ice, so that normally it is necessary to resort to mechanical drilling. Our most successful augers are those with triangular cutting heads (Fig. 1); they drill a 9-inch diameter hole in 7-foot thick ice in about 10 minutes — once the two-stroke engine is persuaded to start. Larger holes are formed by drilling a ring of 9-inch "dry" holes and merging them together with explosives detonated within a "wet" central hole. A more difficult problem is to prevent the transducers from being trapped below the ice by refreezing of the holes. For short periods, water can be excluded from the hole by the inflation of a cloth-reinforced neoprene rubber balloon, similar to a "plumber's plug" (Fig. 2). Figure 3 shows the surface appearance of the air bag. The balloon can be removed easily after deflation if it is greased. Unfortunately the water beneath the ice is near the freezing point so that, in very cold weather, convection currents of cold air within the balloon permit a cup of ice to form over the bottom of the balloon. This ice can be broken away after the balloon is deflated, provided that it is not left in place more than a week or so.

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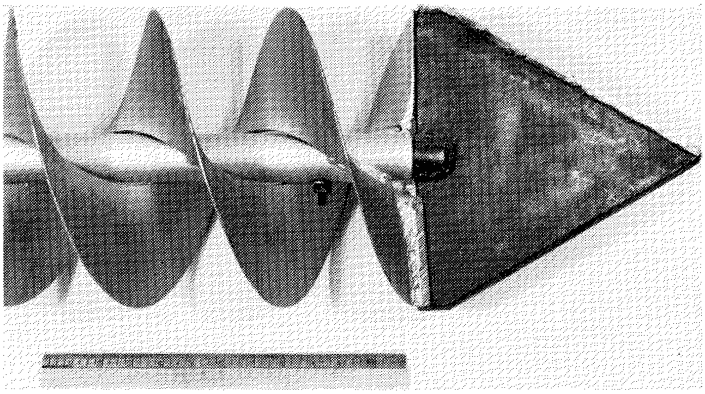

FIG. 1. Ice drill tip.

When equipment must be left unattended for several months we have used a recovery method nicknamed the "rope trick" (Fig. 4). An open-ended cylinder is prepared beforehand, which is 10 feet long and 7 inches in diameter, and the cylinder is wrapped with nylon rope embedded in a silicon rubber having a very low tensile strength (Dow Corning #501). The "rope trick" cylinder is temporarily supported within a freshly-drilled 9-inch diameter hole; then the underwater equipment is lowered through the "rope trick" cylinder, and everything is allowed to freeze. To recover the equipment, the rope is simply unravelled from its silicon rubber matrix in much the same manner as fishing line is pulled off a spinning reel. You become involved with quite a bit of rope but it is an easy one-hand pull. When the rope is unravelled, the cylinder, complete with its core of ice containing the equipment cables, is then lifted clear of the ice and the underwater equipment can be pulled through the resulting hole. The main disadvantage of this scheme is that the cables must be cut to free them from the cylinder.

Travel in the winter on rough sea ice, using tracked vehicles towing cargo sleds, is often slow and uncertain. In the dark, speed is usually measured in miles per

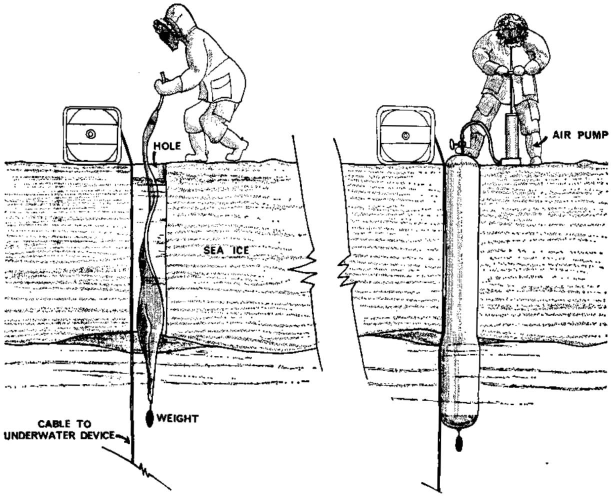

FIG. 2. Inflatable hole plug.

FIG. 3. Daily inspection of the inflatable hole plug.

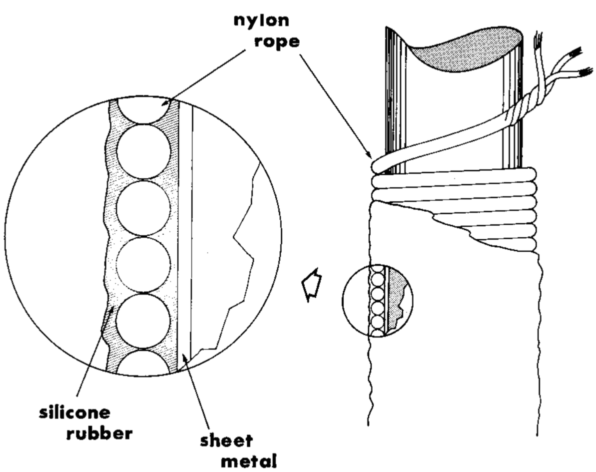

FIG. 4. "Rope trick."

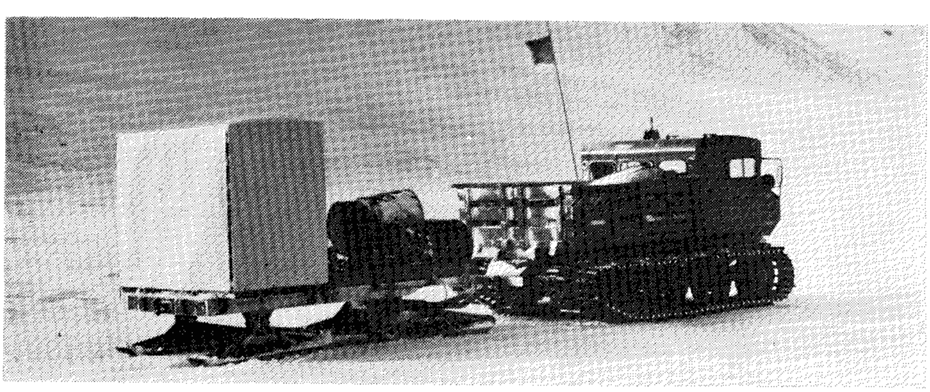

FIG. 5. Four-runner aluminum sled.

day rather than miles per hour, and progress is often halted by equipment failures. Initially we used sleds with two runners; they tended to slam over the rough ice and break. To eliminate this problem the four-runner aluminum sled shown in Fig. 5 was devised. The runners conform to the ice roughness and reduce the slamming. The sled has a bare weight of 780 pounds and can carry up to 3,000 pounds on its 5-foot by 11-foot deck. It is constructed of 65S-T6 aluminum except for "nylatron" bearings and steel shafts. The runners have bearing surfaces 62 inches long by 14 inches wide, are interchangeable, and can be reversed in an emergency. The "wagon" steering of the front runners allows the sled to manoeuvre easily in a forward direction but makes backing up very difficult.

When a vehicle must work away from camp, it carries the emergency shelter shown diagrammatically in Fig. 6. This has been dubbed the "instant igloo," since its primary virtue is that it can be set up in less than a minute even in a wind. The

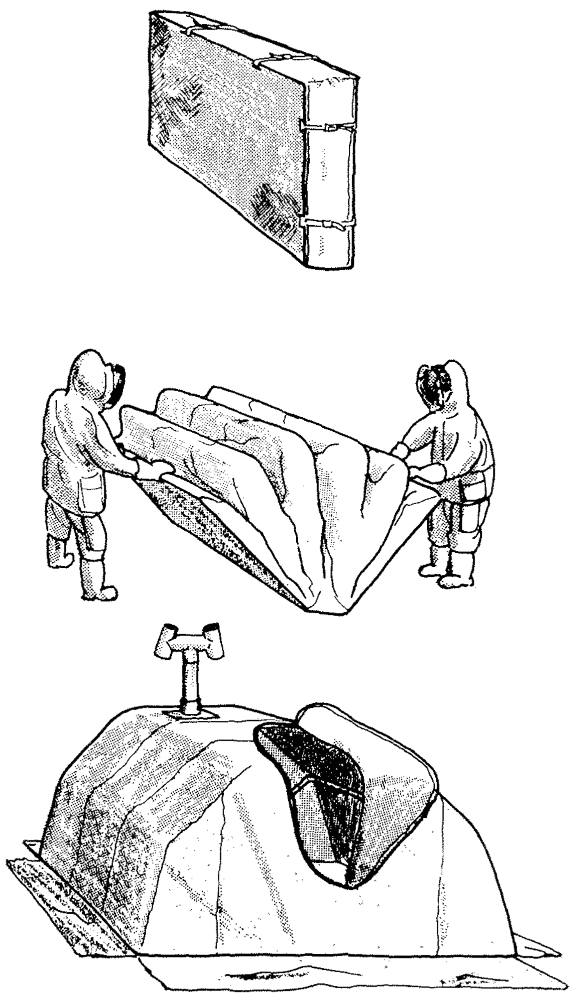

FIG. 6. Instant igloo.

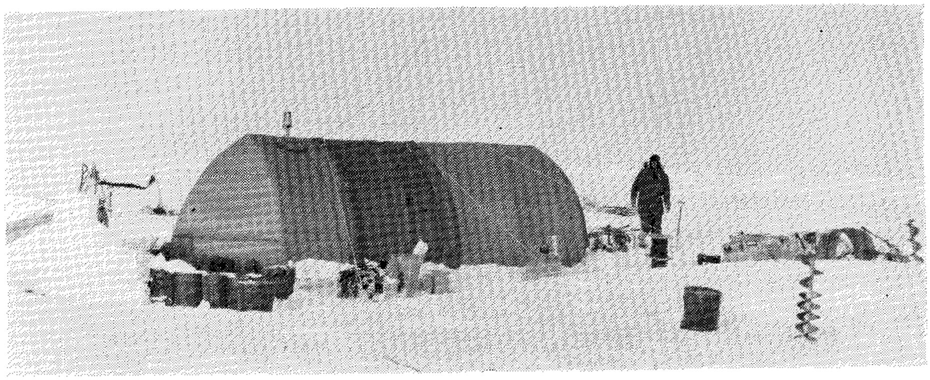

FIG. 7. Main shelter.

shelter folds into a space 7 feet by 4 feet by 1 foot, and it weighs 100 pounds. This weight includes a kerosene-fired stove, fixed in place, and a fibreglass and foam plastic sandwich floor. The shelter is meant to be used with its self-contained stove, but the body heat of two people has maintained the inside temperature at −5°F. when the outside temperature was −32°F. with a 20 mph wind. A Coleman lantern can raise the temperature to shirt-sleeve comfort in a few minutes. The walls of the shelter are constructed of a three-layer sandwich. This sandwich consists of an inner translucent vapour barrier, an outer vapour-permeable windproof shell of nylon "spinnaker cloth," and batts of Dacron fibre insulation in between. The same wall construction is used in our collapsible main shelter shown in Fig. 7. This large shelter has an aluminum frame, a floor area of 7 feet by 20 feet, and weighs 220 pounds, not including the foam plastic floor. A small kero-

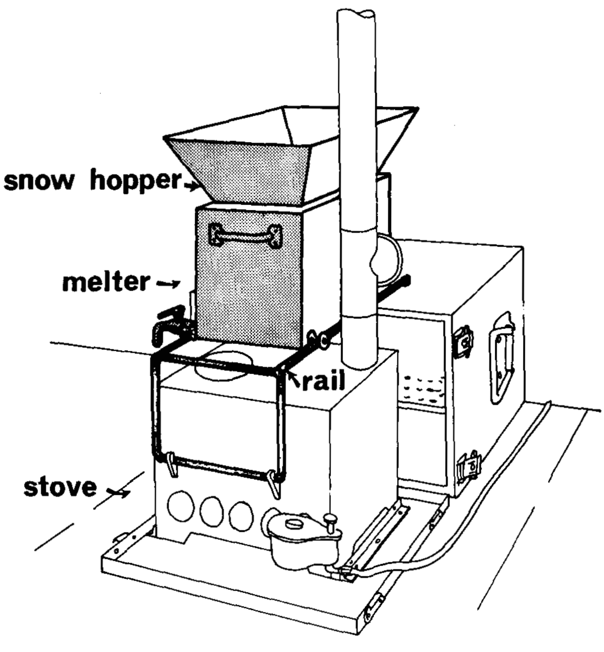

FIG. 8. Water system. The melting tank slides on the rails.

FIG. 9. Oceanographic measurements in a heated shelter.

sene pot-burner stove with a fuel consumption of 10 gallons per week provides adequate heat on a 24-hour basis, plus heat for melting snow for water. A touch of luxury is provided by the "water system" shown in Fig. 8. The snow-melting tank slides on the rails to regulate the rate of snow melting and the temperature of the water. Fig. 9 shows a similar style of shelter, without a floor but with the same type of construction, being used for oceanographic measurements. The shelter was set up over a drilled hole and oceanographic casts were made in tropical comfort despite $-60°F$. air temperatures.

The equipment that has been described represents the ideas of a number of people, and it has all been field tested under winter conditions in the Arctic. The ice drills were developed by Mr. C. L. Murphy at the Prairie Farm Rehabilitation Office of the Canadian Department of Agriculture. The principal contributors at our Establishment were Mr. A. R. Milne, Mr. G. N. Dennison, Mr. T. Hughes and Mr. G. G. Beith. Unfortunately most of the items were either constructed within Canadian Forces Base Esquimalt, or are available commercially only on a custom basis. We would be happy to provide more details on any of the items.