instrument. This is about an order of magnitude worse than that reported by Gillham for his polarimeter and is mainly due to the poor quality, optically speaking, of commercial tinplate surfaces. None the less, it is very adequate for measuring films, such as oil on tinplate, which typically produce a shift of 0·3° and is nearly an order of magnitude better than the repeatability of setting claimed by Murray.

To illustrate that the instrument is responsive to the thin films of oil on tinplate (of the order of 30 Å) a piece of commercial tinplate was de-oiled and oiled a number of times, compensator readings on the ellipsometer being taken at each stage.

De-oiling was by Soxhlet extraction in benzene and oiling was by dipping in and controlled slow removal from dilute solutions of oil (dioctyl sebacate) in benzene. The amount of oil so deposited can be varied in an approximate manner by changing the oil concentration. The results are shown in Table 1 in terms of milli-degrees of compensation. Ten milli-degrees is equivalent to about one angstrom unit of oil film thickness. The changes in the de-oiled state represent a slight lack of reproducibility of the surface rather than instrumental error.

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METEOROLOGY

Measurement of Conducted Flow of Heat in a Sea Ice Cover

In any micro-meteorological study or heat economy survey, the measurement of the conducted flux of heat at, or below, the Earth's surface is important. The two methods normally used to achieve this either involve measuring the temperature gradient if the thermal conductivity can be accurately established, or insertion of a heat flux meter, the basis of which is the measurement of temperature gradient across a thin slab of material of known conductivity. The accuracy of heat flux meters is limited unless the effective conductivity of the device used matches that of the medium in which the flow of conducted heat is being measured. For example, in using a flux meter with square horizontal surfaces with a width to thickness ratio of 12 : 1, a 20 per cent mismatch in conductivities results in an approximately 5 per cent error in indication.

For surface media which are subject to changes in thermal conductivity or are transparent to radiation, one or other of the foregoing methods of heat flow measurement become inapplicable. The first difficulty is met when rainfall alters the effective conductivity of soils or porous rocks so that measuring techniques are restricted to use of a flux meter. Snow and ice covers, on the other hand, present problems due to the penetrating visible radiation heating the sensor surfaces unequally. In the case of fresh-water ice, the properties of which remain essentially constant, the problem is solved by measuring the temperature gradient with small thermocouples having reflecting surfaces.

Sea ice presents an example of the most complex type of situation where both problems of variability in thermal conductivity and transparency to radiation have to be considered. I was able to overcome both these difficulties during a heat budget study on annual sea ice in Hudson Bay. This was achieved by excavating a pit of about 1·5 m across and 25 cm deep and allowing cold fresh-water to freeze, forming a reference block. Frozen into this block were a vertical sequence of four small thermocouples with reflecting surfaces electrically insulated by thin tubular polythene envelopes and spaced 5 cm apart by a transparent 'Perspex' frame. The relatively thick slab of prepared ice was used to gain sufficient temperature difference to avoid the necessity for thermopiles, the increased area of which would have resulted in more serious local absorption of radiation. The four thermocouples enabled a uniform temperature gradient to be detected in the reference ice, under which conditions the most widely separated thermojunctions could be used to determine the heat flux most accurately.

Some optical and conductive matching between the reference block and the surrounding sea ice was accomplished during the preparation of the former. By insulating the prepared excavation from above, the reference ice was made to grow from below and form a relatively dense and transparent medium. On the other hand, permitting the ice to form from above, progressively in layers, resulted in a bubbly mass of small crystal structure. An alternative method which proved satisfactory in controlling the density of the block was to freeze varying mixtures of snow and water. Ice of a given density appeared to be more opaque when prepared by the latter method. Although there was some degree of independent control over thermal conductivity and transparency, relatively accurate matching was attempted only for the former, and was checked by a determination of the conductivity of the surrounding sea ice. Transparency matching was judged by appearance only, but if necessary could be checked by means of a simple light meter. Usually, a light snow cover results in radiation penetration being of reduced importance.

Measurement of the thermal conductivity of the reference ice is necessary. It will be shown elsewhere[1] that a simple measurement of density is sufficient to fix the conductivity of non-saline ice and that the additional determination of salinity enables the thermal conductivity of sea ice to be specified as a function of temperature. The device proved to be satisfactorily sensitive and accurate and its properties, in marked contrast to those of the sea ice, remained essentially constant over a period of three months; in particular no significant diffusion of sea ice brine into the reference ice occurred. The sensitivity of the 'ice heat flux meter' was demonstrated by the fact that the indicated values of surface heat flux were reflected in corresponding rates of sea ice growth after a calculable time delay[2].

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GEOLOGY

Age of the Great Dyke of Southern Rhodesia

The isotopic composition of strontium has been determined for two whole-rock specimens of gabbro from the Wedza Complex of the Great Dyke of Southern Rhodesia. In addition, concentrations of rubidium and strontium were measured for these rocks by the method of isotope dilution. These results led to an estimate of the time since differentiation of this intrusive.

The rock specimens were obtained through the courtesy of Dr. B. G. Worst, who has made a detailed study of the structure and petrogenesis of the Great Dyke[1]. He concluded that the 'Dyke' is in reality a downfaulted remnant of an original sheet-like mafic intrusive composed of four complexes and may be related to the igneous cycle of the Bushveld Igneous Complex.

The isotope ratio determinations for strontium were made in duplicate on a mass spectrometer featuring a 6-in. radius of curvature, 60° sector analyser tube. The details