The stationary part consists of a wooden beam in which a metal tube of such length is inserted that it somewhat exceeds the maximum thickness of the ice to be expected at the place of installation.

Alongside the tube, on the same beam, is affixed a wooden staff graduated in centimetres, of a length such that its dimensions also exceed the probable maximum thickness of the ice. For greater rigidity, the lower end of the stac and upper end of the tube are fastened together by a strong band F.

The movable part of the Ice-Meter consists of a metal shaft with metal rods welded to its lower end, terminating in disc-feelers; also a cap with indicator, fixed to the upper end of the shaft.

As soon as the ice strong enough to permit displacement on it to the site of the proposed measurements, and at sufficient a distance from shore to assure normal conditions for measuring its thickness, an oblong opening is cut through same. The device is brought to the site of measurement and is so installed that the beam lies flat on the ice, so that, on the staff, opposite the indicator, on lifting the shaft to its working position (the disc-feelers must then bear from underneath on the ice), the reading is the same as with the portable staff lowered in the ordinary manner through the opening. The tube is next filled with a mixture of kerosene and naphta.

The actual measurement is effected by pulling up the shaft until the discs come in contact with the under surface of the ice; the thickness of the ice is then read off directly on the staff.

When not in operation, the staff is lowered and the cap with indicator thereupon closes the tube.

The device is simple in construction and handling, and excludes the necessity of having to bore a well prior to each measurement.

The cooling effect of the tube should not be so great as to produce abnormal conditions for the growth of ice around it.

However, in view of this possibility, a distance of not less than 1 m. should be maintained between the discs of the metal rods.

It is very desirable that special experiments with the device be carried out alongside measurements by the ordinary methods recommended for the measurement of the thickness of the ice, in order to ascertain the extent of the thermic influence on the tube filled with kerosene and naphta.

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# ON THE WINTER INSTALLATION OF A TIDE-GAUGE ON THE ICE.

by

K. G.

(Translated from *Problemy Arktiki*, 5-6, Leningrad, 1938, p. 161).

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For the continuous recording of the oscillations of sea level in winter in the Arctic, the installation of a tide-gauge on the ice is currently used. As a rule, the float of such tide-gauges is replaced by a weight, lowered to the bottom of the sea. The tide-gauge itself is set up on the ice and records the oscillations of the ice-cover which has followed the movements of the sea level. One of these devices, which later became the standard pattern, was still utilised in 1925 by I.L. RUSINOVA at the polar station Matotshkin Shar and is described in Vol. LIII of the *Zapiski po Ghidrografii*.

The device made use of by E.T. PAVLOV during the winter season of 1937-38 at the polar station Mare Sale, differs somewhat in the simplicity of its construction, from those mentioned above. In this device there exist neither chains, cables nor driving shafts.

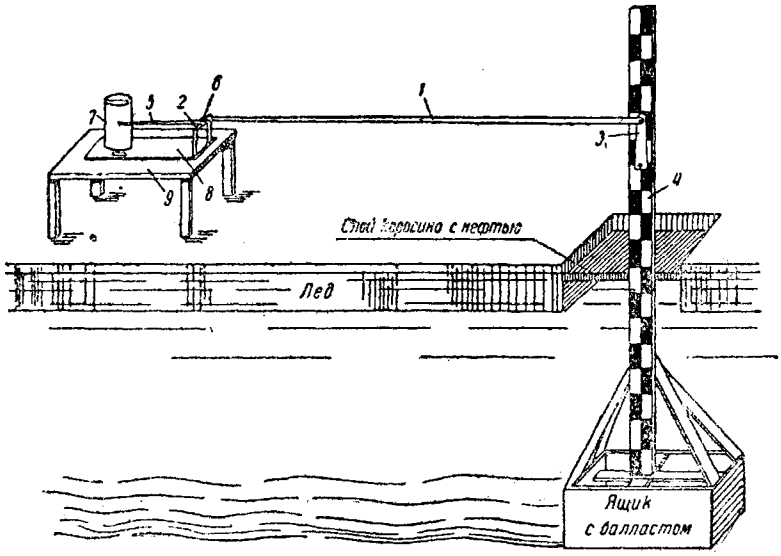


FIG. 2. — *Installation of the Tide-Gauge on the Ice.*

The device is constructed from the parts of a barograph, and consists of the following basic parts: (a) a thin wooden lever 1, 80 cm. long, secured rigidly by one of its ends to the axis 2, and by its other end movably to the connecting rod 3, which, in turn, is connected movably by its lower end to the tide-pole 4; (b) the index-pointer with pen 5, 16 cm. long, fastened on the axis 3 by a screw 6; (c) a drum with clock-work mechanism 7, mounted on the plank 8. The device is placed on a stool 9, the legs of which are frozen into the ice.

The ratio of the length of index-pointer with pen 5 to length of lever 1 is conditioned by the amplitude of the tide. In the present case the ratio was 1 : 5; the staff 4 can be installed, by means of a small box loaded with boulders or small sacks of sand, at any depth down to 5 m.

A mixture of kerosene and naphta is poured on the surface of the water in the opening in the ice to form a protective layer against freezing.

The operation of the device is as follows: with the lifting of the ice, as a result of the rising of sea-level, the tide gauge is lifted up. The lever 1, following with one of its ends the tide-gauge, causes the axis 2, to which it is secured, to rotate through a certain angle, which, in turn, rotates the index-pointer through a corresponding angle, practically equal to the angle of rotation of the lever 1.

On the falling of sea level, all movements occur in the reverse sequence. It should be noted that the moving of the point of fixation of lever 1, i.e. practically of the axis 2, takes place along a vertical line, but that of the pen of the index-arrow 5, moves in an arc of radius equal to the length of the index-pointer, and not along a tangent to same. With the maximum angular displacement of the index-pointer, from the lowest to the highest position, equal, in the given case, to 43°, the error in reading of the range is, in all, about 2%, and lies, therefore, within the limts of accuracy of reading of the staff.

The influence of the displacement of the centre of rotation of the right-hand extremity of the lever, together with the extremity of the connecting rod, resulting in a certain amplification of the angular motion of the index-pointer with pen, is insignificant; with the given conditions it is of less than 1°, and does not exceed the limits of accuracy of reading on the band of a registering tide-gauge. Besides, it reduces the size of the first error, since it acts in the opposite direction.

The comparison of differences in check-readings on the staff effected three times daily, with differences of readings for the same moments on the mareogram, showed insignificant discrepancies, not exceeding 1.5 cm., i.e. were also within the limits of accuracy of reading on the staff.

# TIDE-POLE OBSERVATIONS DURING THE WINTER SEASON.

by

F. A. KURENKOV.

(Translated from *Problemy Arktiki*, 5-6, Leningrad, 1938, p. 163).

All the instructions and text-books on making tide-pole observations in winter deal only with the installation of the ice tide-pole of standard type (i.e. on installations in which the staff is secured to a frame made fast on the ice, the readings being effected from an index on a cable), but do not mention the inadequacies of such an installation. Yet the observations thus obtained are viciated by considerable errors, which cannot ordinarily be foreseen. In hydrological practice at the polar stations, various modified types of such installations are used, but, again, without allowing for these detrimental influences.

In this article, we shall touch upon the method of installation of the tide-pole in the presence of an ice sheet, and shall treat as fully as possible the question of tide-pole observations in winter.

The sources of error in the indications of the ordinary ice tide-pole may be summarized as follows :

1. Uplifting of the upper side of the ice, and consequently of the zero of the staff, with the growing of ice above sea level; if the specific weight of the ice be assumed equal to 0.9, then one-tenth of the thickness of same will rise above the water; if, during the observations, the ice grows by 50 cm., the upper side of the ice will rise by 5 cm. above sea level.

2. Sinking of the ice due to the weight of the snow which has fallen on it.

3. Joining up of the ice with the shores.

4. Horizontal displacement of the ice. (1)

5. Sinking into the ice of the staff, or of the frame on which the latter is fixed. This sinking is especially great in spring, and when the tide-pole is housed in a heated hut in which hydrological observations are being carried on simultaneously; besides, the frame sinks into the ice under the influence of its own weight, the depth of the sinking may thereby attain a few centimetres.

6. Deflection of the cable, which runs from the bottom weight to the staff, due to strong currents (especially with a great length and great thickness of the cable).

Almost all the sources of error are produced by the ice cover, which serves in principle the purposes of a float, and communicates to the index the oscillations of sea level with respect to the staff installed on the ice. It is obvious from the above that the only way of avoiding errors in the observations is by eliminating the ice as the basis of the appliance. The device hereunder described exactly satisfies the last requirement (Fig. 1).

The principle of this device is similar to that of the ordinary pile-work tide-pole. The difference resides in that, here, the staff is held in a fixed position in space, not by a solid base, but by a "base" formed by the cable running from the bottom-weight to the lower end of the staff. The cable is kept taut by means of a counterpoise of sufficient weight, connected to the upper end of the staff; the readings of the sea level are effected directly