Meteorological Office Translation No. 1674

EXTRACTS FROM :

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**MAIN HYDROGRAPHIC ADMINISTRATION**

HYDROMETEOROLOGICAL SERVICE

# INSTRUCTIONS

for making

# HYDROLOGICAL AND METEOROLOGICAL

# OBSERVATIONS

at Coast Stations and on floating lightships

OF THE MARINE DEPARTMENT

St. Petersburg
Ministry of Shipping Publishing House, Main Admiralty
1913

## 2. Water Temperature

12. **Instruments.** A Celsius thermometer in a metal holder is used for observing the water surface temperature (Fig. 2). The thermometer bulb is in a cylindrical brass chamber with apertures through which the water can enter. The chamber walls protect the thermometer bulb from heat reflected by objects around it or emitted by them. The base of the chamber is a sleeve which is removed after making observations to let the water leave it.

13. Observations are made in the following manner : a bucket of water is taken from the surface of the sea after the bucket has first been rinsed several times in the sea where the observations are to be made; the full bucket is then at once placed in the shade, or if this is not possible the observer stands with his back to the sun; the observer lowers the thermometer into the bucket and stirs the water with it, taking readings from time to time without removing the thermometer bulb from the water; as soon as the readings of the thermometer have stopped changing (after five minutes), the last reading is recorded, first the tenths of a degree and then the whole degrees.

14. **The following rules must be observed when surface water temperatures are recorded at littoral stations :**

a) the water is always taken at the same point;

b) this point must if possible be on an open shore at a considerable depth, and at some distance from the shore, i.e. for instance from the end of a mole or from a boat, since the more freely the sea water passes the point where observations are made the less will the recorded temperature depend on the local conditions.

c) the point at which observations are made must not be close to drain piping from towns, entry of water from bath houses, etc..

15. **Thermometer readings and their entry in logs.** To read

temperatures correctly the observer's eye must, while he is reading the thermometer, be precisely opposite the scale divisions being read. The scale divisions on thermometers intended for scientific research are in degrees Celsius*.

When temperature observations are made tenths of a degree as well as whole degrees are determined. If the spaces between the scale lines corresponding to whole degrees were subdivided into ten parts, the divisions would be too small and it would be difficult to read them. Usually, therefore, these intervals between whole degrees are divided into five (Fig. 3) or two (Fig. 4) parts; sometimes there are only whole degree markings (Fig. 5). In the first case each division corresponds to two tenths (0.2°), in the second it corresponds to five tenths (0.5°) of a degree, and in the third case to a whole degree. The tenths of degrees therefore have to be determined by eye. For instance in the case shown in Fig. 3 the reading is + 15.7°; in the case in Fig. 4 the reading is + 18.7°, and in the case in Fig. 5 it is - 1.5°. At temperatures above 0.0° the plus sign (+) is usually omitted; the minus sign (-) is written before temperatures below 0.0°. Temperature readings are at once recorded in the log.

16. **Thermometer corrections.** Each thermometer must be checked for degree division correctness, also with regard to the 0° point; this must correspond precisely to the temperature of thawing ice; when a thermometer is delivered to a station it must bear a list of corrections, which the observer must record both in the appropriate column at the start of the observation

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* The Celsius scale is in divisions from the freezing point (± 0.0°) to the boiling point (+ 100.0°) of distilled water; there are a hundred equal divisions and these are continued on the scale at both ends; on the Réaumur scale the freezing point of water is zero and the boiling point + 80.0°; finally, on the Fahrenheit scale, the boiling point of water is + 212.0°, its freezing point + 32.0°; on this scale zero is the temperature of a mixture of ice and sea salt; the divisions are continued to both sides of the constant boundaries.

logs and in the monthly tables. At the end of observations a correction corresponding to the readings made must be entered at a particular time in the appropriate column in the log below the thermometer reading, and the corrected reading or the true temperature are then calculated in the following manner. To obtain true temperatures plus corrections should be made to the thermometer readings (i.e. with the + sign) if the temperature is above zero, and the corrections should be deducted if the readings are below zero; on the other hand minus corrections (with the - sign) should be deducted from the thermometer readings if these are above zero and added to them if the thermometer readings are below zero. We can assume, for instance, that for any thermometer :

| With temperatures : | Corrections : |
|---|---|
| From 40.0° to 28.8° | + 0.2° |
| " 28.7° " 15.3° | + 0.1° |
| " 15.2° " 6.4° | 0.0° |
| " 6.3° " -1.2° | - 0.1° |
| " -1.1° " -5.0° | - 0.2° |

in this case the following true temperatures will correspond to the direct thermometer readings given below :

| Thermometer readings : | True temperatures : |
|---|---|
| 35.2° | + 35.4° |
| 23.7° | + 23.8° |
| 11.2° | + 11.2° |
| 0.2° | + 0.1° |
| 0.0° | - 0.1° |
| - 2.9° | - 3.1° |

17. **Recording of observations in Tables and calculation.** At the end of a day's observations, having corrected these the corrected readings are recorded in the observation Table on the line for the day in which the observations were made and in the column for the particular hour of observation. Observations made at odd times are not entered in the Tables

but appended separately to them.

Mean temperatures are calculated in the following manner : the temperatures recorded at three times (7 a.m., 1 p.m. and 9 p.m.) are added up for each day and the sum is divided by three. At the end of each month, all the figures for all the days in that month in which no observations were omitted are added up in each of the vertical columns individually, and the total obtained is divided by the number of these days. This gives what is called the monthly mean figures, calculated with an accuracy of up to a tenth. If in any of the appointed hours no observation was made, when the monthly means are calculated none of the observations on that day are included in the calculation.

18. Observations of water temperature at a depth. Our lightships and other vessels are equipped with overturning Negretti and Zambra thermometers in Ersch holders (Fig. 6). These thermometers ab (Fig. 7) differ from standard thermometers in that, in them, the tube is narrowed close to the reservoir and so bent that, if it is turned with the reservoir upwards, the entire column of mercury is separated from the reservoir at the point of narrowing (c) and drops to the bottom of the tube; the length of this column shows the temperature of the medium around the thermometer with the reservoir in the normal downward position. The tube is therefore calibrated with markings from its end to the reservoir so that readings can only be made with the thermometer overturned. The latest model of the Negretti and Zambra thermometer consists of two thermometers : the thermometer ab just described with the breaking column of mercury and the correction thermometer d, housed in a common tube of thick glass withstanding pressures of up to 3 tons. This latter thermometer shows the temperature of the instrument and makes it possible to correct the readings from the first thermometer, i.e. the thermometer with the column of mercury overturned in it. The tube containing the thermometers (or one thermometer) is in a metal holder (Fig. 6), constructed as follows in order to overturn the thermometer at the required

depth. The lower part of the cylindrical holder tube is hinged (p), and the top is held by the catch r. To release the thermometer for overturning, it is necessary to strike the part of the catch r projecting upwards. This is done by means of a weight lowered down the line ss' from which the thermometer is suspended.

To carry out observations the thermometer is firmly secured to a lead-line with a weight at its end; this keeps the line vertical, which is important for the weight to slide down it. For the same reason the line must be fine and smooth, and the depth markings must be made on it with special thread in the same way as the marks are made on running tackle; otherwise the weight is not free to travel down. The instrument is fixed to the line with screw clamps not less than 2 feet from the lead (so that the thermometer will not strike the lead when it is overturned). Five minutes after the thermometer has been lowered to the required depth in the sea, i.e. when the thermometer is showing the temperature of the water around it, the weight is lowered down the line, strikes the arm rr', and the thermometer overturns. The thermometer is taken out of the water and the reading taken and recorded in the log according to the rules set forth earlier. The scales of the Negretti and Zambra thermometers for depths are in half-degrees or fifths of a degree.

**19. Observation times and depths at which they should be made.** Observations of the water temperature at depths in the sea need only be made once a day, at one o'clock, at the same depths in each case, namely : at the surface, at 5 m (= 16 1/3 ft), 10 m (= 33 ft), 15 m (= 49 ft), 20 m (= 65 1/2 ft), 30 m (= 98 ft), etc. at every 10 m down to the bottom, where the temperature at the bottom is recorded 1/2-1 m (= 1.6-3.3 ft) above it. When observations are made at different depths they are always started at the top, i.e. the temperature at the surface is determined first, followed by the temperatures at greater and greater depths, ending with the temperature of the water at the bottom. If two or three thermometers of the design described are used, observations can be made simultaneously at two or three depths.

For this purpose the thermometers, with the weights in position, are secured at the appropriate distances one above the other on the one line and lowered into the water. When dropping the weight frees the upper thermometer and it overturns, another weight, fixed to its lower end (p), drops off the catch, travels down the line, and strikes the next thermometer down, which is also overturned; the weight from it has the same action on the next thermometer.

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Major J.H. Dixon, F.I.L. (Russ).

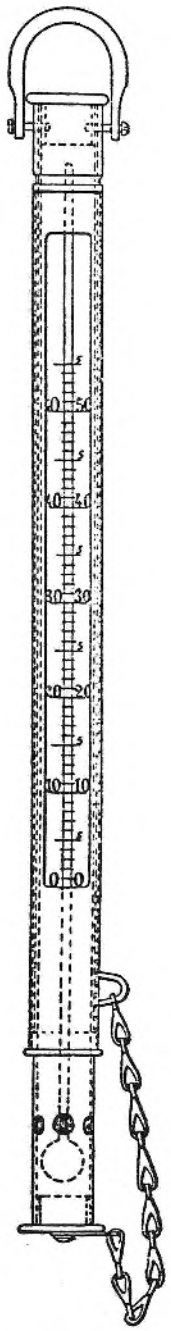


Fig. 2. Thermometer for measuring the water surface temperature. At the bottom on the chain is the sleeve which is opened after observations to let water out of the chamber. The interrupted lines show the position of the thermometer bulb in the metal holder.

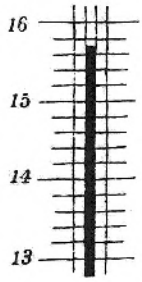



Fig. 3

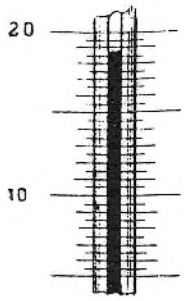



Fig. 4

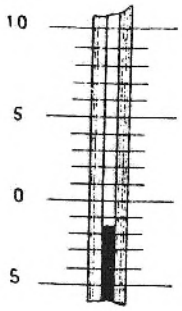
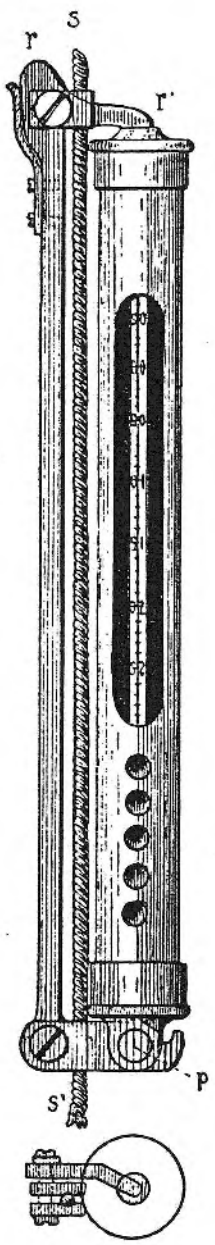



Fig. 5

Positions of the column of mercury against the different thermometer scales



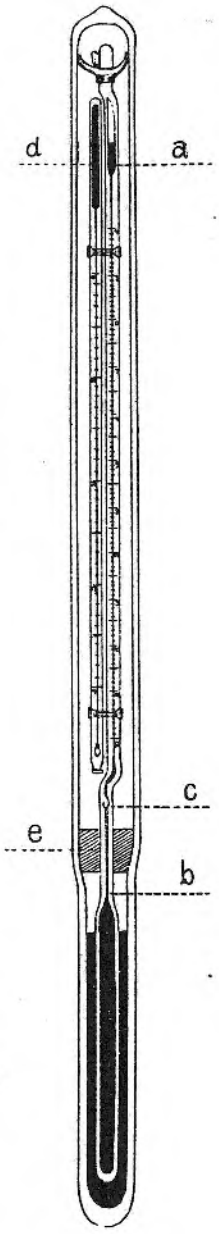




Fig. 6 Fig. 7

Fig. 6. General diagram of the Negretti and Zambra thermometer in its holder (single thermometer). Fig. 7. Negretti and Zambra thermometer itself, consisting of two thermometers : 1) ab, the main thermometer with a column which breaks when the thermometer is overturned, and 2) d, the correction thermometer.