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AN OPTICAL EVALUATING METHOD FOR THE FINNISH RADIOSONDE

by

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Through two decades the method of evaluating the results of observations obtained with the Finnish radiosonde has been practically unchanged [1, 2, 3]. A hyperbolic scale is used in the measuring of the recordings, resulting in calibration curves which are nearly straight lines for the pressure and temperature elements. The humidity calibration curve, too, was a straight line in the case of a hygrometer with natural hair when the so-called GAY-LUSSAC scale is used, but it becomes distinctly curved when the same scale is employed in connection with a Pernix hair. As a rule the evaluation of the recording with the aid of the hyperbolic scale is performed in two stages, the first part of the record being evaluated while the measurements are still in progress, whereas the second part is dealt with after termination of the ascent. In this way the measurements, the calculations based thereupon, and the temp message have been completed in about 2½ hours from the start of the balloon.

Quite recently TOMMILA [4] has presented a graphical method for the transferring of the results to the aerogram. This method is considerably superior in speed to the previous procedure, the evaluation of the recording being carried out continuously as the record appears in the course of ascent of the radiosonde. TOMMILA has designed a suitable type of radiosonde for this method, together with a special type of receiver.[1])

The author's objective was to devise a rapid evaluating method for the Finnish radiosonde which should be usable in connection with available equipment. Experiments carried out since 1952 at Ilmala Observatory

[1]) During the printing of this paper, VÄISÄLÄ has presented preliminary report concerning a device with the aid of which the recording is directly obtained on the aerogram.

resulted in the autumn of 1955 in the choice of an optical evaluating method. This method has been found practically useful in the tests which have been performed.

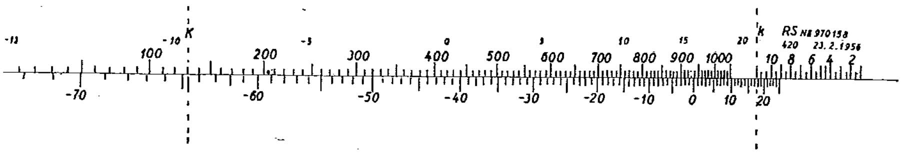

Fig. 1. P, T and U scales with fixed capacitors K and k for optical system.

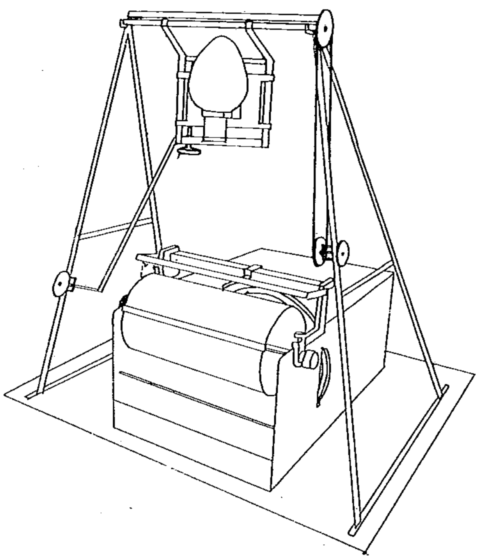

Fig. 2. The optical apparatus and receiver.

In the optical method, the results of calibration are read from a uniform scale. The pressure and temperature calibration curves will then be hyperbolas, and the humidity curve a straight line against the linear humidity scale, if the Pernix hair is used. From these calibration curves the pressure, temperature and humidity scales are plotted for each radiosonde; the points are arranged on both sides foa straight line, together with the readings of the fixed capacitors (Fig. 1). A lantern slide is prepared from the scales and projected directly onto the record with the aid of an optical system. The optical system has a strong source of light and it is attached above the recording cylinder (Fig. 2). Its controls permit the adjustment of the image in size and position so that the fixed condenser marks on the scale agree with the recording. The temperature and humidity at the time in question and the pressure corresponding to $+20°C$ barometer temperature can then be read immediately. The difference, in mb, of the $+20$ and $-60°$ C pressure calibrations has further been entered above the pressure scale, enabling the correction of the pressure reading for barometer temperature to be made.

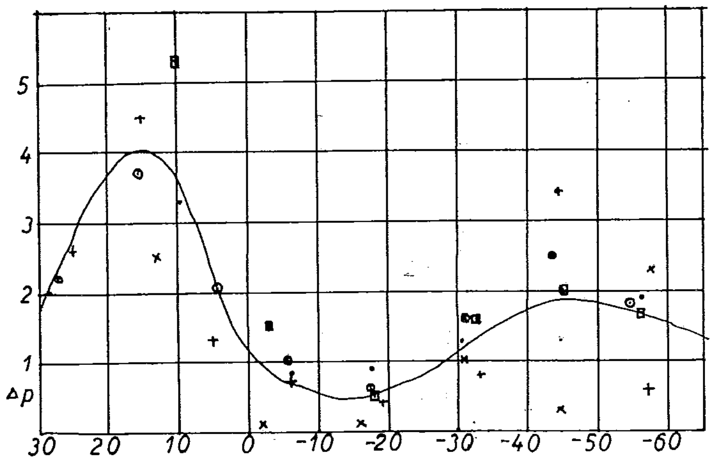

Fig. 3. The mean change of barometer reading with temperature.

In order to calculate the pressure on the basis of the pressure calibrations at two different temperatures, it is necessary to determine by means of experiments the change of the barometer reading with temperature. At Ilmala Observatory pressure readings have also been taken in connection with the temperature calibrations. In this way the average changes shown in fig. 3 were obtained as a result of five separate calibration runs (of altogether 35 radiosondes which are now in use). It is seen that the pressure change is greatest at temperatures above 0° C; below 0° C it is quite small at first, but larger again below $-40°$ C. Although some differences are observed between the different calibrations, it can be said that their mean gives a reliable representation of the influence of temperature upon the measurement of pressure with the Finnish radiosonde. On the basis of the above-mentioned results the corrections of the pressure reading can be calculated for any temperature from the difference between the calibrations at $+20$ and $-60°$ C. For instance, this can be done according to the graphical method illustrated by fig. 4, which is used at Ilmala Observatory. In the neighbourhood of 0° C this method, which takes into account the experimental results, produces the greatest deviations from the values found by linear interpolation.

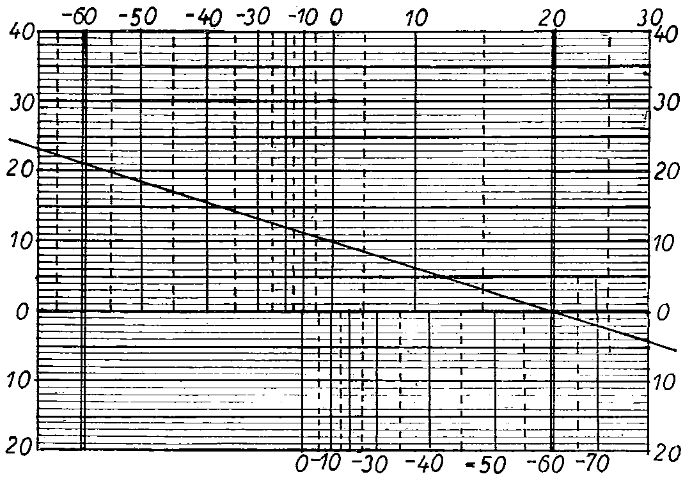

Fig. 4. A nomogram for interpolating the pressure values by means of pressure difference and observed temperature. (The plotted line represents a pressure differens of 21 mb thus, for instance, the temperature 10° C gives the pressure correction + 6 mb for + 20° C scale.)

With the aid of the optical evaluating method the measuring of a point chosen from the record can be performed a few minutes after it has been recorded. The person who does the evaluating has time enough further to plot the measured points in the aerogram, to trace the pressure vs. temperature, pressure vs. humidity and pressure vs. time curves, as well as to calculate the isobar levels. The PTU temp message can thus be dispatched almost immediately after the balloon has burst. If, for instance, the ascent has a duration of 1 h 15 min, between 1 and 1½ hours of working time are saved by the optical method. The method is quite easy to use, and the sounding staff learns to use it competently after 1—3 soundings.

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