PREFACE

The improvement of the tables for correction and reduction of barometer readings was taken up by the Norwegian Weather Service about ten years ago. Since then, several Norwegian meteorologists have been working at the theme. Many ideas have been brought forward, especially from *Birkeland*, *Bjørkdal*, *Petterssen* and *Amble*. *Winther Hansen* composed a first design for an instruction for calculation of the tables. Revision of this instruction was started by *Dahle;* and since the autumn 1942, the author has been occupied with the conclusion of this task. Director *Hesselberg* has all the time followed the work with interest, and has given much good advice. In this paper, advantage has been taken of the experience gained by the above mentioned investigations.

Recently the determination of the index errors for the barometers at the Norwegian barometer stations has been revised by *Russeltvedt* and *Evjen.* On the basis of these new values for the index errors, new barometer tables will soon be prepared for the Norwegian barometer stations. These tables will be prepared according to the methods developed in this paper.

LIST OF SYMBOLS

b barometer reading

p_s air pressure at the barometer station

p_o air pressure reduced to the mean sea level, or to any other level

$\triangle b = p_s - b$ barometer correction

$\triangle p = p_o - p_s$ reduction to the sea, or to any other level } in mb

c_t correction for temperature

c_g correction for gravity

c_i correction for index error

$\bar{b}$ annual mean of b

t_b reading of the attached thermometer in °C

t_s air temperature at the station, in °C

$T_s = 273 + t_s$, absolute air temperature at the station

t_m barometric mean temperature, in °C

ε_m virtual temperature increase, in °C

$T'_m = 273 + t_m + \varepsilon_m$, barometric mean of the absolute virtual temperature

τ quantity determining the intensity of temperature inversion, in °C

γ vertical temperature gradient, in °/m

H_b geometrical height of the barometer cistern, in metres

Φ_b dynamical height of the barometer cistern, in gdm

g_s acceleration of gravity at the station, in m/sec^2

$g_{45} = 9.8062$ m/sec^2, normal acceleration of gravity in latitude 45°

$\triangle g = g_s - g_{45}$

$R = 287.08$ m^2/sec^2 degree, gas constant for dry air

ON THE CORRECTION AND REDUCTION OF BAROMETER READINGS

BY

ARNT ELIASSEN

(Manuscript received 15th February 1943.)

CHAPTER I. THE THEORETIC FOUNDATION.

1. Correction of the barometer reading.

In the Norwegian weather service, the air pressure is measured by means of a mercury barometer with fixed, reduced scale. That the scale is reduced means that by the graduation of the scale, allowance is made for the variation in height of the mercury surface in the cistern. Thus the reading of the scale directly gives the difference in height between the surface of the mercury in the tube and the surface in the cistern.

To find the air pressure, the reading of the barometer must be corrected for variations in temperature and in gravity, and also for instrumental errors.

Correction for temperature. In order to neutralize the effect of expansion of the mercury and the scale with temperature, a correction term (c_t) must be applied, which is a function of barometer reading (b) and reading of the attached thermometer (t_b)[1]:

$$c_t = c_t(b, t_b) = -a(b) \cdot t_b \tag{1}$$

where:

$$a(b) = \begin{cases} 0.000163 \cdot (b + 49) \text{ for the Kew pattern barometer} \\ 0.000163 \cdot (b + 31) \text{ for the Fuess barometer.} \end{cases} \tag{2}$$

The values of the function $a(b)$ may be found from table I (page 19).

Correction for gravity. The scale is constructed for correct reading by normal acceleration of gravity in latitude 45° ($g_{45} = 9.8062$ m/sec²). If the acceleration of gravity at the station (g_s) differs from this value, a correction term (c_g) must be added. Putting $g_s - g_{45} = \triangle g$, and denoting by p_s the air pressure at the station, we have

$$c_g = \frac{\triangle g}{g_{45}} p_s .$$

In this formula we may, without any noticeable error, write b instead of p_s:

$$c_g = c_g(b) = \frac{\triangle g}{g_{45}} b. \tag{3}$$

The values of $\frac{\triangle g}{g_{45}}$ for the Norwegian barometer stations are computed by means of the formula

$$g_s = g_0 - 0.000002\, H_b ,$$

where g_0 is the acceleration of gravity at sea level. g_0 is taken from a chart of the quantity $\triangle g_0 = g_0 - g_{45}$, prepared by *Amble* on the basis of data procured from Norges Geografiske Opmåling in Oslo and from *Heiskanen* (Finland). This chart is reproduced in fig. 11 (page 17).

The correction for index error (c_i) may be regarded as a function of b:

$$c_i = c_i(b). \tag{4}$$

---

[1]) See *Irgens:* «Über die Temperaturreduktion des Gefässbarometers mit fester, reduzierter Skala». Met. Zeitschr. 45, 1928, p. 441.

This function must be determined empirically by comparison with a normal barometer, or a hypsometer.

The air pressure at the station. When b and t_b are observed, c_t, c_g and c_i may be computed by means of the formulae above. The air pressure at the station then is:

(5) $$p_s = b + \triangle b,$$

where:

(6) $$\triangle b = \triangle b\,(b, t_b) = c_t\,(b, t_b) + c_g\,(b) + c_i\,(b).$$

2. Reduction of the air pressure to mean sea level.

In order to compare the air pressure at different stations, the pressure must be reduced to the same level, in general to the mean sea level. For this purpose, we conceive an air column, stretching from the station to the level of the sea. Since this air column in general does not exist in reality, its properties must be defined in a serviceable way.

To this air column we apply the equation of vertical equilibrium:

$$-\frac{dp}{p} = \frac{gdz}{RT'} = \frac{10\,d\Phi}{RT'}.$$

Here p denotes the pressure, and T' the virtual temperature of the air; R is the gas constant for dry air, g the acceleration of gravity, z the geometrical heigth and Φ the dynamic height, measured in dynamic metres. Integrating along the air column from the sea level ($\Phi = 0$) to the station ($\Phi = \Phi_b$), we obtain:

$$ln\left(\frac{p_0}{p_s}\right) = \frac{10}{R}\int_0^{\Phi_b}\frac{d\Phi}{T'}.$$

Here p_s is the air pressure at the station, and p_0 the pressure reduced to the sea level. Introducing the barometric mean value of the virtual temperature, T'_m, defined by:

(7) $$\int_0^{\Phi_b}\frac{d\Phi}{T'} = \frac{\Phi_b}{T'_m},$$

we find:

(8) $$ln\left(\frac{p_0}{p_s}\right) = \frac{10\,\Phi_b}{RT'_m}, \text{ or } p_0 = p_s\,e^{\frac{10\,\Phi_b}{RT'_m}}.$$

Practically, the reduction of air pressure is performed by adding a quantity $\triangle p$:

(9) $$p_0 = p_s + \triangle p.$$

From equation (8) we find:

(10) $$\triangle p = p_0 - p_s = p_s\left(e^{\frac{10\Phi_b}{RT'_m}} - 1\right).$$

This formula may be replaced by a simpler one. Consider the following expansion:

$$e^x - 1 - \frac{1}{\frac{1}{x} - \frac{1}{2}} = -\frac{x^3}{12} - \frac{x^4}{12}\cdots\cdot$$

The series on the right-hand side converges when $x| < 2$, and when $|x|$ is considerably smaller than 1, the sum of the series will not differ very much from the first term $-\frac{x^3}{12}$. Thus, when $|x|$ is small, the function $(e^x - 1)$ may be replaced by $\frac{1}{\frac{1}{x} - \frac{1}{2}}$; the error is approximately equal to $-\frac{x^3}{12}$. If $\frac{10\,\Phi_b}{RT'_m}$ is small, this may be applied to the formula (10), which may then be written:

(11) $$\triangle p = \frac{p_s}{\frac{RT'_m}{10\,\Phi_b} - \frac{1}{2}}.$$

The error thus involved is approximately equal to:

$$-\frac{p_s}{12}\left(\frac{10\,\Phi_b}{RT'_m}\right)^3.$$

In Norway, the air pressure is reduced only for heights less than 650 gdm. Hence, the exponent $\frac{10\,\Phi_b}{RT'_m}$ does not exceed 0.1, and since $p_s \approx 1000$ mb, the error will for the highest stations be of the order of magnitude 0.1 mb, and for lower stations considerably smaller. This error is of no importance, and the formula (11) may therefore always be used instead of (10).

The mean temperature T'_m, which is defined by equation (7), is seen to depend on the distribution of temperature and humidity in our imaginary air column. As we shall see later, T'_m will be considered as a function of the air temperature at the station, t_s:

$$T'_m = T'_m\,(t_s).$$

Equation (11) may then be written:

(12) $$\triangle p = \triangle p\,(p_s, t_s) = p_s \cdot f\,(t_s),$$

where:

(13) $$f\,(t_s) = \frac{1}{\frac{RT'_m}{10\,\Phi_b} - \frac{1}{2}}.$$

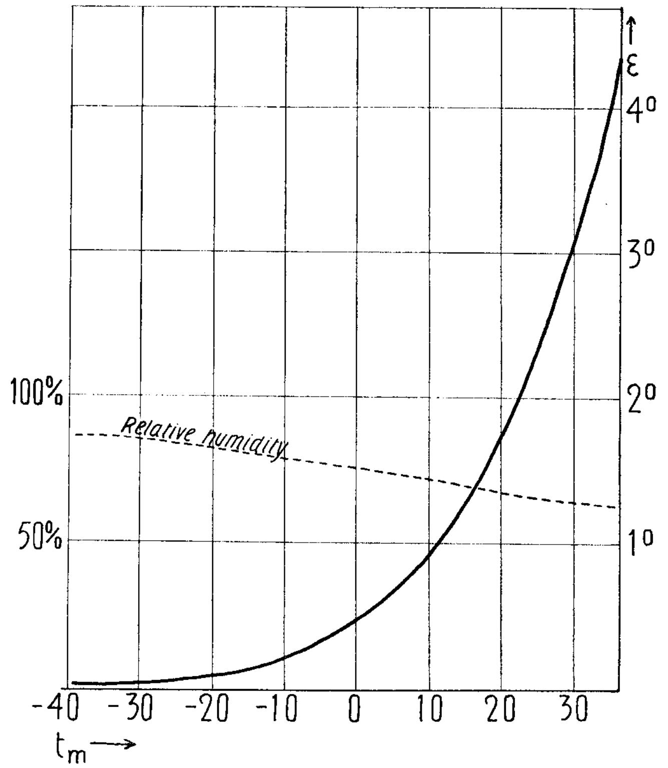


Fig. 1.

For T'_m we write

(14) $$T'_m = 273.00 + t_m + \varepsilon_m,$$

where t_m is the barometric mean temperature in °C, and ε_m the mean virtual increase of the temperature. For simplicity, ε_m is assumed to depend on t_m only, corresponding to certain reasonable values of the relative humidity. In fig. 1, ε_m is represented graphically as a function of t_m; the corresponding values of the relative humidity, which are also presented in the diagram, have been taken from *Birkeland*'s tables of the mean relative humidity in Norway[1]).

With sufficient accuracy, we may for t_m assume the expression:

(15) $$t_m = \frac{1}{H_b}\int_0^{H_b} t\,dz.$$

In the following we shall discuss different suppositions concerning the temperature distribution, which leads to different expressions for t_m.

1. Constant temperature gradient. If the temperature gradient γ of the air is constant, the temperature at the lower end of the air column is $t_s + \gamma H_b$, and the formula (15) gives:

(16) $$t_m = t_s + \tfrac{1}{2}\gamma H_b.$$

This method, with $\gamma = 0.005$ °/m, is recommanded in the international conventions for reduction of air pressure. Other methods, however, which may give better results, are also allowable, provided that the method is published.

According to *Birkeland* and *Føyn*[1]), the value $\gamma = 0.006$ °/m is the most appropriate in Norway. This value is therefore applied in the Norwegian Weather Service.

2. Irgens' method. According to *Irgens*, the temperature gradient in the air column is determined by means of the mean difference between the temperature at the station (t_s) and the temperature (t_B) at a basis station in the neighbourhood, which lies near the level of the sea. The temperature at the basis station ought to be as representative as possible. In a Cartesian coordinate system, we mark out points with abscissae t_s and ordinates $\frac{1}{2}(t_s + t_B)$ for several values of the temperatures (mean values may also be used). Between the points thus determined, a smooth curve is drawn, which deviates as little as possible from the points. This curve is taken to define t_m as a function of t_s.

As long as the temperature is not too low, both these methods give satisfactory results. But at very low temperatures, both methods give absurdly high values for the reduced pressure. This is distinctly seen from the maps of the monthly mean pressure at the sea level; on these maps, powerful anticyclones occur over the high regions of the country. The reason is, that the low temperatures generally correspond to temperature inversions near the ground, so that the temperature at the station is not representative. In fig. 2, such a temperature curve is schematically drawn in a diagram with temperature and height as coordinates. The point S represents the barometer station. If in this case the method with constant temperature gradient is applied, a very cold air column is obtained, corresponding to the stippled line SA in the diagram. Thus the reduced pressure becomes very high.

The stippled line SB represents the tempera-

[1]) *B. J. Birkeland:* Mittel und Extreme der Luftfeuchtigkeit in Norwegen. Not yet published.

[1]) *Köppen-Geiger:* Handbuch der Klimatologie, Klima von Nordwesteuropa, s. 93.

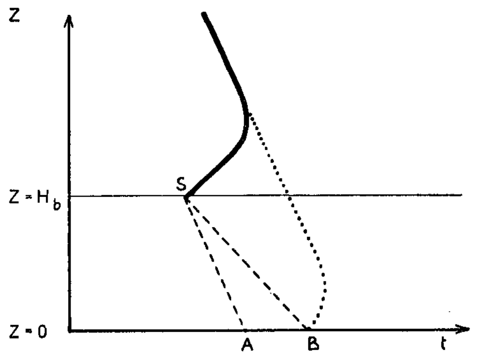


Fig. 2.

ture curve in the air column when *Irgens*' method is used; the point B is the basis station, and the dotted line is the temperature curve at this station. If the temperature inversion at the basis station is relatively small, *Irgens*' method will give a warmer air column and consequently a better pressure reduction than the first method. But even *Irgens*' method gives to high pressure at low temperatures.

Third method. In order to find a more reasonable method for reduction of air pressure, we shall apply the following principle: *If we imagine the country lowered so much, that the station were lying at the sea level, the distribution of the temperature, then considered most probable, should be used in order to calculate the pressure reduction.*

In fig. 3 a, the heavy drawn curve represents the temperature curve at the station (S). If the station had lain at sea level, the temperature curve had probably been much as the stippled curve CDE. To find the pressure which in that case would have been observed at the sea level, the pressure must be reduced from C to E along the curve CDE in fig. 3 a. We may, however, apply the curve $CSDF$ in fig. 3 b as well, because these two curves have the same barometric mean temperature. That is to say, the imaginary air column is assumed to have a temperature distribution corresponding to the stippled curve DF in fig 3 b. Denoting by τ the temperature difference between the points D and S, and assuming the temperature gradient (γ) of the curve DF to be constant, we obtain:

$$t_m = t_s + \tau + \tfrac{1}{2}\gamma H_b. \tag{17}$$

The quantity τ should be determined from the ascent curve at the station. But since this is practically impossible, we have to use average values for τ. For high temperatures, τ is equal to zero, and equation (17) is reduced to (16). The lower the temperature, the greater will generally be τ; we shall therefore consider τ as a function of the temperature at the station (t_s). In fig. 4, τ is represented graphically as a function of t_s. The diagram is drawn on the basis of ascent curves from Kjeller, and will probably be appropriate for continental stations which are lying in a relatively plain country.

Fig. 5 a shows a map of the monthly mean pressure, reduced to the sea level, computed by means of the first method; fig. 5 b shows a similar map, where the third method is applied. In fig. 5 a, the isobars have a rather perturbed course; especially, the great gradient between the stations Dombås (D in the diagram) and Tafjord (T) is very unreasonable. (Dombås lies at 635.5 gdm. above the sea, and Tafjord at 27.6 gdm.)

In fig. 5 b, on the other hand, the isobars have a much more smooth course, and the perturbations rising from the shape of the country seem to be nearly neutralized. Thus it seems that in Norway, where

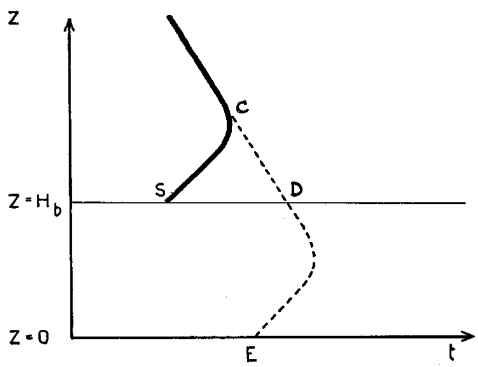


Fig. 3 a.

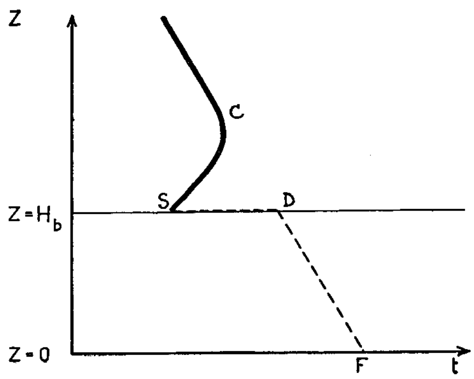


Fig. 3 b.

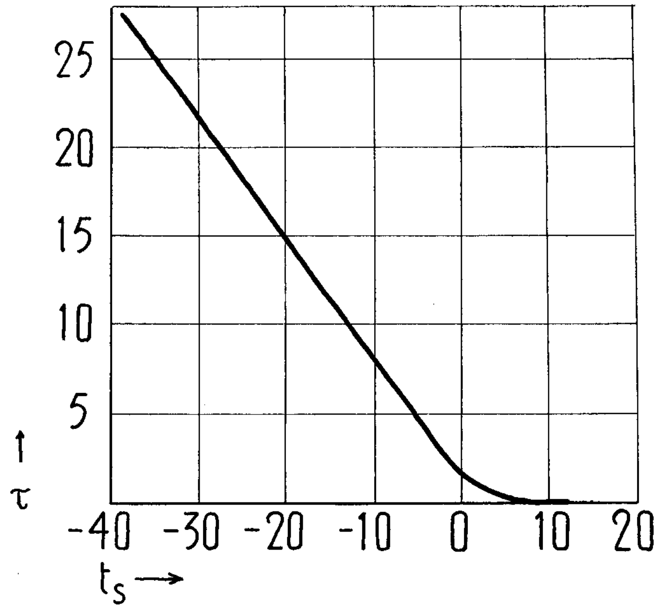


Fig. 4.

several barometer stations are lying at considerable height, the third method is the most serviceable.

If we study the map in fig. 5 b more minutely, we shall see that even the third method does not give quite satisfactory results for all stations. The pressure at Kutjern (K), for instance, seems to be too low, and the pressure at Nesbyen (N) too high. The reason is, that the country near these stations is not plain; Kutjern lies on a hill, with lower country around, and Nesbyen lies in a valley. The inversion at Kutjern is thus generally less, and at Nesbyen greater than the average inversion at Kjeller. Thus the values of τ, given in the diagram fig. 4 will not be representative for the stations Kutjern and Nesbyen.

Disturbances originating in this way from the shape of the country may be eliminated, as a principle, by reducing the pressure by means of the

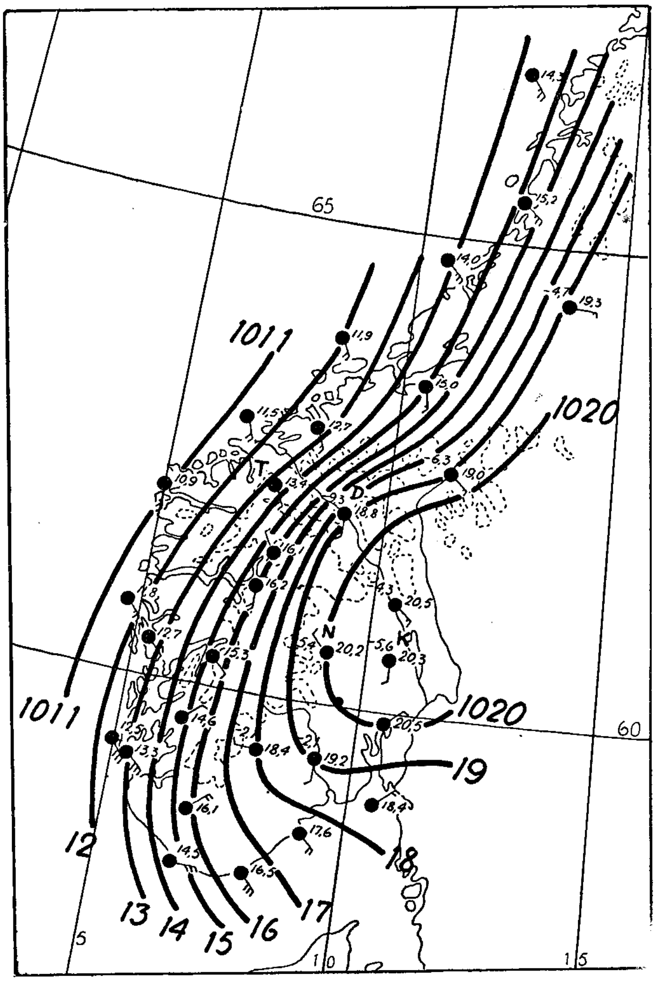


Fig. 5 a. Monthly mean values of p_0 for december 1938, computed by means of the first method.

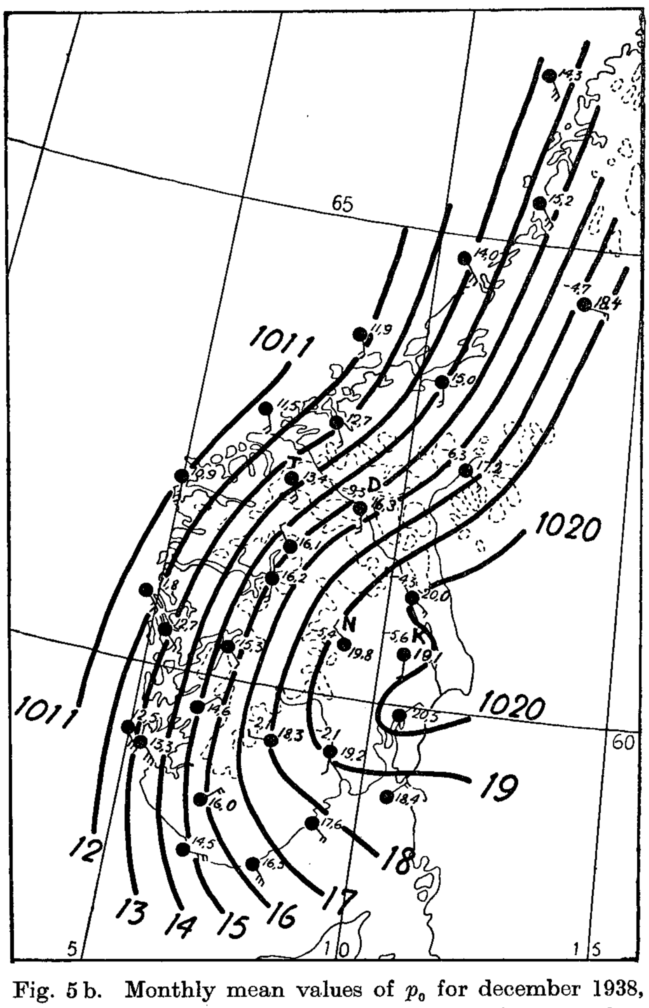


Fig. 5 b. Monthly mean values of p_0 for december 1938, computed by means of the first method for coastal stations, and the third method for inland stations.

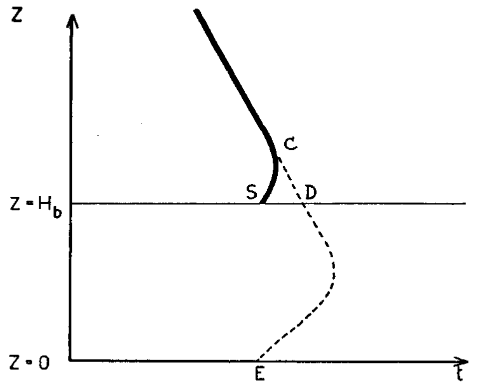


Fig. 6 a.

temperature curve which had been observed if the station had lain *on a plain* at the sea level.

In fig. 6 a the heavy drawn line represents the temperature curve at a station with a temperature inversion which is less than the average inversion above plain country. The stippled line represents the curve above plain country at sea level. According to what is said above, we must first determine the pressure in the point *C*, and then reduce this pressure to sea level by means of the curve *CDE*. That is to say, the pressure at the station *S* should be reduced to sea level by means of the curve *SCDE*. Similarly, fig. 6 b represents a temperature curve at a station with a very great temperature inversion. As in fig. 6 a, the reduction should be performed by means of the curve *SCDE*.

To enable us to use this method in practice, the mean temperature t_m of the curve *SCDE* must be determined as a function of the temperature at the station (t_s). This must be done separately for each station by means of ascent curves at the stations. For the present, however, we are unable to do this, because we do not possess enough of ascent curves for this purpose. Until the necessary ascent curves are procured, we may, for stations lying on a hill or in a valley use the following method, originating from *Grytøyr*.

Forth method. On several weather charts or charts of the monthly mean pressure at the sea level, we determine p_0 for the station in question by interpolation. In a coordinate system with t_s as abscissa, we mark out points with the ordinates $\frac{p_0 - p_s}{p_s} = \frac{\triangle p}{p_s}$. Between these points we draw a smooth curve, such that the deviation from the points is as small as possible. This curve is taken to define the function $f(t_s)$, corresponding to equation (12). This method should be used only for low temperatures. For high temperatures $(t_s > 10°)$, we use the first method, which then gives satisfactory results.

In the preceding, four methods for the determination of the function $f(t_s)$ have been described. Which of these methods is the most serviceable, depends on the site of the station in question. For stations on the coast, the first method should be used. For inland stations, the third method should be used if the temperature inversion at the station on the average does not deviate too much from the inversion at Kjeller; otherwise, the fourth method should be applied.

New reduction tables will soon be prepared for the Norwegian barometer stations, and these methods will then be tried in practice. Until necessary experience has been gained, however, the methods cannot be entirely judged.

The formulae developed above for reduction of the pressure to the sea level may also be used for reduction to any other level. Φ_b is then the dynamic height difference between the station and this level, reckoned positive by reduction to a lower, and negative by reduction to a higher level.

3. Differential formulae.

For the calculation of the tables it may be of interest to know the variation of $\triangle b$ and $\triangle p$ which corresponds to a certain increase in b, t_b, p_s and t_s. Differentiating equation (6), and utilizing the equations (1) and (3), we obtain:

$$(18) \qquad \delta \triangle b = \left(\frac{\triangle g}{g_{45}} + \frac{dc_i}{db} - \frac{da}{db}\, t_b\right) \delta b - a(b)\, \delta t_b .$$

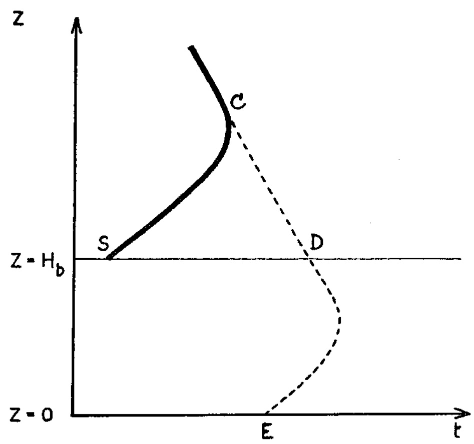


Fig. 6 b.

The values of $a(b)$ is seen from equation (2) to be about 0.17 mb/degree. As a maximum value we can take the figure 0.18 mb/degree. For most barometer stations in Norway, $\frac{\triangle g}{g_{45}}$ is less than 0.002, and the quantity $\frac{dc_i}{db}$ will generally not exceed 0.002. Since $\frac{da}{db} = 0.000163$ (according to equation (2)), the expression $\left|\frac{\triangle g}{g_{45}} + \frac{dc_i}{db} - \frac{da}{db} t_b\right|$ has the maximum value 0.005 (when $t_b > -6°$). Hence we may write

$$(19) \qquad \frac{\partial \triangle b}{\partial b} < 0.005, \quad -\frac{\partial \triangle b}{\partial t_b} < 0.18 \text{ mb/degree}.$$

For some stations, however, the quantity $\frac{dc_i}{db}$ is considerably greater than 0.002 (up to 0.04); for such stations, $\frac{\partial \triangle b}{\partial b}$ will exceed the value given in (19).

Writing as a rough approximation:

$$f(t_s) \approx \frac{10\,\Phi_b}{RT_s} = \frac{10\,\Phi_b}{R\,(273 + t_s)},$$

we find by differentiating equation (12):

$$(20) \qquad \delta \triangle p = \frac{10\,\Phi_b}{RT_s}\,\delta p_s - \frac{10\,\Phi_b}{RT_s}\frac{p_s}{T_s}\,\delta t_s.$$

If we adopt the values $T_s = 265°$, $p_s = 1000$ mb, we obtain:

$$(20') \qquad \delta \triangle p = \frac{\Phi_b}{8000}\,\delta p_s - \frac{\Phi_b}{2000}\,\delta t_s,$$

a formula which may be used when no great accuracy is needed.

CHAPTER II. CALCULATION OF TABLES.

4. The different tables.

By international convention, the weather telegrams shall contain p_0 for all stations where Φ_b is less than 600 gdm, and p_s for stations where Φ_b is greater than this figure.[1] The yearly reports shall contain the monthly means of p_s (except for stations below 30 metres above sea level), and the monthly means of the pressure reduced to the nearest standard level (sea level, 1000 gdm, 2000 gdm and so on).[2]

[1] Instructions and Explanations for the International Codes for Synoptic Weather Reports. Secrétariat de l'Organisation météorologique internationale, No. 9, Fascicule I. Leyde 1936, p. 93—94.

[2] Conference des directeurs à Varsovie, 6—13 septembre 1935. Secrétariat de l'Organisation météorologique internationale, No. 29, Tome I. Leyde 1936, p. 40—41.

In Norway, exceptions are made from these rules in the case of the stations Dombås and Røros; the pressure at these stations is reduced to the sea level, although they lie higher than 600 gdm above the sea.

Tables are needed both at the barometer stations which send weather telegrams, and at the Meteorological Institute in Oslo. The tables at the stations are to be used in composing the weather telegrams, and are computed with one decimal. These tables must be especially simple in use; thus interpolation, for instance, should be avoided. The tables at the Meteorological Institute are mostly applied to mean values of the pressure. Since by the calculation of mean values two decimals are applied, these tables must be computed with two decimals. These tables need not, however, be so simple in use; thus they may, for instance, be given in a graphical form.

To meet these different claims, two sets of tables must be prepared, one to be used at the stations, and the other to be used at the Meteorological Institute. The following tables are used:

A. Barometer correction tables.
   1. Correction tables, for all barometer stations, to be used at the Meteorological Institute.
   2. Correction tables for the barometer stations which send weather telegrams, and which are lying higher than 600 gdm above the sea (except Dombås and Røros), to be used at the station.

B. Diagram for reduction of air pressure, for all stations, to be used at the Meteorological Institute.

C. Combined table for correction of the barometer reading and reduction of the air pressure to sea level, for the barometer stations which send weather telegrams, and which are lying below 600 gdm above the sea (and also Dombås and Røros), to be used at the stations.

As arguments in the tables b, p_s, t_b and t_s occur. The tables should be calculated for the following ranges of these arguments:

For b and p_s from $\bar{b} - 65$ mb to $\bar{b} + 45$ mb ($\bar{b}$ is the annual mean value of the barometer reading, rounded to the nearest 0 or 5 mb).

For t_b from $-10°$ (for some stations from $-15°$) to $+30°$.

For t_s between the lowest and the highest temperature measured at the station.

The values of the constants used in calculating the table must be given on the table, and likewise, the date when the table was put into use. In fig. 7, 8, 9 and 10 (page 15—18) examples are given of the different tables. It is seen that in the tables which are to be used at the stations, the intervals for the arguments are given, instead of the values having been used in calculating the tables.

5. The calculation of the tables.

A. Barometer correction tables.

These tables shall give the value of $\triangle b$, with b and t_b as arguments. The tables are calculated according to equation (6), which by means of (1) may be written:

$$\triangle b = c_g(b) + c_i(b) - a(b) t_b. \tag{21}$$

Firstly, we compute the function $[c_g(b) + c_i(b)]$ with two decimals for the values of b which are needed. The function $a(b)$ is given in table I (page 19). From equation (21), the table for $\triangle b$ is then easily computed by means of a calculating machine.

Barometer correction table to be used at the Meteorological Institute (fig. 7).

To facilitate the interpolation, the table is computed for every 10th mb of b, so that b ends with either 0 or 5 mb. As the table is to be used for mean values as well as single values of b, it must be calculated with two decimals. But since the monthly mean values of b does not deviate very much from $\bar{b}$, it is sufficient to compute $\triangle b$ with two decimals only in the medium part of the table (from $\bar{b} - 20$ mb to $\bar{b} + 20$ mb); the rest of the table is calculated with one decimal only. At the foot of the main table, is given an interpolation table for tenth parts of t_b, consisting of the following figures:

$$a(\bar{b}) \cdot 0.1, \quad a(\bar{b}) \cdot 0.2, \ldots . \, a(\bar{b}) \cdot 0.9, \quad a(\bar{b}) \cdot 1.0.$$

Barometer correction table to be used at the station (fig. 8).

This table is computed with one decimal. To avoid interpolation, the jump in $\triangle b$ shall not be greater than 0.1 mb. According to (19), this is attained, for the most stations, by choosing 20 mb as interval for b, and 0.5° as interval for t_b in the table.

B. Diagram for reduction of air pressure (fig. 9).

$\triangle p$ can be computed by means of equation (12), when p_s and t_s are known. This is most easily done graphically. There are more methods to represent $\triangle p$ graphically as a function of p_s and t_s; but according to *Koschmieder*[1]), the simplest method is the following, which therefore will be applied here: In a Cartesian coordinate system with p_s as abscissa and $\triangle p$ as ordinate, curves are drawn for $t_s =$ constant. From equation (12) it is seen that these curves are always straight lines. It is thus sufficient to calculate two points on every line. For stations where $\Phi_b > 20$ gdm, the lines $t_s =$ constant are drawn for every degree of t_s; for stations where $\Phi_b < 20$ gdm, it is sufficient to draw lines for every fifth degree of t_s. For these values of t_s, the function $f(t_s)$ must be computed, as described in chapter I. When $f(t_s)$ is computed, the diagram is easily calculated according to equation (12). The scale for p_s ought to be: 1 mb = 1 mm. For $\triangle p$, the scale should be chosen according to the following table:

Φ_b	0—75	75—150	150—300	> 300gdm
1 mb =	10	5	2	1 cm

C. Combined table for correction of the barometer reading and reduction of the air pressure to mean sea level.

For the major part of the Norwegian barometer stations, the correction of the barometer reading and the reduction to sea level has till now been effected in the following way: For stations above 20 metres, two tables have been used, the one containing $\triangle b$, with b and t_b as arguments, and the other containing $\triangle p$, with b and t_s as arguments. For stations below 20 metres, one single table, containing $\triangle b + \triangle p$, with b and t_b as arguments has been used, whereas the influence of t_s has been neglected; this is in agreement with the international rules for reduction of air pressure.[2])

[1]) H. *Koschmieder:* Dynamische Meteorologie, 2. Auflage page 35.

[2]) See page 11, loc, cit.

The neglection of the influence of t_s for stations up to 20 metres, however, leads to an error which may in many cases amount to 0.3 millibars (the error may approximately be written $\frac{\Phi_b}{2000}(t_s - \bar{t}_s)$ where $\bar{t}_s$ is the annual mean of t_s). This lack as shown by *Vedø* could be corrected by addition of a special table with t_s as argument, and this idea was later taken up by *Christensen* and *K. Dahle;* they showed that for all stations, the expression $\triangle b + \triangle p$ may approximately be written in the form $\varphi(b, t_b) + \psi(t_s)$, so that the reduction may be performed by means of two tables, one of which has one argument only.

In the sequel, it will be shown that the expression $\triangle b + \triangle p$, with sufficient accuracy, may be written in the form $\alpha(t_b) + \beta(b, t_s)$; this leads to a form of the tables which is probably the most advantageous.

According to the equations (5) and (9), we have

$$p_0 - b = \triangle b + \triangle p = \triangle b\left(1 + \frac{\triangle p}{p_s}\right) + \triangle p\left(1 - \frac{\triangle b}{p_s}\right)$$
$$= \triangle b \frac{p_0}{p_s} + \triangle p \frac{b}{p_s}.$$

Substituting for $\triangle b$ the expression (21), we obtain:

$$(22) \quad p_0 - b = -\frac{a(b)}{p_s} p_0 t_b + (c_g + c_i)\frac{p_0}{p_s} + b\frac{\triangle p}{p_s}.$$

Let $\bar{p}_0$ and $\bar{t}_b$ be two constants, corresponding to average values of p_0 and t_b, and being the same for all stations in question. By means of the identity

$$p_0 t_b = (p_0 - \bar{p}_0)(t_b - \bar{t}_b) + \bar{p}_0(t_b - \bar{t}_b) + p_0 \bar{t}_b,$$

equation (22) may be written

$$(23) \quad p_0 - b = -\frac{a(b)}{p_s}(p_0 - \bar{p}_0)(t_b - \bar{t}_b)$$
$$-\frac{a(b)}{p_s}\bar{p}_0(t_b - \bar{t}_b) + (c_g + c_i - a(b)\bar{t}_b)\frac{p_0}{p_s} + b\frac{\triangle p}{p_s}.$$

The first term on the right-hand side of this equation is approximately equal to

$$-0.00017\,(p_0 - \bar{p}_0)(t_b - \bar{t}_b).$$

When $|p_0 - \bar{p}_0|$ and $|t_b - \bar{t}_b|$ are both very great, this expression may amount to 0.2 millibars, but this happens very seldom. In the great majority of cases, the expression is less than 0.05 millibars. We are therefore justified in neglecting this term.

In the second term on the right-hand side of equation (23), the factor $\frac{a(b)}{p_s}$ may, with a slight approximation, be replaced by a constant, since $a(b)$ and p_s are both approximately proportional to b. Thus we may write:

$$(24) \quad \frac{a(b)}{p_s}\bar{p}_0 = c = \text{constant}.$$

With these approximations, equation (23) takes the form

$$p_0 - b = -c(t_b - \bar{t}_b) + \triangle b(b, \bar{t}_b)\frac{p_0}{p_s} + b\frac{\triangle p}{p_s}.$$

But according to equation (12), we have

$$\frac{\triangle p}{p_s} = f(t_s),$$

and consequently

$$\frac{p_0}{p_s} = 1 + f(t_s).$$

Hence, we obtain the formula

$$(25) \quad p_0 - b = -c(t_b - \bar{t}_b) + \triangle b(b, \bar{t}_b) + (b + \triangle b(b, \bar{t}_b)) \cdot f(t_s).$$

Introducing the functions

$$(26) \quad \alpha(t_b) = c(\bar{t}_b - t_b) + k,$$

$$(27) \quad \beta(b, t_s) = \triangle b(b, \bar{t}_b) - k + (b + \triangle b(b, \bar{t}_b)) \cdot f(t_s),$$

where k is a constant which will later be determined, we have

$$(28) \quad p_0 = b + \alpha(t_b) + \beta(b, t_s).$$

Thus p_0 may be determined by means of tables of the functions α and β.

As appropriate values for the Norwegian barometer stations, we choose

$$(29) \quad \bar{p}_0 = 1012 \text{ mb}, \ \bar{t}_b = 10\ °\text{C}.$$

Putting $p_s \approx b$, we have for the Kew pattern barometer according to equation (2):

$$\frac{a(b)}{p_s} \approx \frac{0.000163\,(b + 49)}{b} \approx 0.000163\left(1 + \frac{49}{1000}\right).$$

For Fuess barometers the figure 49 is to be replaced by 31. Thus we obtain for the constant c of equation (24) the value:

$$(30) \quad c = \bar{p}_0\frac{a(b)}{p_s} = \begin{cases} 0.173 & \text{for the Kew pattern barometer,} \\ 0.170 & \text{for the Fuess barometer.} \end{cases}$$

The constant k in the expressions (26) and (27) is added in order to avoid negative values of a in the table. This is attained by choosing k such that $a\,(30) = 0$, because 30° is the highest value of t_b in the table. This gives

$$k = c\,(30 - \bar{t}_b) = 20\,c,$$

or

$$(31)\quad k = \begin{cases} 3.46 \text{ mb for the Kew pattern barometer,} \\ 3.40 \text{ mb for the Fuess barometer.} \end{cases}$$

The expression (26) for $a\,(t_b)$ then becomes

$$(32)\qquad a\,(t_b) = c\,(30 - t_b).$$

We see that this function is the same for all stations with the same type of barometer, and therefore, this function may be tabulated once for all. A table of $a\,(t_b)$ for Kew pattern barometers as well as Fuess barometers, is given in Table II page 20.

The function $\beta\,(b, t_s)$ must be calculated separately for every station. This is most easily done in the following way: First, tabulate the function $\triangle b\,(b. \bar{t}_b)$ by means of the formula

$$(33)\qquad \triangle b\,(b, \bar{t}_b) = c_g\,(b) + c_i\,(b) - 10\,a\,(b).$$

Then, tabulate the functions $[\triangle b\,(b, \bar{t}_b) - k]$, $[b + \triangle b\,(b, \bar{t}_b)]$ and $f\,(t_s)$ for the values of b and t_s which are needed. $\beta\,(b, t_s)$ is now easily computed from equation (27) by means of a calculating machine.

From equation (27), we deduce with a rough approximation:

$$(34)\qquad \begin{cases} \dfrac{\partial \beta}{\partial b} = \dfrac{\triangle g}{g_{45}} - 0.0016 + \dfrac{dc_i}{db} + \dfrac{\Phi_b}{8000}, \\ \dfrac{\partial \beta}{\partial t_s} = \dfrac{\Phi_b}{2000} \end{cases}$$

These formulae are useful for the determination of the intervals (δb and δt_s) of b and t_s in the table. These intervals ought to be chosen such that the jumps of β in the table do not exceed 0.1 millibar, i. e.:

$$\delta b \leqq \frac{0.1}{\left|\dfrac{\partial \beta}{\partial b}\right|} \qquad \delta t_s \leqq \frac{0.1}{\left|\dfrac{\partial \beta}{\partial t_s}\right|}.$$

This would, however, involve that the dimension of the table would be unreasonably great for stations lying at high levels. To avoid this, we prefer to desist from such great accuracy and permit the jumps of β in the table to amount to 0.2 millibars, and even more for the highest stations. For the majority of the Norwegian barometer stations, the quantity $\dfrac{\triangle g}{g_{45}}$ lies between 0.0012 and 0.0020, and for many of the stations, the quantity $\dfrac{dc_i}{db}$ is very small. For these stations, we may write approximately

$$\frac{\partial \beta}{\partial b} = \frac{\Phi_b}{8000},$$

and the following choise of intervals will then be to the purpose:

$\Phi_b =$	0—10	10—25	25—50	50—120	> 120 gdm
$\delta b =$	20	20	10	10	5 mb
$\delta t_s =$	20	10	5	2	1 °C

The method described above for determination of p_0 by means of tables of a and β has the following advantages:

(i) The tables are simple to use, because one of them has only one argument;
(ii) the dimensions of the tables become small;
(iii) the table of $a\,(t_b)$ may be calculated once for all.

Barometer correction table

(Table of $\triangle b = c_g + c_i + c_t$)

Barometer: *Adie C 850.* Station: *Oslo (Blindern)*

$$\frac{\triangle g}{g_{45}} = 1.33 \cdot 10^{-3}$$

c_i	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	c_i
t_b \ b	940	950	960	970	980	990	1000	1010	1020	1030	1040	b \ t_b
30	-3.2	-3.2	-3.3	-3.3	-3.33	-3.36	-3.40	-3.44	-3.47	-3.5	-3.5	30
29	-3.0	-3.1	-3.1	-3.1	-3.16	-3.19	-3.23	-3.27	-3.29	-3.3	-3.4	29
28	-2.9	-2.9	-2.9	-3.0	-3.00	-3.02	-3.06	-3.09	-3.12	-3.2	-3.2	28
27	-2.7	-2.7	-2.8	-2.8	-2.83	-2.85	-2.89	-2.92	-2.94	-3.0	-3.0	27
26	-2.5	-2.6	-2.6	-2.6	-2.66	-2.68	-2.72	-2.75	-2.77	-2.8	-2.8	26
25	-2.4	-2.4	-2.4	-2.5	-2.49	-2.51	-2.54	-2.57	-2.60	-2.6	-2.7	25
24	-2.2	-2.2	-2.3	-2.3	-2.32	-2.35	-2.37	-2.40	-2.42	-2.5	-2.5	24
23	-2.1	-2.1	-2.1	-2.1	-2.16	-2.18	-2.20	-2.23	-2.25	-2.3	-2.3	23
22	-1.9	-1.9	-1.9	-2.0	-1.99	-2.01	-2.03	-2.06	-2.08	-2.1	-2.1	22
21	-1.7	-1.8	-1.8	-1.8	-1.82	-1.84	-1.86	-1.88	-1.90	-1.9	-1.9	21
20	-1.6	-1.6	-1.6	-1.6	-1.65	-1.67	-1.69	-1.71	-1.72	-1.7	-1.8	20
19	-1.4	-1.4	-1.5	-1.5	-1.49	-1.50	-1.52	-1.54	-1.55	-1.6	-1.6	19
18	-1.3	-1.3	-1.3	-1.3	-1.32	-1.33	-1.35	-1.37	-1.38	-1.4	-1.4	18
17	-1.1	-1.1	-1.1	-1.1	-1.15	-1.16	-1.18	-1.19	-1.20	-1.2	-1.2	17
16	-0.9	-0.9	-1.0	-1.0	-0.98	-0.99	-1.01	-1.02	-1.03	-1.0	-1.1	16
15	-0.8	-0.8	-0.8	-0.8	-0.81	-0.82	-0.83	-0.85	-0.86	-0.9	-0.9	15
14	-0.6	-0.6	-0.6	-0.6	-0.64	-0.65	-0.66	-0.68	-0.69	-0.7	-0.7	14
13	-0.4	-0.5	-0.5	-0.5	-0.48	-0.48	-0.49	-0.50	-0.50	-0.5	-0.5	13
12	-0.3	-0.3	-0.3	-0.3	-0.31	-0.31	-0.32	-0.33	-0.33	-0.3	-0.3	12
11	-0.1	-0.1	-0.1	-0.1	-0.14	-0.14	-0.15	-0.16	-0.16	-0.2	-0.2	11
10	0.0	0.0	0.0	0.0	0.02	0.02	0.02	0.02	0.02	0.0	0.0	10
9	0.2	0.2	0.2	0.2	0.19	0.19	0.19	0.19	0.19	0.2	0.2	9
8	0.4	0.4	0.4	0.4	0.36	0.36	0.36	0.36	0.36	0.4	0.4	8
7	0.5	0.5	0.5	0.5	0.53	0.53	0.53	0.53	0.54	0.5	0.5	7
6	0.7	0.7	0.7	0.7	0.69	0.70	0.70	0.70	0.71	0.7	0.7	6
5	0.8	0.8	0.9	0.9	0.86	0.87	0.88	0.88	0.89	0.9	0.9	5
4	1.0	1.0	1.0	1.0	1.03	1.04	1.05	1.05	1.06	1.1	1.1	4
3	1.2	1.2	1.2	1.2	1.20	1.21	1.22	1.23	1.24	1.2	1.2	3
2	1.3	1.3	1.4	1.4	1.36	1.38	1.39	1.40	1.41	1.4	1.4	2
1	1.5	1.5	1.5	1.5	1.53	1.55	1.56	1.57	1.59	1.6	1.6	1
0	1.6	1.7	1.7	1.7	1.90	1.72	1.73	1.74	1.76	1.8	1.8	0
-1	1.8	1.8	1.8	1.9	1.87	1.89	1.90	1.91	1.93	1.9	2.0	-1
-2	2.0	2.0	2.0	2.0	2.04	2.06	2.07	2.09	2.11	2.1	2.1	-2
-3	2.1	2.1	2.2	2.2	2.20	2.22	2.24	2.26	2.28	2.3	2.3	-3
-4	2.3	2.3	2.3	2.4	2.37	2.39	2.41	2.43	2.46	2.5	2.5	-4
-5	2.5	2.5	2.5	2.5	2.54	2.57	2.59	2.61	2.63	2.6	2.7	-5
-6	2.6	2.6	2.7	2.7	2.71	2.74	2.76	2.78	2.81	2.8	2.8	-6
-7	2.8	2.8	2.8	2.9	2.87	2.90	2.93	2.95	2.98	3.0	3.0	-7
-8	2.9	3.0	3.0	3.0	3.04	3.07	3.10	3.12	3.15	3.2	3.2	-8
-9	3.1	3.1	3.2	3.2	3.21	3.24	3.27	3.29	3.33	3.4	3.4	-9
-10	3.3	3.3	3.3	3.4	3.38	3.41	3.44	3.47	3.50	3.5	3.6	-10

Interpolation table

0°.1	0°.2	0°.3	0°.4	0°.5	0°.6	0°.7	0°.8	0°.9	1°.0
0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.15	0.17

Used from $^5/_1$ *1943*

Fig. 7.

Barometer correction table

(Table of $\triangle b = c_g + c_i + c_t$)

Station: *Gaustatoppen.* Barometer: *Fuess 3248*

$\varphi = 59° 51' \text{N}, \ \lambda = 8° 40' \text{E}, \ \frac{\triangle g}{g_{45}} = 0.87 \cdot 10^{-3}$

$\bar{b} = 805$ mb $c_i = 0.32$ mb.

	730 to 750	750 to 770	770 to 790	790 to 810	810 to 830	830 to 850
30.0	-3.5	-3.5	-3.6	-3.7	-3.8	-3.9
29.5	-3.4	-3.5	-3.5	-3.6	-3.7	-3.8
29.0	-3.3	-3.4	-3.5	-3.5	-3.6	-3.7
28.5	-3.3	-3.3	-3.4	-3.5	-3.6	-3.6
28.0	-3.2	-3.3	-3.3	-3.4	-3.5	-3.6
27.5	-3.1	-3.2	-3.3	-3.3	-3.4	-3.5
27.0	-3.1	-3.1	-3.2	-3.3	-3.4	-3.4
26.5	-3.0	-3.1	-3.1	-3.2	-3.3	-3.4
26.0	-2.9	-3.0	-3.1	-3.1	-3.2	-3.3
25.5	-2.9	-2.9	-3.0	-3.1	-3.1	-3.2
25.0	-2.8	-2.9	-2.9	-3.0	-3.1	-3.1
24.5	-2.8	-2.8	-2.9	-2.9	-3.0	-3.1
24.0	-2.7	-2.8	-2.8	-2.9	-2.9	-3.0
23.5	-2.6	-2.6	-2.7	-2.8	-2.9	-2.9
23.0	-2.6	-2.6	-2.7	-2.7	-2.8	-2.9
22.5	-2.5	-2.5	-2.6	-2.7	-2.7	-2.8
22.0	-2.4	-2.5	-2.5	-2.6	-2.7	-2.7
21.5	-2.4	-2.4	-2.5	-2.5	-2.6	-2.6
21.0	-2.3	-2.4	-2.4	-2.5	-2.5	-2.6
20.5	-2.3	-2.3	-2.4	-2.4	-2.5	-2.5
20.0	-2.2	-2.2	-2.3	-2.3	-2.4	-2.4
19.5	-2.1	-2.2	-2.2	-2.3	-2.3	-2.4
19.0	-2.1	-2.1	-2.2	-2.2	-2.2	-2.3
18.5	-2.0	-2.0	-2.1	-2.1	-2.2	-2.2
18.0	-1.9	-2.0	-2.0	-2.1	-2.1	-2.1
17.5	-1.9	-1.9	-2.0	-2.0	-2.0	-2.1
17.0	-1.8	-1.9	-1.9	-1.9	-2.0	-2.0
16.5	-1.8	-1.8	-1.8	-1.9	-1.9	-1.9
16.0	-1.7	-1.7	-1.8	-1.8	-1.8	-1.9
15.5	-1.6	-1.7	-1.7	-1.7	-1.8	-1.8
15.0	-1.6	-1.6	-1.6	-1.7	-1.7	-1.7
14.5	-1.5	-1.5	-1.6	-1.6	-1.6	-1.6
14.0	-1.4	-1.5	-1.5	-1.5	-1.6	-1.6
13.5	-1.4	-1.4	-1.4	-1.4	-1.5	-1.5
13.0	-1.3	-1.3	-1.4	-1.4	-1.4	-1.4
12.5	-1.3	-1.3	-1.3	-1.3	-1.3	-1.4
12.0	-1.2	-1.2	-1.2	-1.2	-1.3	-1.3
11.5	-1.1	-1.1	-1.2	-1.2	-1.2	-1.2
11.0	-1.1	-1.1	-1.1	-1.1	-1.1	-1.2
10.5	-1.0	-1.0	-1.0	-1.0	-1.1	-1.1
10.0	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0

	730 to 750	750 to 770	770 to 790	790 to 810	810 to 830	830 to 850
10.0	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0
9.5	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
9.0	-0.8	-0.8	-0.8	-0.8	-0.9	-0.9
8.5	-0.7	-0.8	-0.8	-0.8	-0.8	-0.8
8.0	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
7.5	-0.6	-0.6	-0.6	-0.6	-0.7	-0.7
7.0	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
6.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
6.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
5.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
5.0	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
4.5	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
4.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
3.5	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
3.0	-0.1	0.0	0.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	0.0	0.0	0.1
2.0	0.1	0.1	0.1	0.1	0.0	0.1
1.5	0.1	0.1	0.2	0.2	0.2	0.2
1.0	0.2	0.2	0.2	0.2	0.3	0.3
0.5	0.3	0.3	0.3	0.3	0.3	0.3
0.0	0.3	0.3	0.4	0.4	0.4	0.4
-0.5	0.4	0.4	0.4	0.4	0.5	0.5
-1.0	0.4	0.5	0.5	0.5	0.5	0.6
-1.5	0.5	0.5	0.6	0.6	0.6	0.6
-2.0	0.6	0.6	0.6	0.7	0.7	0.7
-2.5	0.6	0.7	0.7	0.7	0.7	0.8
-3.0	0.7	0.7	0.8	0.8	0.8	0.8
-3.5	0.8	0.8	0.8	0.9	0.9	0.9
-4.0	0.8	0.9	0.9	0.9	0.9	1.0
-4.5	0.9	0.9	1.0	1.0	1.0	1.0
-5.0	0.9	1.0	1.0	1.1	1.1	1.1
-5.5	1.0	1.0	1.1	1.1	1.2	1.2
-6.0	1.1	1.1	1.2	1.2	1.2	1.3
-6.5	1.1	1.2	1.2	1.3	1.3	1.3
-7.0	1.2	1.2	1.3	1.3	1.4	1.4
-7.5	1.3	1.3	1.4	1.4	1.4	1.5
-8.0	1.3	1.4	1.4	1.5	1.5	1.5
-8.5	1.4	1.4	1.5	1.5	1.6	1.6
-9.0	1.5	1.5	1.5	1.6	1.6	1.7
-9.5	1.5	1.6	1.6	1.7	1.7	1.8
-10.0	1.6	1.6	1.7	1.7	1.8	1.8

Fig. 8.

Example: Attached thermometer 4.5 °C

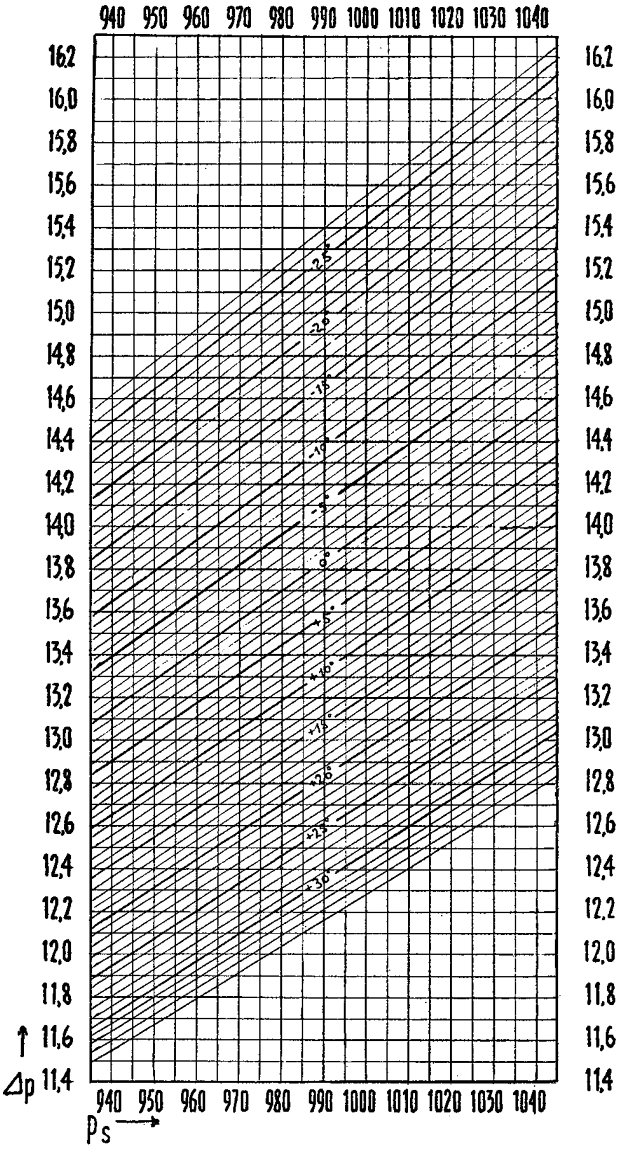
Barometer reading	773.6
From the table we find the correction	— 0.2
Air pressure at the station	773.4
Code figure	73.4

Used from $^{24}/_{1}$ 43 at 9^{00} h.

Reduction of air pressure to mean sea level.

Station: *Oslo* (*Blindern*) $\varphi_b = 109.1$ gdm

$t_m = t_s + 0.33$



Used from $^{20}/_{1}$ 43.

Fig. 9.

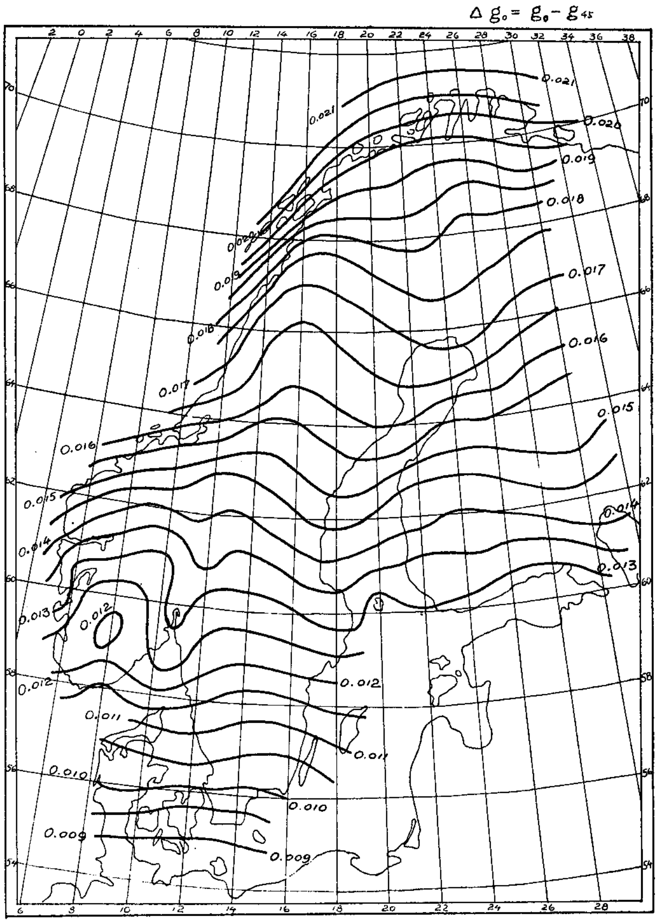


Fig. 11. Chart of $\triangle g_0$, according to *Amble*.

Barometer Reduction Table
to mean sea level.

Station *Oslo* (*Blindern*) Baromerer *Adie C* 850

$\varphi = 59° \, 56' \, \mathrm{N}$ $\Phi_b = 109.1$ gdm $\bar{b} = 1000$ mb

$\lambda = 10° \, 44' \, \mathrm{E}$ $\dfrac{\triangle g}{g_{45}} = 0.00133$ $t_m = t_s + 0.33$

Attached termometer.

+30.0	0.0	+ 7.5	3.9
+29.5	0.1	+ 7.0	4.0
+29.0	0.2	+ 6.5	4.1
+28.5	0.3	+ 6.0	4.2
+28.0	0.3	+ 5.5	4.2
+27.5	0.4	+ 5.0	4.3
+27.0	0.5	+ 4.5	4.4
+26.5	0.6	+ 4.0	4.5
+26.0	0.7	+ 3.5	4.6
+25.5	0.8	+ 3.0	4.7
+25.0	0.9	+ 2.5	4.8
+24.5	1.0	+ 2.0	4.8
+24.0	1.0	+ 1.5	4.9
+23.5	1.1	+ 1.0	5.0
+23.0	1.2	+ 0.5	5.1
+22.5	1.3	0.0	5.2
+22.0	1.4	— 0.5	5.3
+21.5	1.5	— 1.0	5.4
+21.0	1.6	— 1.5	5.4
+20.5	1.6	— 2.0	5.5
+20.0	1.7	— 2.5	5.6
+19.5	1.8	— 3.0	5.7
+19.0	1.9	— 3.5	5.8
+18.5	2.0	— 4.0	5.9
+18.0	2.1	— 4.5	6.0
+17.5	2.2	— 5.0	6.1
+17.0	2.2	— 5.5	6.1
+16.5	2.3	— 6.0	6.2
+16.0	2.4	— 6.5	6.3
+15.5	2.5	— 7.0	6.4
+15.0	2.6	— 7.5	6.5
+14.5	2.7	— 8.0	6.6
+14.0	2.8	— 8.5	6.7
+13.5	2.9	— 9.0	6.7
+13.0	2.9	— 9.5	6.8
+12.5	3.0	—10.0	6.9
+12.0	3.1	—10.5	7.0
+11.5	3.2	—11.0	7.1
+11.0	3.3	—11.5	7.2
+10.5	3.4	—12.0	7.3
+10.0	3.5	—12.5	7.4
+ 9.5	3.5	—13.0	7.4
+ 9.0	3.6	—13.5	7.5
+ 8.5	3.7	—14.0	7.6
+ 8.0	3.8	—14.5	7.7
+ 7.5	3.9	—15.0	7.8

c_i	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40

Barometer reading.

Dry bulb termometer.	935.0 to 944.9	945.0 to 954.9	955.0 to 964.9	965.0 to 974.9	975.0 to 984.9	985.0 to 994.9	995.0 to 1004.9	1005.0 to 1014.9	1015.0 to 1024.9	1025.0 to 1034.9	1035.0 to 1045.0
34 to 32	8.2	8.3	8.4	8.5	8.7	8.8	8.9	9.0	9.1	9.2	9.4
32 to 30	8.3	8.4	8.5	8.6	8.8	8.9	9.0	9.1	9.2	9.3	9.5
30 to 28	8.3	8.5	8.6	8.7	8.8	9.0	9.1	9.2	9.3	9.4	9.6
28 to 26	8.4	8.6	8.7	8.8	8.9	9.1	9.2	9.3	9.4	9.5	9.7
26 to 24	8.5	8.7	8.8	8.9	9.0	9.2	9.3	9.4	9.5	9.6	9.8
24 to 22	8.6	8.7	8.9	9.0	9.1	9.2	9.4	9.5	9.6	9.7	9.9
22 to 20	8.7	8.8	9.0	9.1	9.2	9.3	9.5	9.6	9.7	9.8	10.0
20 to 18	8.8	8.9	9.1	9.2	9.3	9.4	9.6	9.7	9.8	10.0	10.1
18 to 16	8.9	9.0	9.2	9.3	9.4	9.5	9.7	9.8	9.9	10.1	10.2
16 to 14	9.0	9.1	9.3	9.4	9.5	9.6	9.8	9.9	10.0	10.2	10.3
14 to 12	9.1	9.2	9.3	9.5	9.6	9.7	9.9	10.0	10.1	10.3	10.4
12 to 10	9.2	9.3	9.4	9.6	9.7	9.8	10.0	10.1	10.2	10.4	10.5
10 to 8	9.3	9.4	9.5	9.7	9.8	9.9	10.1	10.2	10.3	10.5	10.6
8 to 6	9.4	9.5	9.6	9.8	9.9	10.0	10.2	10.3	10.4	10.6	10.7
6 to 4	9.5	9.6	9.7	9.9	10.0	10.1	10.3	10.4	10.5	10.7	10.8
4 to 2	9.6	9.7	9.8	10.0	10.1	10.2	10.4	10.5	10.6	10.8	10.9
2 to 0	9.7	9.8	9.9	10.1	10.2	10.3	10.5	10.6	10.7	10.9	11.0
0 to −2	9.8	9.9	10.0	10.2	10.3	10.4	10.6	10.7	10.9	11.0	11.1
−2 to −4	9.9	10.0	10.1	10.3	10.4	10.6	10.7	10.8	11.0	11.1	11.3
−4 to −6	10.0	10.1	10.2	10.4	10.5	10.7	10.8	11.0	11.1	11.2	11.4
−6 to −8	10.1	10.2	10.4	10.5	10.6	10.8	10.9	11.1	11.2	11.3	11.5
−8 to −10	10.2	10.3	10.5	10.6	10.8	10.9	11.0	11.2	11.3	11.5	11.6
−10 to −12	10.3	10.4	10.6	10.7	10.9	11.0	11.1	11.3	11.4	11.6	11.7
−12 to −14	10.4	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.8
−14 to −16	10.5	10.6	10.8	10.9	11.1	11.2	11.4	11.5	11.7	11.8	12.0
−16 to −18	10.6	10.8	10.9	11.1	11.2	11.3	11.5	11.6	11.8	11.9	12.1
−18 to −20	10.7	10.9	11.0	11.2	11.3	11.5	11.6	11.8	11.9	12.1	12.2
−20 to −22	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	12.0	12.2	12.3
−22 to −24	11.0	11.1	11.2	11.4	11.6	11.7	11.8	12.0	12.1	12.3	12.5
−24 to −26	11.1	11.2	11.4	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6
−26 to −28	11.2	11.3	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7

Example 1: Dry bulb thermometer 22.3
Attached thermometer 19.5

Barometer reading	1012.4
From table 1 we find	1.8
From table 2 we find	9.5
Air pressure reduced to sea level	1023.7
Code figure	237

Example 2: Dry bulb thermometer — 14.9
Attached thermometer + 8.0

Barometer reading	972.5
From table 1 we find	3.8
From table 2 we find	10.9
Air pressure reduced to sea level	987.2
Code figure	872

Used from $^5/_1$ 43 at 15^{00} h.

Fig. 10.

Table I.

Table of the function *a (b)*.

Kew pattern barometer $a(b) = 0.000163\,(b + 49)$		Fuess barometer $a(b) = 0.000163\,(b + 31)$	
b	$a(b)$	b	$a(b)$
855	0.1474	855	0.1444
860	0.1482	860	0.1452
865	0.1490	865	0.1460
870	0.1498	870	0.1469
875	0.1506	875	0.1477
880	0.1514	880	0.1485
885	0.1522	885	0.1493
890	0.1531	890	0.1501
895	0.1539	895	0.1509
900	0.1547	900	0.1518
905	0.1555	905	0.1526
910	0.1563	910	0.1534
915	0.1571	915	0.1542
920	0.1579	920	0.1550
925	0.1588	925	0.1558
930	0.1596	930	0.1566
935	0.1604	935	0.1575
940	0.1612	940	0.1583
945	0.1620	945	0.1591
950	0.1628	950	0.1599
955	0.1637	955	0.1607
960	0.1645	960	0.1615
965	0.1653	965	0.1623
970	0.1661	970	0.1632
975	0.1669	975	0.1640
980	0.1677	980	0.1648
985	0.1685	985	0.1656
990	0.1694	990	0.1664
995	0.1702	995	0.1672
1000	0.1710	1000	0.1681
1005	0.1718	1005	0.1689
1010	0.1726	1010	0.1697
1015	0.1734	1015	0.1705
1020	0.1742	1020	0.1713
1025	0.1751	1025	0.1721
1030	0.1759	1030	0.1729
1035	0.1767	1035	0.1738
1040	0.1775	1040	0.1746
1045	0.1783	1045	0.1754
1050	0.1791	1050	0.1762
1055	0.1800	1055	0.1770

Table II.

Table of the function $a(t_b)$.

Kew pattern barometer
$a(t_b) = 0.173\,(30 - t_b)$

t_b	$a(t_b)$	t_b	$a(t_b)$
30.0	0.0	7.0	4.0
29.5	0.1	6.5	4.1
29.0	0.2	6.0	4.2
28.5	0.3	5.5	4.2
28.0	0.3	5.0	4.3
27.5	0.4	4.5	4.4
27.0	0.5	4.0	4.5
26,5	0.6	3.5	4.6
26.0	0.7	3.0	4.7
25.5	0.8	2.5	4.8
25.0	0.9	2.0	4.8
24.5	1.0	1.5	4.9
24 0	1.0	1.0	5.0
23.5	1.1	0.5	5.1
23.0	1.2	0.0	5.2
22.5	1.3	— 0.5	5.3
22 0	1.4	— 1.0	5.4
21.5	1.5	— 1.5	5.4
21 0	1.6	— 2.0	5.5
20.5	1.6	— 2.5	5.6
20.0	1.7	— 3.0	5.7
19.5	1.8	— 3.5	5.8
19.0	1.9	— 4.0	5.9
18.5	2.0	— 4.5	6.0
18 0	2 1	— 5.0	6.1
17.5	2.2	— 5.5	6.1
17.0	2.2	— 6.0	6.2
16.5	2.3	— 6.5	6.3
16 0	2.4	— 7.0	6.4
15.5	2.5	— 7.5	6.5
15.0	2.6	— 8.0	6.6
14.5	2.7	— 8.5	6.7
14.0	2.8	— 9.0	6.7
13.5	2.9	— 9.5	6.8
13.0	2.9	— 10.0	6.9
12.5	3.0	— 10.5	7.0
12.0	3.1	— 11.0	7.1
11.5	3.2	— 11.5	7.2
11.0	3.3	— 12.0	7.3
10.5	3.4	— 12.5	7.4
10.0	3.5	— 13.0	7.4
9.5	3.5	— 13.5	7.5
9.0	3.6	— 14.0	7.6
8 5	3.7	— 14.5	7.7
8.0	3.8	— 15.0	7.8
7.5	3.9		

Fuess barometer
$a(t_b) = 0.170\,(30 - t_b)$

t_b	$a(t_b)$	t_b	$a(t_b)$
30.0	0.0	7.0	3.9
29.5	0.1	6.5	4.0
29.0	0.2	6.0	4.1
28.5	0.3	5.5	4.2
28.0	0.3	5.0	4.2
27.5	0.4	4.5	4.3
27.0	0.5	4.0	4.4
26.5	0.6	3.5	4.5
26.0	0.7	3.0	4.6
25.5	0.8	2.5	4.7
25.0	0.8	2.0	4.8
24.5	0.9	1.5	4.8
24.0	1.0	1.0	4.9
23.5	1.1	0.5	5.0
23.0	1.2	0.0	5.1
22.5	1.3	— 0.5	5.2
22.0	1.4	— 1.0	5.3
21.5	1.4	— 1.5	5.4
21.0	1.5	— 2.0	5.4
20.5	1.6	— 2.5	5.5
20.0	1.7	— 3.0	5.6
19.5	1.8	— 3.5	5.7
19.0	1.9	— 4.0	5.8
18.5	2.0	— 4.5	5.9
18.0	2.0	— 5.0	6.0
17.5	2.1	— 5.5	6.0
17.0	2.2	— 6.0	6.1
16.5	2,3	— 6.5	6.2
16.0	2.4	— 7.0	6.3
15.5	2.5	— 7.5	6.4
15.0	2.6	— 8.0	6.5
14.5	2.6	— 8.5	6.5
14.0	2.7	— 9.0	6.6
13.5	2.8	— 9.5	6.7
13.0	2.9	— 10.0	6.8
12.5	3.0	— 10.5	6.9
12.0	3.1	— 11.0	7.0
11.5	3.1	— 11.5	7.1
11.0	3.2	— 12.0	7.1
10.5	3.3	— 12.5	7.2
10.0	3.4	— 13.0	7.3
9.5	3.5	— 13.5	7.4
9.0	3.6	— 14.0	7.5
8.5	3.7	— 14.5	7.6
8.0	3.7	— 15.0	7.6
7.5	3.8		

Printed March 18th, 1944.