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SEA SURFACE TEMPERATURES OF THE NORTH ATLANTIC

1887 - 1936

Report on Research

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SEA SURFACE TEMPERATURES OF THE NORTH ATLANTIC

1887 - 1936

by

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While the meteorological literature contains many allusions to relations between weather abnormalities and sea surface temperatures, ^{but} little data actually substantiating such relations have been published. Moreover, the physical connection between changes of ocean temperature and atmospheric flow patterns has not been demonstrated generally. In that respect, seasonal hurricane frequencies offer a promising opportunity for study since these storms depend greatly for their maintenance on local heat transfer from ocean to atmosphere. One may argue that if a positive anomaly center of sea surface temperatures is situated in the principal areas of hurricane formation during the season, hurricane frequency will tend to exceed average.

To explore this hypothesis a copy of a collection of Atlantic sea surface temperatures for 1887 to 1936 was obtained. This collection was prepared by a project of the United States Weather Bureau under W. F. MacDonald during the 1930's. Though it represented an enormous effort, it is nevertheless fractional in that only certain areas of the Atlantic are covered and some of these not continuously. World War I, in particular, accounts for many unwelcome interruptions. According to the writer's understanding a large additional file of sea surface temperatures is available at the National Weather Records Center at Asheville, North Carolina. Moreover, the analysis could be extended to the present. Such extension had been planned if the initial evaluation proved encouraging; this however proved not to be the case.

The Weather Bureau data are arranged on a monthly basis for "squares" bounded by five degrees of latitude and longitude. In some months there were several hundred observations in some individual squares, in others only a few, sometimes less than ten. These uneven frequencies plus the unreliability of many of the measurements made careful processing necessary.¹

At first, means for each month were computed for each square and these means averaged over the whole period. The resulting mean monthly values were then plotted on graphs. These yielded smooth seasonal variations in almost all squares. Occasional irregular values could be traced to isolated extremely low or high temperature reports, or months with very few reports. They were considered incorrect and replaced by values on the curve. Fig. 1 shows the mean monthly temperatures.²

Secular Variation

Before proceeding to monthly temperature anomalies it was necessary to determine the secular trend because of the large climatic variation known to have occurred in the Atlantic in recent decades. This was done by computing annual temperatures in each square and expressing these as deviations from the mean annual temperature for the whole period. Mean annual temperatures were calculated from the data of fig. 1. The result is shown in fig. 2 which also indicates the periods for which observations were available in each square.

One observes relatively strong year to year variations in many squares, some of these quasi-periodic. Very large changes occurred in the region of

¹ It could not be ascertained to what extent, if any, changes in methods of measurement have affected the temperatures as recorded. No allowance has been made for this factor.

² The Weather Bureau data extend beyond 50°N, but the polar part of the ocean was not studied in this project.

strong temperature gradient near the American coast and during World War I; the latter of course must be considered as unreliable. Superimposed on these fluctuations are unmistakable secular trends which, however, vary with latitude and longitude. In the tropics cooling predominates up to 1915-20, followed by warming especially after 1925. This pattern also occurs at many squares farther north but other types of curves are ~~also~~ found such as continuous warming levelling off toward the end of the record. Fig. 3 summarizes the secular variation by latitude belts.

The somewhat irregular character of the secular trends may be resolved partly by plotting charts of annual anomaly. As example, figs. 4 and 5 show the anomalies and their analysis for 1936. A distinct and suggestive pattern is in evidence. Along the western edge of the ocean positive anomalies are pronounced, with a little increase with latitude. But these anomalies decrease regularly eastward. Slight negative values occur in the easternmost squares and one suspects that a strong negative anomaly center is situated in the southeastern part of the ocean. This anomaly gradient plus the northeast-southwest tilt of the whole field suggests a connection with circulation anomalies rather than a general radiative influence. Actually the circulation of the whole subtropical anticyclone (measured geostrophically) was above average in 1936; thus the departure was in the right sense to explain the oceanic temperature anomaly field. This matter, though very interesting, could not be studied further within the scope of the project.

The analysis of the secular variations can be refined by considering the contribution of individual months or seasons to the annual variation. This refinement was not carried out beyond noting qualitatively that trends were similar in all seasons. Further the secular trends, though relatively

large when viewed as a whole, are quite small compared to changes in monthly anomaly patterns, say from one July to the next. Thus, as long as one compares only a few adjacent years, one may proceed without reference to the long term trend. For this reason straight monthly anomalies were computed from the temperatures of fig. 1. It has been planned, however, to remove secular changes from any correlations with the atmosphere covering the whole period.

It should be noted that analysis of the secular trend by months or seasons could be utilized to normalize the data of fig. 1. These are composed from records of varying length and periods, hence not fully comparable. Normalization would produce some changes in the configuration of annual and monthly anomaly patterns.

Monthly Anomalies

The eventual purpose of the program was to draw monthly anomaly charts and trace anomaly centers from month to month noting paths and changes in intensity. Two difficulties are to be overcome before this can be done:

- 1) Due to poor or sparse observations large and fictitious oscillations of anomaly can occur. These must be located and eliminated.
- 2) The strength of the anomalies may undergo seasonal variations; they may for instance decrease from winter to summer as in the atmosphere. If this is the case, the seasonal variation must be taken into account in following anomaly centers.

The second problem was investigated by calculating the variability, or mean deviation, of the (uncorrected) monthly temperatures for each month in each square. Fig. 6 shows the result on graphs and fig. 7 on charts. Outstanding is the lack of important seasonal differences. Certainly no organized decrease takes place from winter to summer; some squares actually have largest

variability in summer. A few irregular values result from poor data.

This outcome is favorable since it permits analysis without reference to season. As the next step, the monthly anomalies were plotted on time sections for all squares and curves drawn. Poor values usually could be located easily. Most often a large positive or negative anomaly appeared in a single month in one square without history either in that or surrounding squares. Such values were disregarded. Except for such irregular values (and the years of World War I) little smoothing proved necessary. Especially in the later years when data was most plentiful in many squares, anomaly variations became very regular and consistent. The time sections could be used to fill in occasional gaps of one or two months in a record.

From the curves adjusted monthly anomaly values were plotted on charts. These charts are reproduced as the main part of this report. The anomalies are in tenths degrees Fahrenheit.³

The charts can be analyzed with some effort. Enough irregularity, however, is left to suggest another smoothing. This was done by preparing a set of charts with four-square overlapping means. This new set could be analyzed with great ease. It shows pronounced anomaly centers which sometimes persist for many months and usually, though not always, travel on a clockwise path through the ocean. Unfortunately, these charts could not be prepared for all years because of the small number of squares available in many of the years. Hence it was decided to reproduce the original set of charts which contains no analysis but all data.

³ Due to the large number of charts the data could not be drafted for reproduction. Apology is made for the occasional values which are difficult to read. Underlined numbers: less than ten observations.

Atmospheric Correlations

According to the initial hypothesis the charts should furnish a partial predictor of the hurricane season if the analysis uncovers definite anomaly centers which travel in relatively steady state over several months. Excepting the Gulf of Mexico the frequent existence of such centers has indeed been demonstrated but the hurricane correlations have failed to materialize.

Of course, there were further handicaps. In particular, the anomaly analysis does not cover the whole region of hurricane formation and conditions far upstream are quite unknown. This difficulty was realized before the work was begun; but we thought that the available data should give a fair indication. For the western part of the hurricane region temperatures upstream exist in many years. Moreover one can compare sea temperatures and hurricane frequencies on a contemporary basis.

Many correlations were carried out, for the area as a whole and for smaller portions. Since these correlations proved unsuccessful they will not be discussed further. It should be noted, however, that only a partial correlation was expected. Atmospheric circulation anomalies should furnish another indicator, even though circulation anomalies and sea temperatures may also be partly correlated. For the purpose of studying the relation between hurricanes and circulation in the subtropics and temperature westerlies, monthly sea-level pressure anomalies (1899-1939) were obtained through courtesy of the Extended Forecast Section of the United States Weather Bureau. These were analyzed and compared with ocean temperatures and hurricane frequencies. One notes quickly that there is some tendency for hurricane frequency to be low if in late spring the subtropical anticyclone has above average strength with east-west elongation. The lag correlation, however, is not good enough for forecasting pur-

poses; a combined surface circulation - sea temperature index produces no improvement. Conceivably extension of the work to the period following 1945 might do better since upper-air data can be used from then onward.

When the time scale of correlation is increased to five years and more much better relations appear. Only the secular trends are important in considering these longer periods. The marked year-to-year changes drop out as "turbulence." Indeed, when fig. 2 is viewed as a whole, it gives the appearance of a typical turbulence record with underlying trend.

Only a few indications of long period correlations based on non-overlapping five-year means can be given here. As already noted, the sea temperature at first declined, later rose over a large part of the western Atlantic including the subtropics (fig. 2). For comparison, fig. 8 shows the pressure anomaly at 30°N, 65°W. Clearly, the pressure rose as the sea temperature decreased, then the reverse took place. At the same time, the geostrophic vorticity in the Bermuda area at first became more anticyclonic, later more cyclonic. These data furnish strong clues toward an understanding of secular trends.

Even the hurricane frequencies become fairly manageable on the five-year time scale. Fig. 9 correlates hurricane frequencies and sea temperatures in the region of formation for non-overlapping five-year periods. Though not wholly satisfactory, a parallel trend is nevertheless evident. One may raise the question whether figs. 8 and 9 demonstrate a general principle, namely that ocean temperature and atmosphere are correlated only when time steps of about five years or more are considered, and that other factors dominate shorter period fluctuations.

Turning to hurricane tracks, one observes that since the beginning of the century the location of the tracks has undergone a marked cycle. In the early years recurvatures in September took place mostly east of Florida (fig. 10). They then shifted westward to the Gulf between 1910 and 1920; later they returned at first to Florida and adjoining waters, finally to the West Atlantic. The shift in average recurvature longitude is no less than 20° near latitude 25°N and must be accepted as real.

During the years when the tracks migrated westward ocean temperatures decreased, and during the years when the tracks returned eastward, they rose. Fig. 11 shows five-year average anomalies corresponding to parts of the periods with easternmost and westernmost track positions. Patterns are out-of-phase; the period 1932-36 agrees with fig. 5. Correlation between sea temperatures and hurricane tracks is excellent, but a direct connection appears difficult to establish. A change in recurvature longitude, as indicated by fig. 10, should from all knowledge of hurricane motion be related to changes in the position of mean troughs and ridges in the westerlies. Direct evidence does not exist from the years studied, but a glance at fig. 8 will show that the track changes are correlated well with sea-level pressure near Bermuda. Tracks shifted westward with rising pressure and eastward with falling pressure. If the pressure changes reflect east-west displacements of the Azores-Bermuda High, the track displacements can be interpreted as due to general circulation changes.

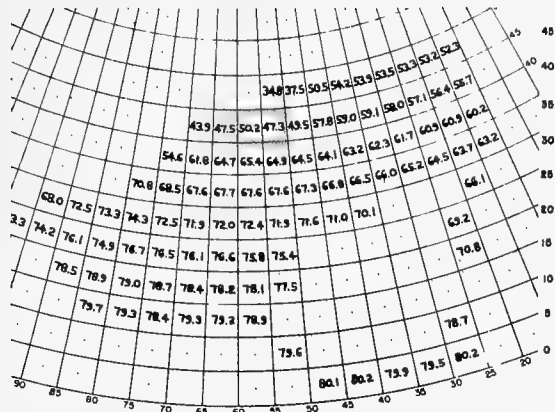
Conclusion

It is the writer's belief that in spite of many difficulties of sea temperature observations and sea temperature records anomaly charts have been constructed which by and large are fairly accurate. Second approximations could be made to the whole series of charts beginning with fig. 1, but it is doubtful whether this would prove worth the effort.

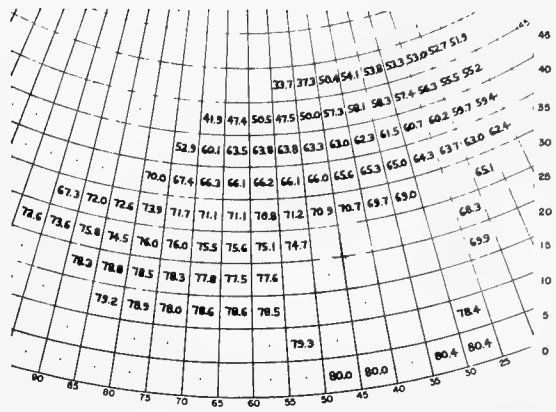
The immediate aim for which the charts were prepared has not been attained. But it is evident that they can be used for many studies of importance in oceanography and long range forecasting. A few suggestions of interesting relations have been made, especially in figs. 4 and 5 and figs. 8 and 9; but further exploration of these topics is beyond the scope of this project. For this reason the initial summary diagrams and all anomaly charts have been reproduced in the hope that they will prove useful to other investigators.

Acknowledgment

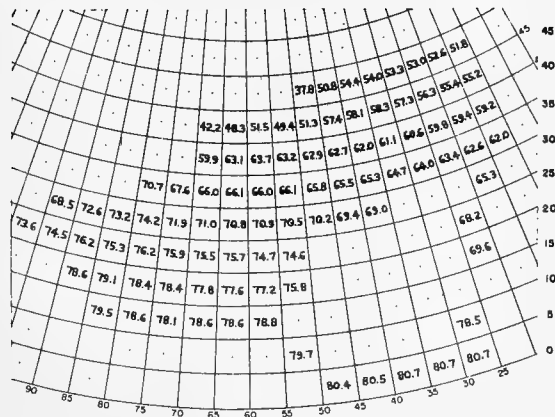
The writer wishes to acknowledge the assistance of Mrs. E. S. Jordan who supervised preparation of the anomaly charts and did most of the analyses.



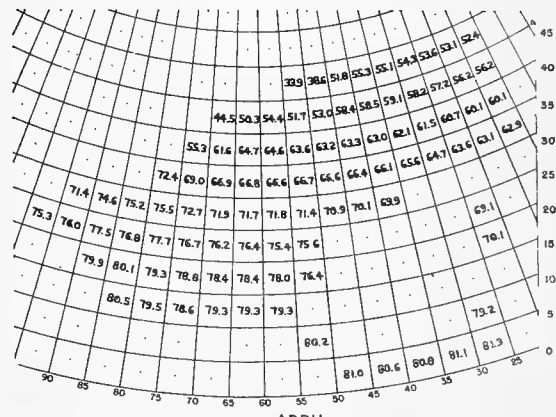
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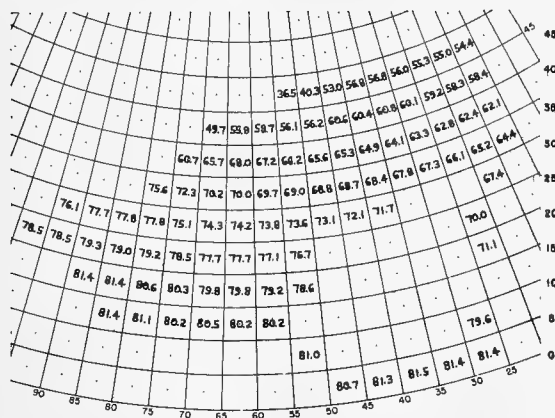
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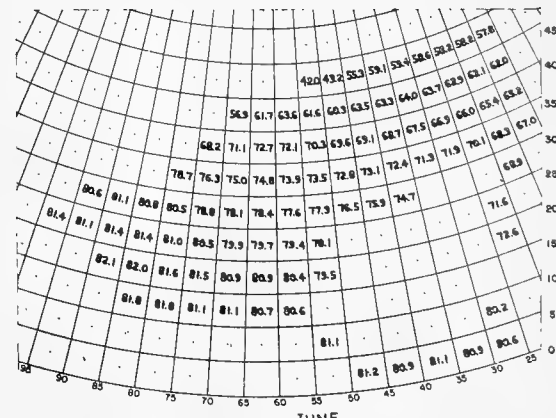
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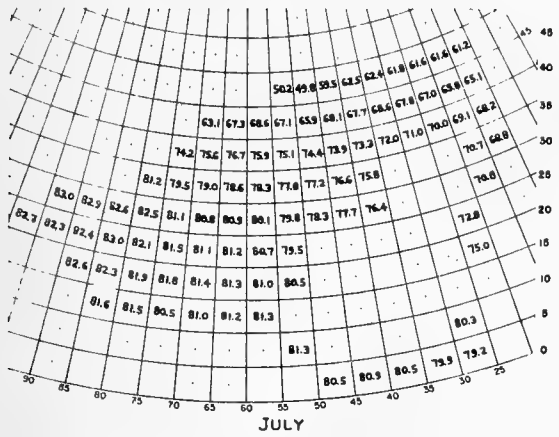


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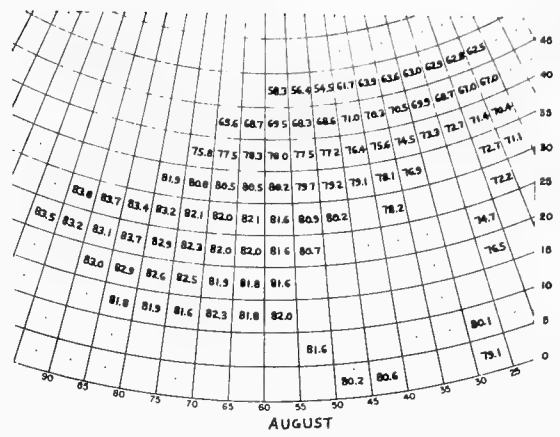
Figure 1 Mean monthly sea surface temperatures (°F).

Figure 1

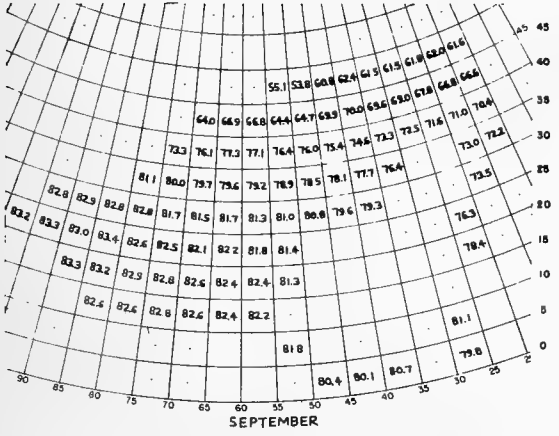
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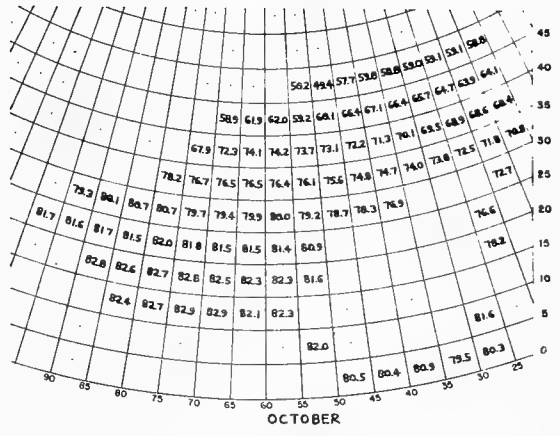
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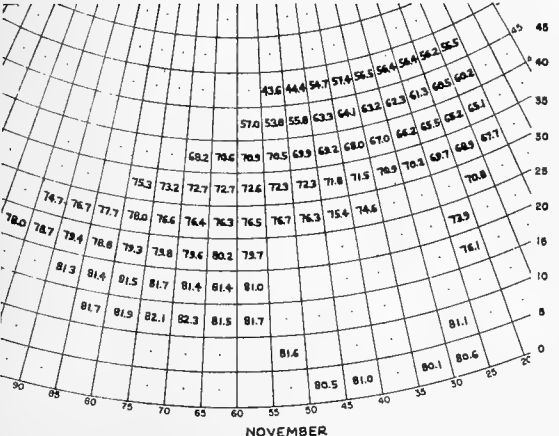
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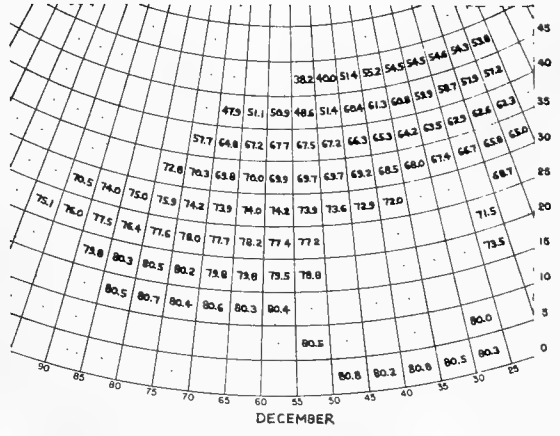
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DECEMBER

Figure 2

Departure of annual sea surface temperature
from mean ($^{\circ}\text{F}$) for all five-degree squares
(coordinates given for southeast corner).



Figure 2

(continued)



Figure 3

Course of annual sea surface temperature anomaly summed over latitude belts. In each belt all available five-degree squares have been used.

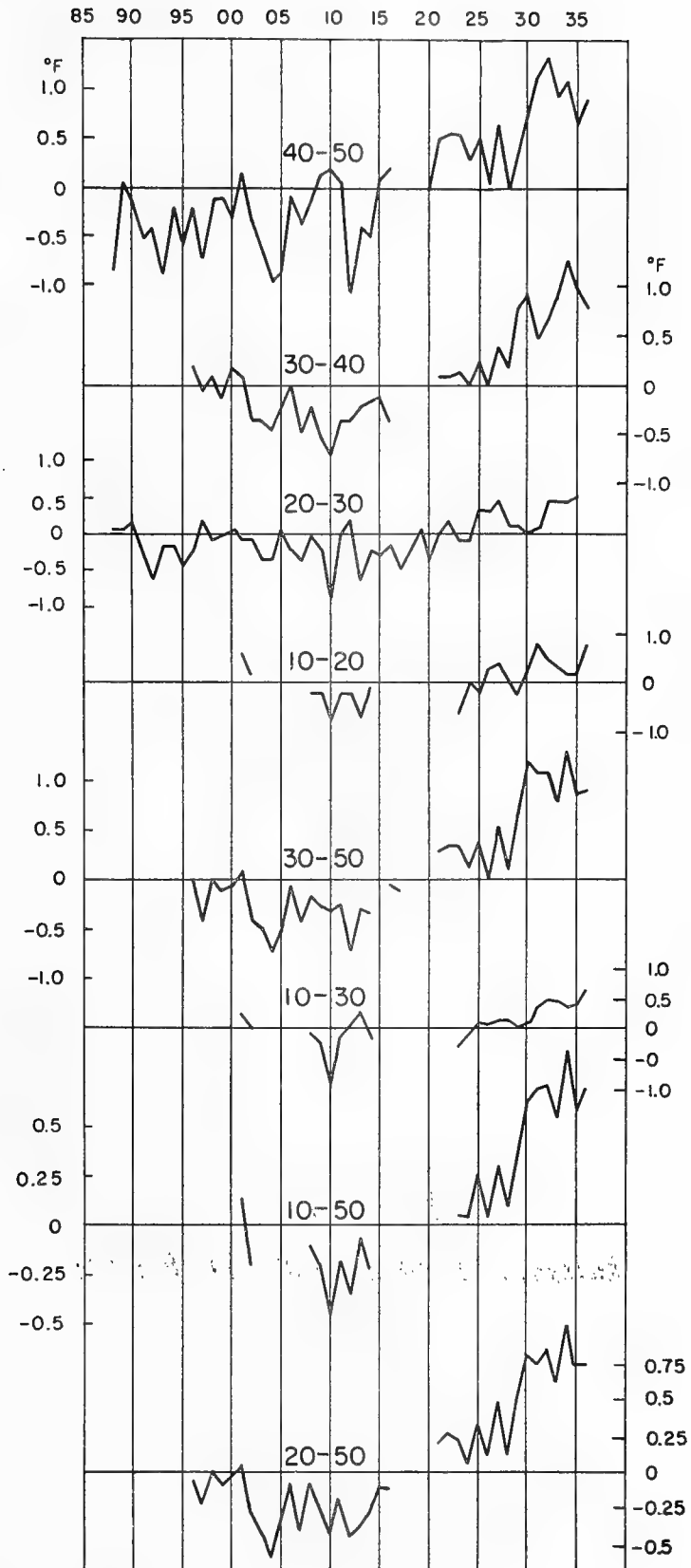


Figure 4

Sea surface temperature anomalies for 1936 ($^{\circ}\text{F}$).

Figure 5

Analysis of the data of fig. 4 ($^{\circ}\text{F}$).

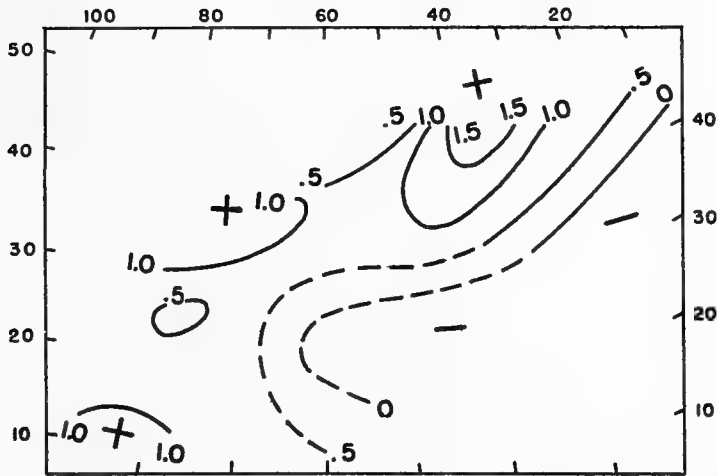
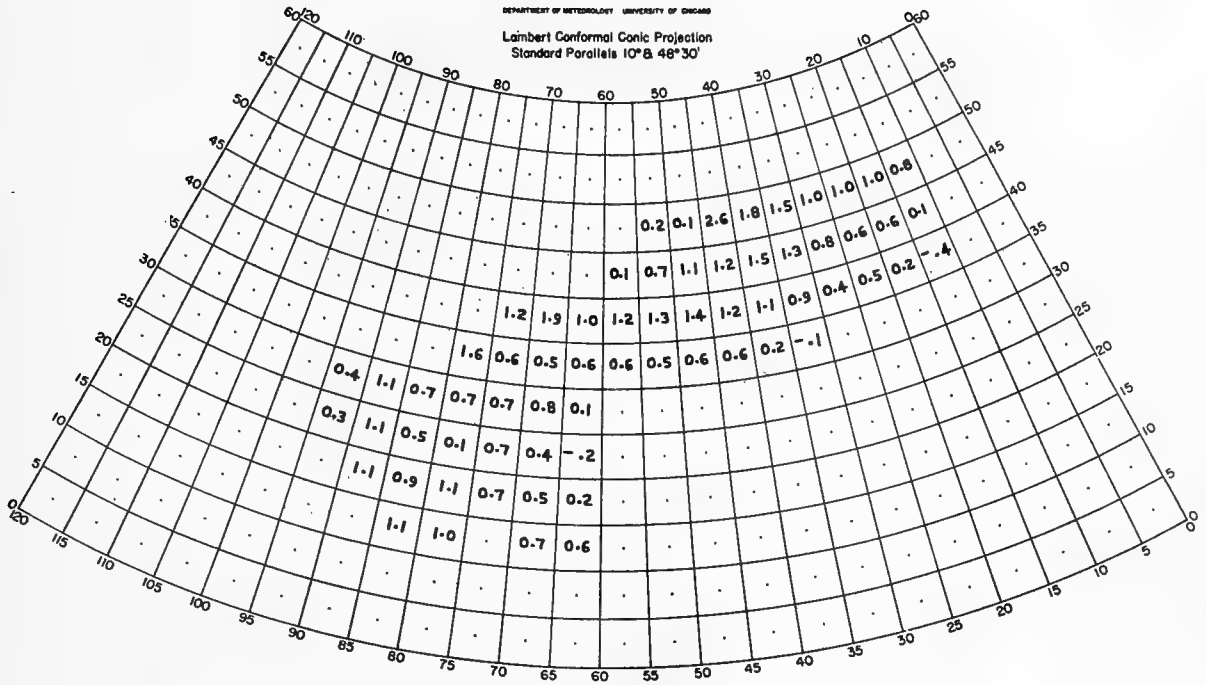
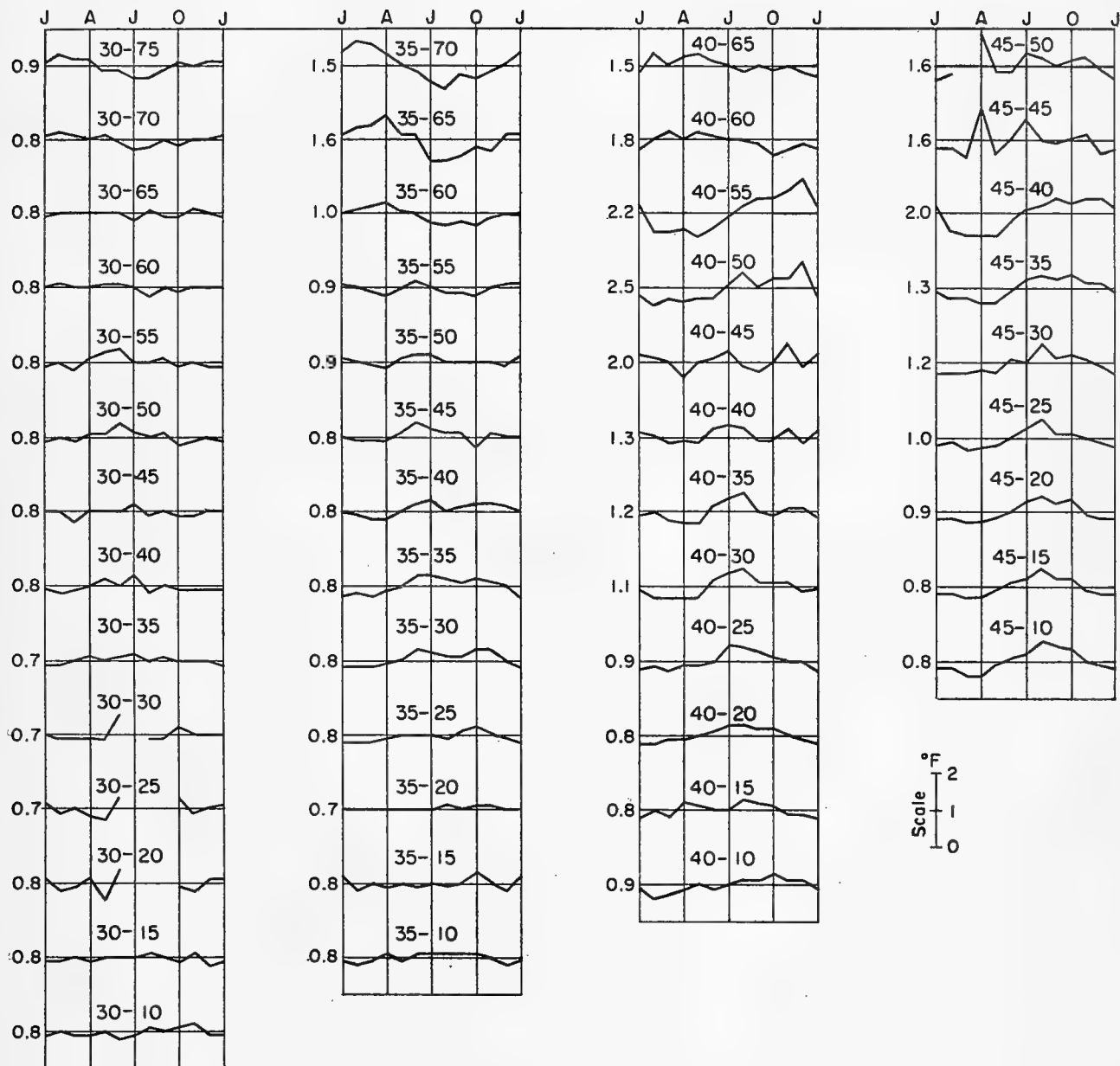


Figure 6

Annual course of mean deviation of monthly sea surface temperatures (°F) for all five-degree squares (coordinates given for southeast corner). Numbers on left indicate average annual value of monthly deviations. Scale given at bottom.

Figure 6

(continued)



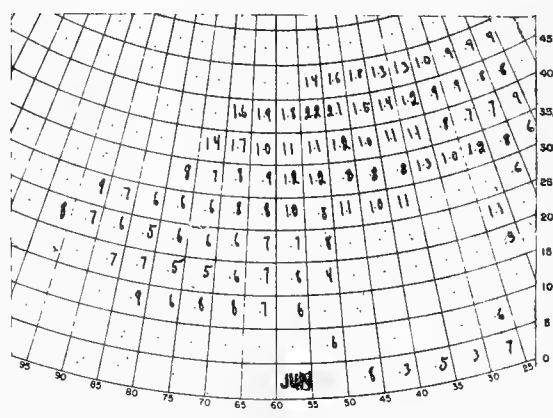
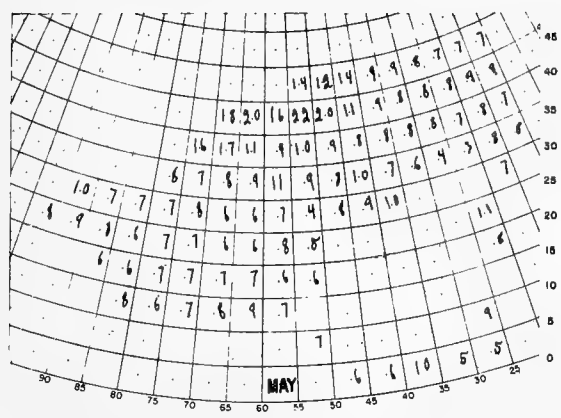
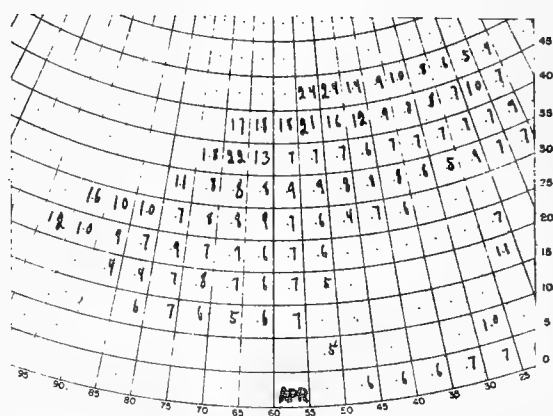
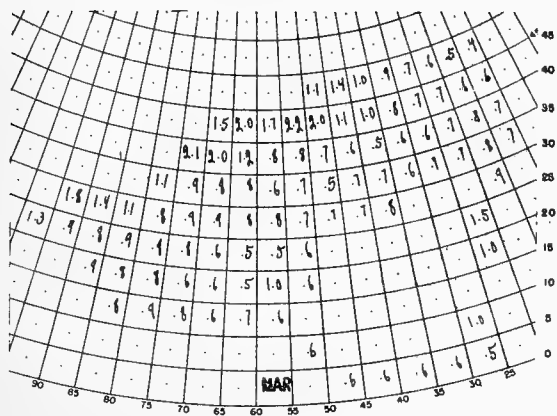
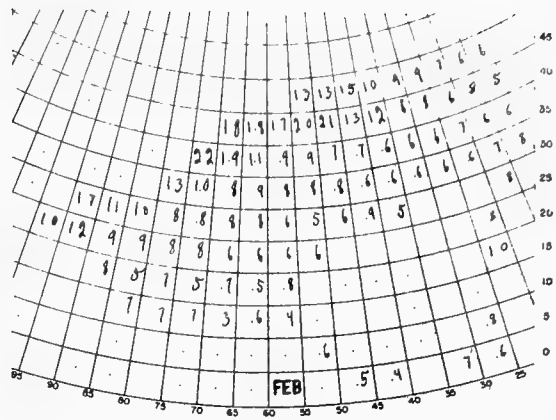
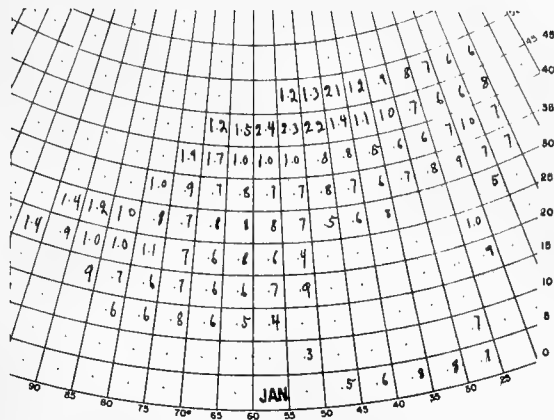


Figure 7 Monthly charts of mean deviation of monthly sea surface temperatures (°F).

Figure 7

(continued)

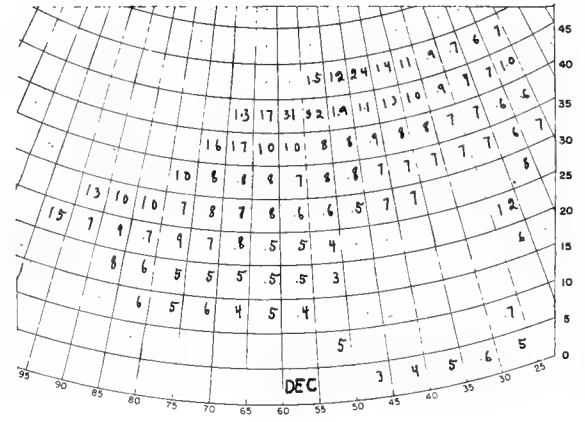
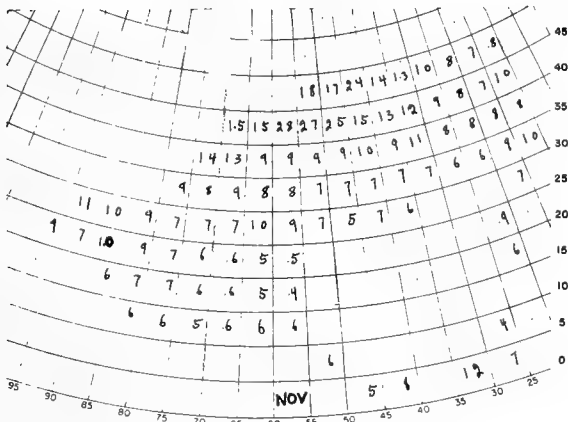
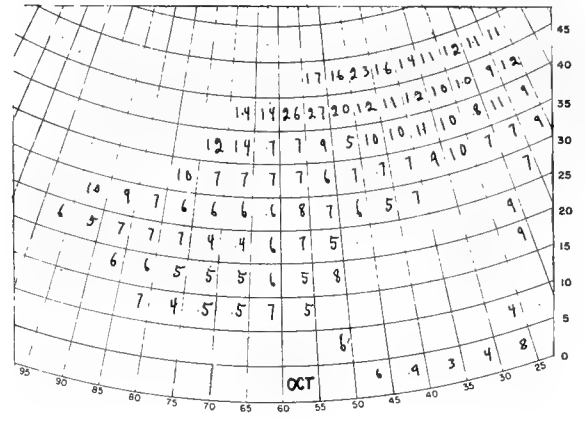
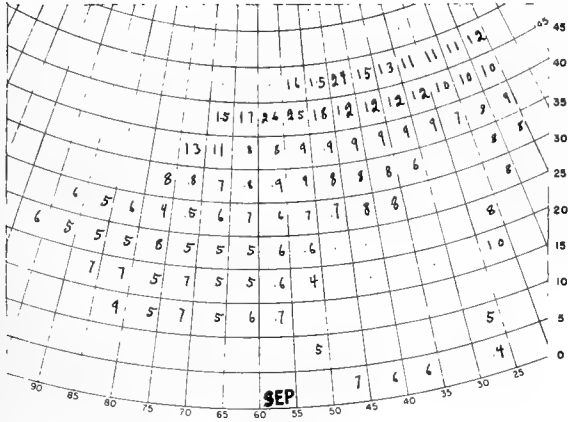
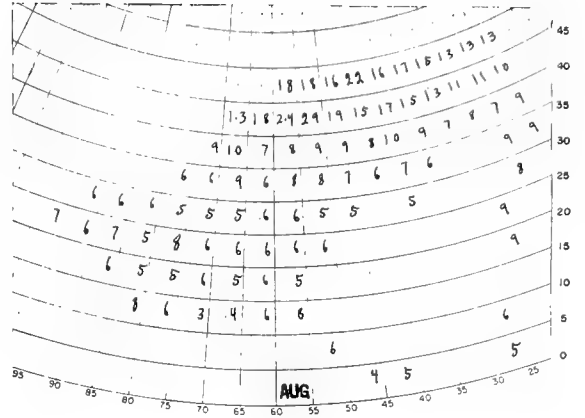
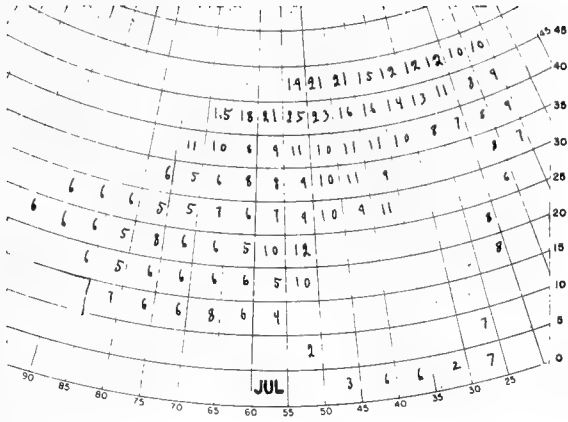


Figure 8

Course of five-year means of July surface pressure anomaly at 30°N, 65°W (upper) and of surface geostrophic vorticity anomaly for July in the 20°-square centered on 30°N, 65°W (lower).

Figure 9

Course of five-year means of annual sea surface temperature anomaly for the belt 15-25°N, 65-85°W (upper) and of hurricane frequency in the whole Atlantic hurricane region (lower).

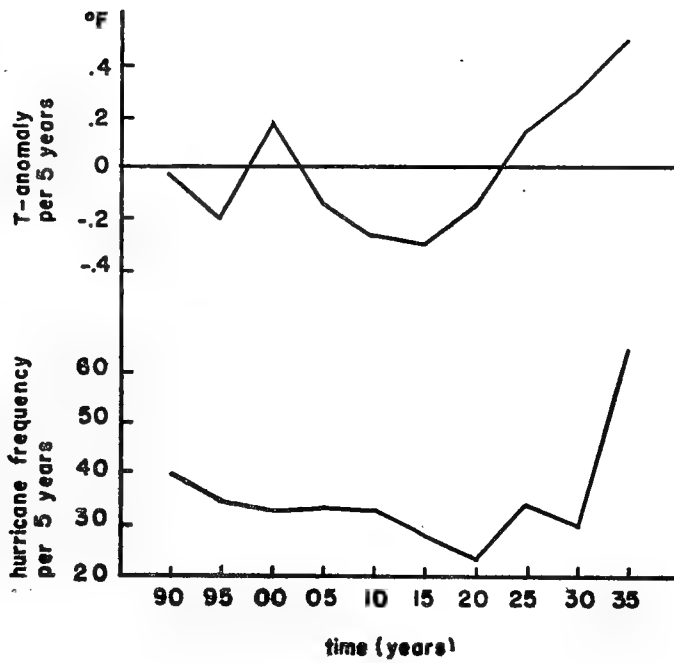
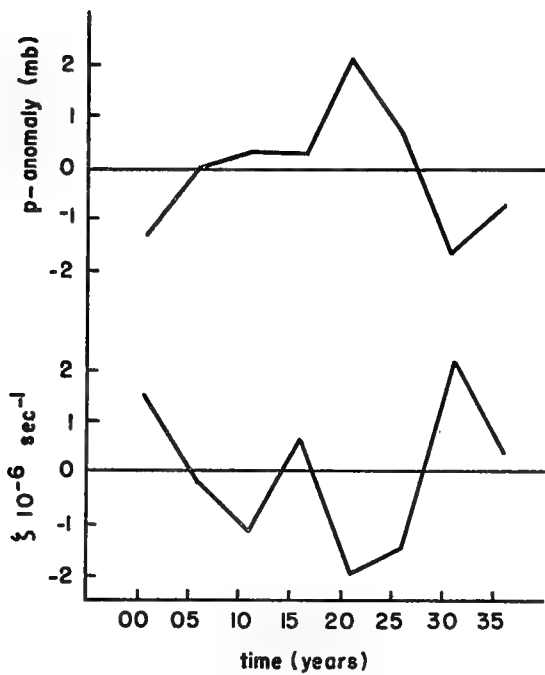


Figure 10

September hurricane tracks with duration
of three days and more, 1901-1944.

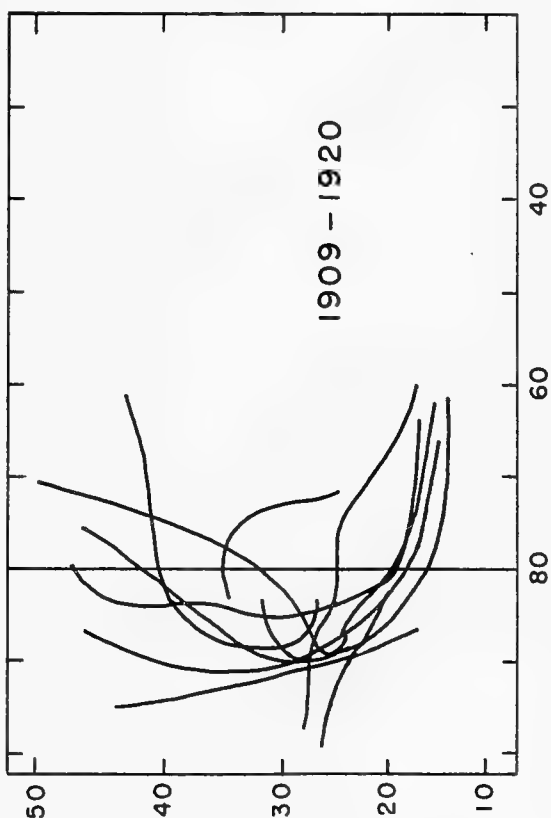
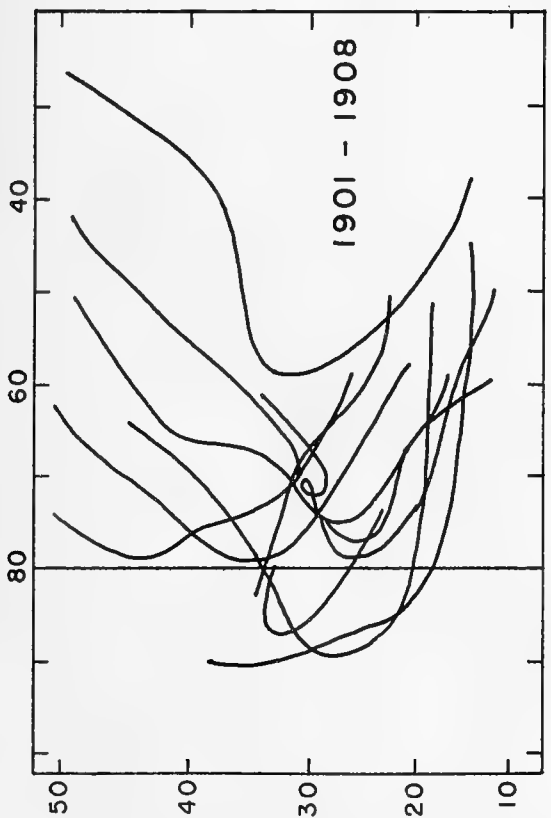
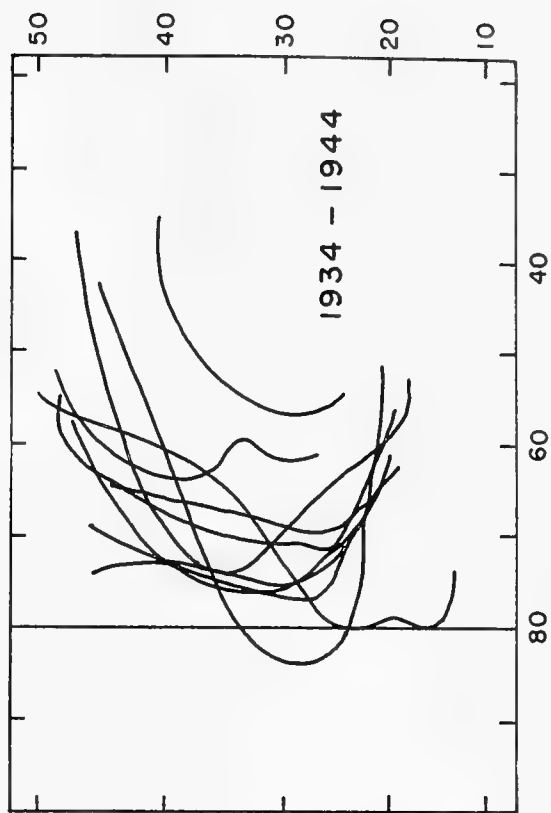
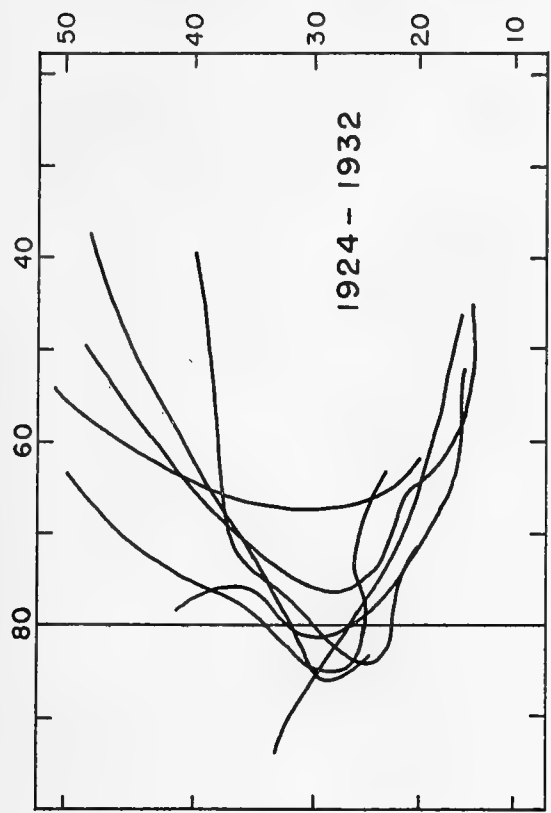
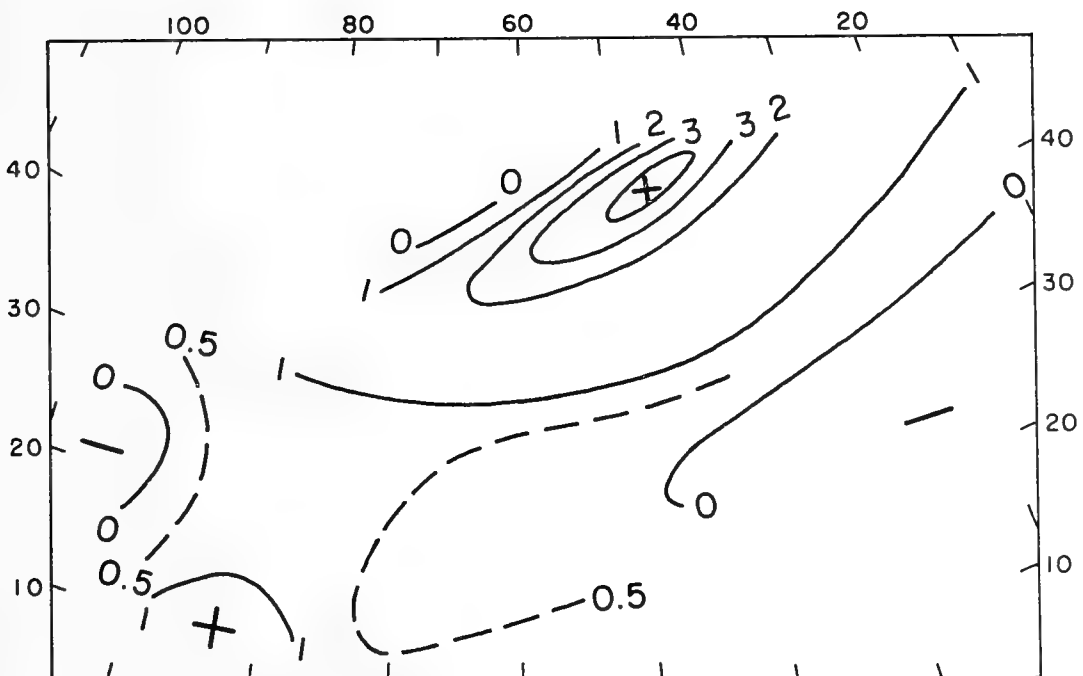
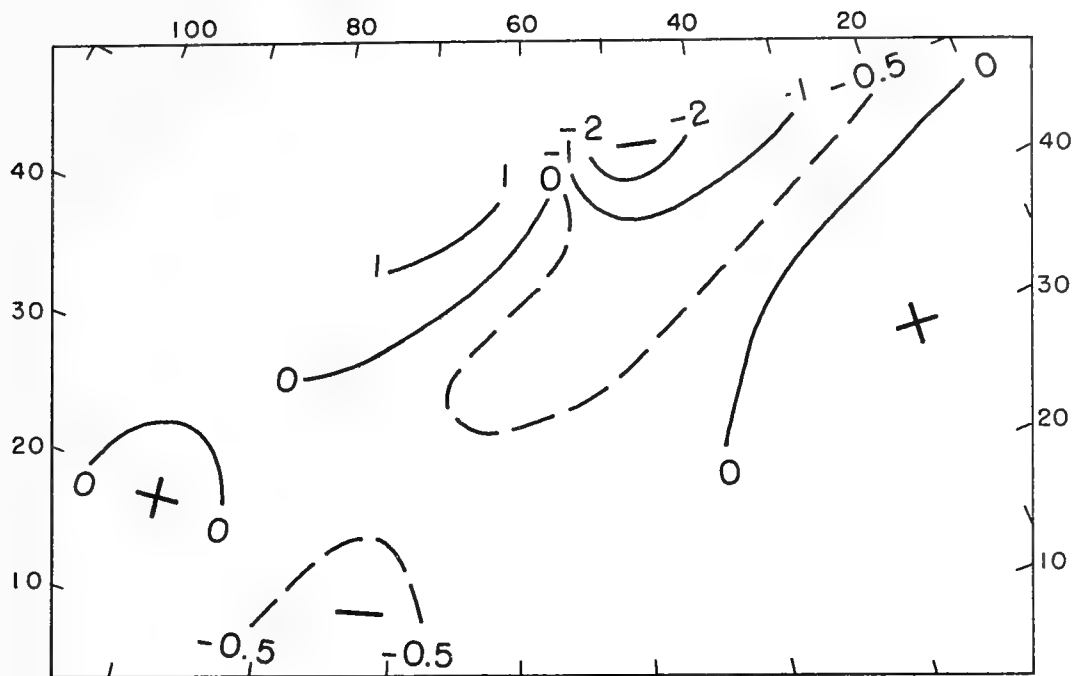
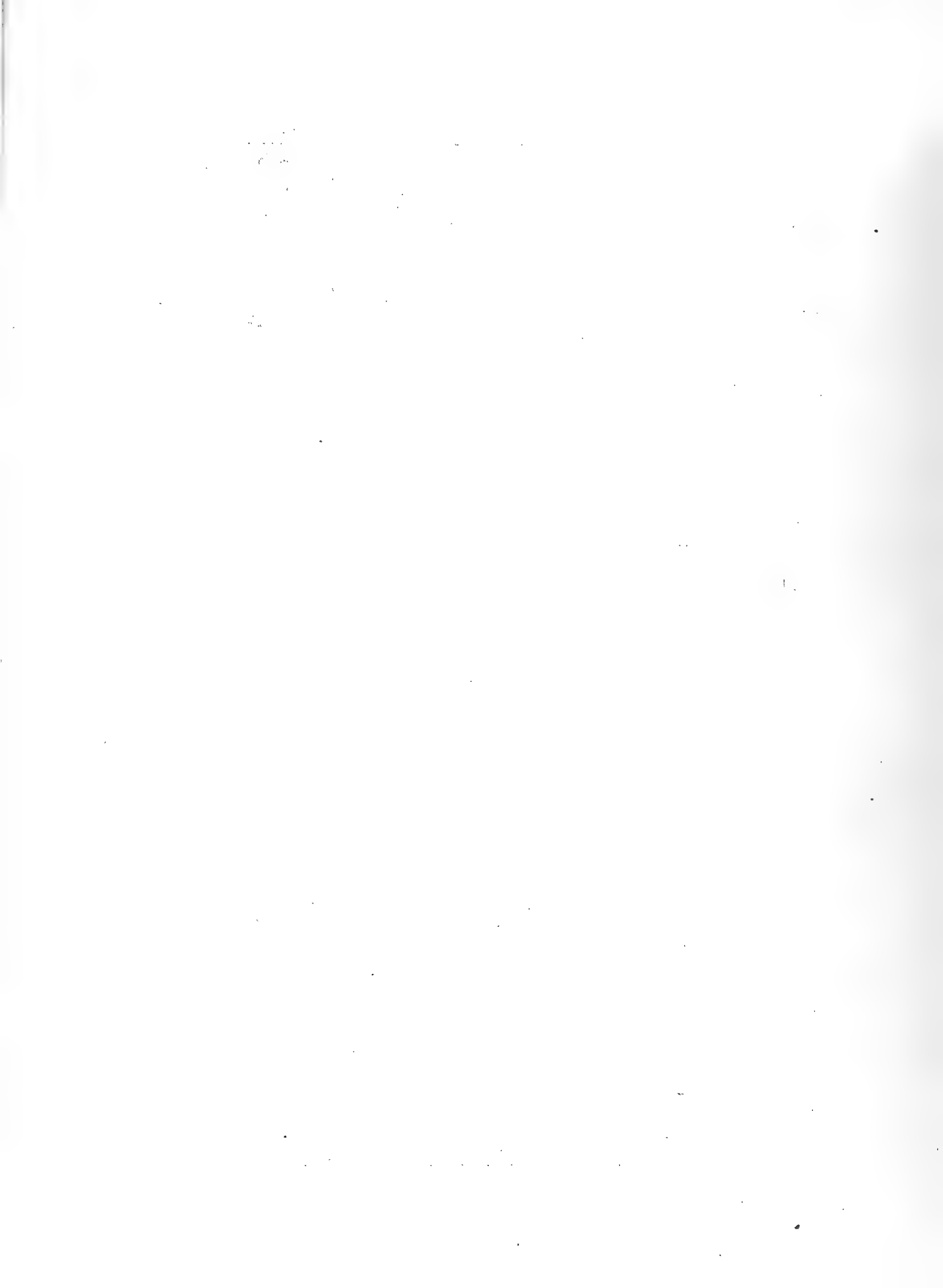
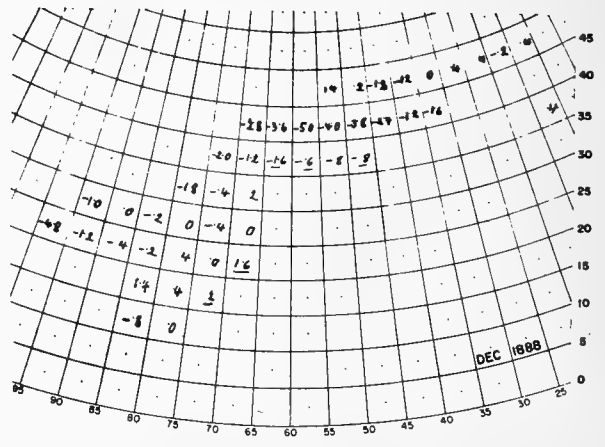
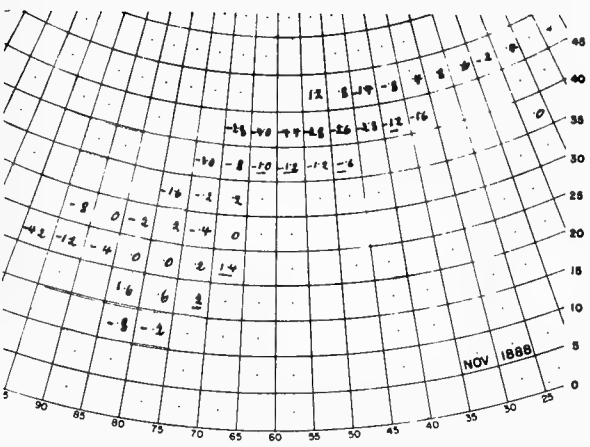
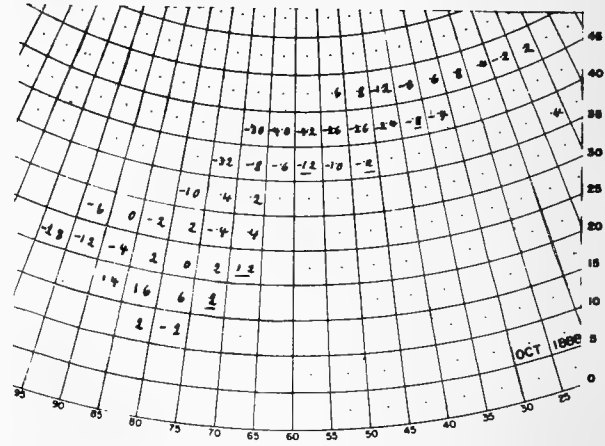
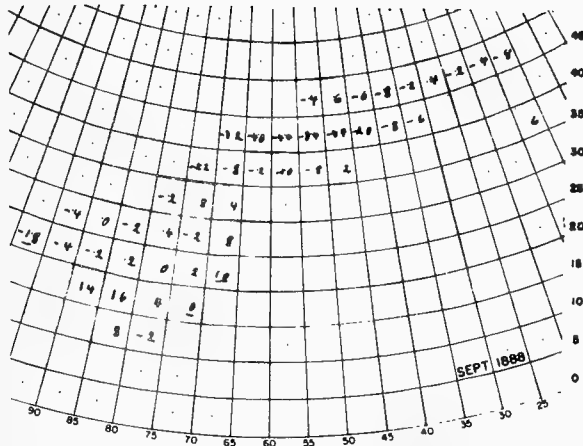
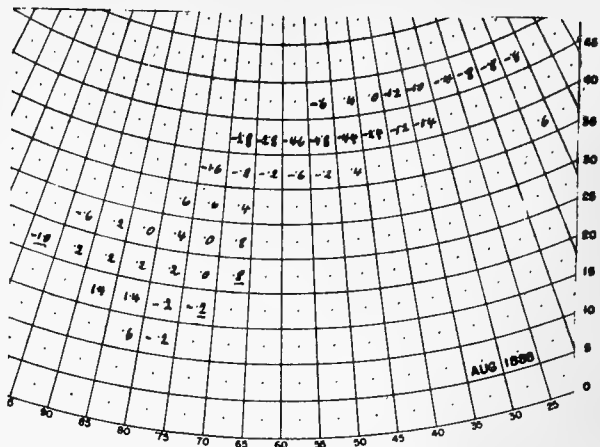
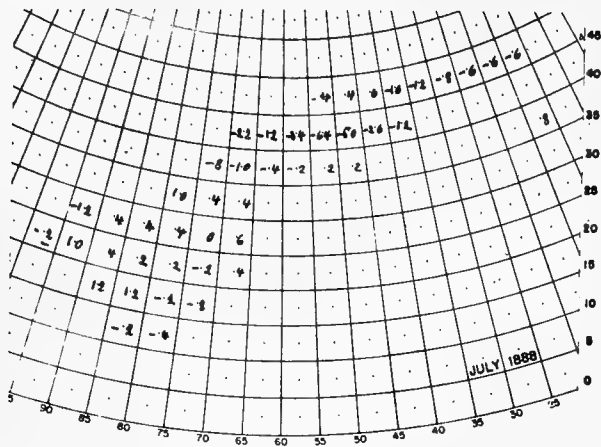


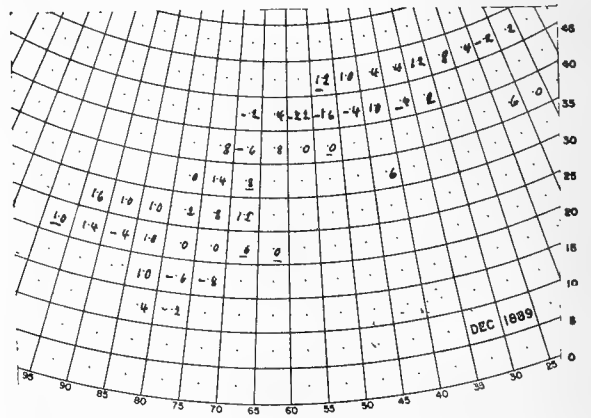
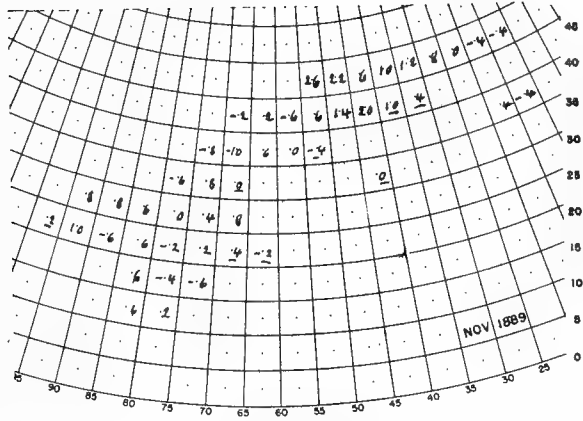
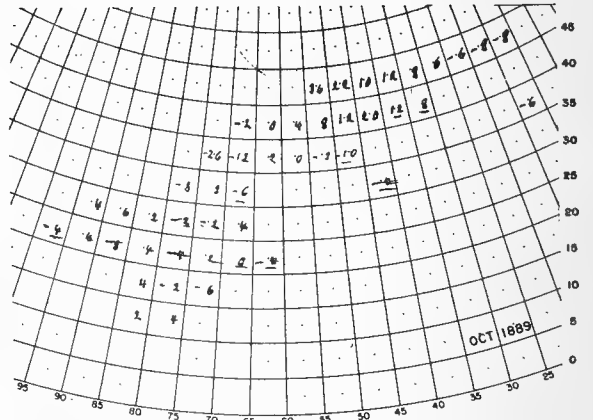
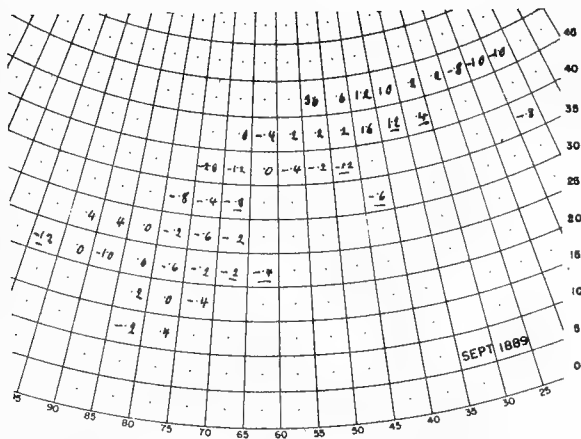
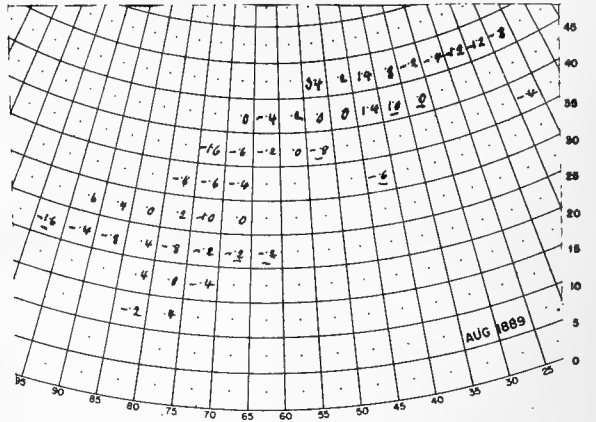
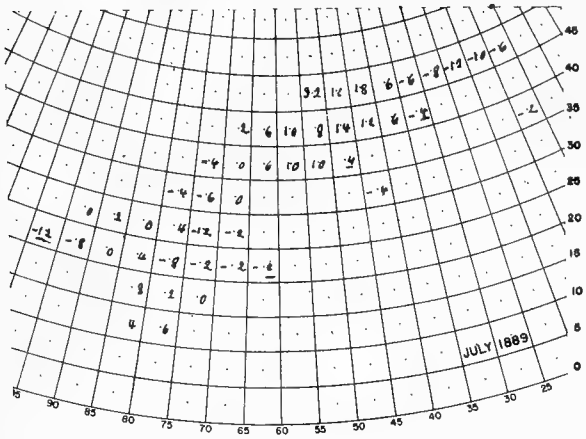
Figure 11

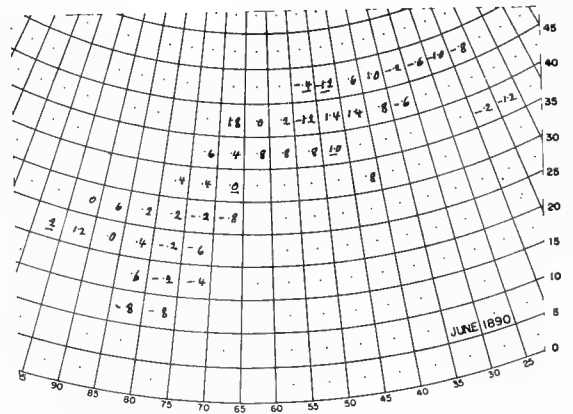
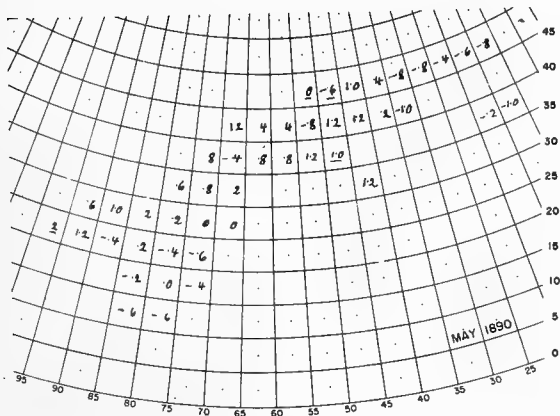
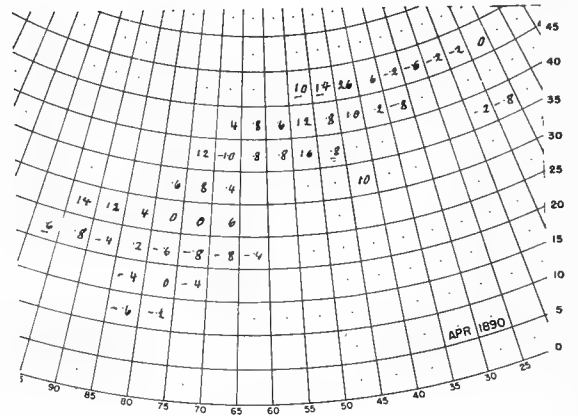
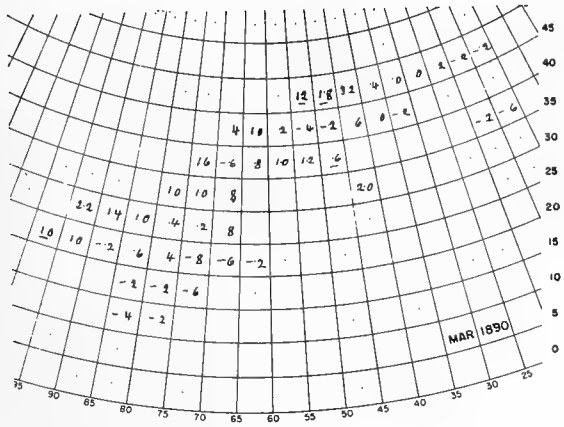
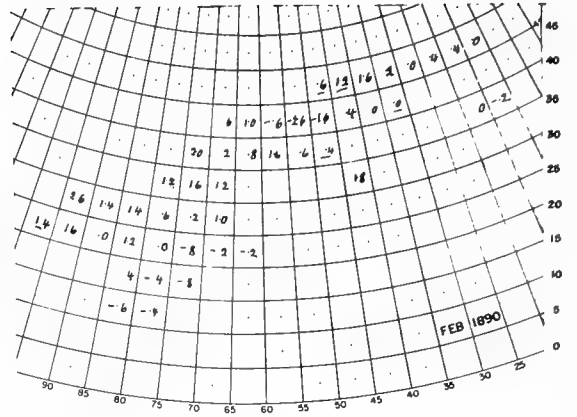
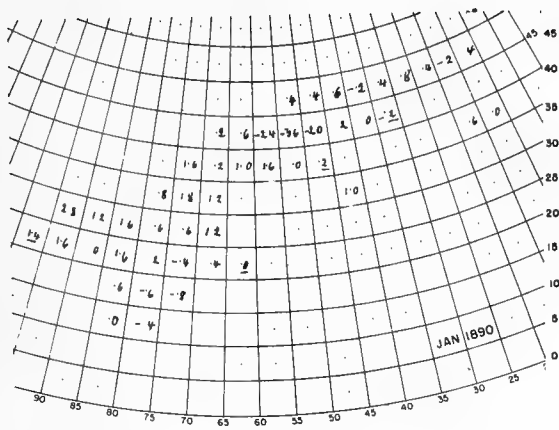
Sea surface temperature anomalies (°F)
for September. Top: mean for 1911-1915;
bottom: mean for 1932-1936.

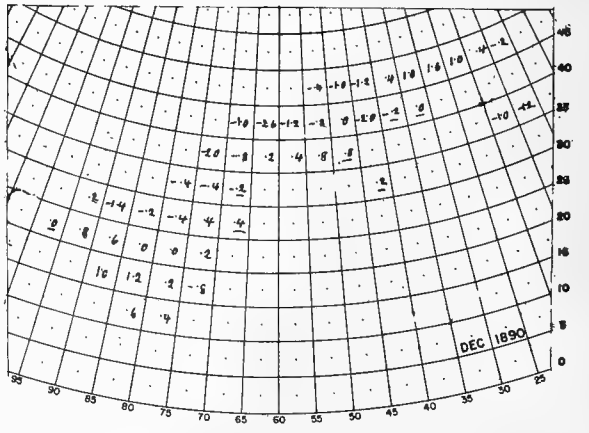
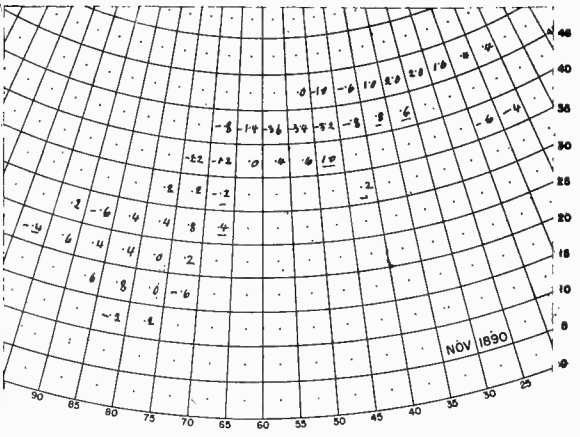
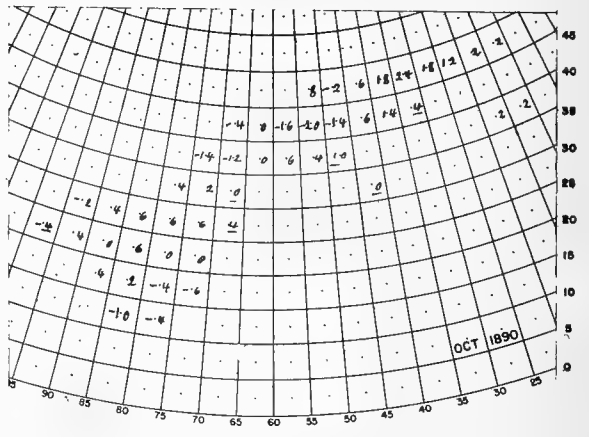
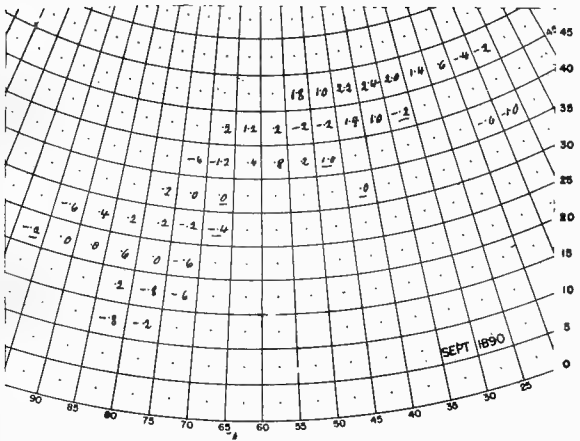
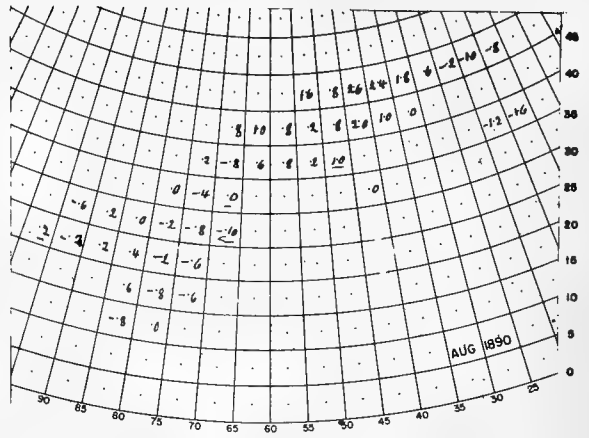
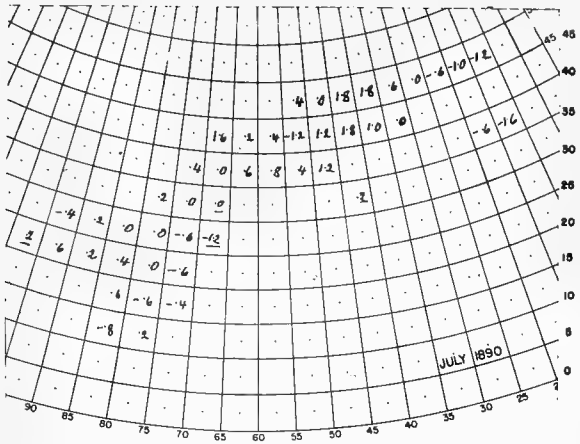


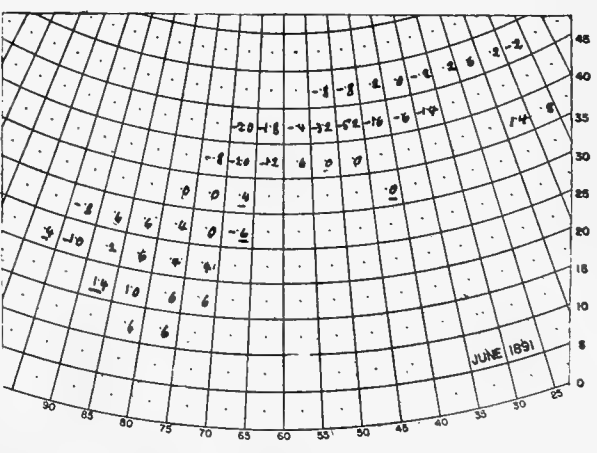
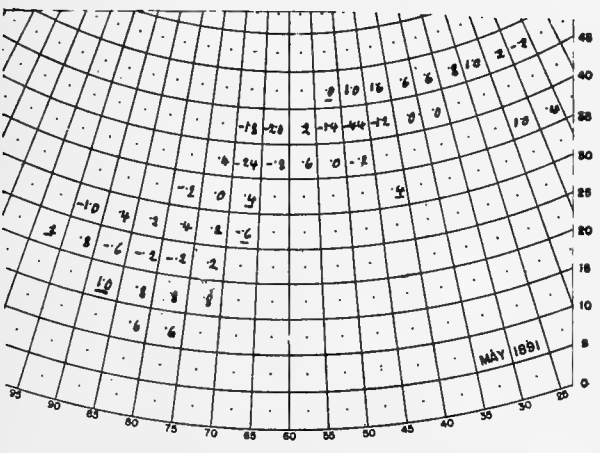
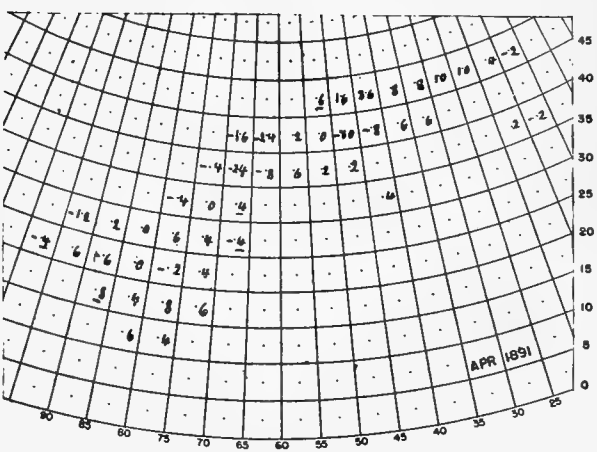
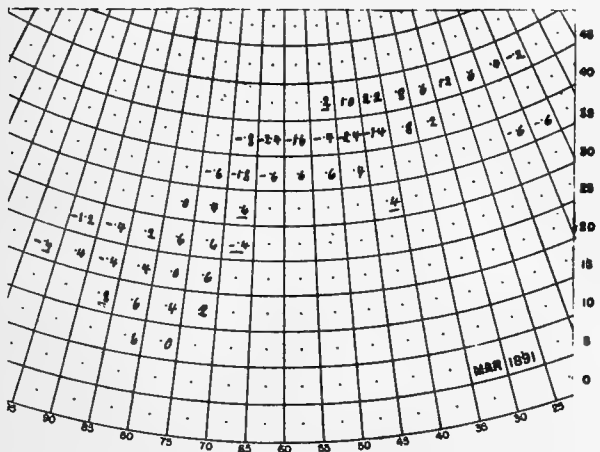
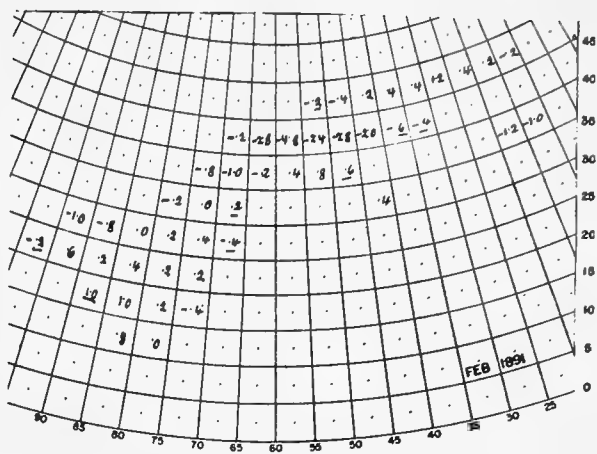
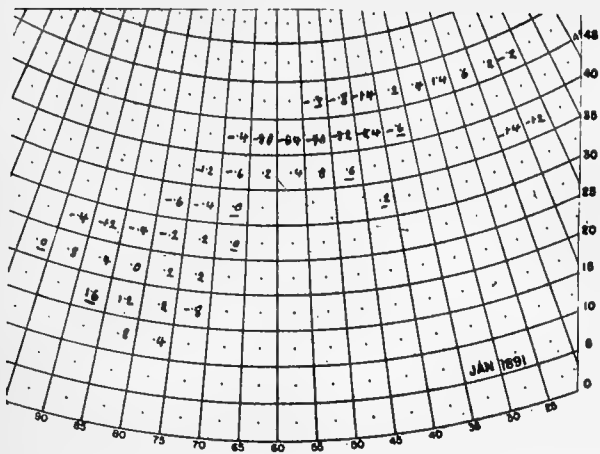


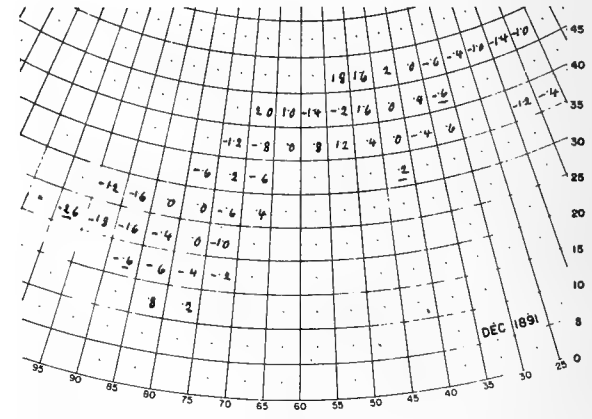
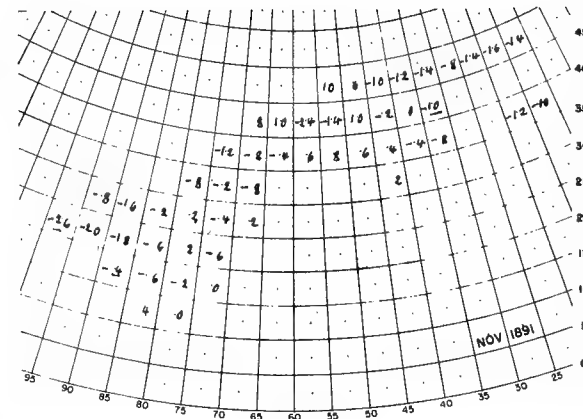
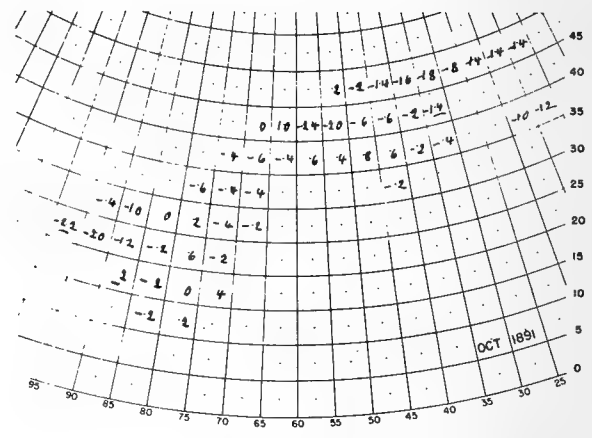
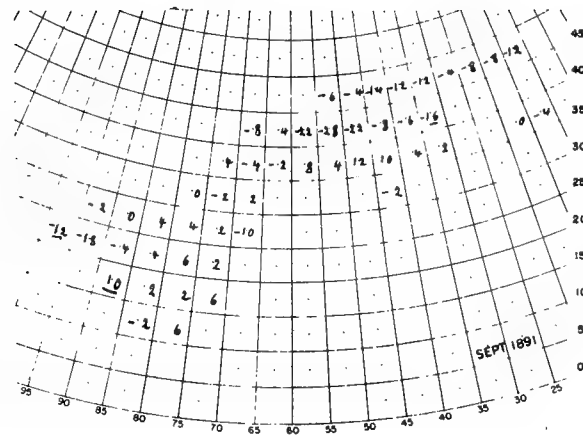
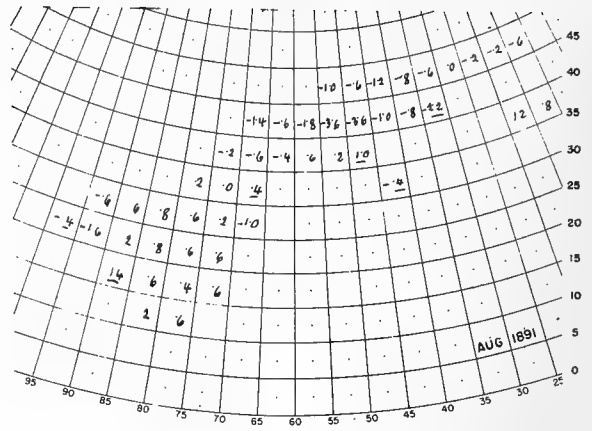
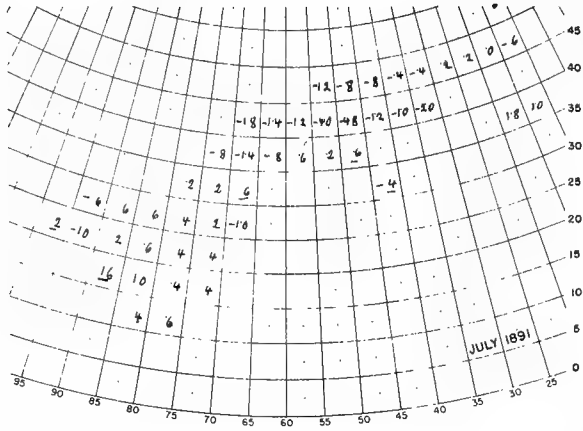


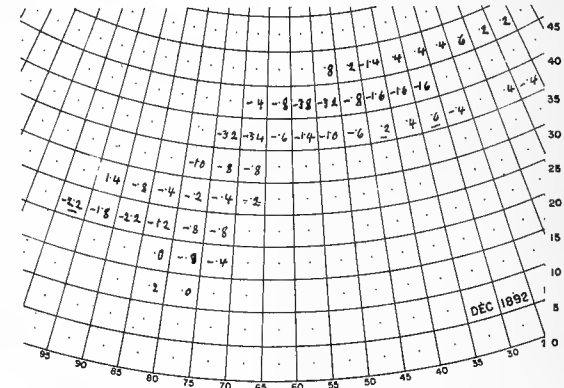
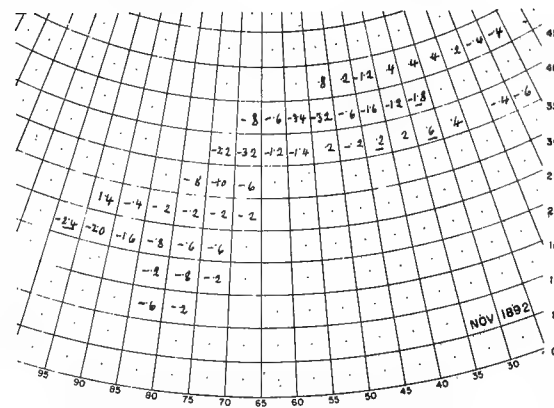
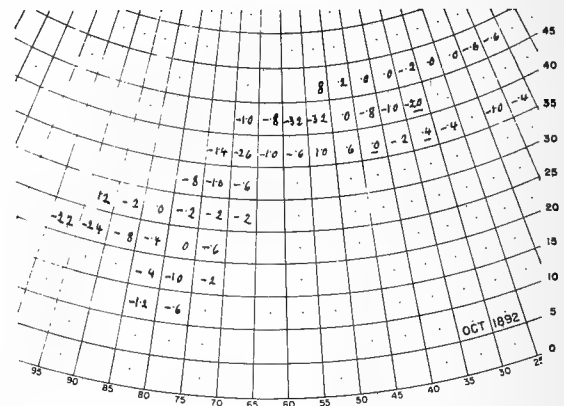
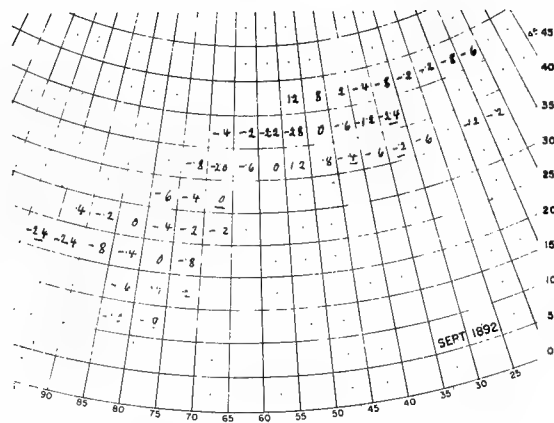
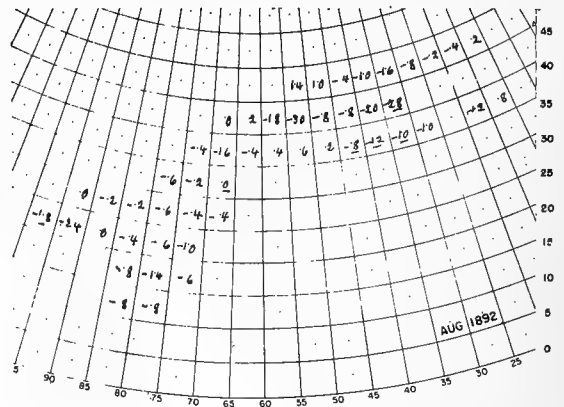
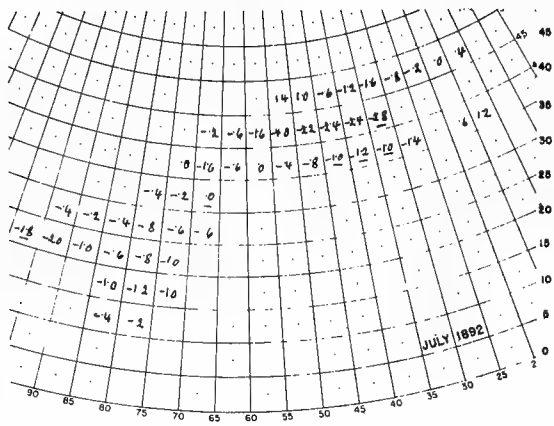




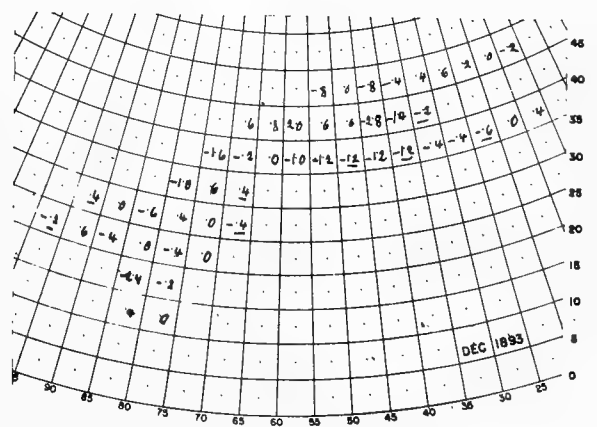
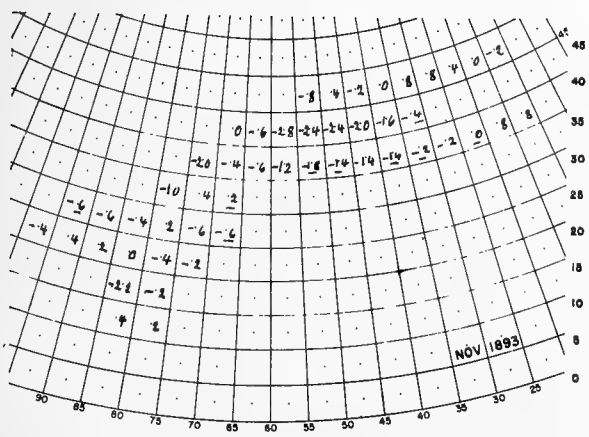
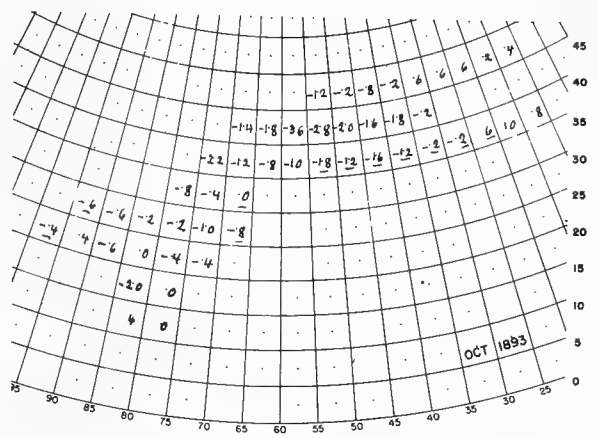
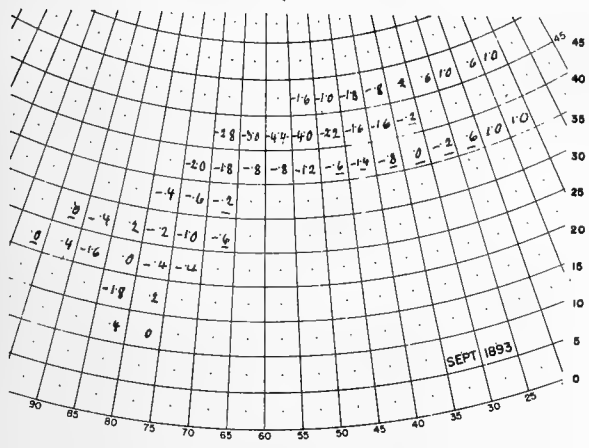
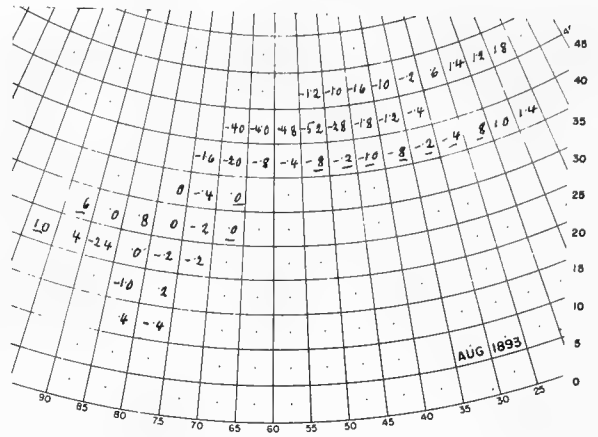
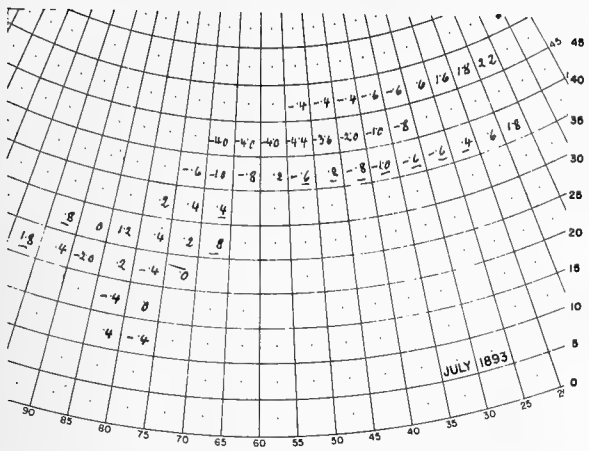




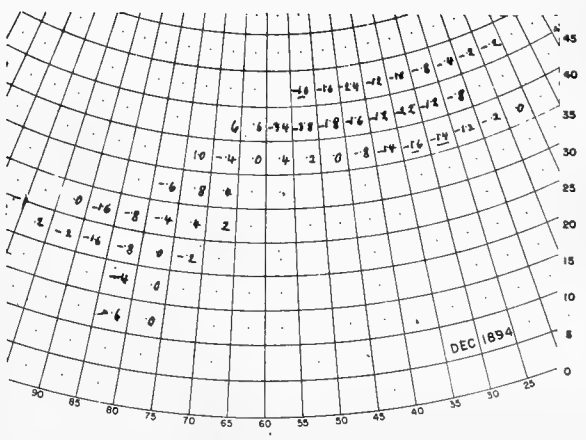
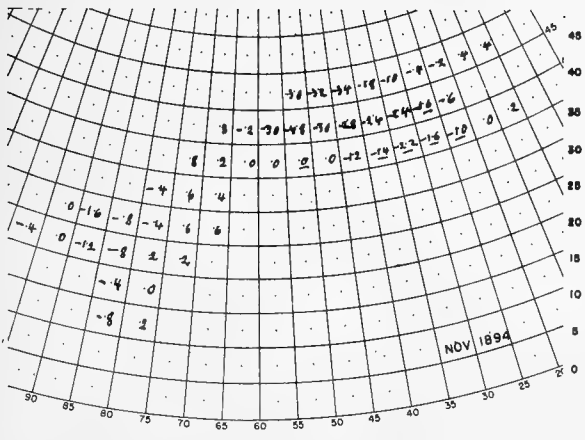
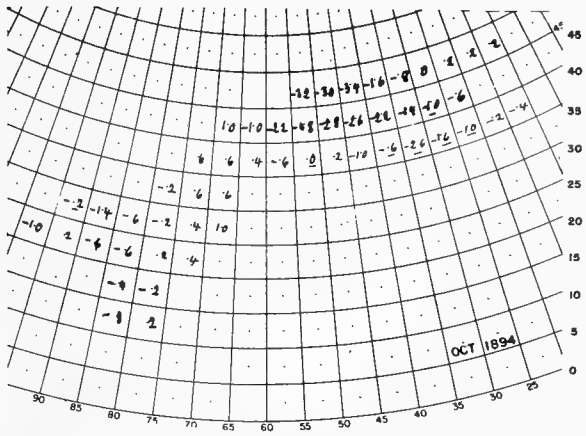
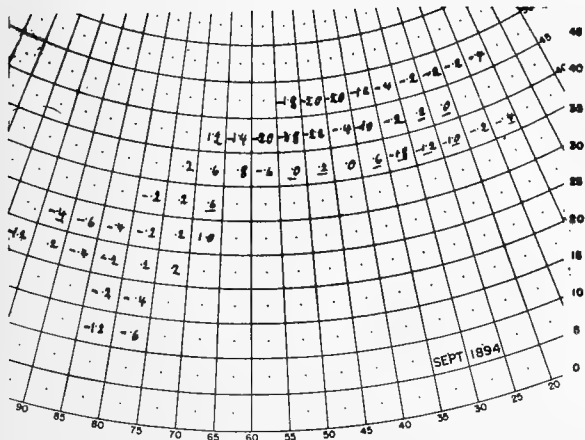
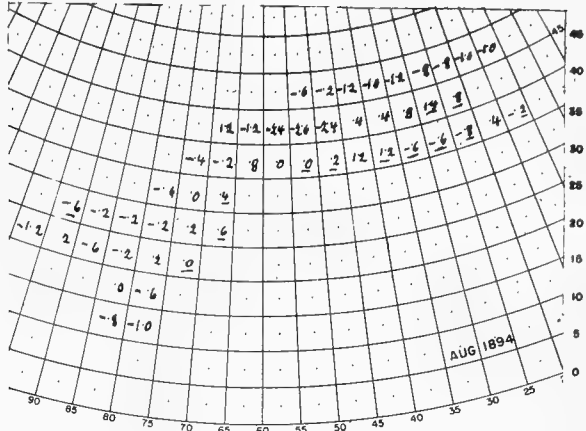
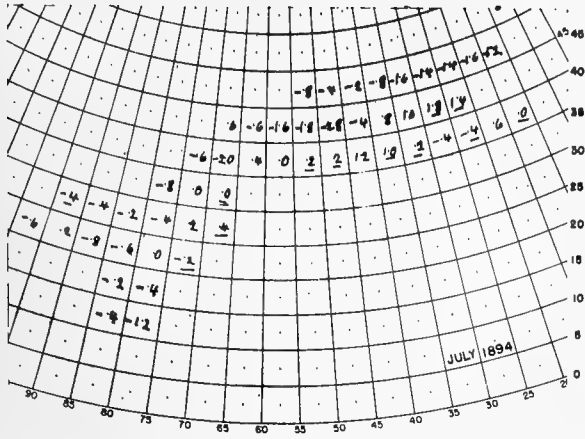




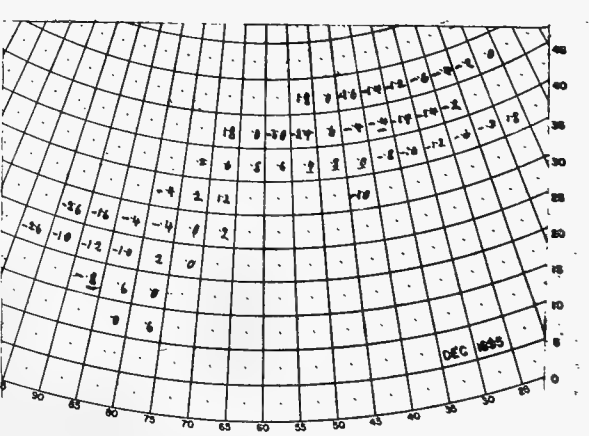
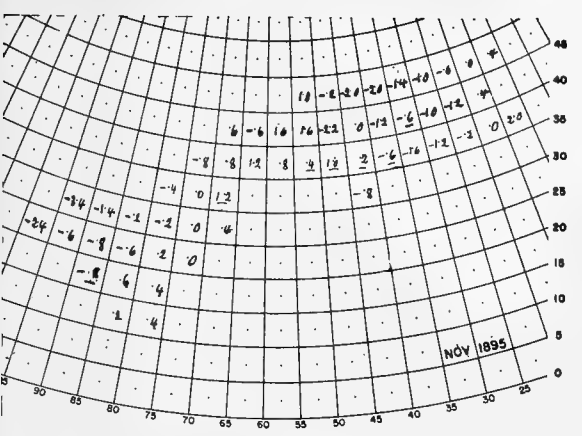
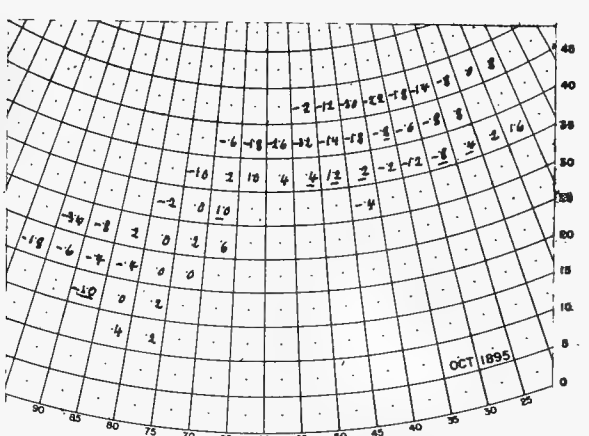
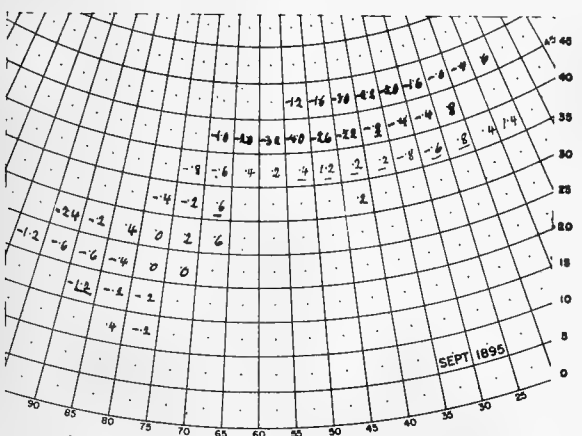
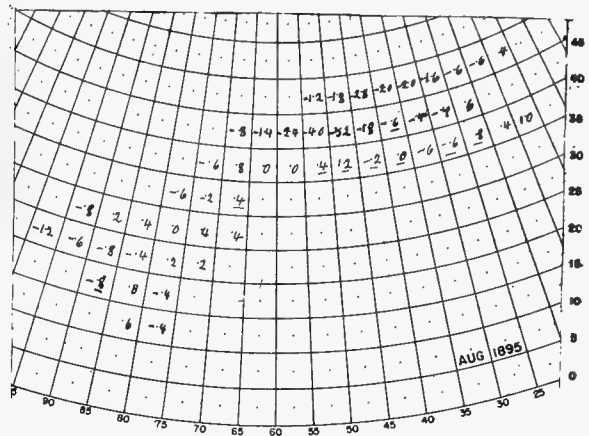
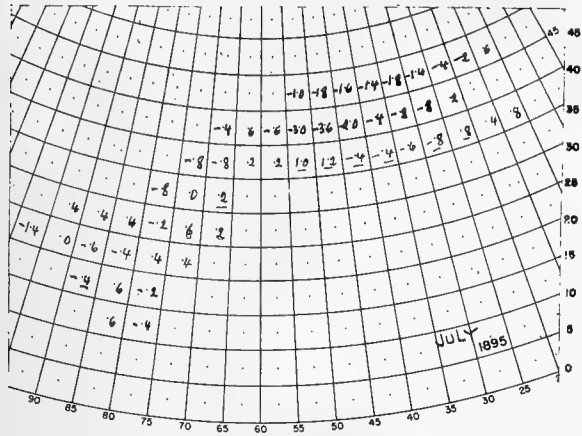
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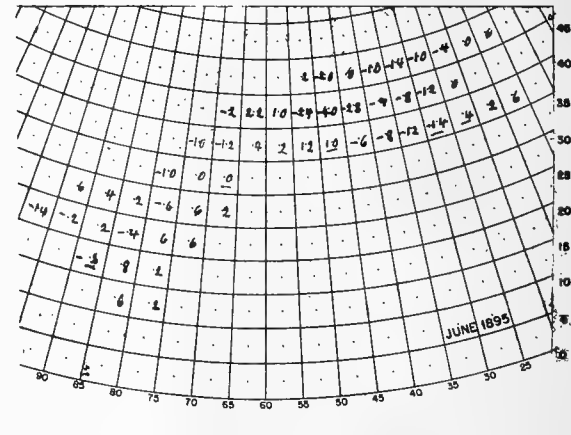
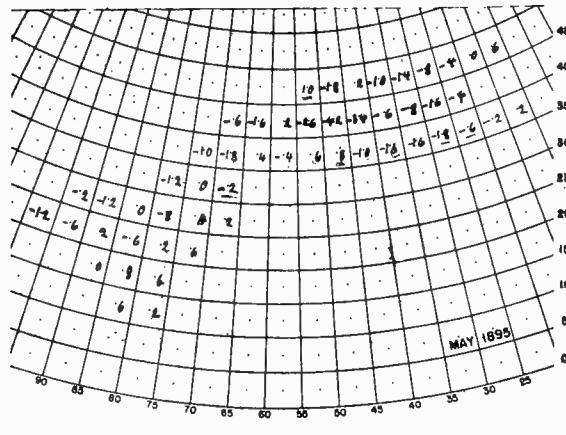
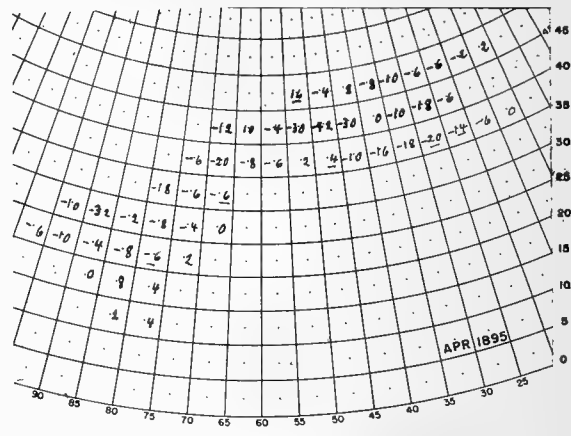
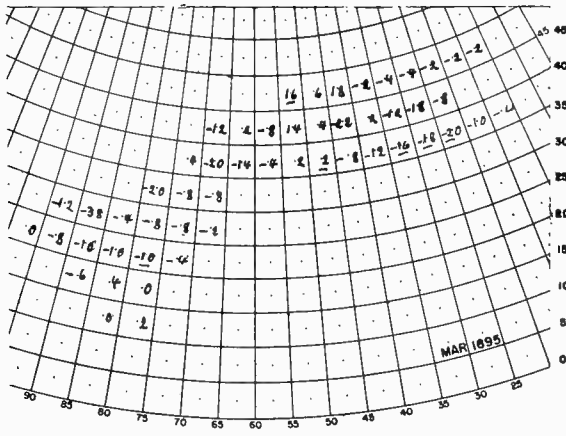
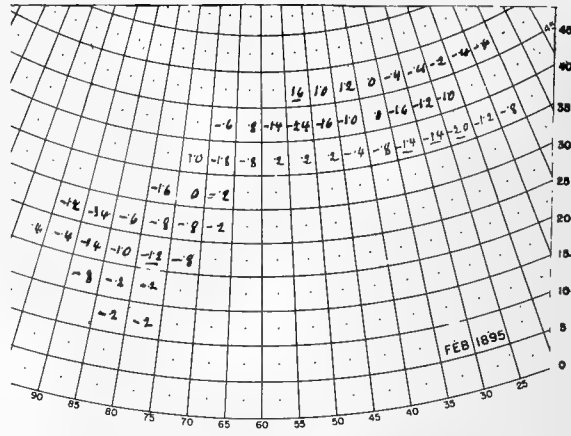
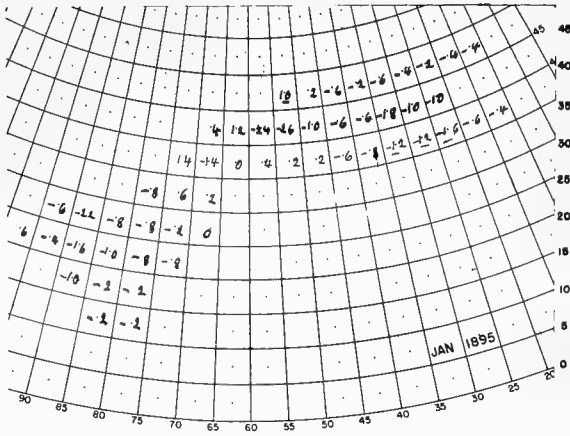


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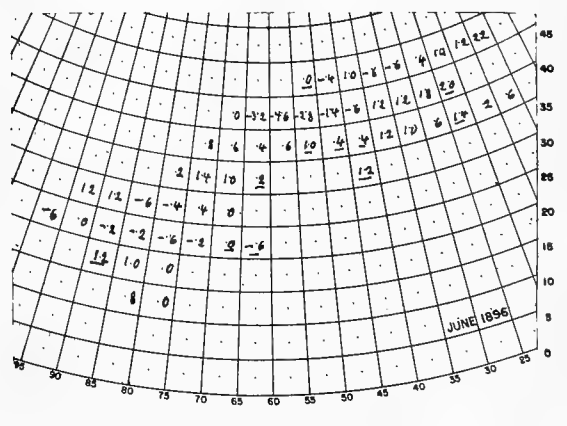
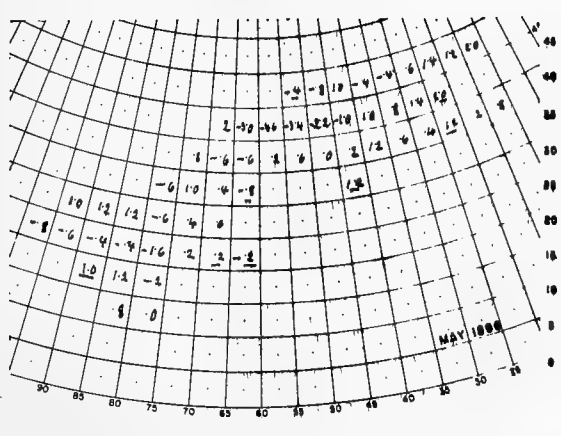
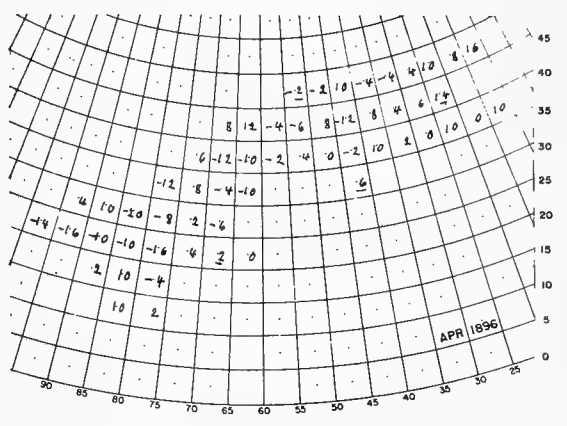
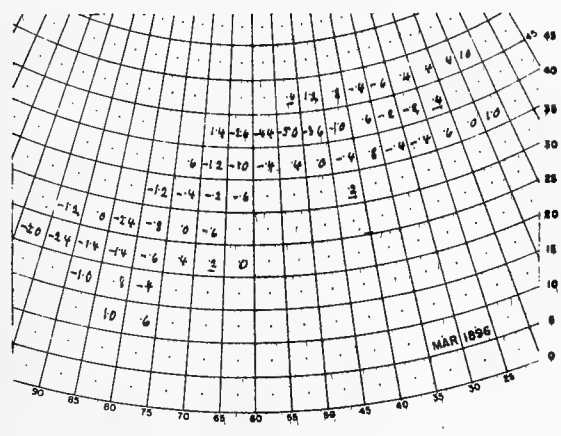
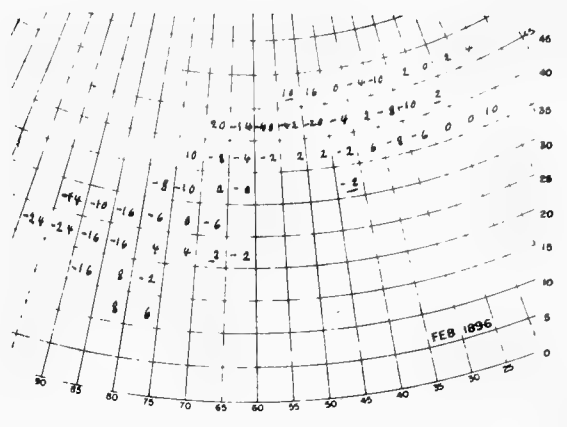
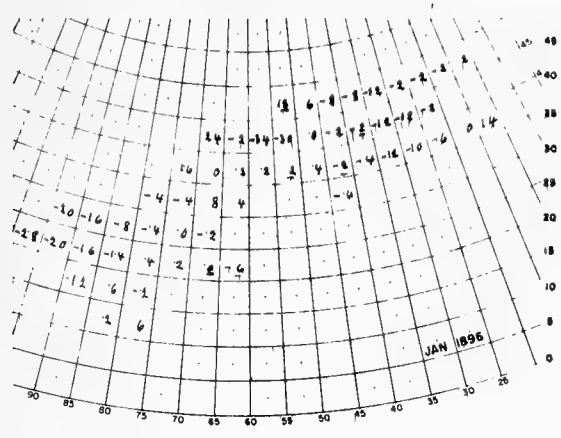


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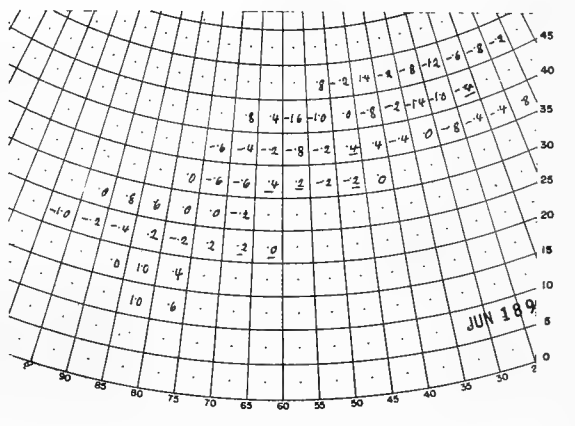
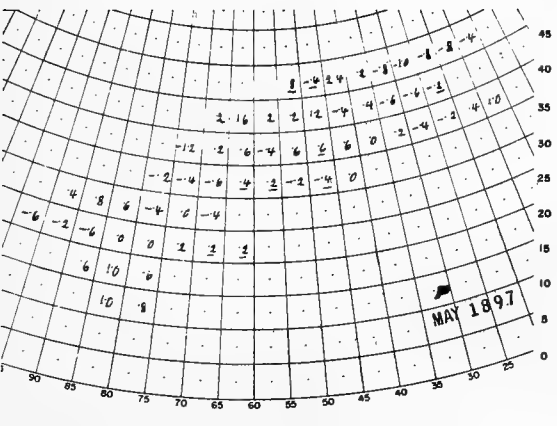
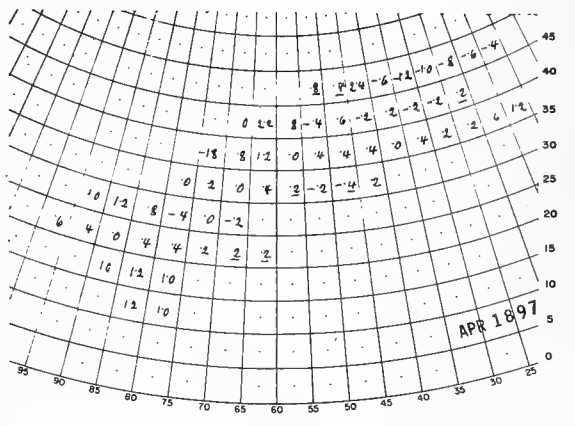
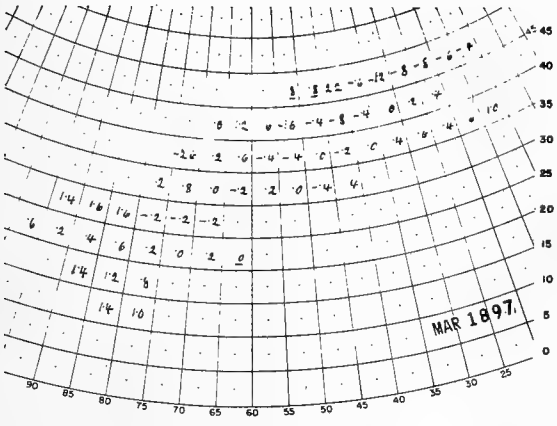
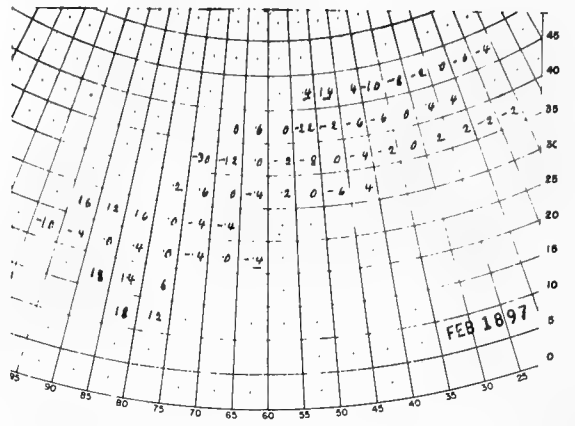
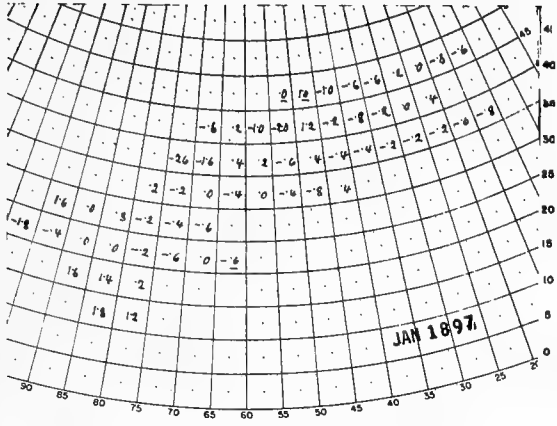


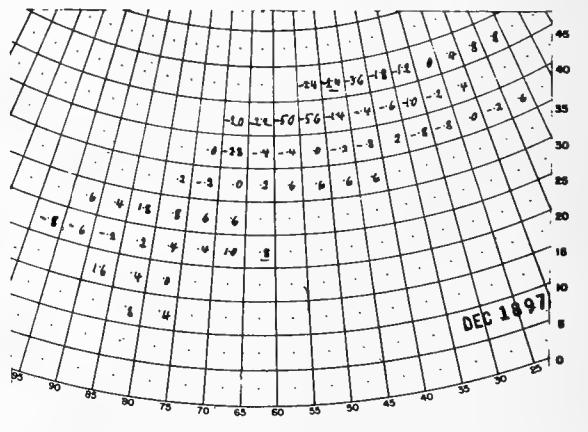
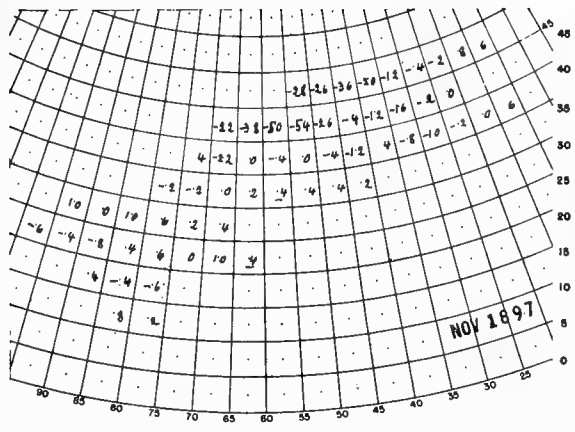
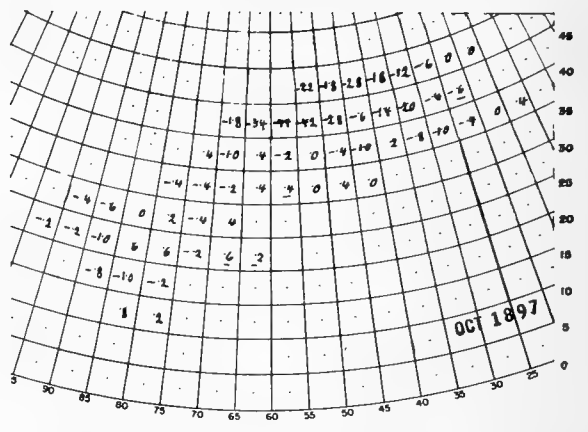
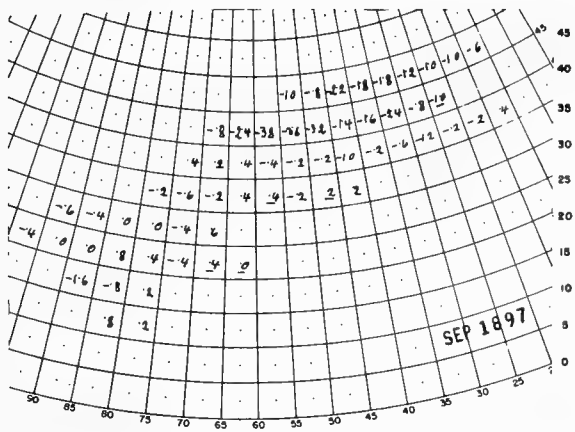
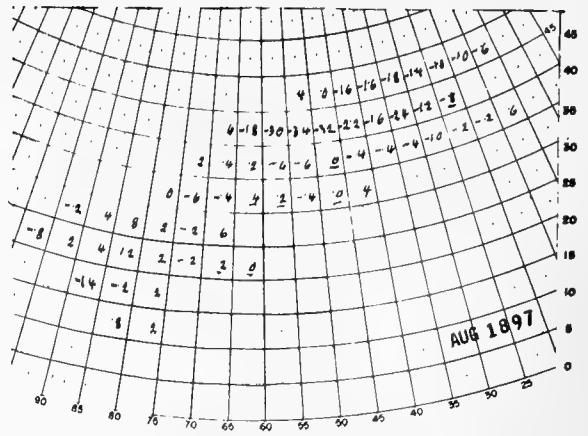
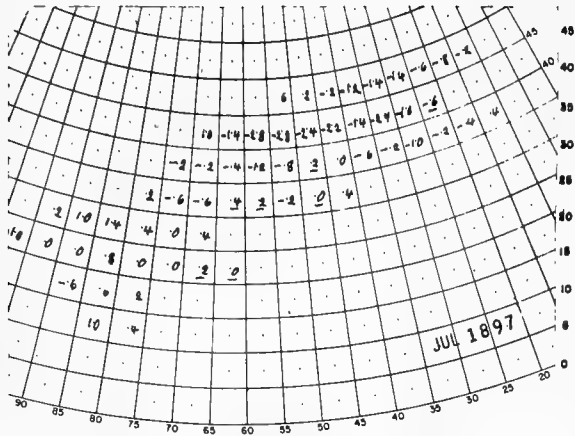


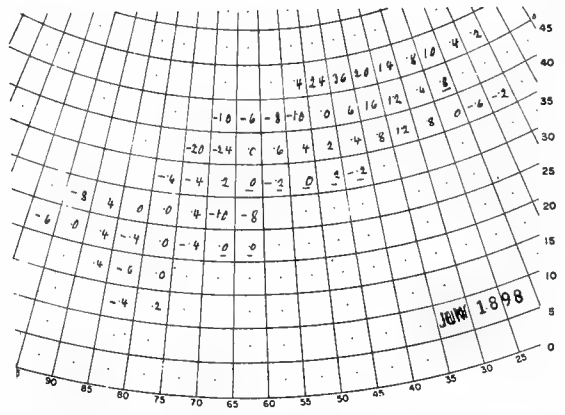
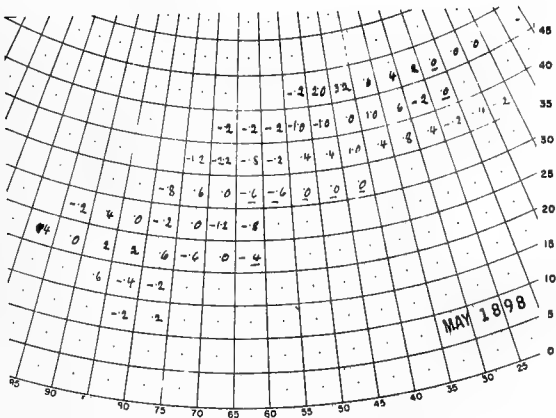
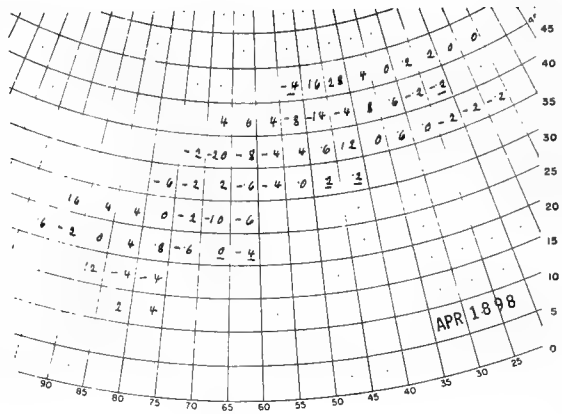
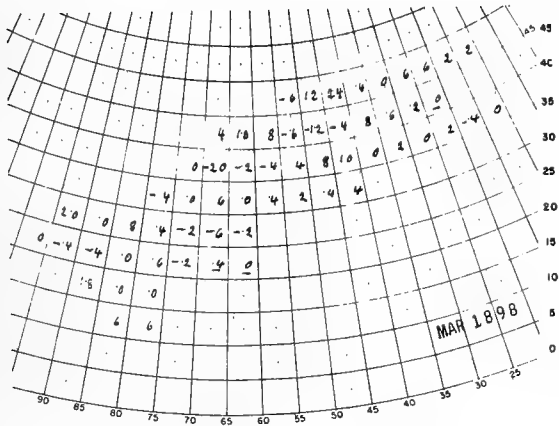
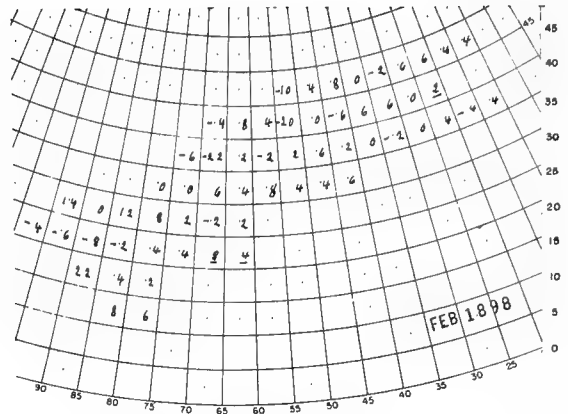
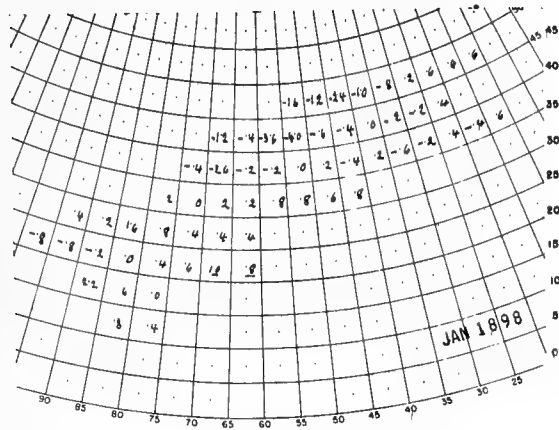
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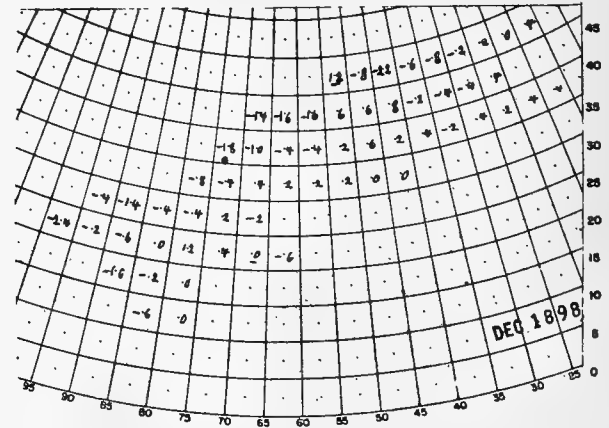
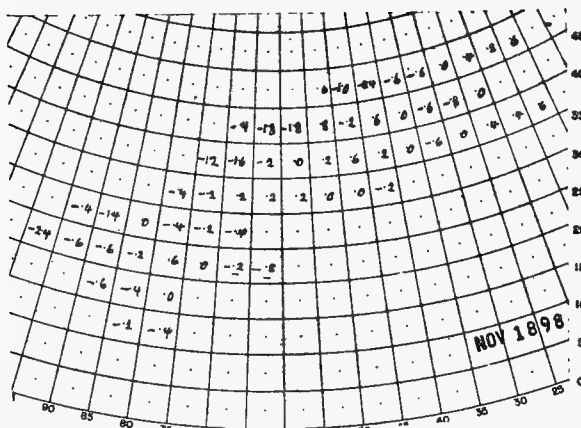
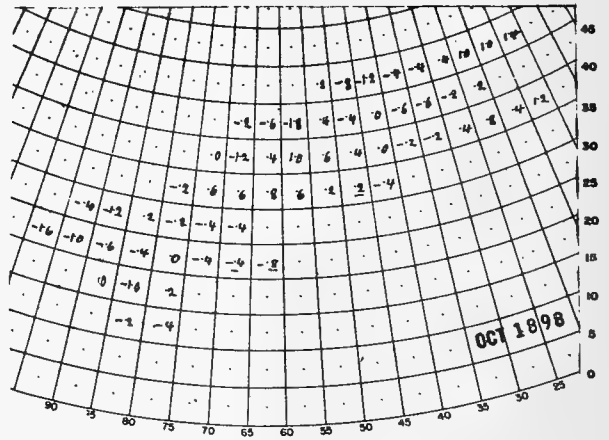
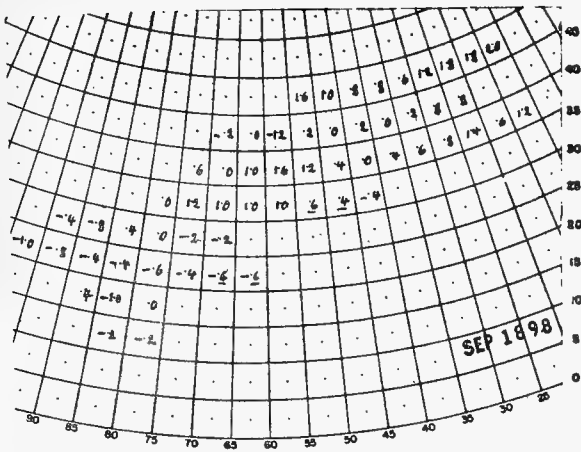
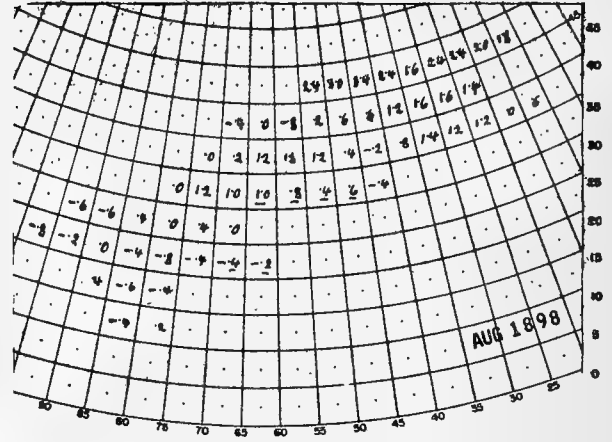
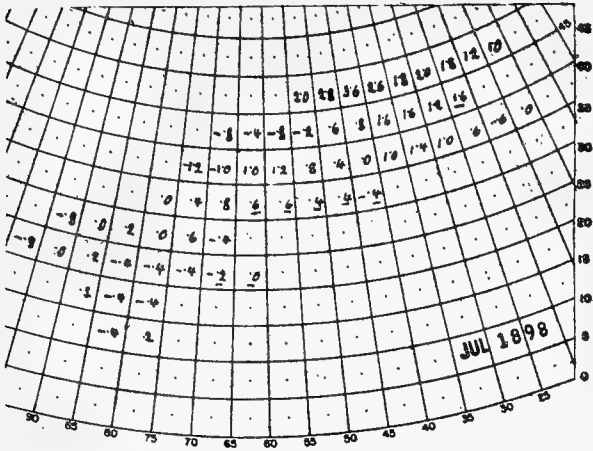


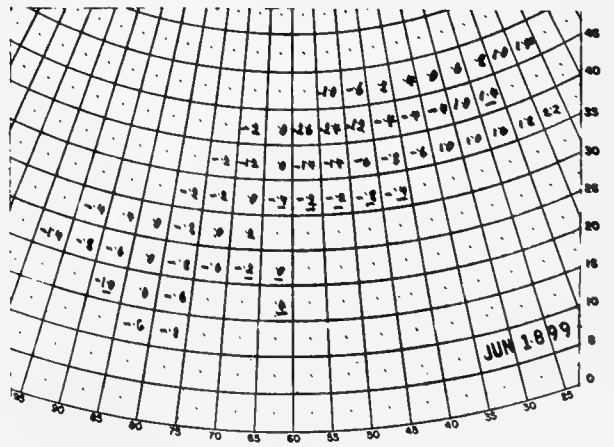
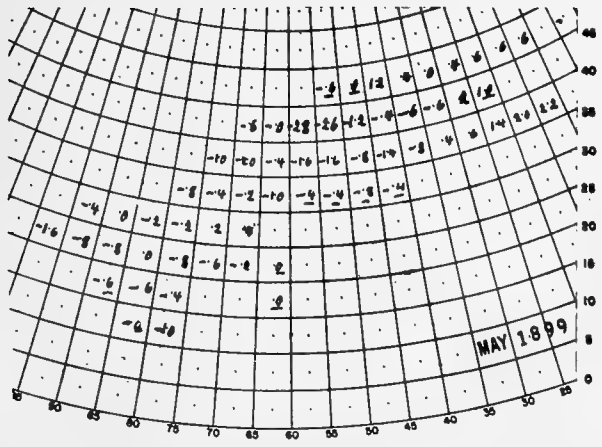
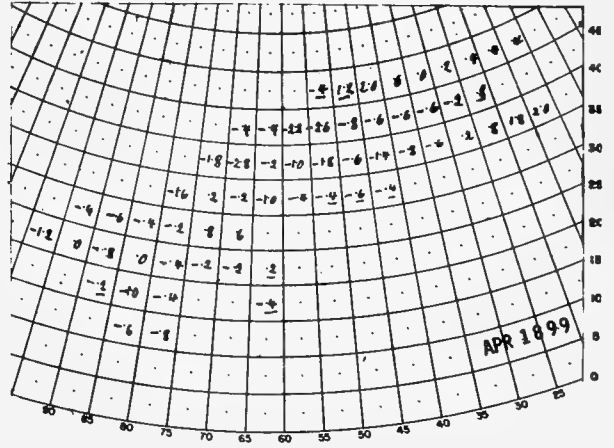
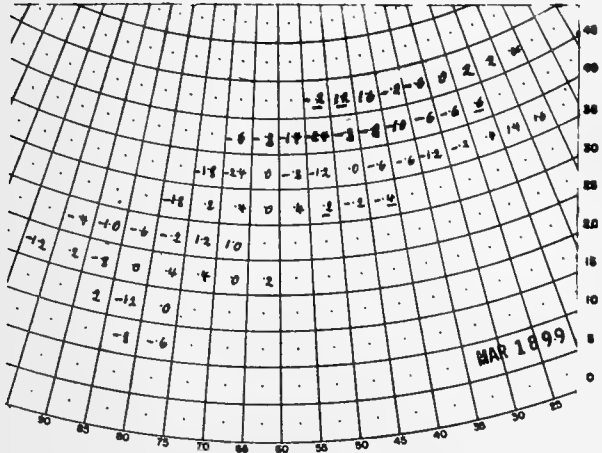
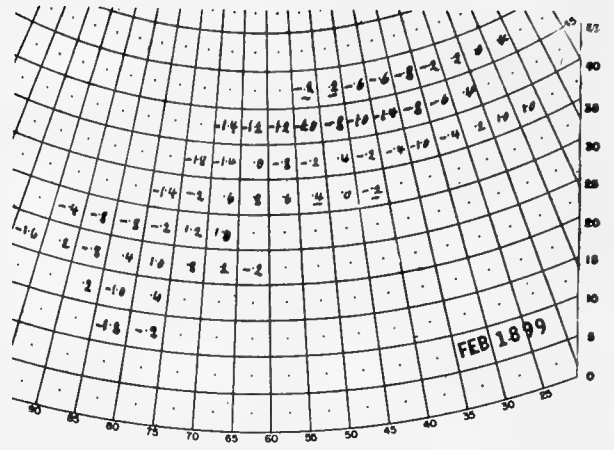
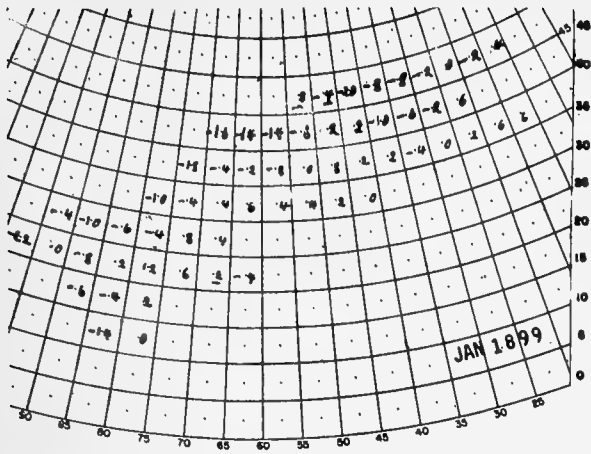
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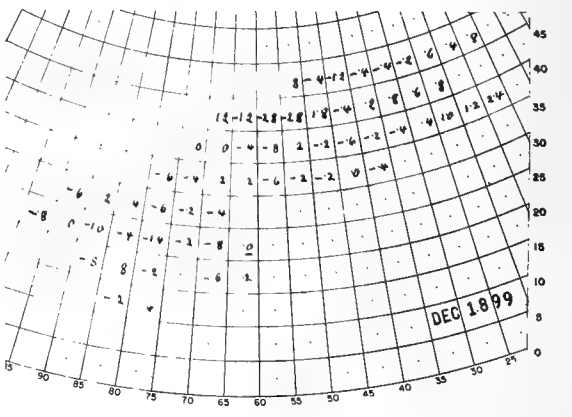
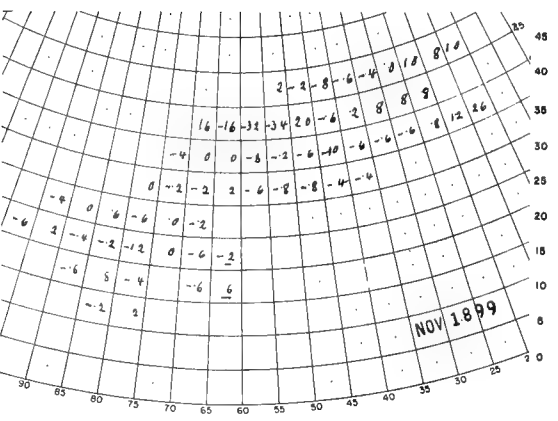
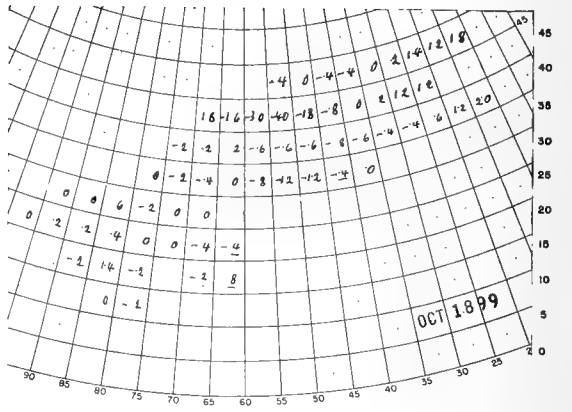
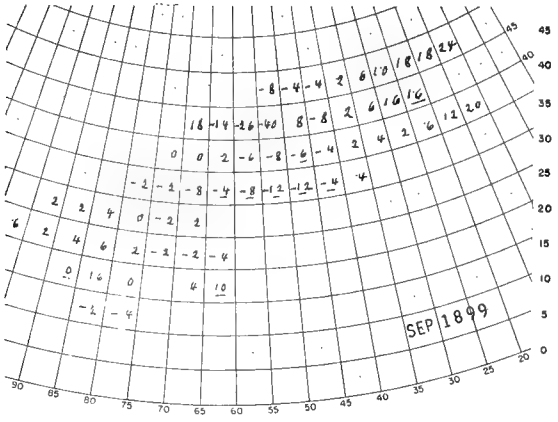
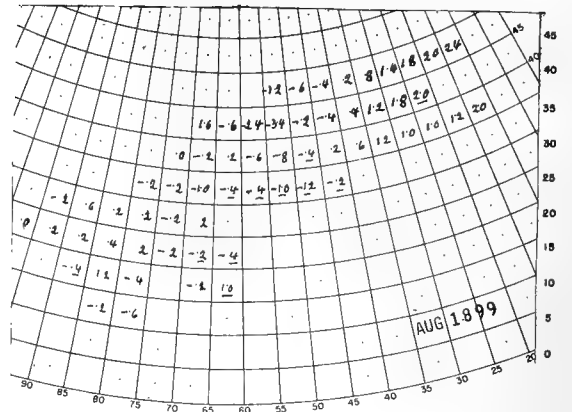
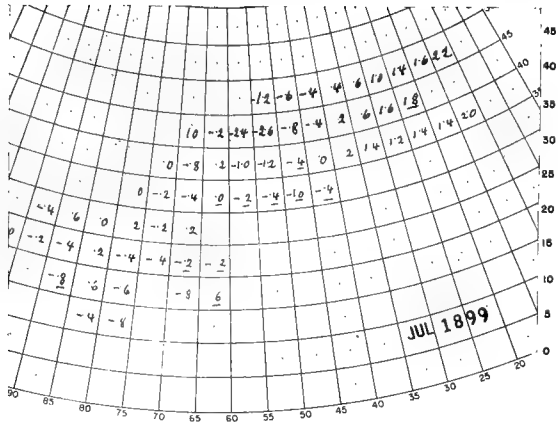


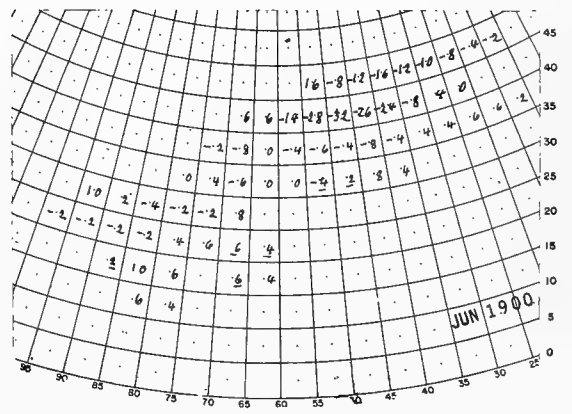
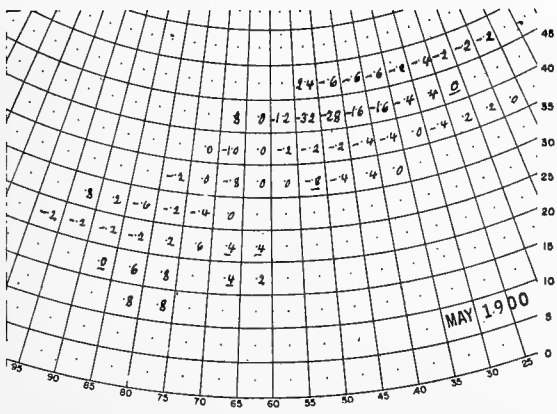
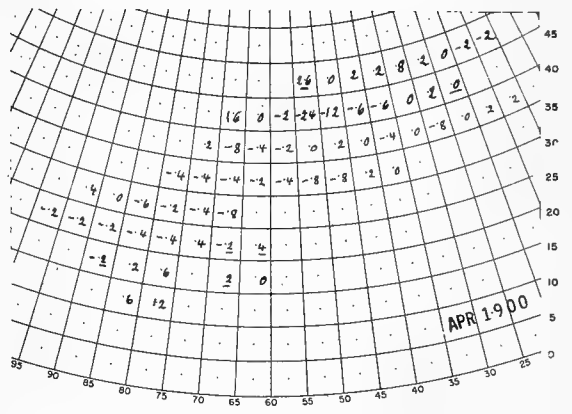
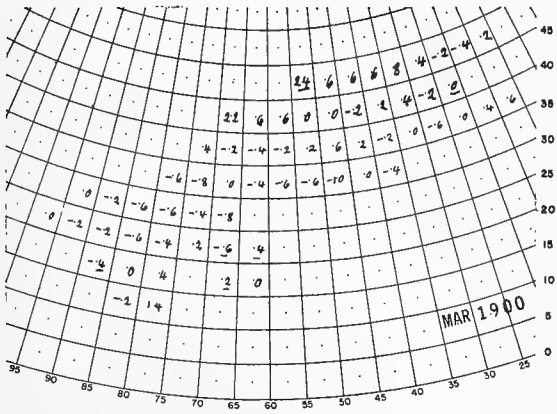
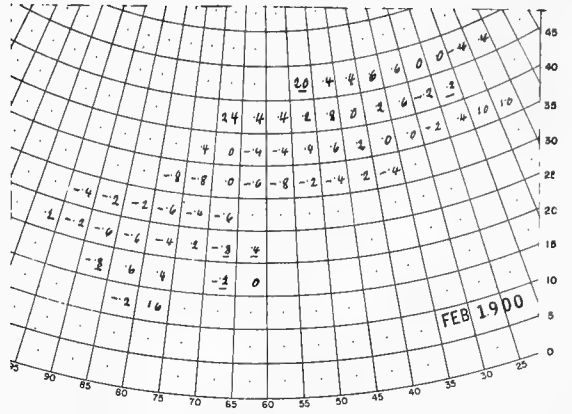
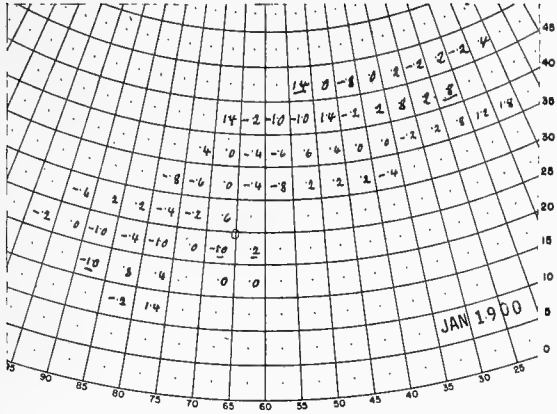


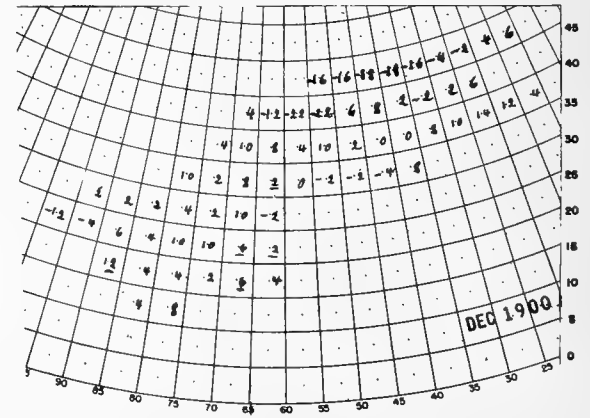
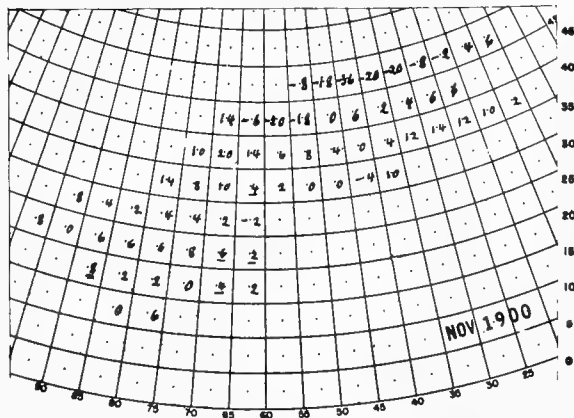
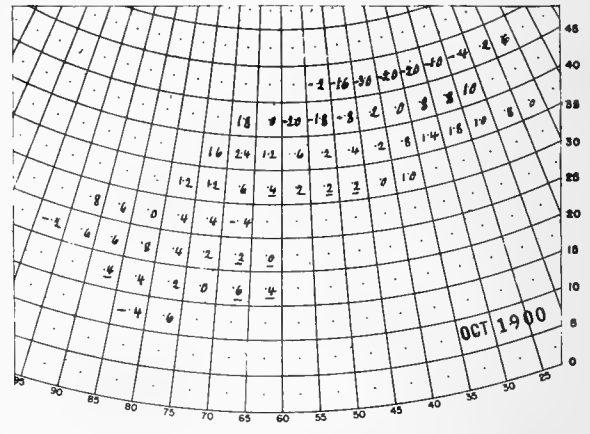
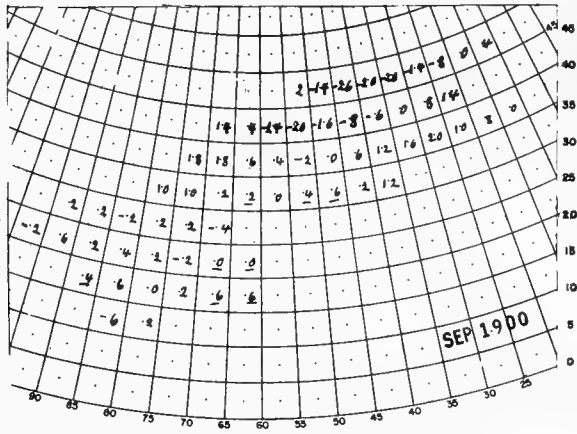
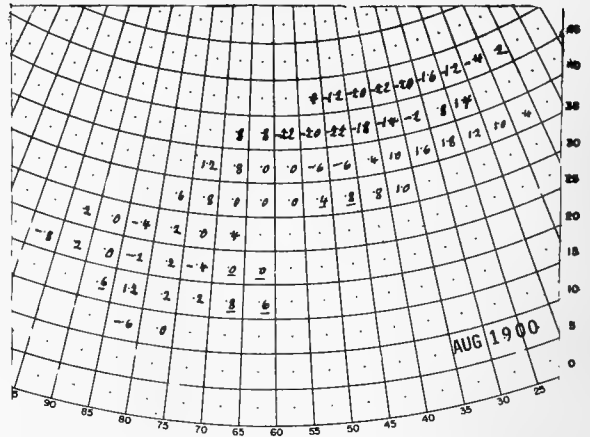
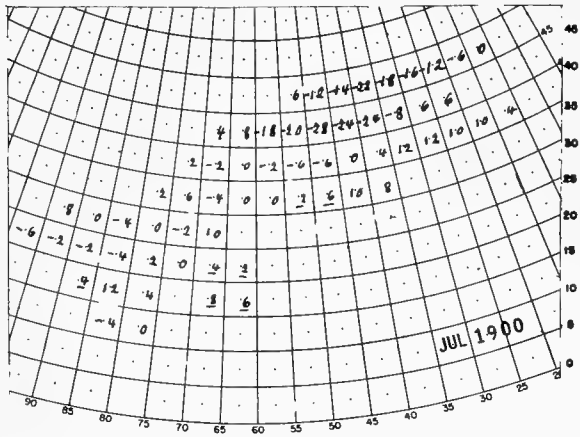


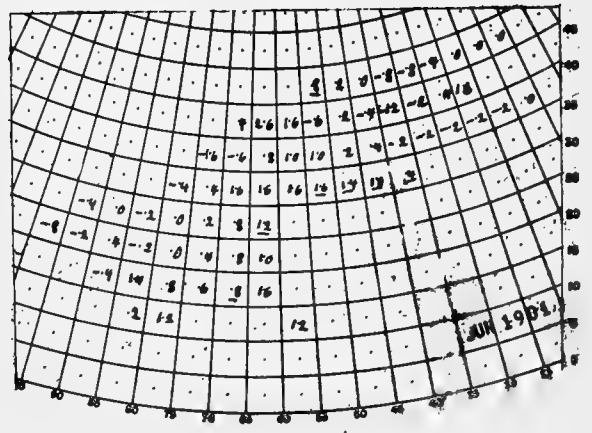
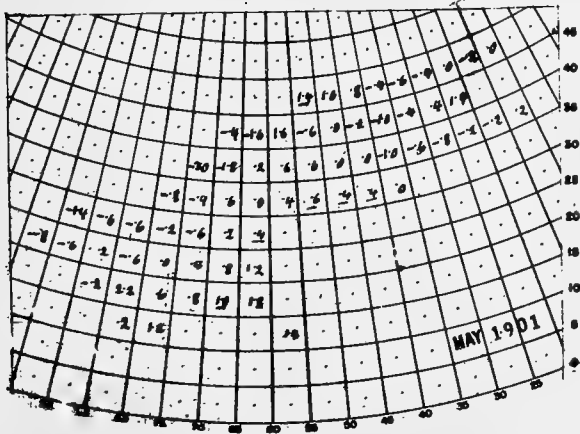
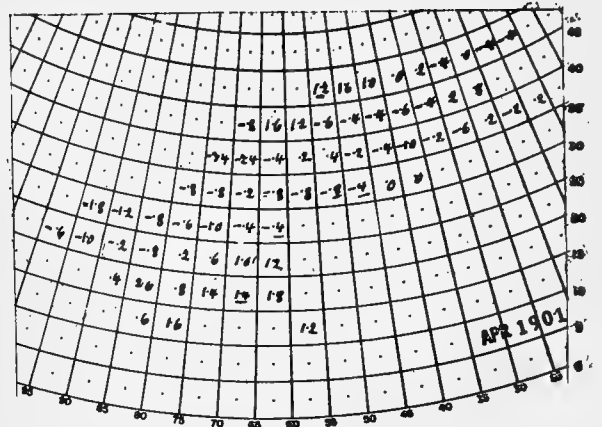
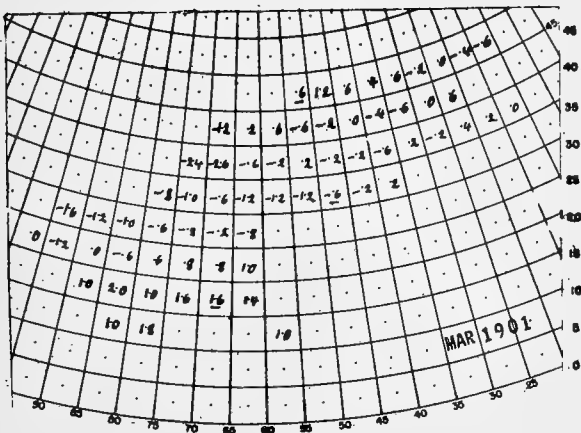
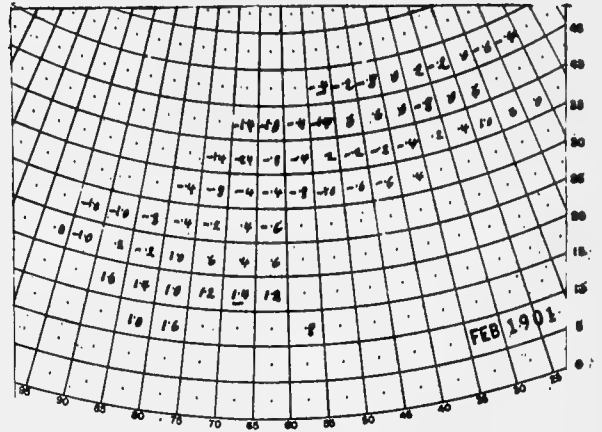
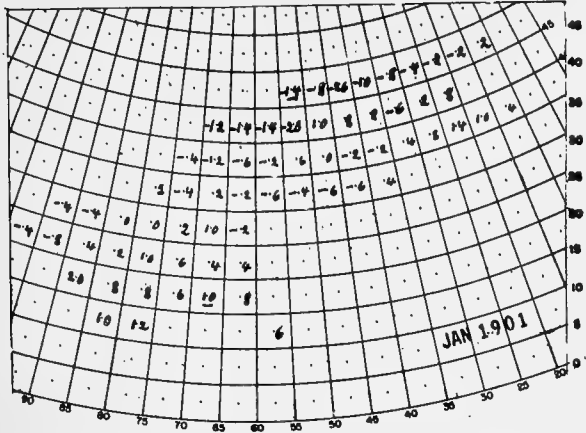


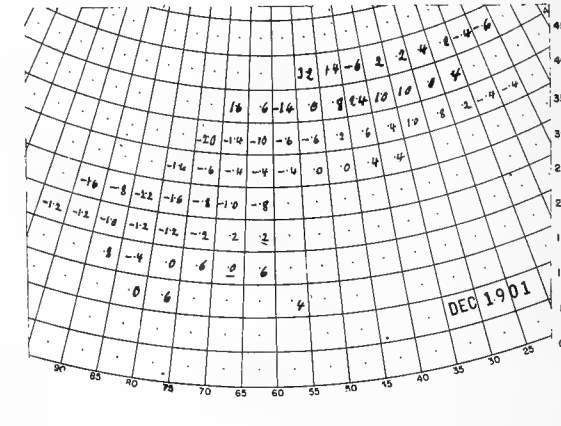
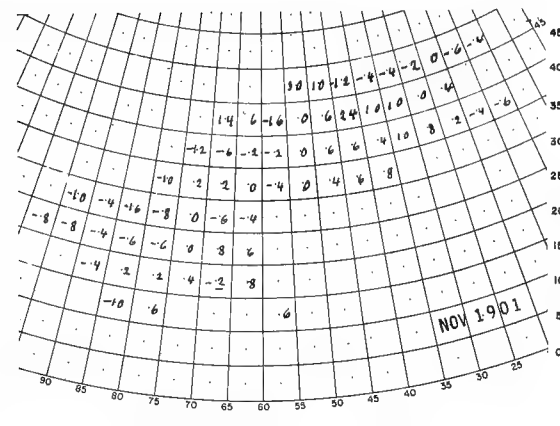
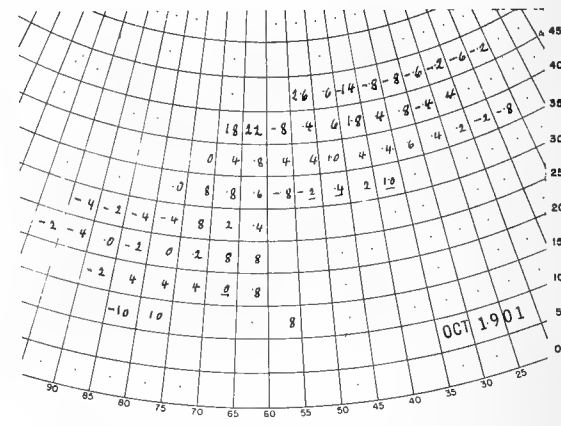
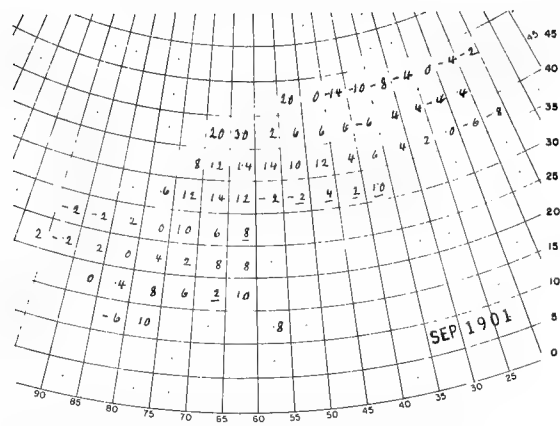
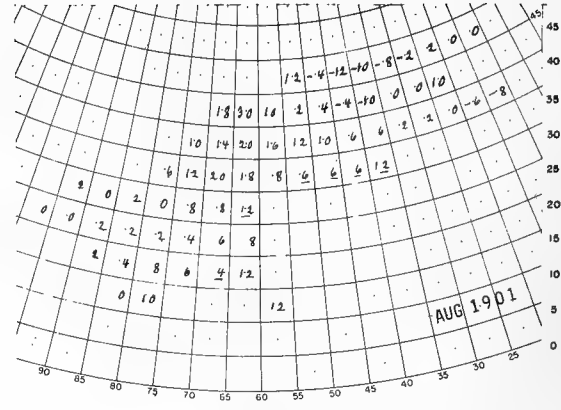
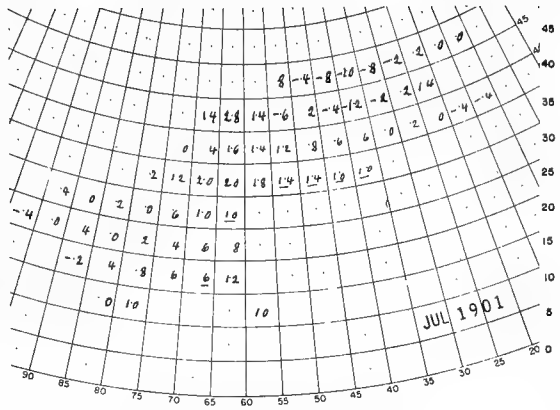


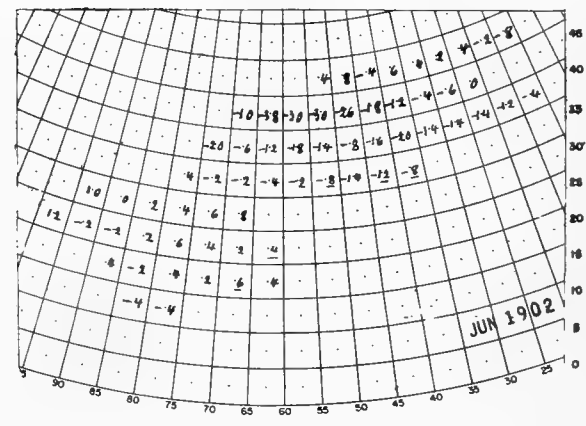
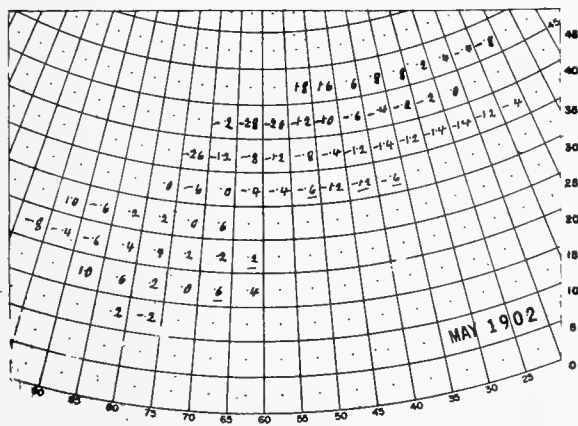
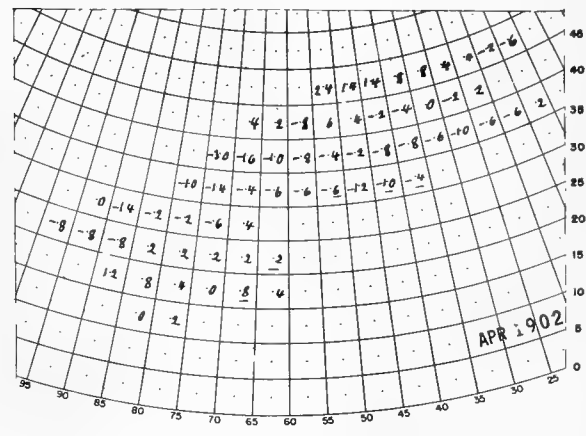
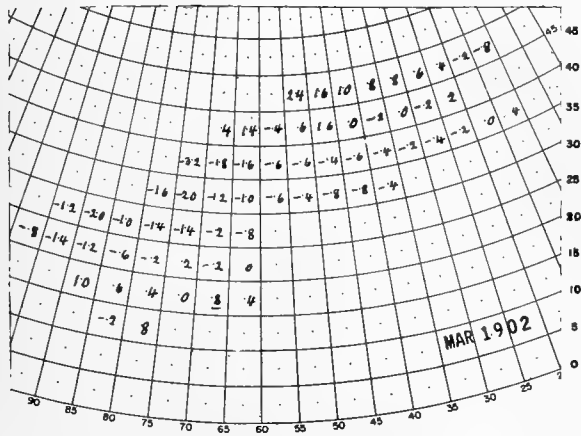
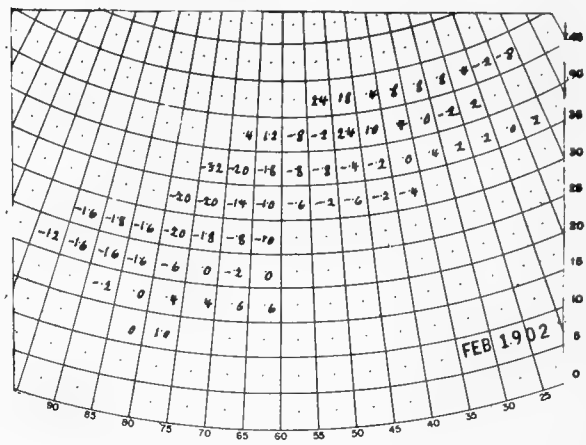
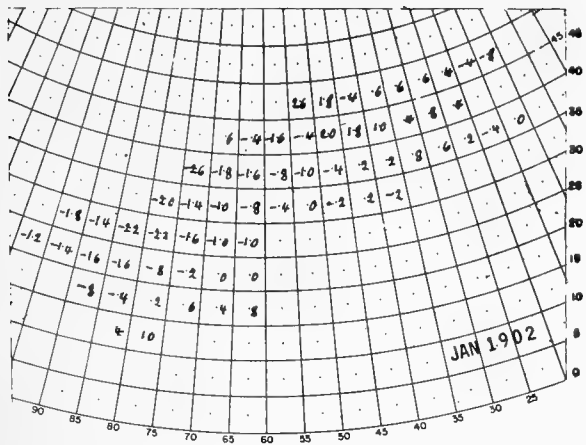


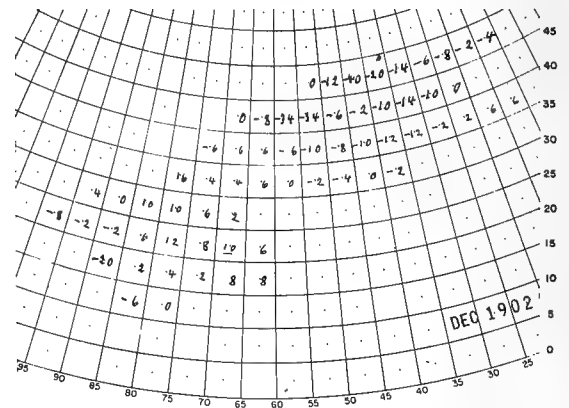
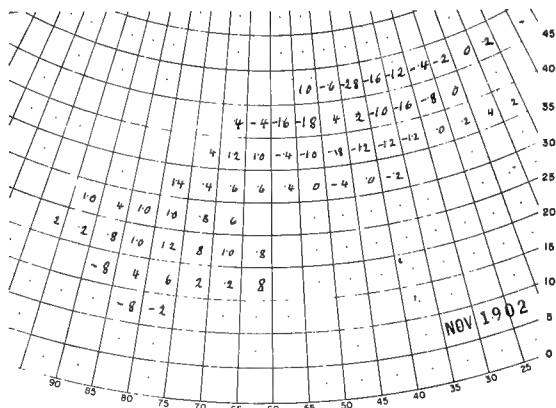
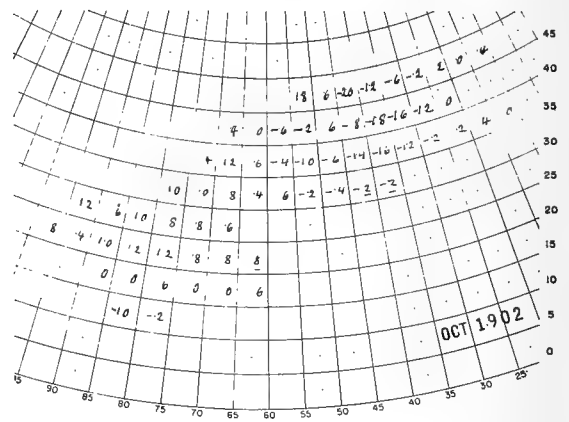
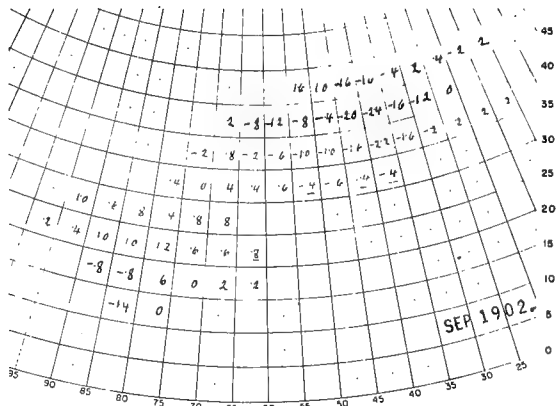
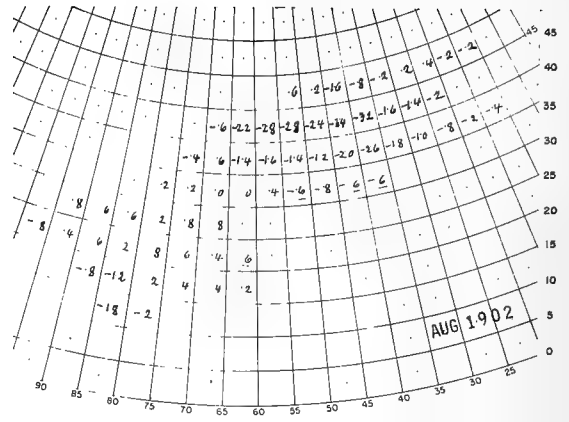
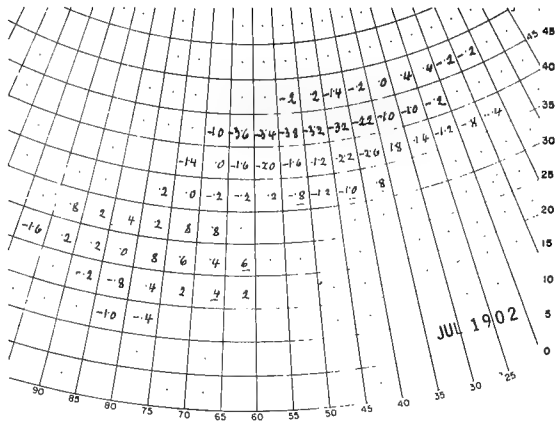


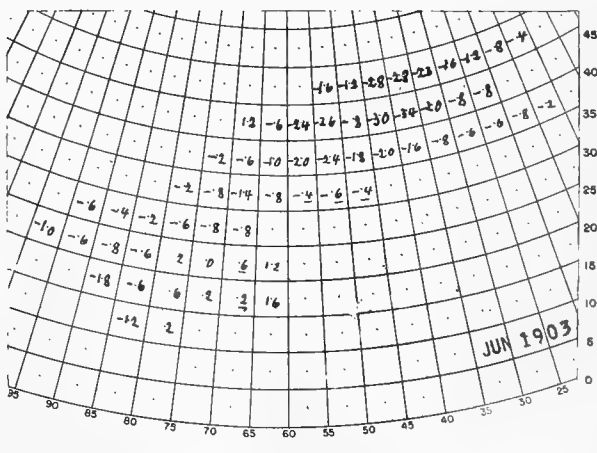
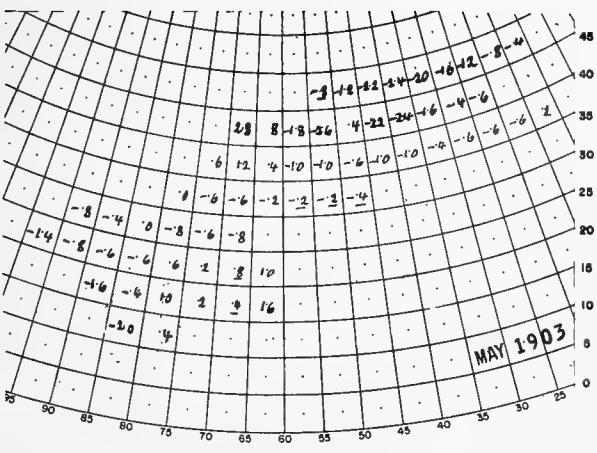
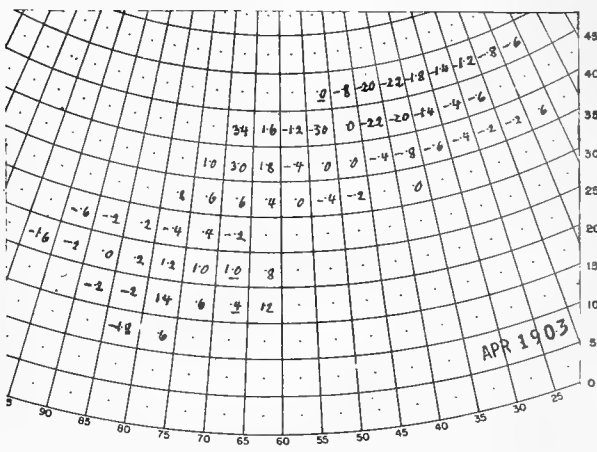
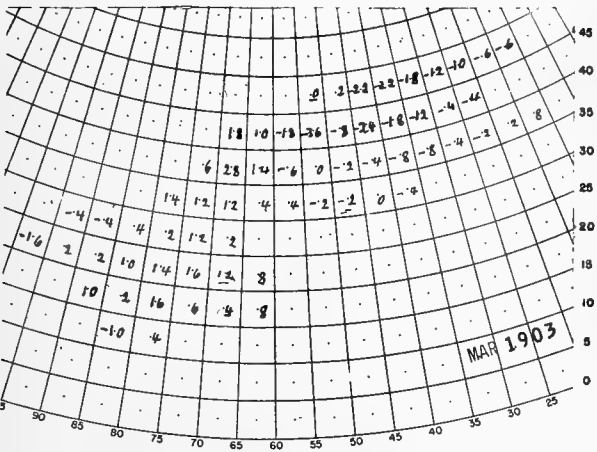
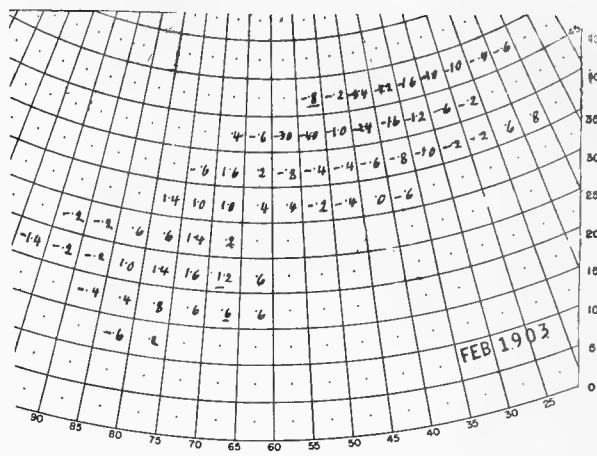
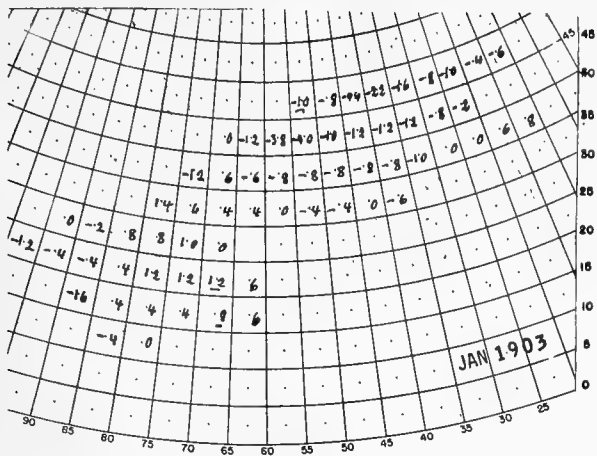


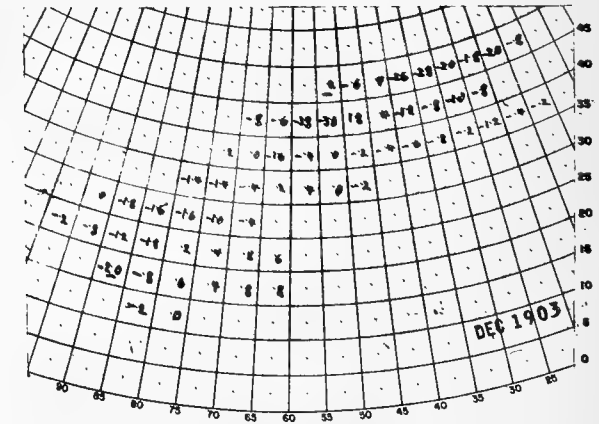
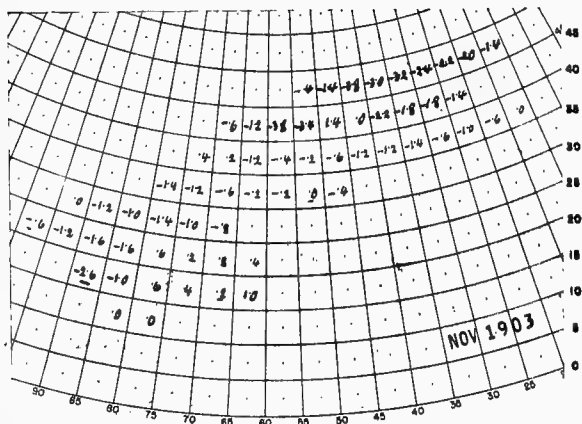
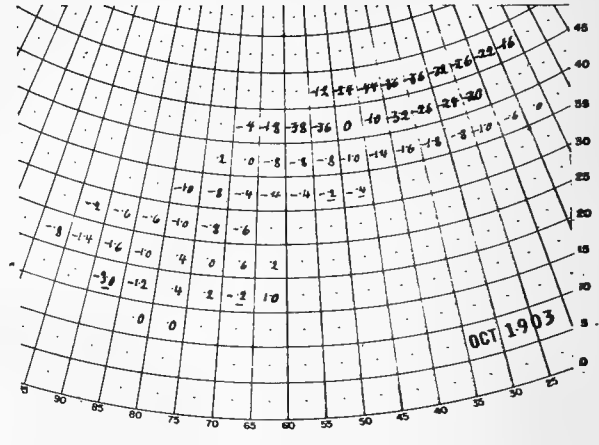
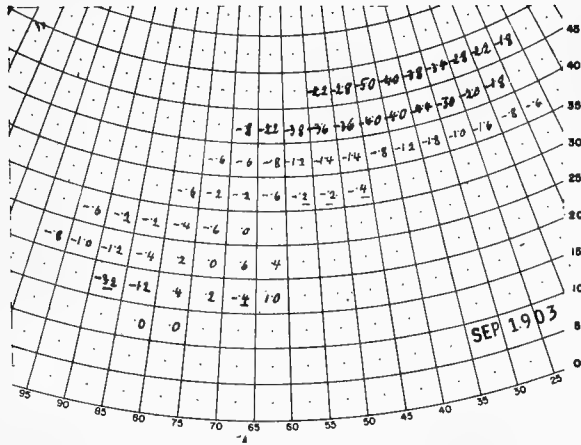
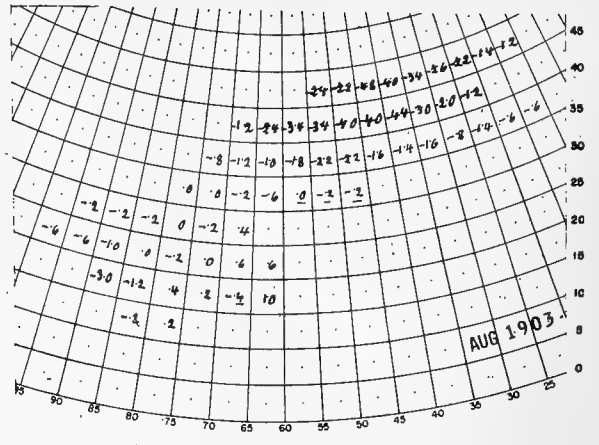
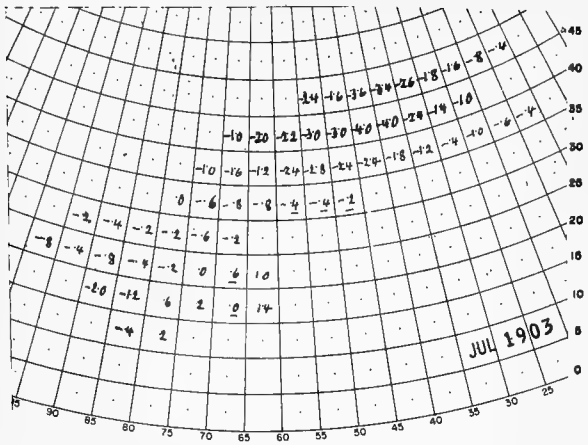


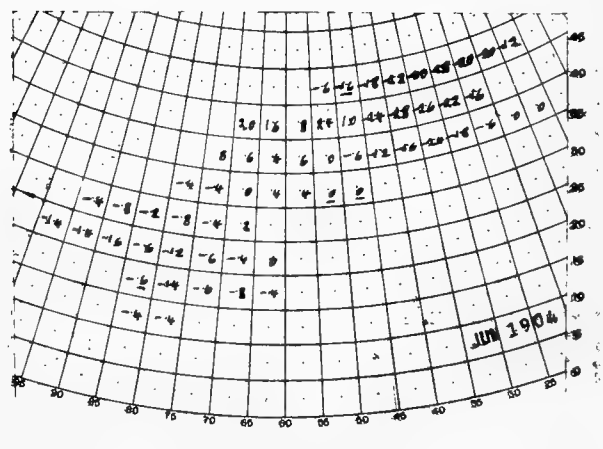
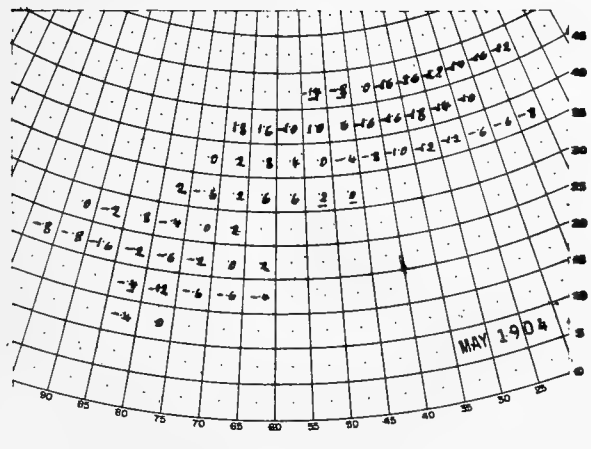
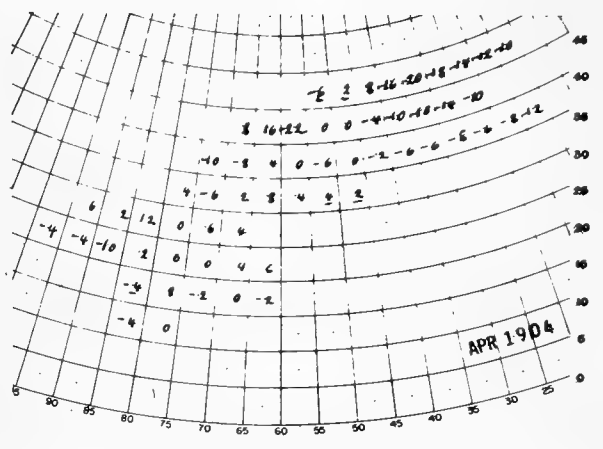
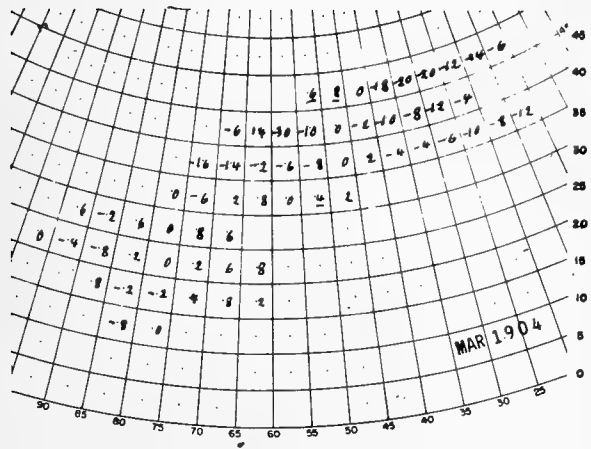
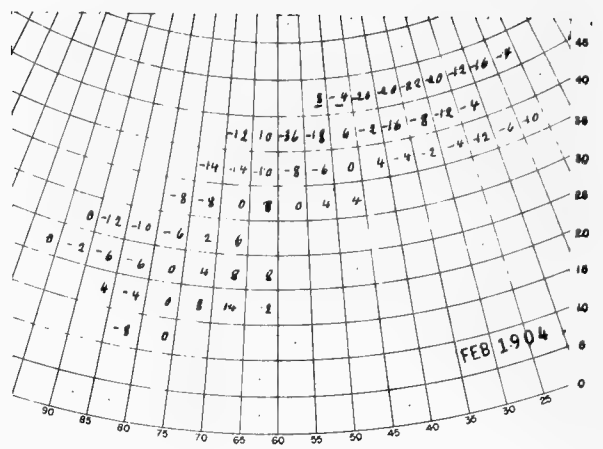
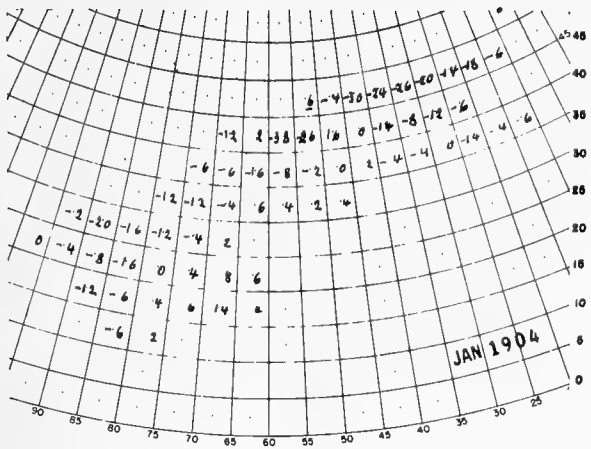


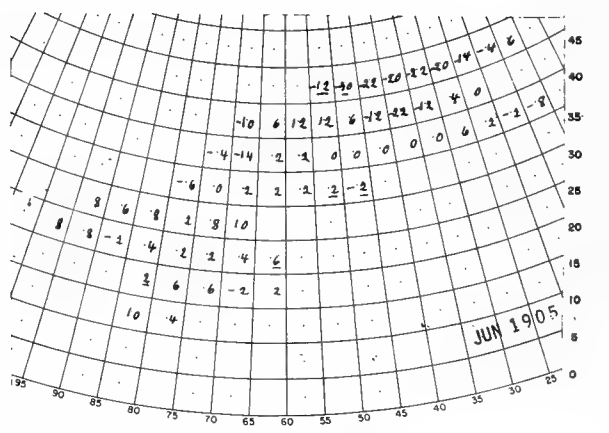
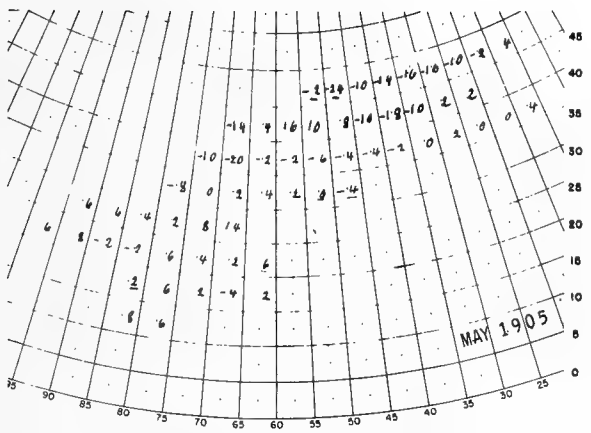
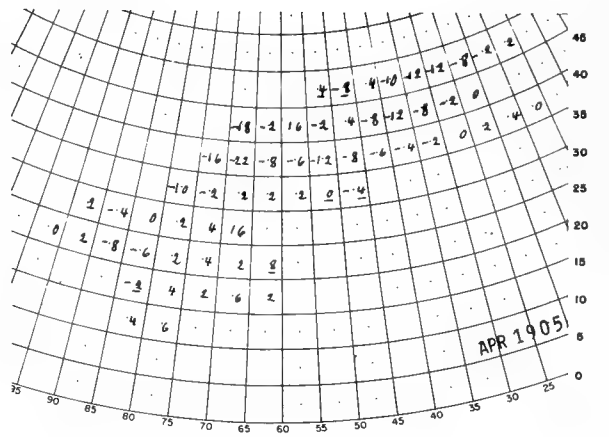
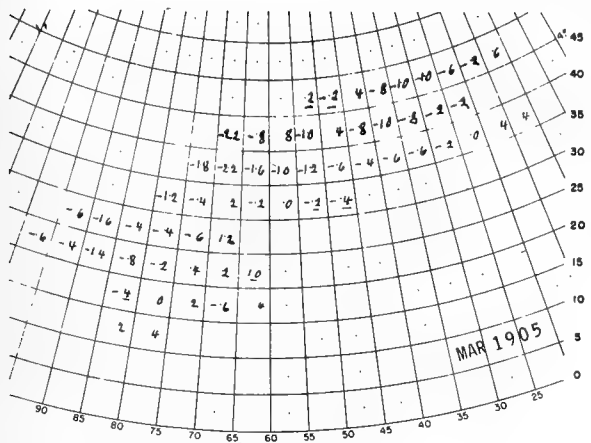
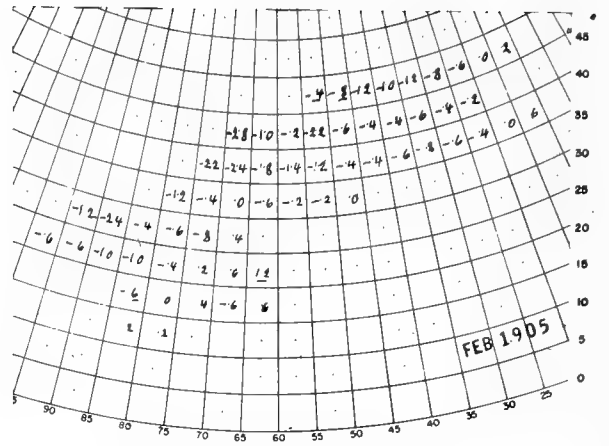
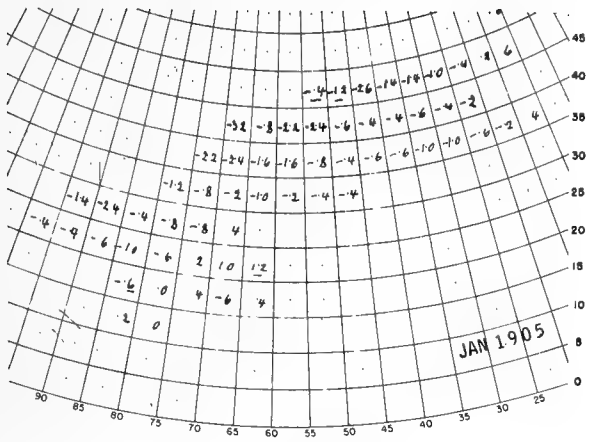


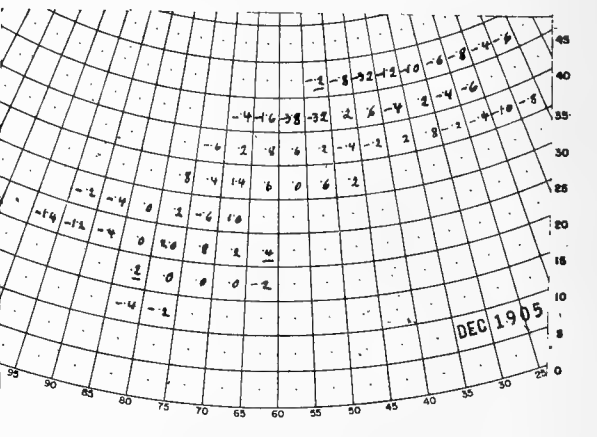
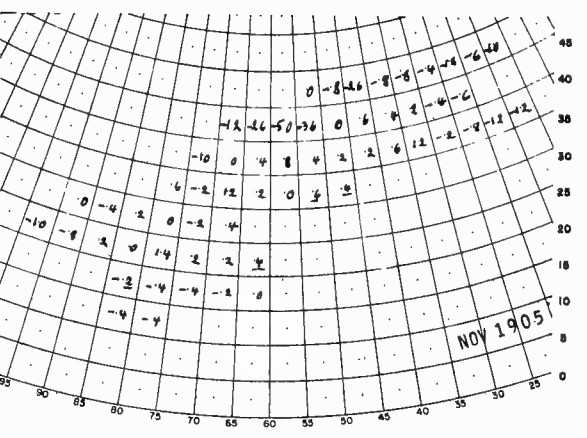
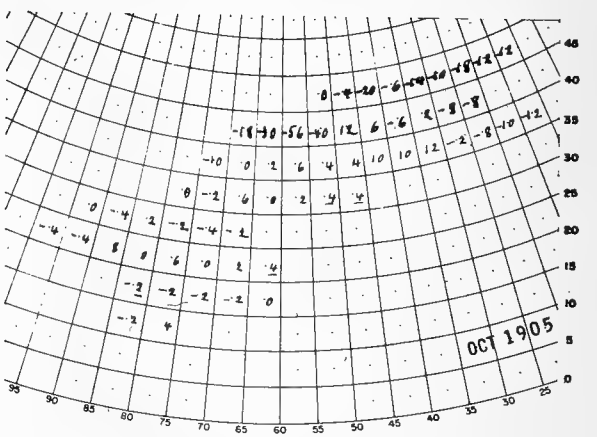
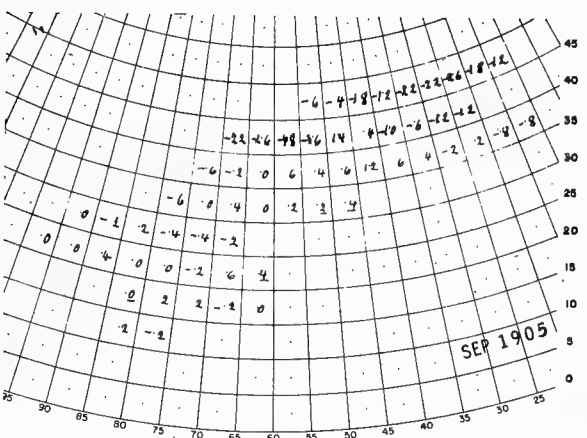
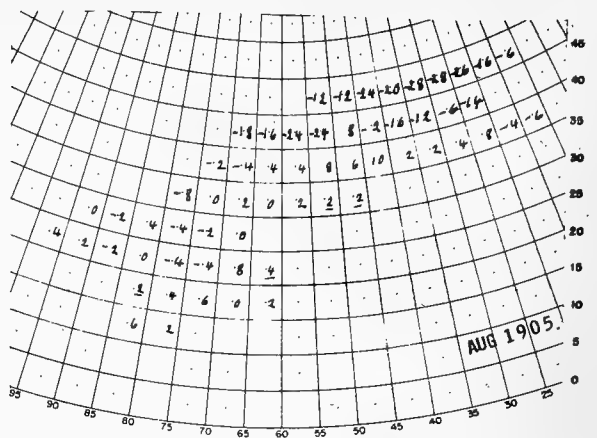
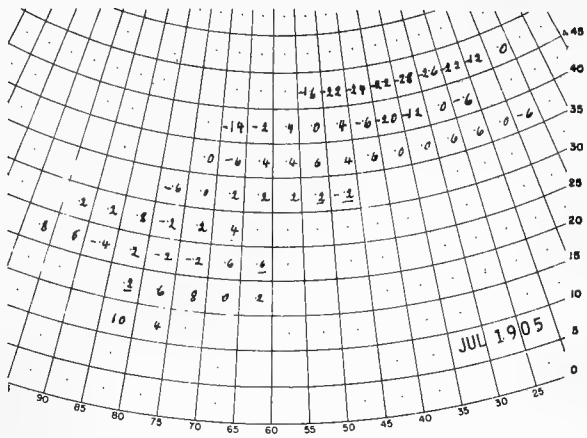


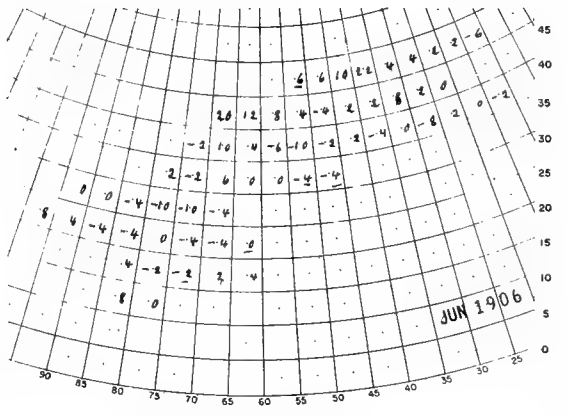
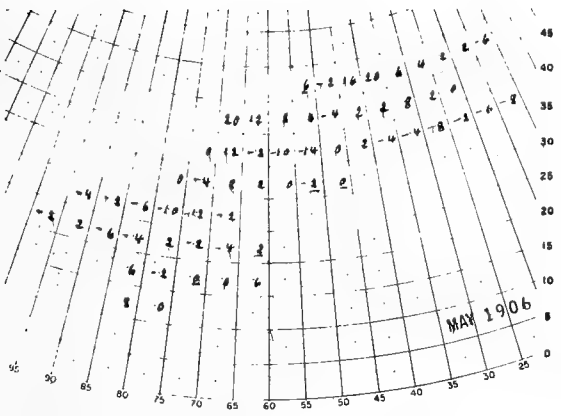
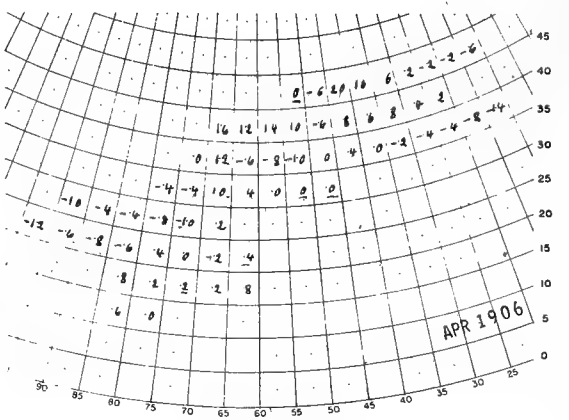
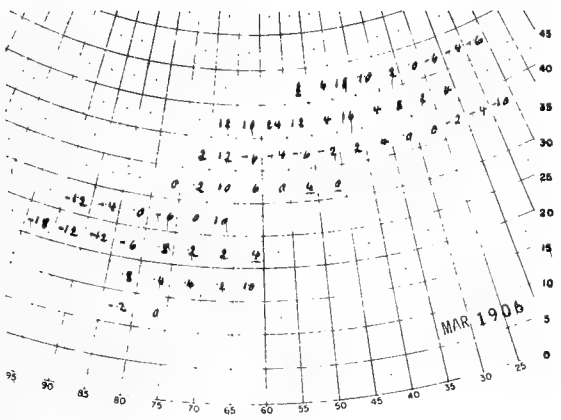
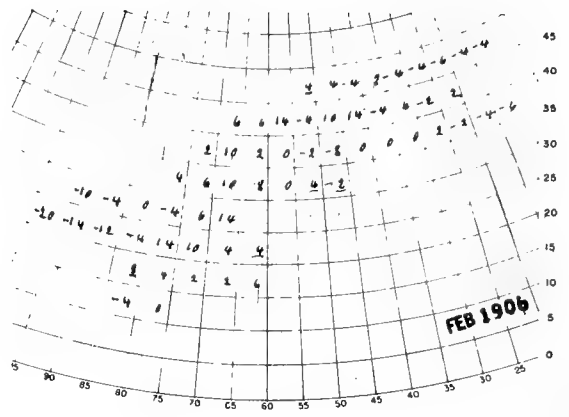
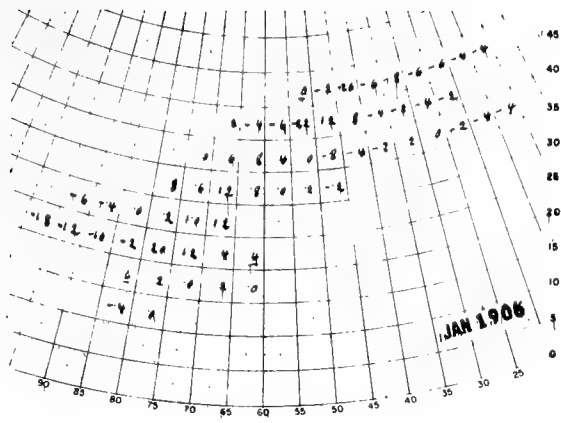


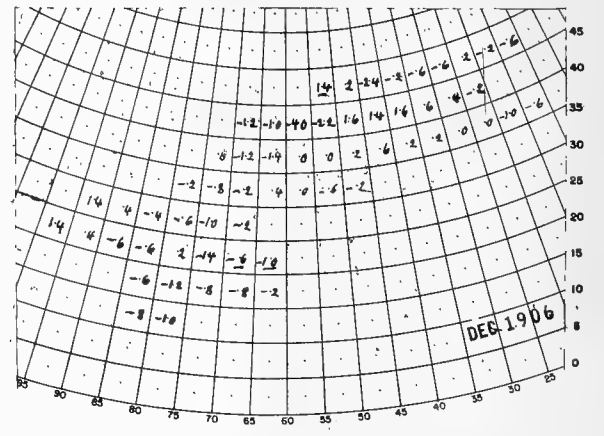
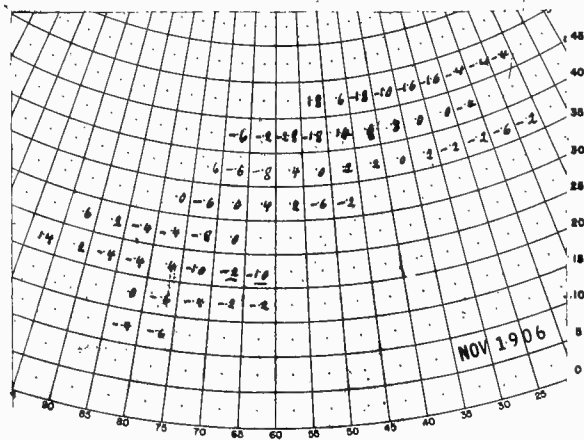
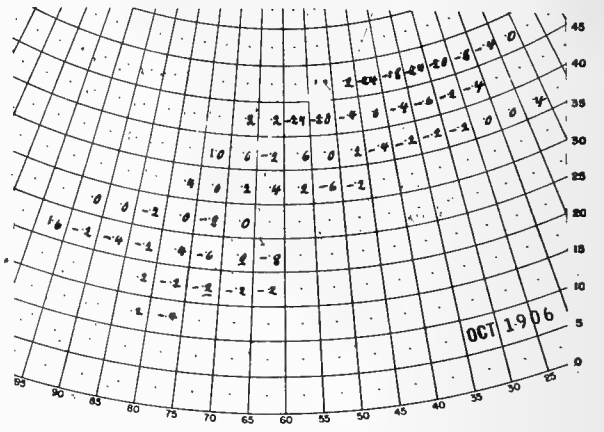
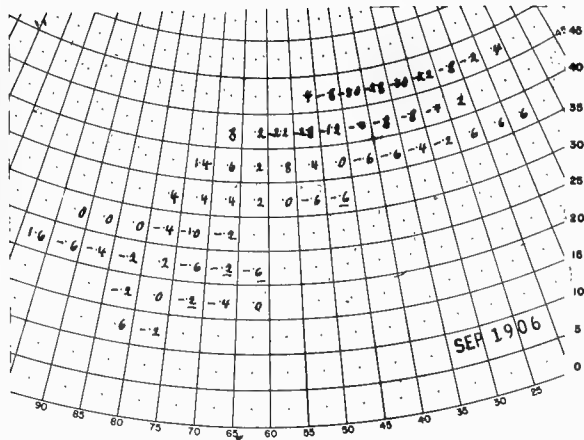
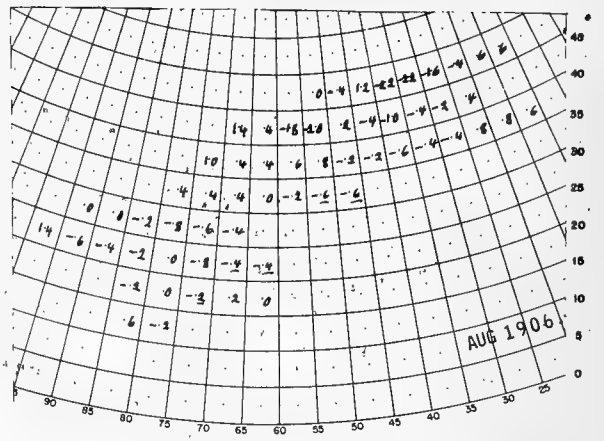
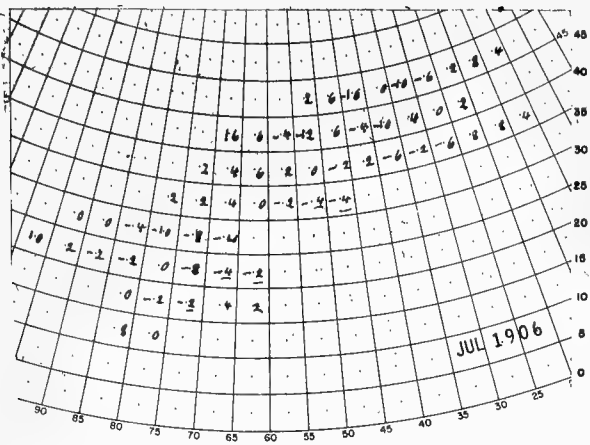


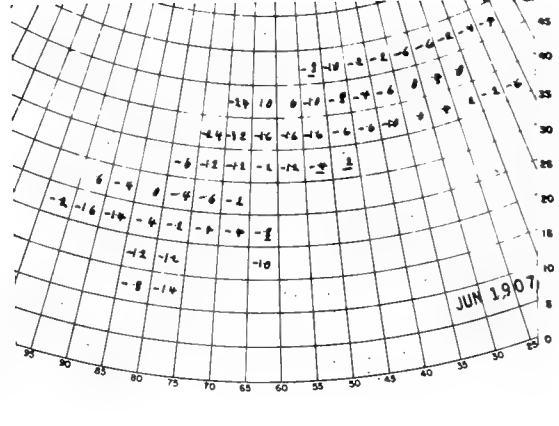
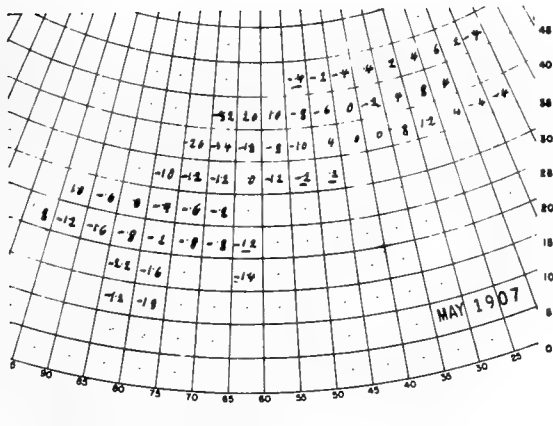
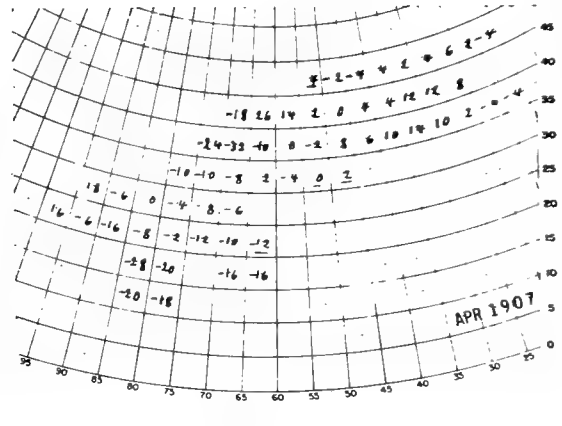
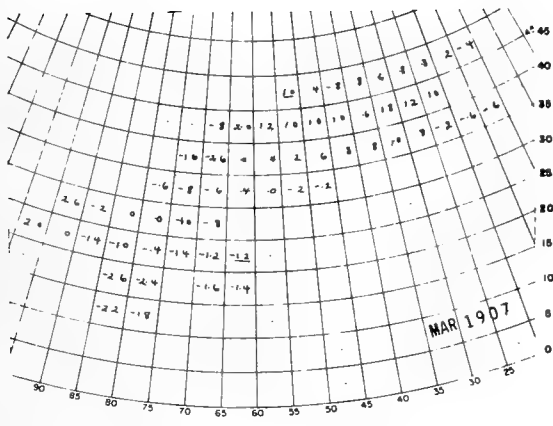
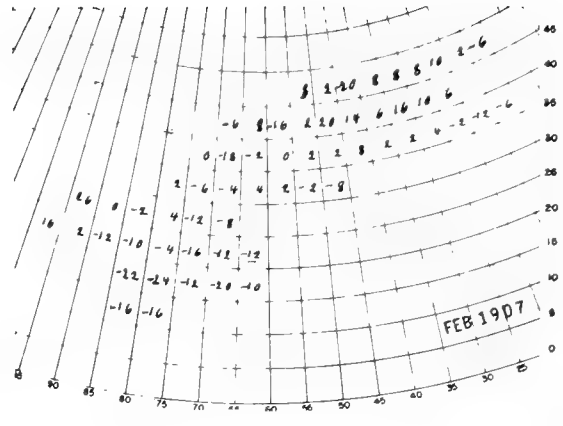
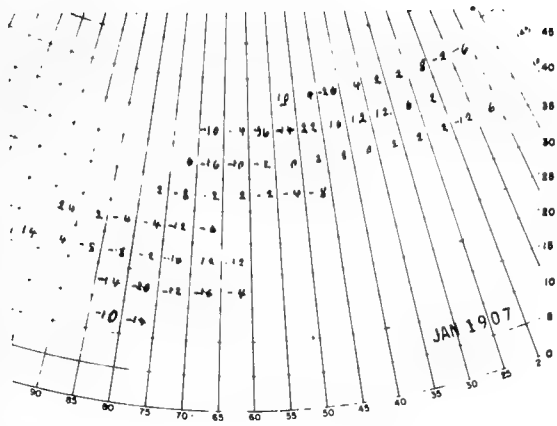


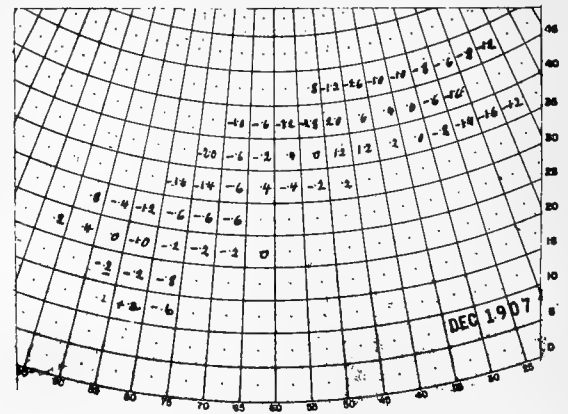
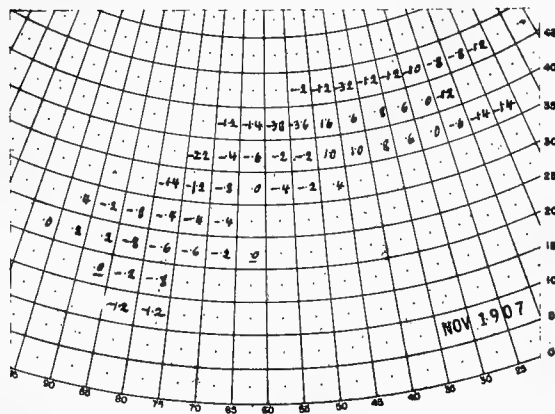
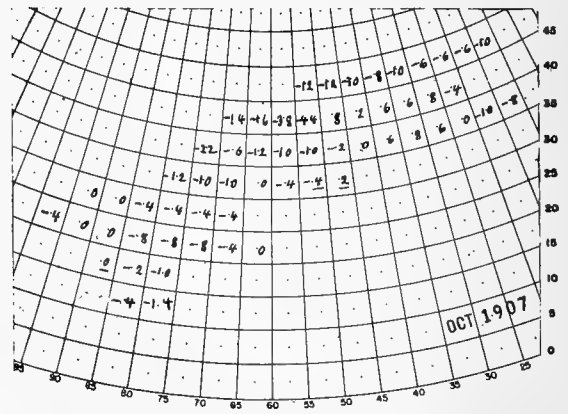
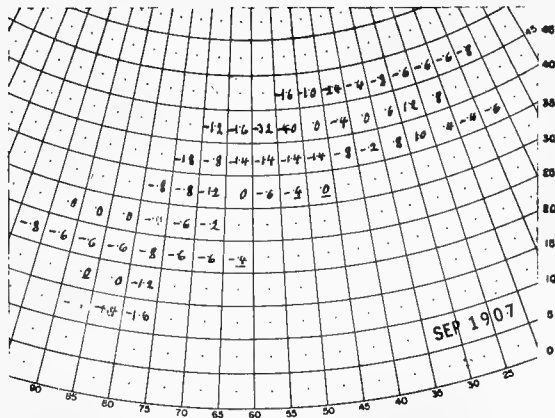
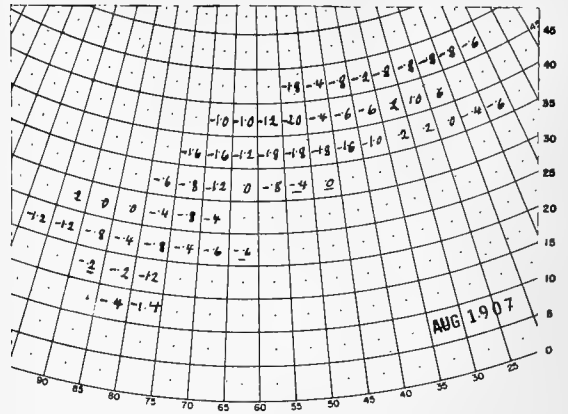
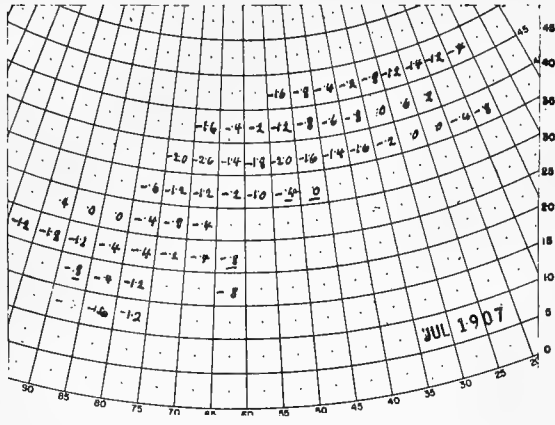


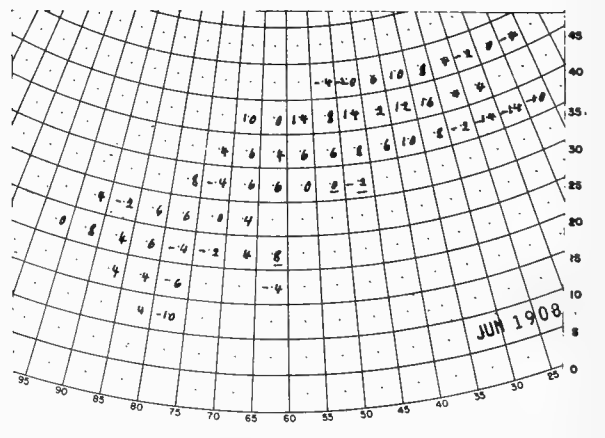
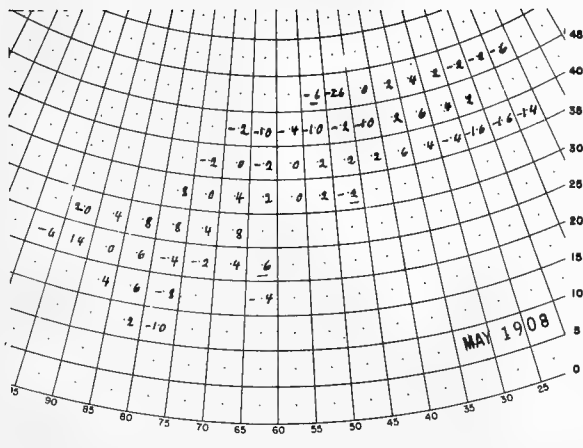
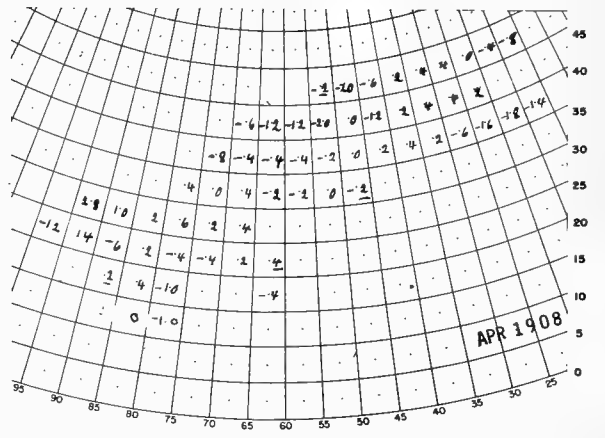
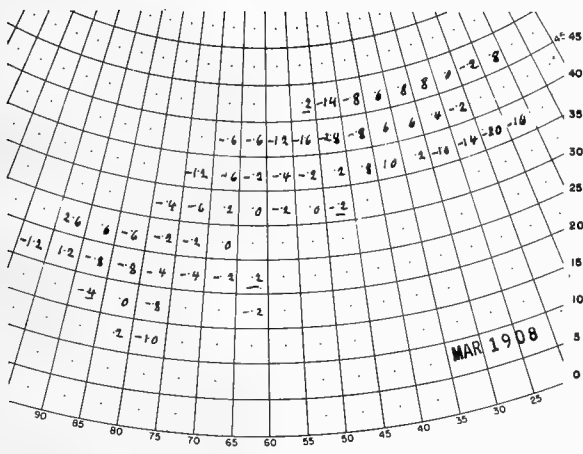
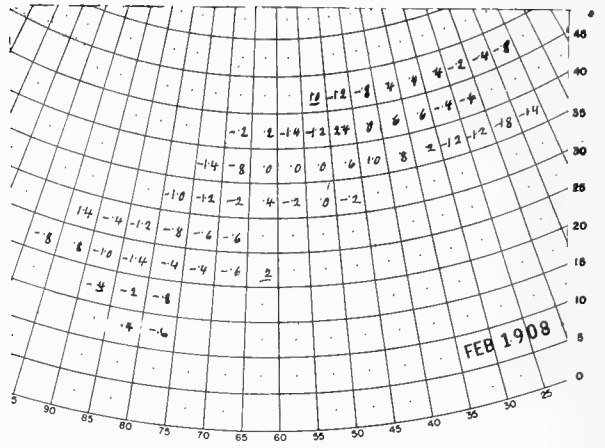
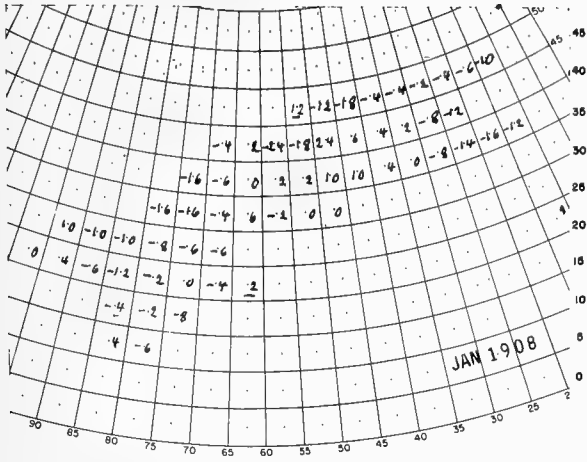


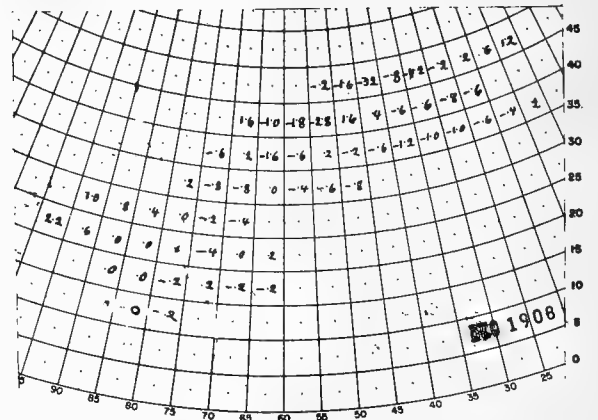
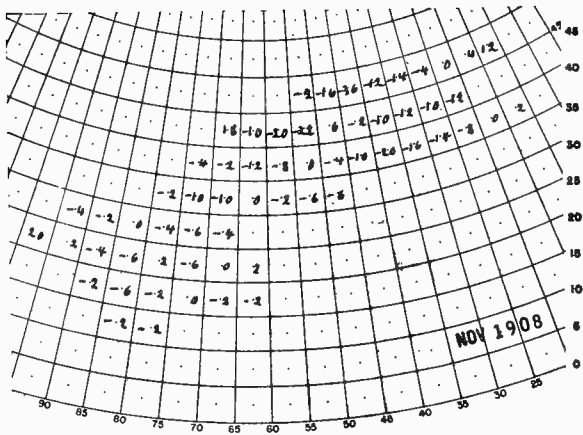
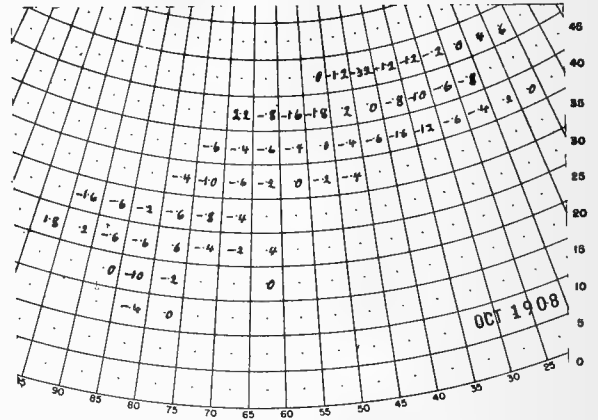
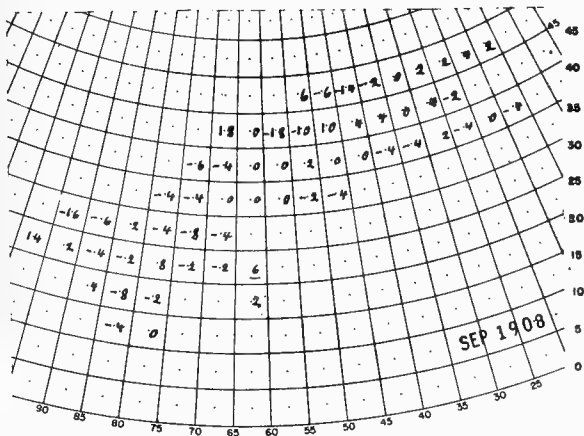
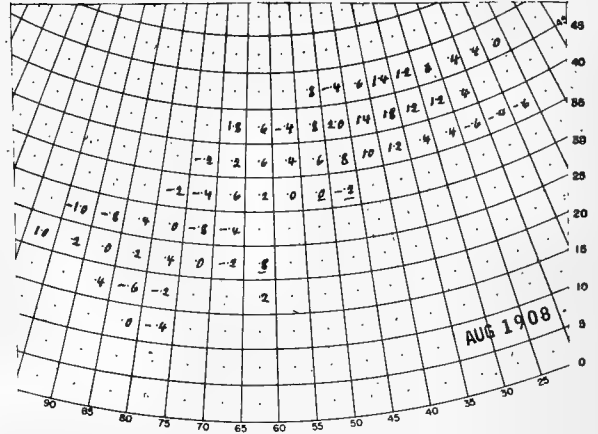
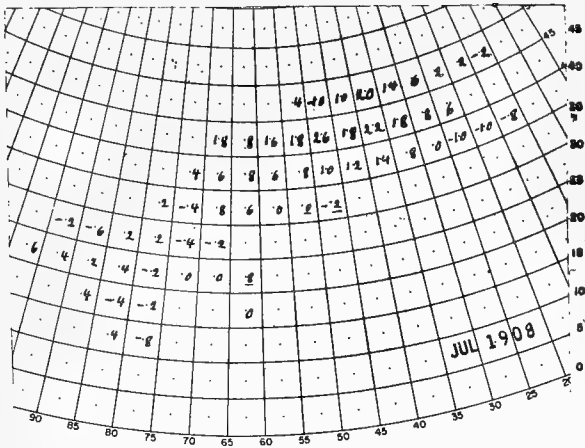


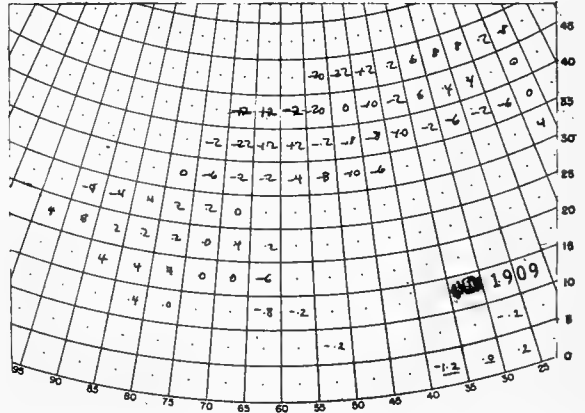
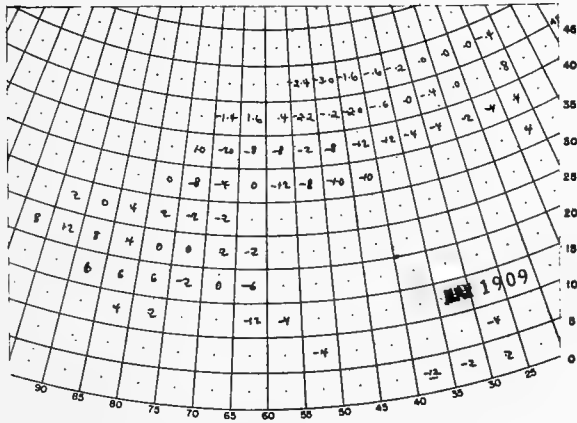
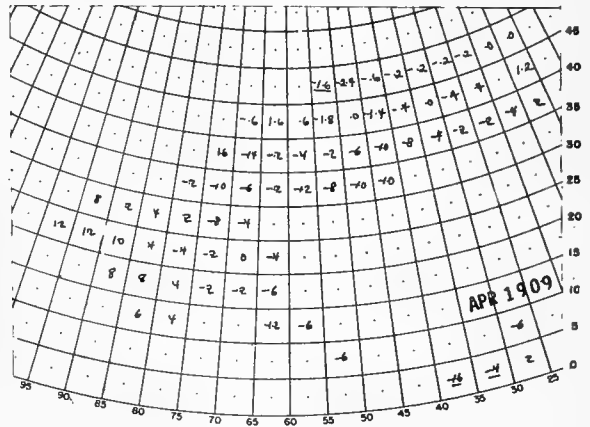
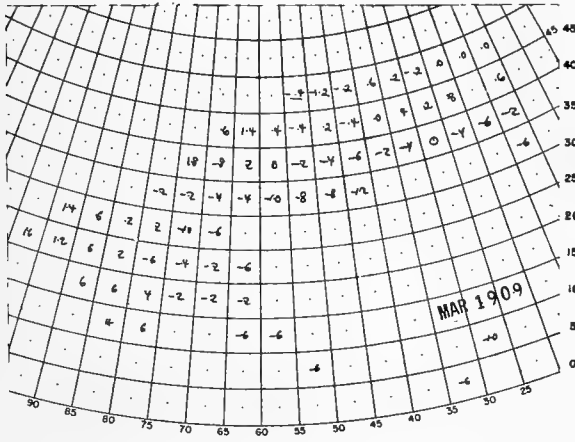
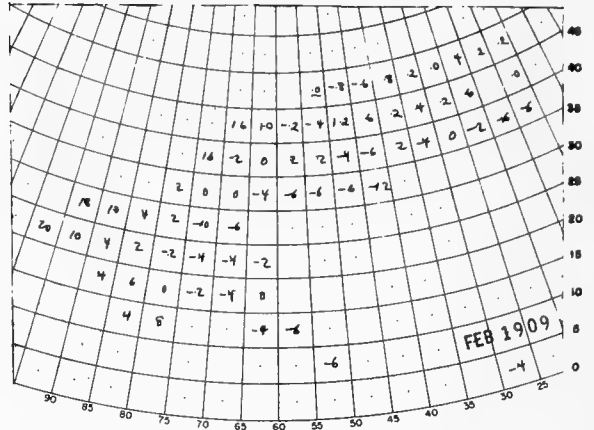
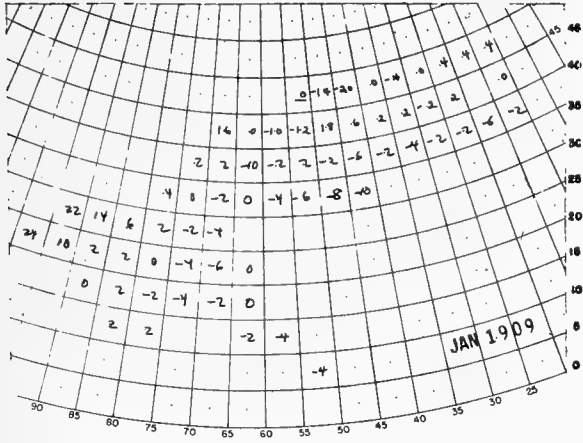


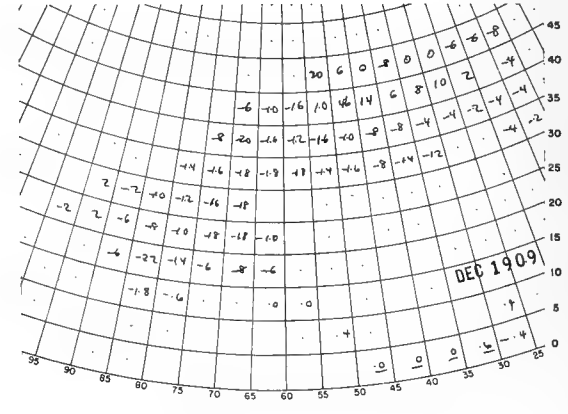
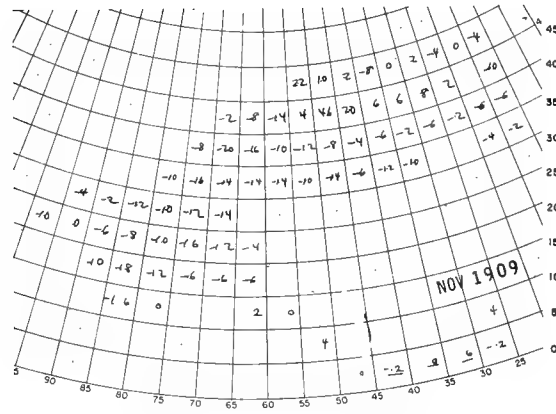
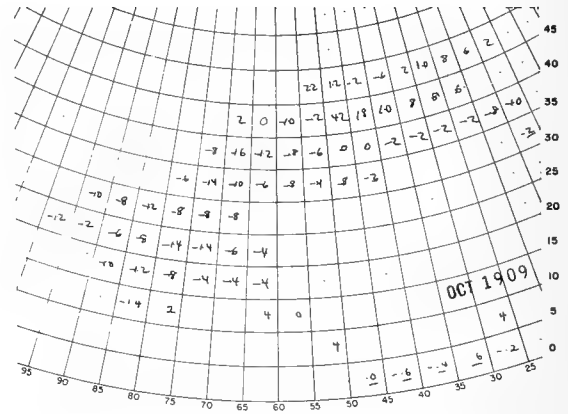
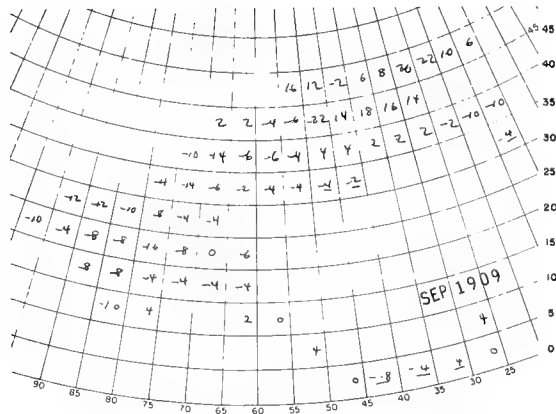
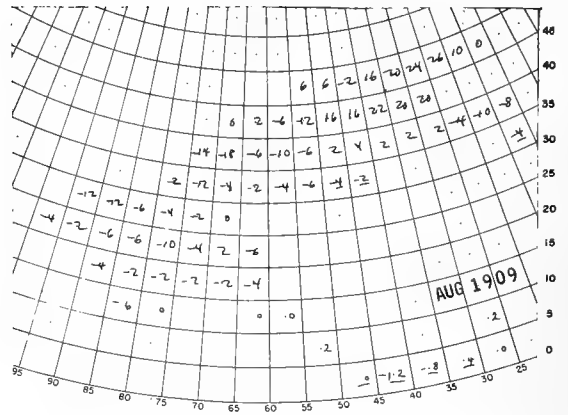
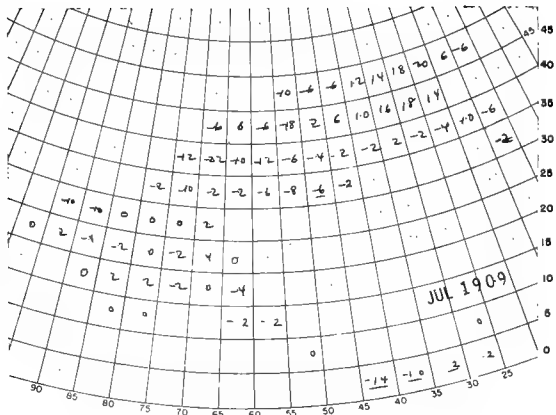


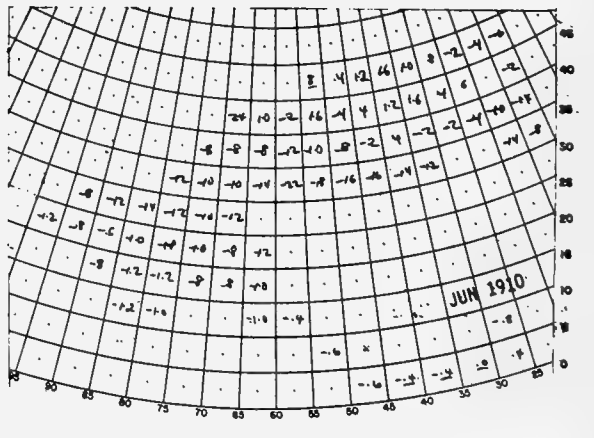
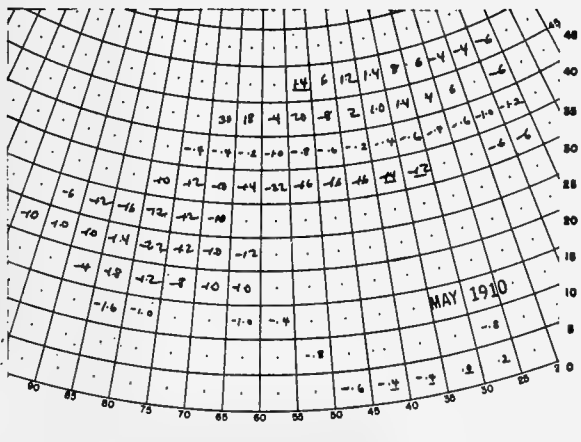
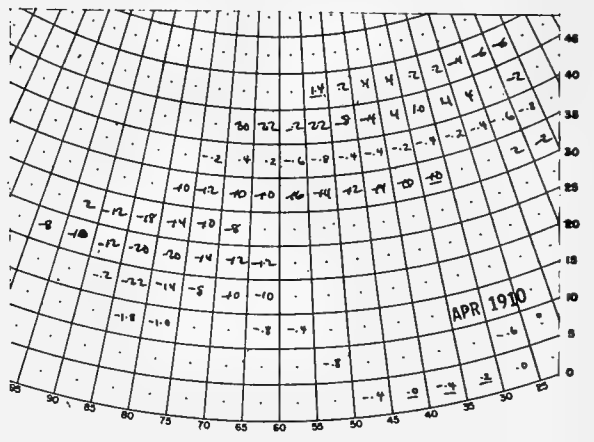
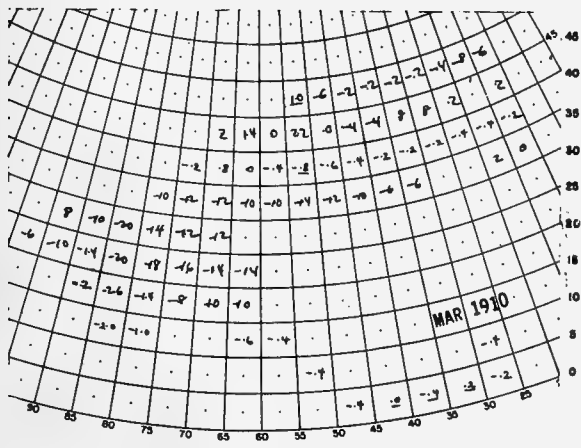
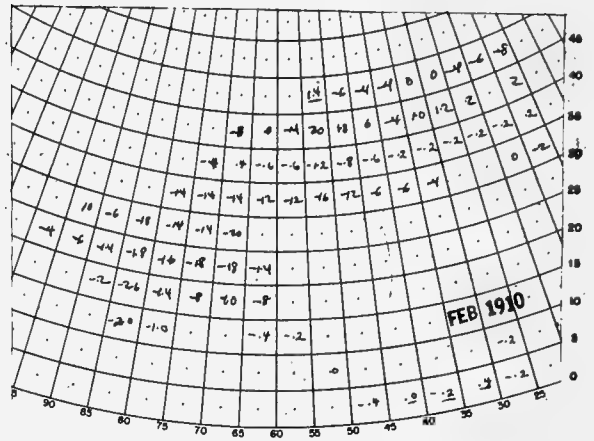
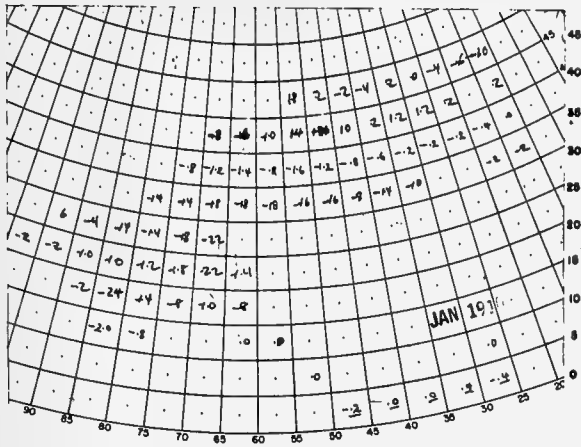


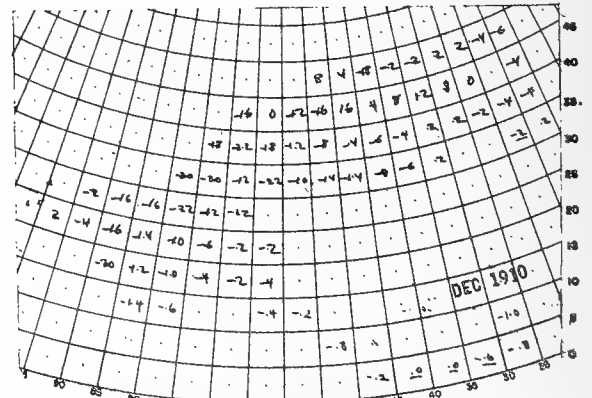
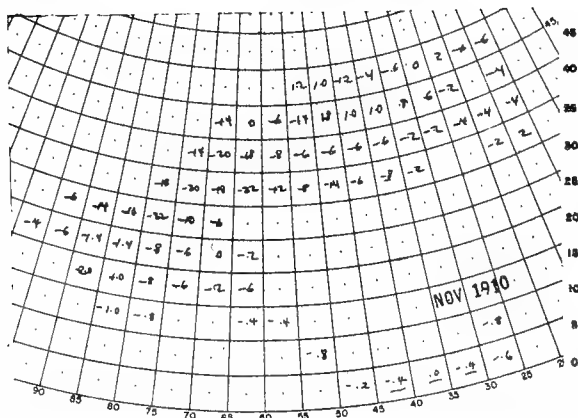
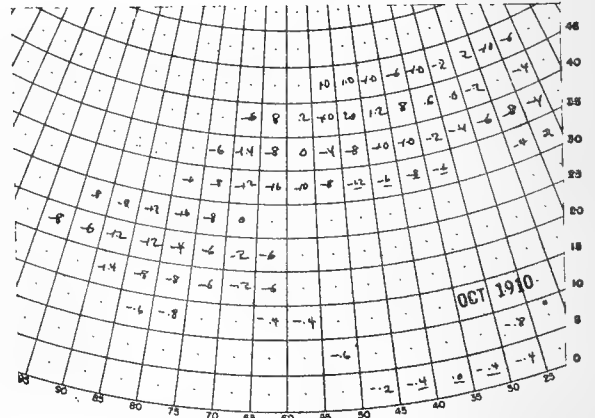
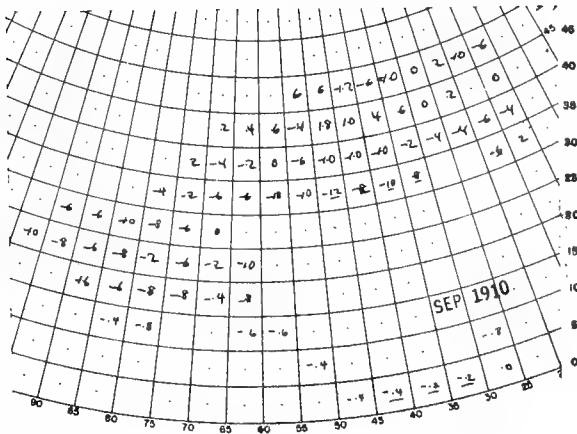
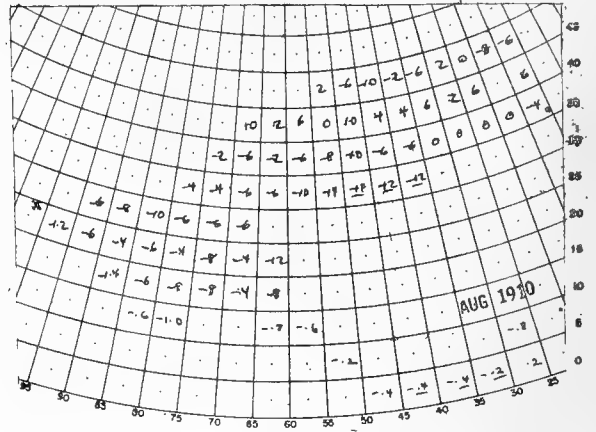
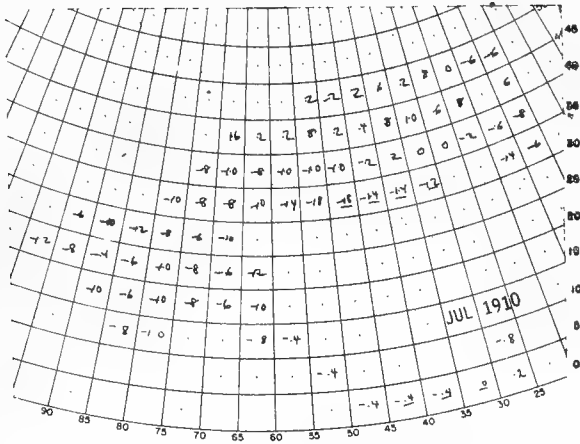


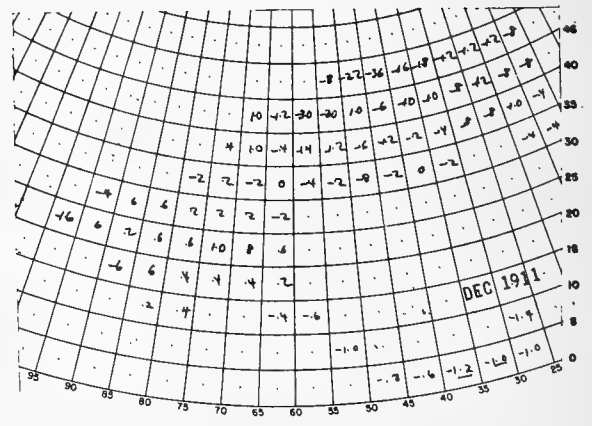
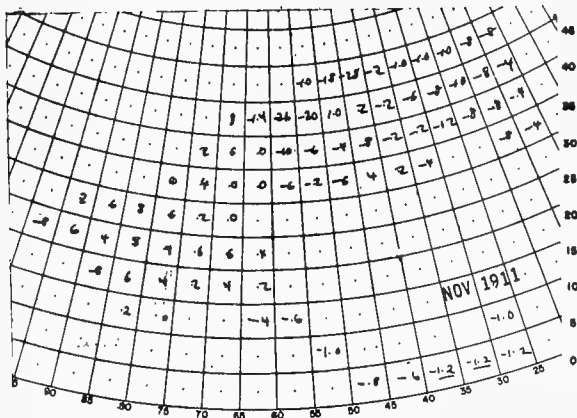
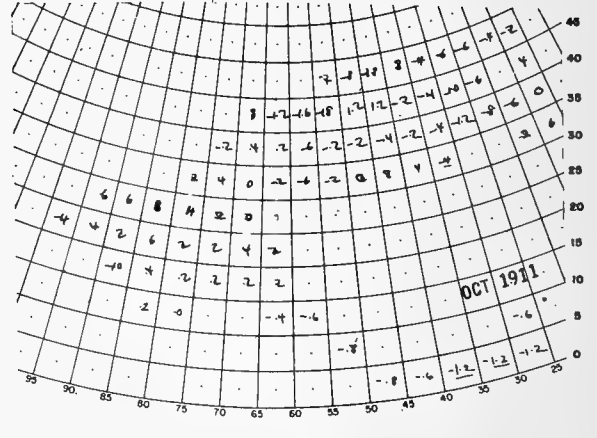
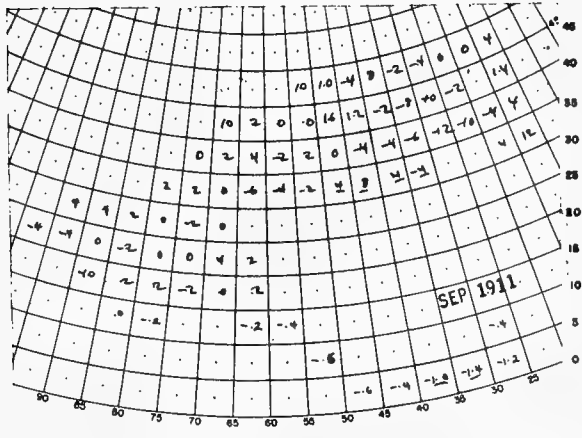
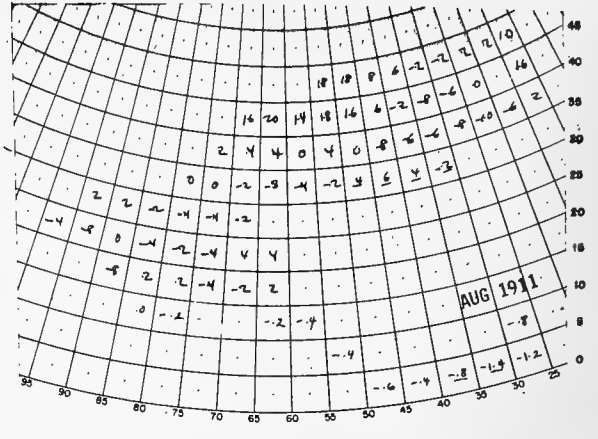
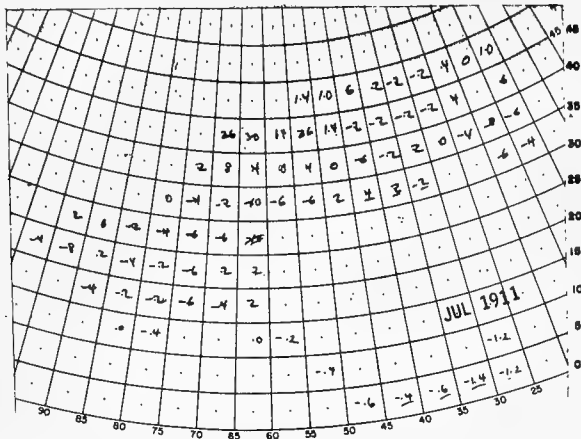


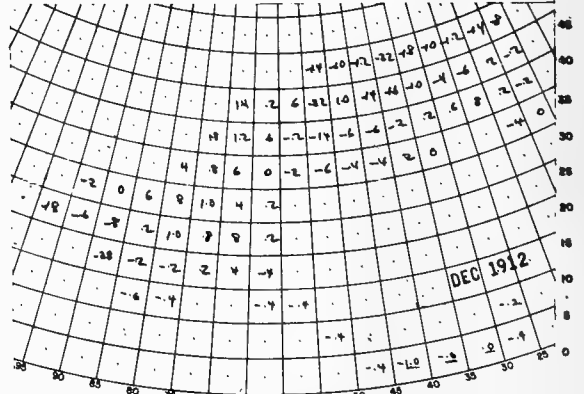
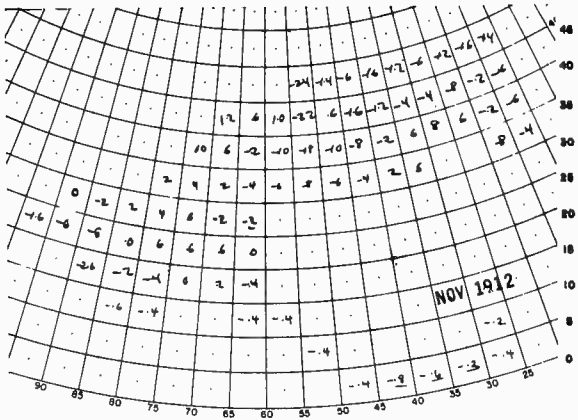
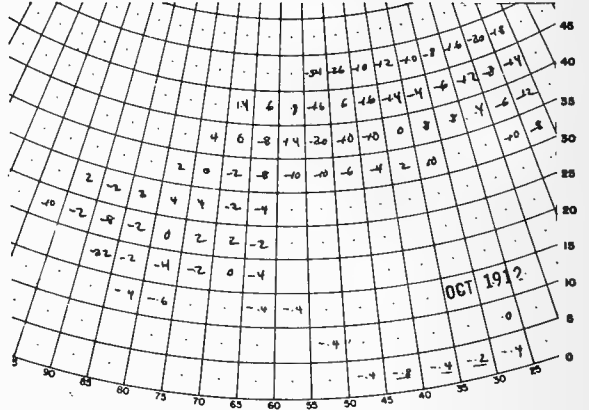
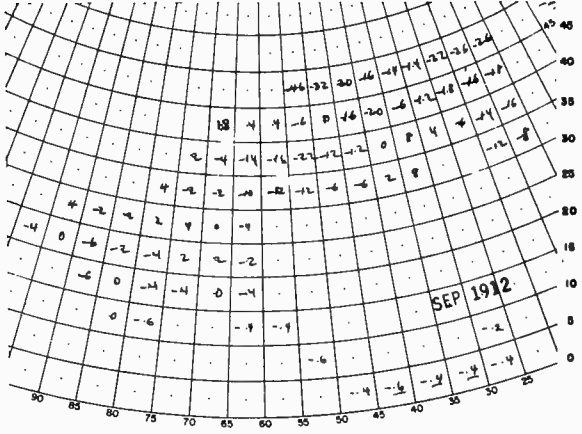
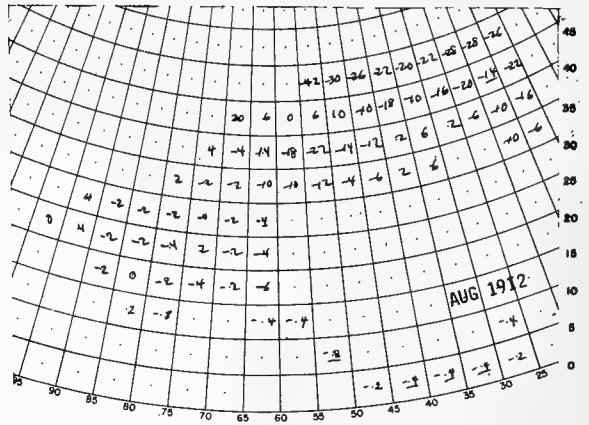
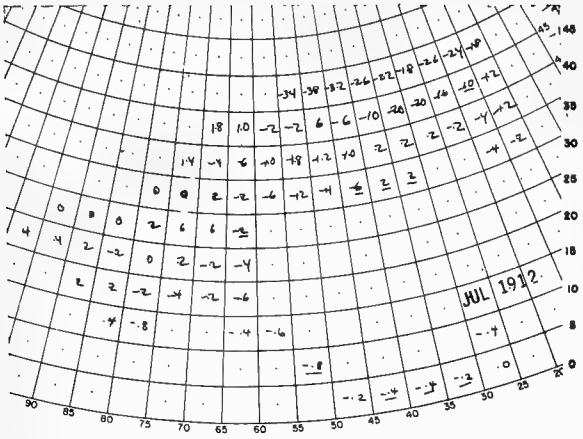


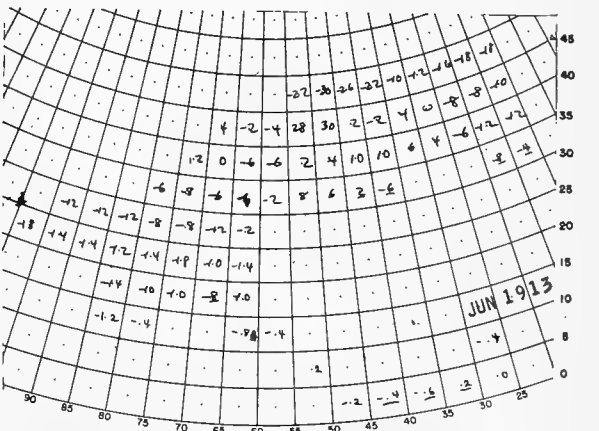
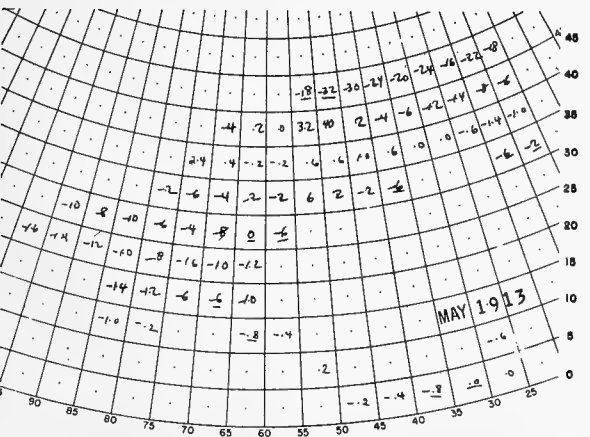
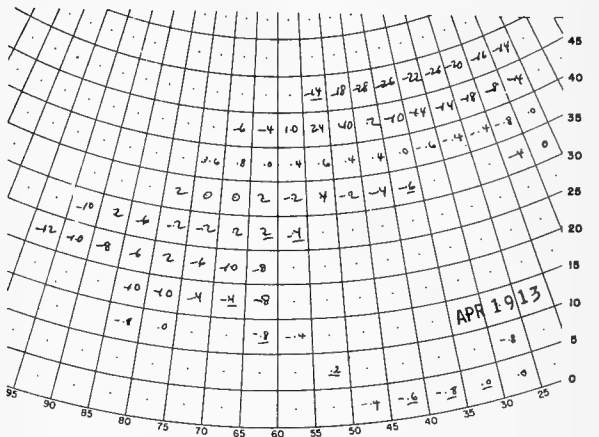
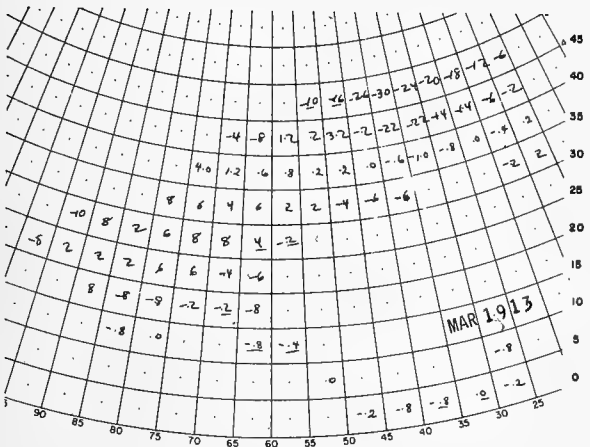
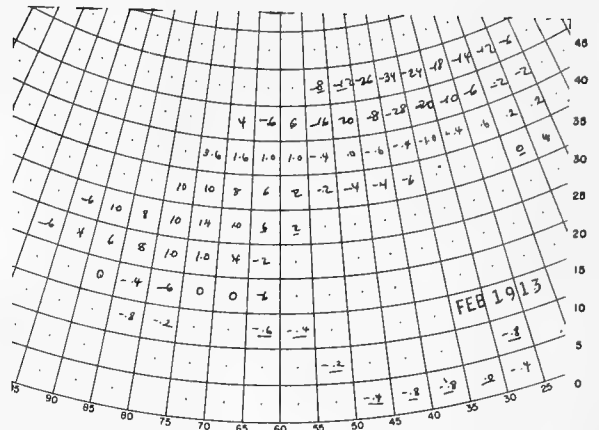
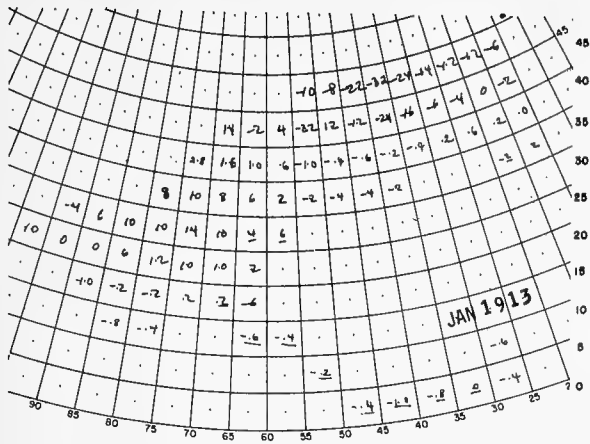


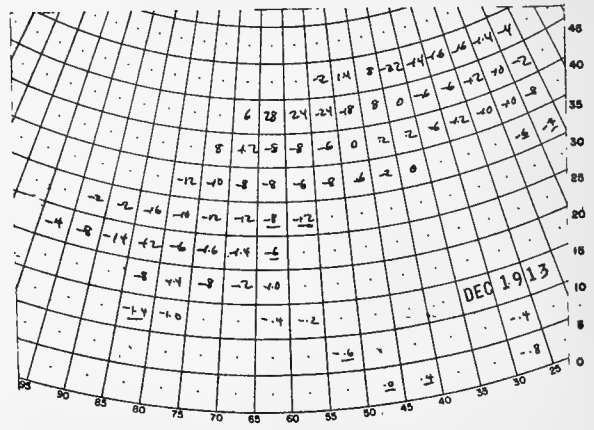
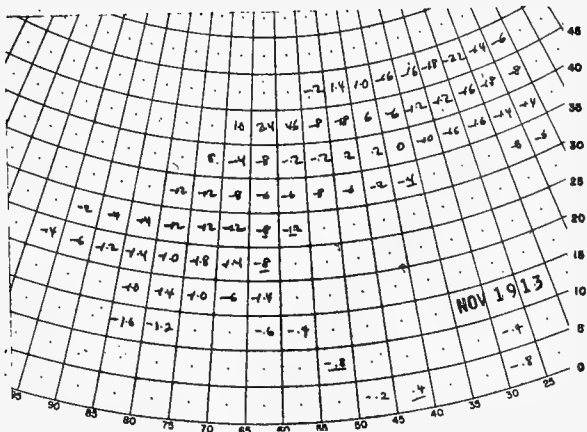
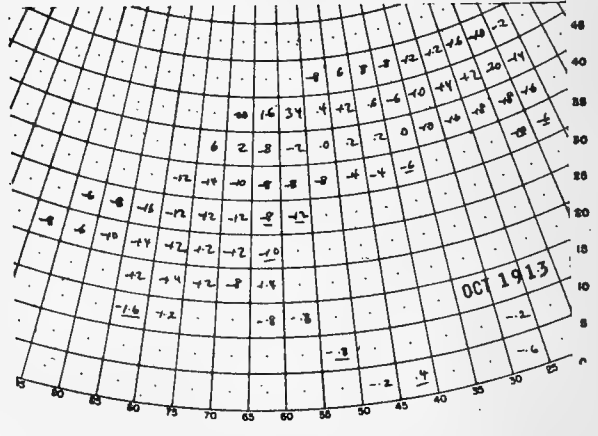
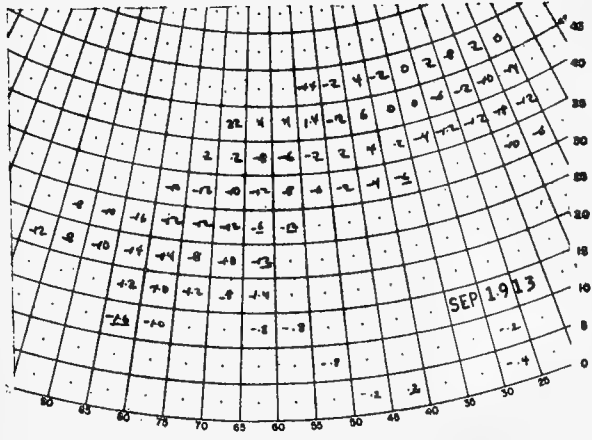
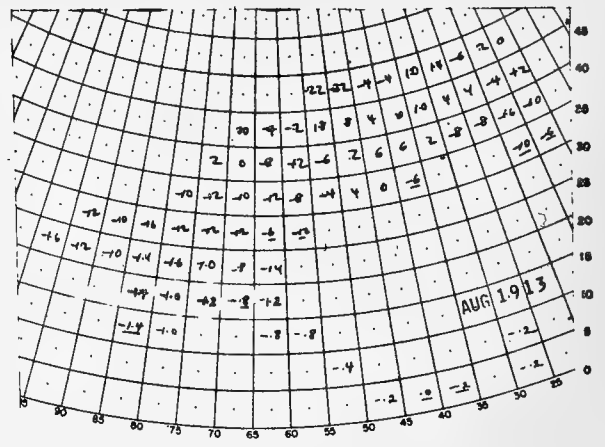
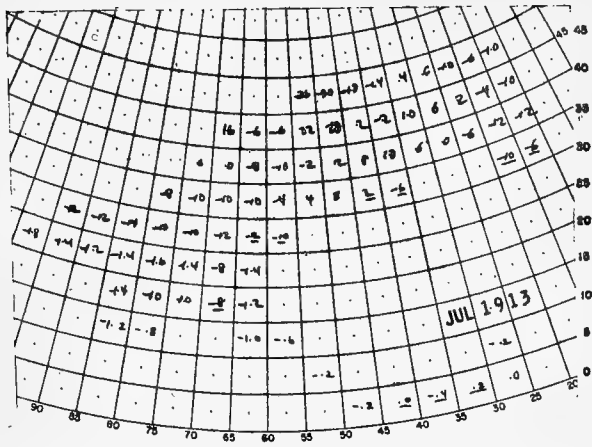


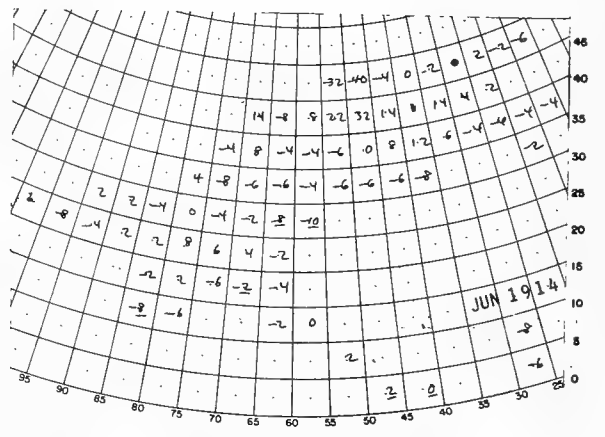
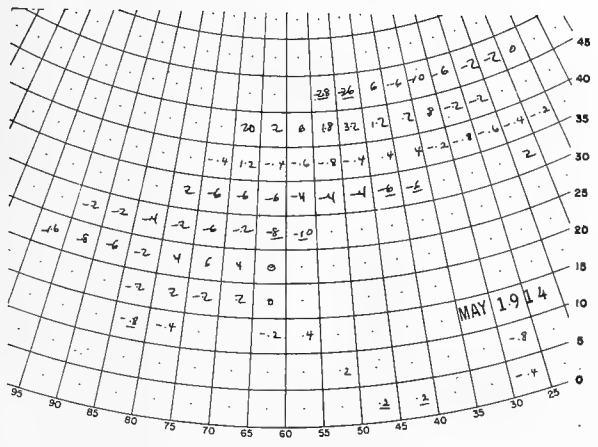
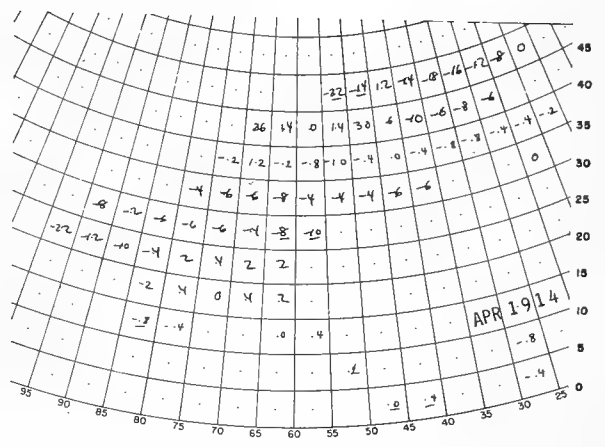
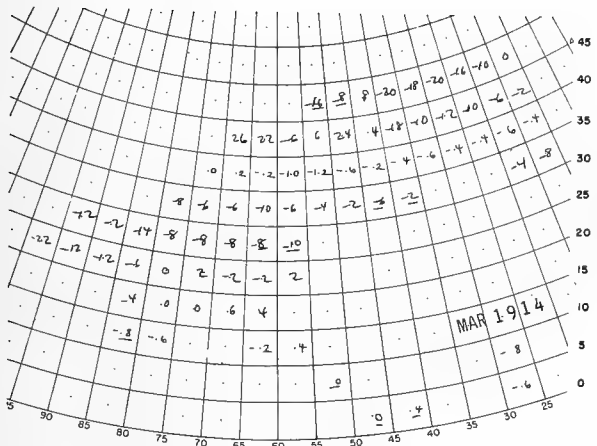
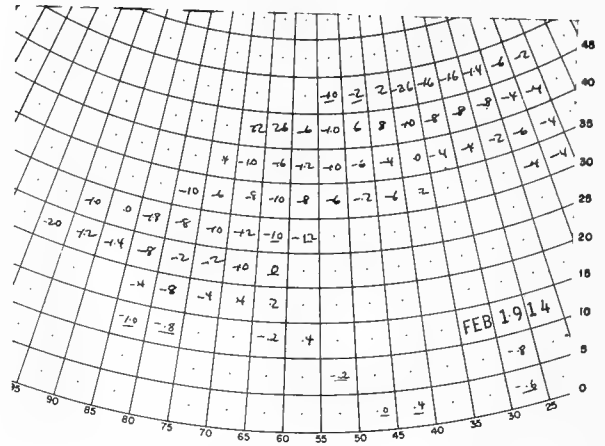
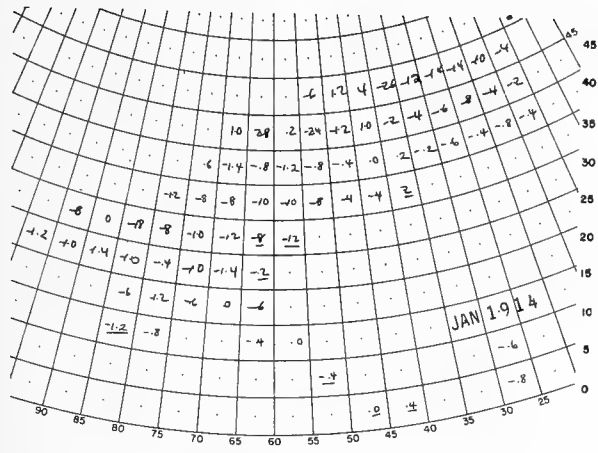


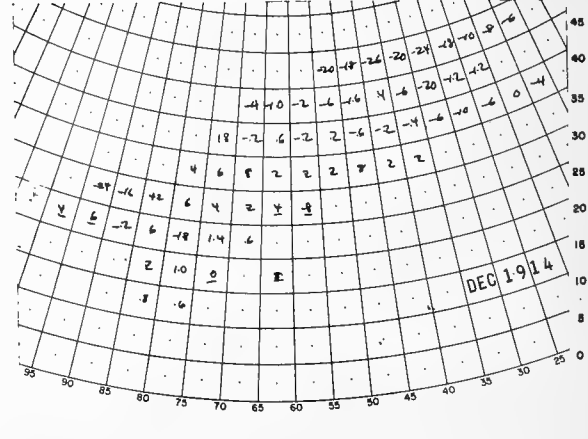
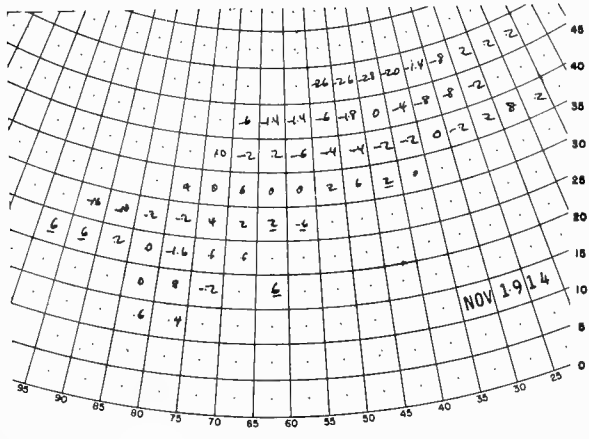
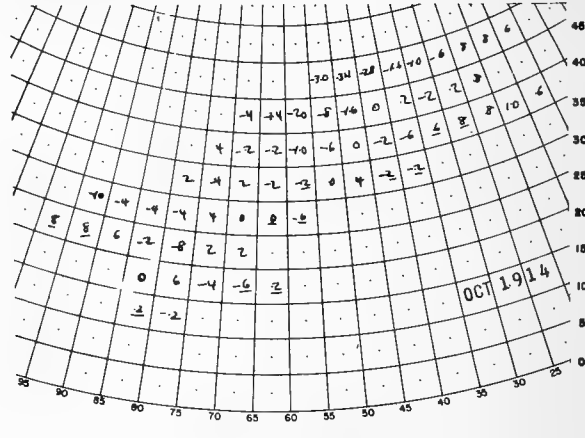
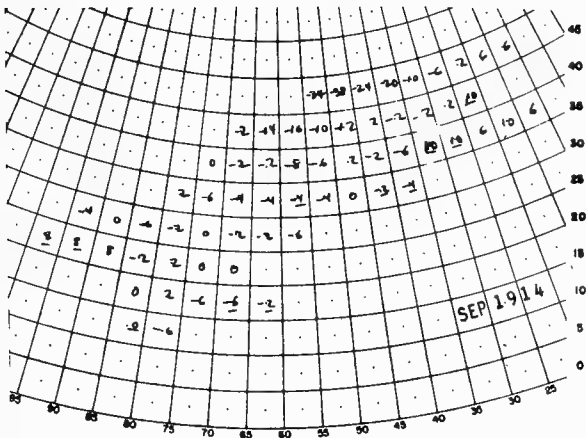
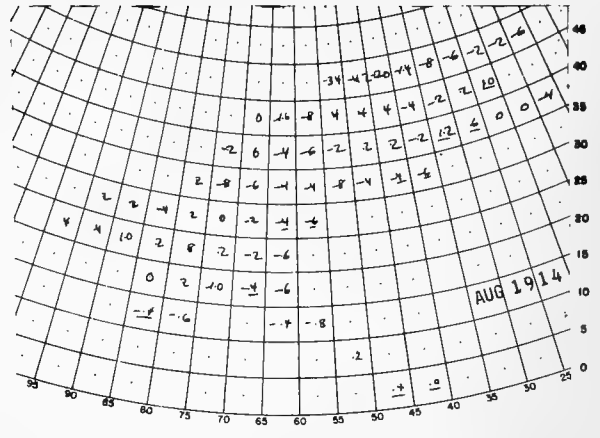
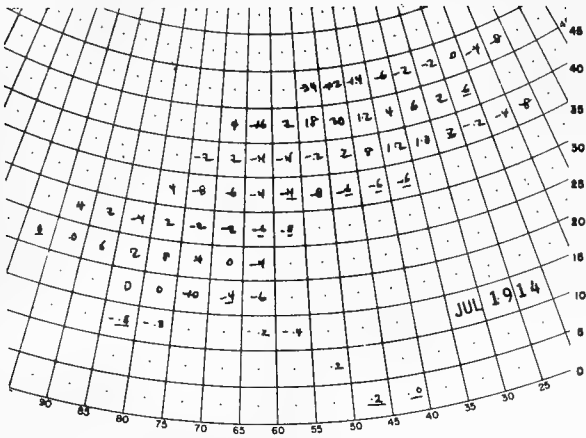


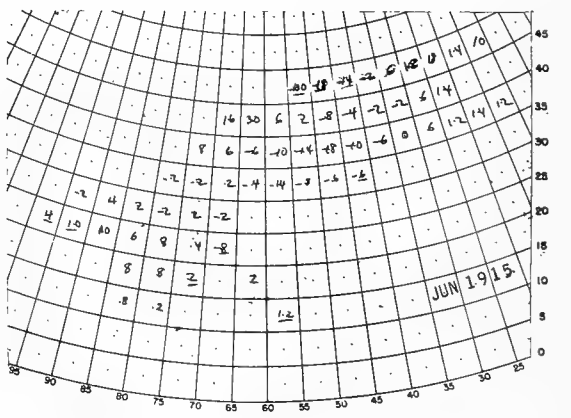
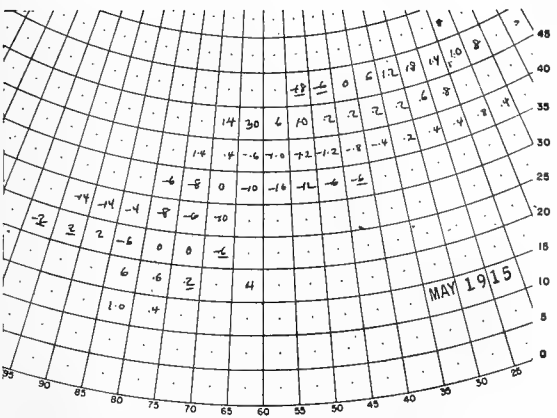
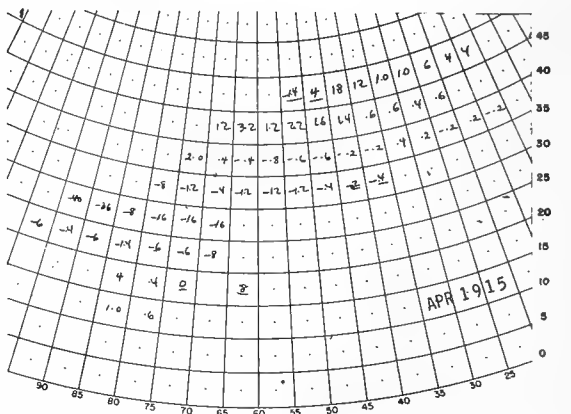
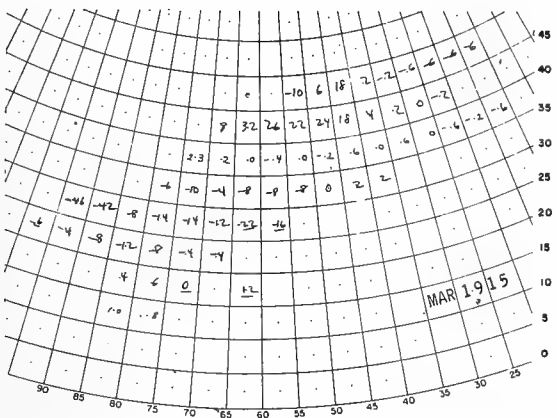
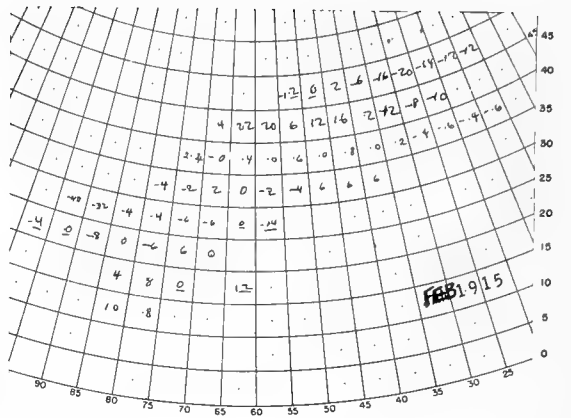
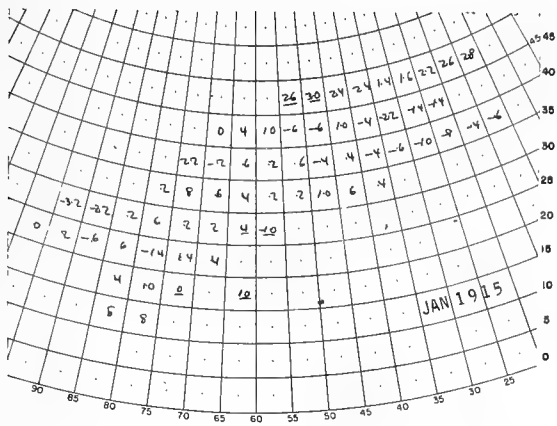


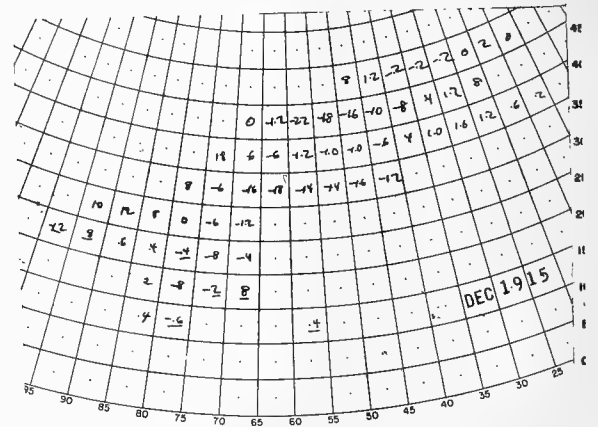
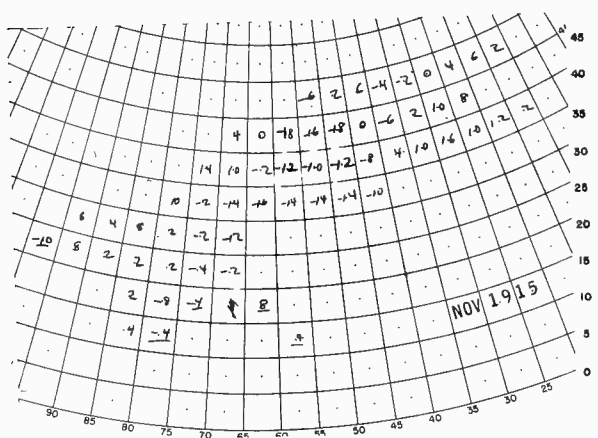
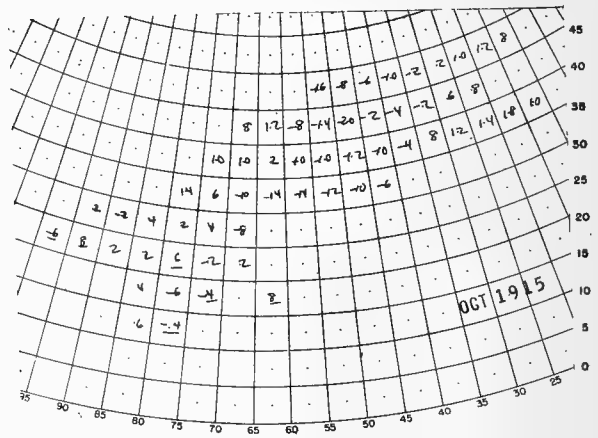
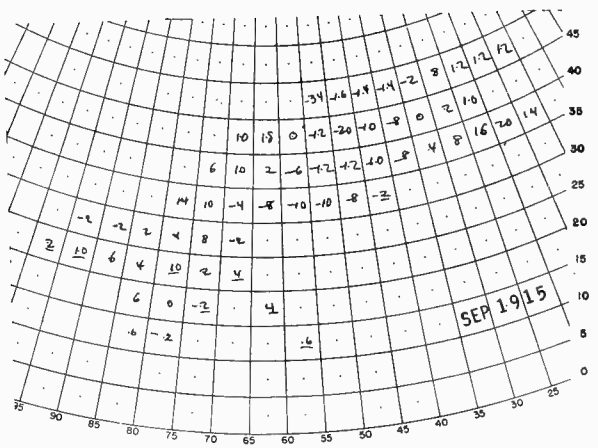
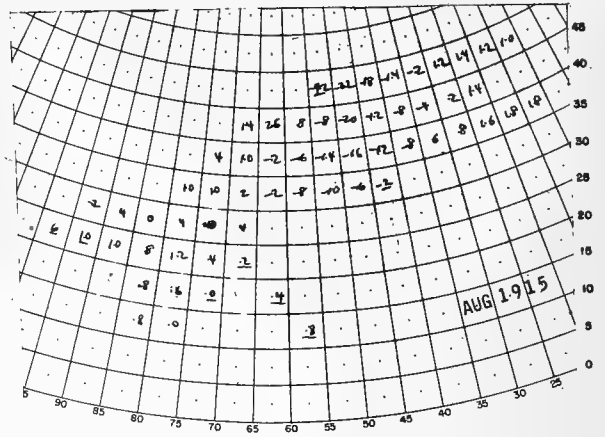
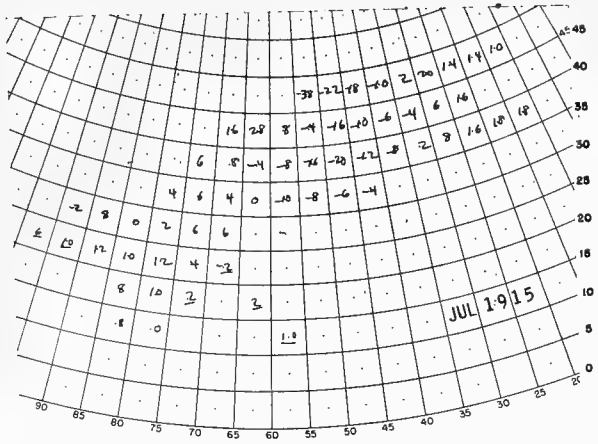


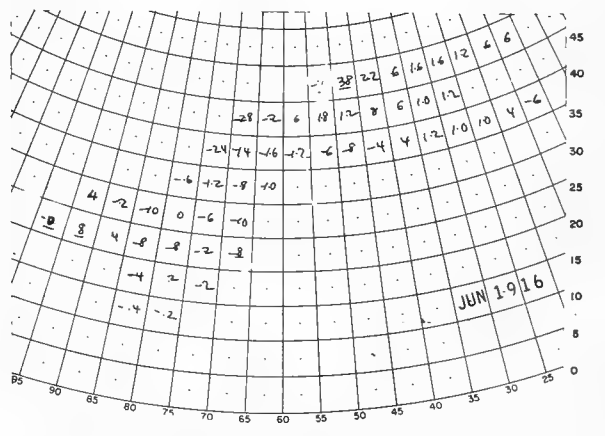
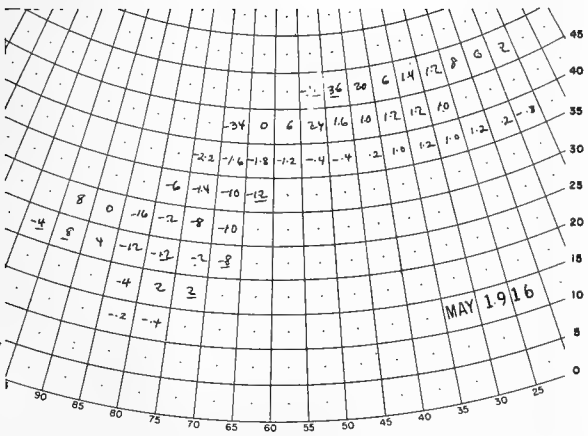
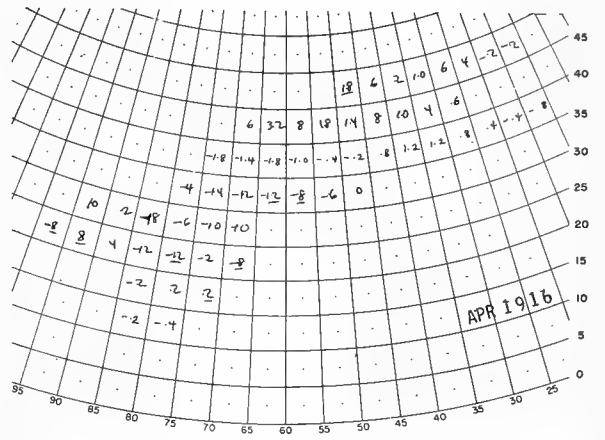
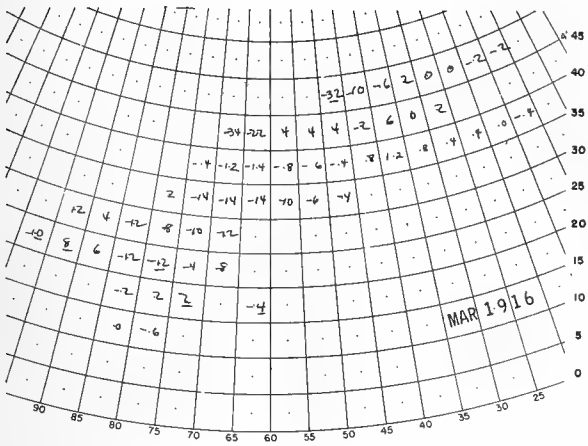
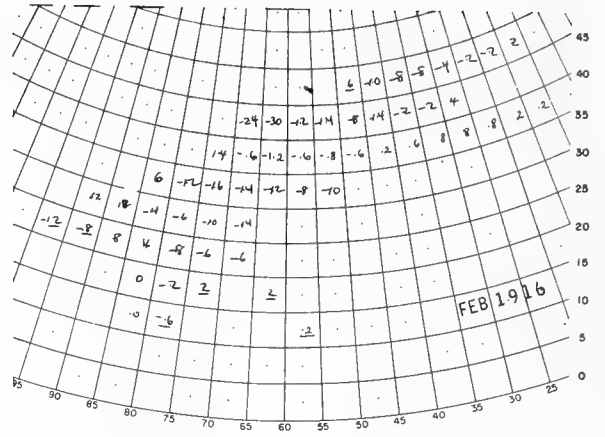
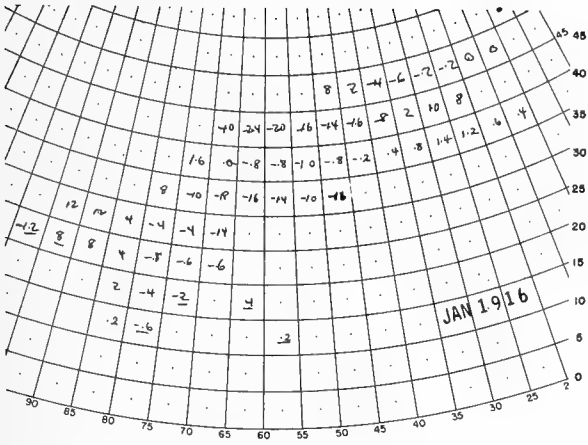


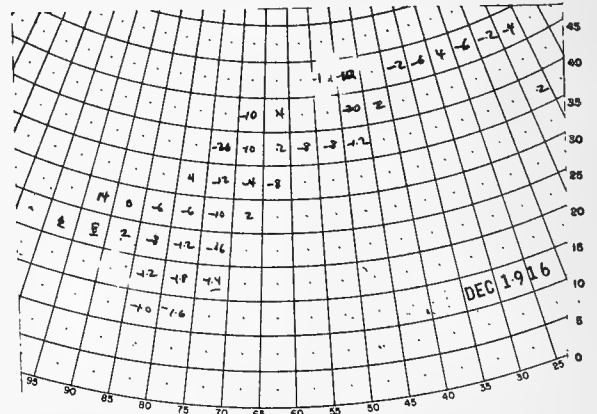
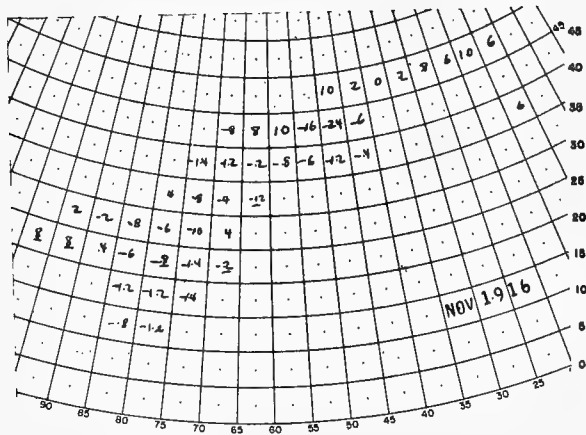
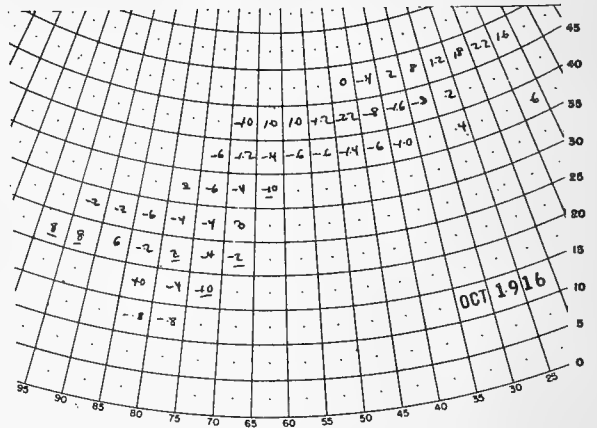
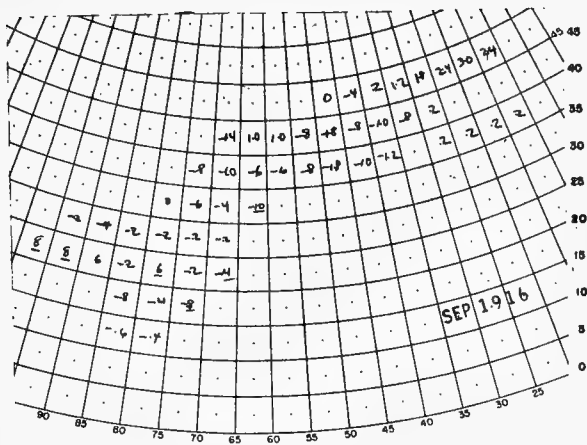
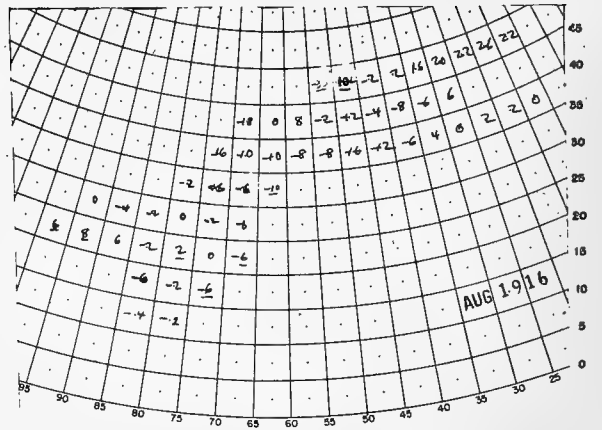
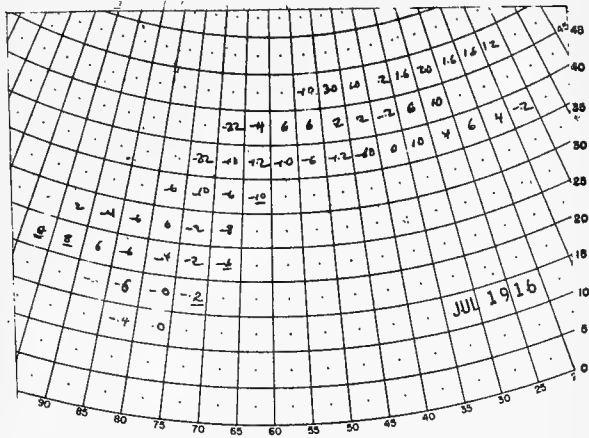


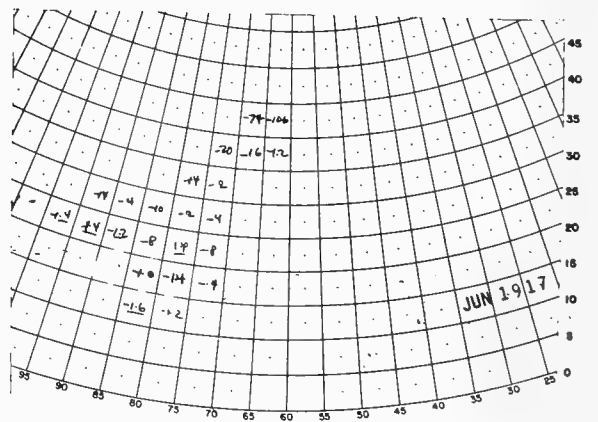
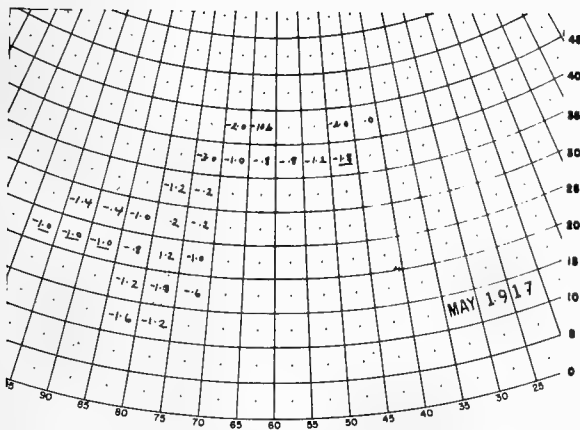
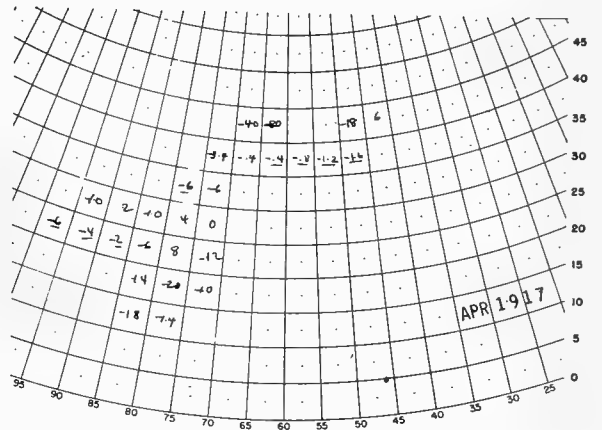
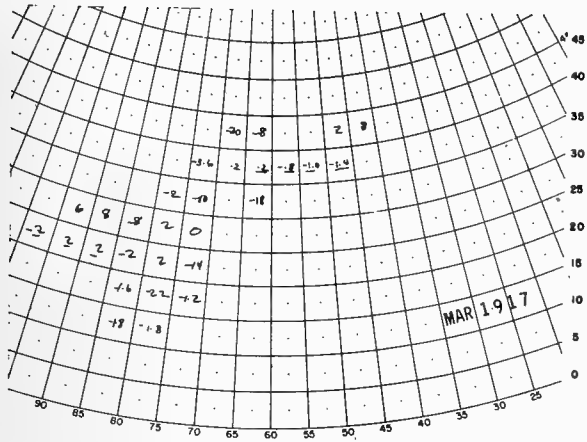
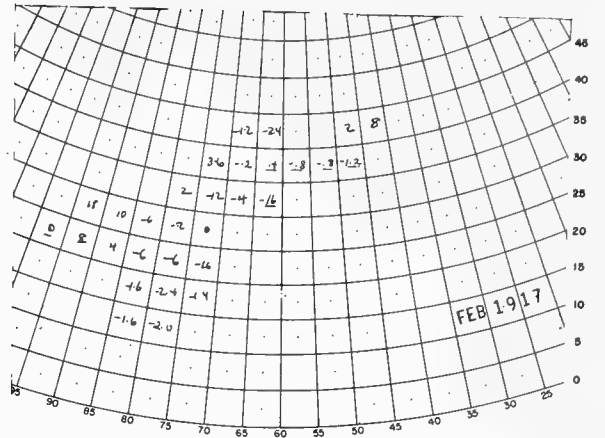
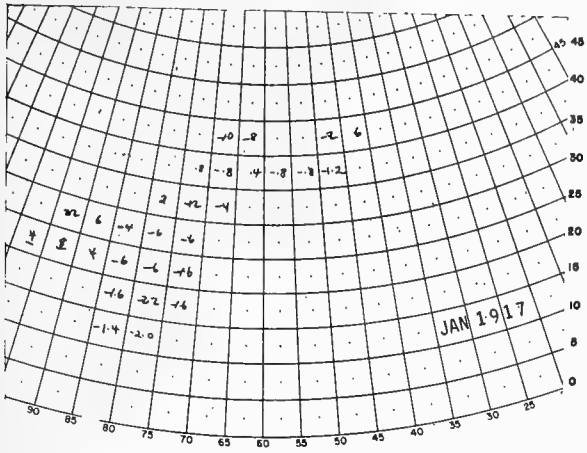


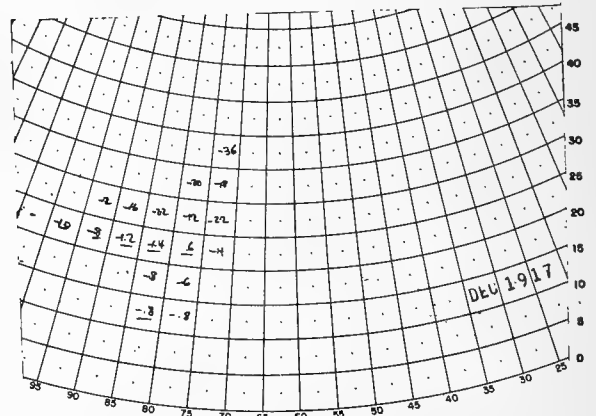
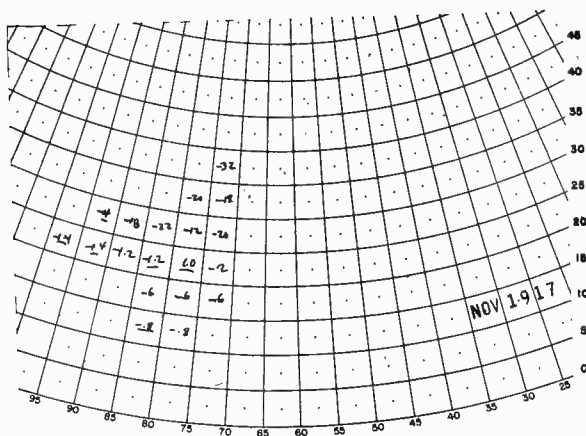
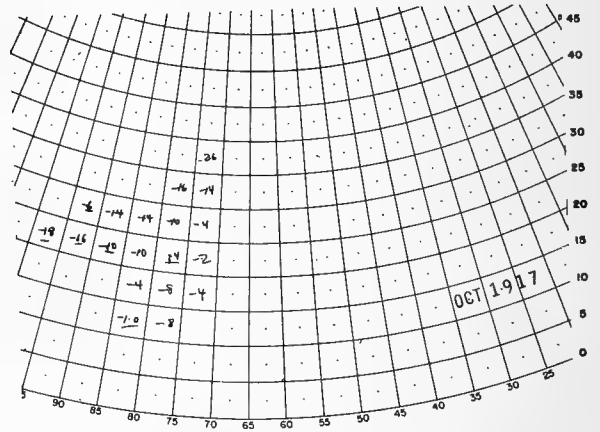
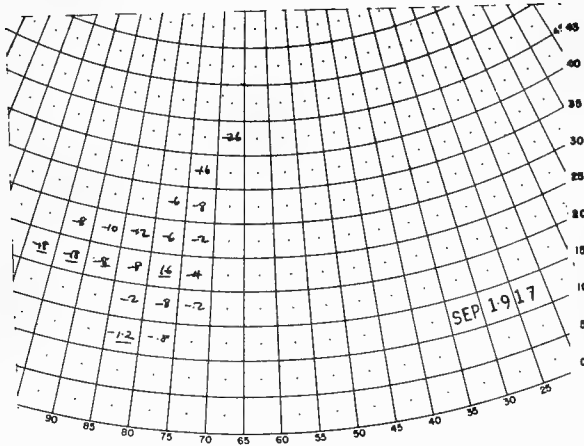
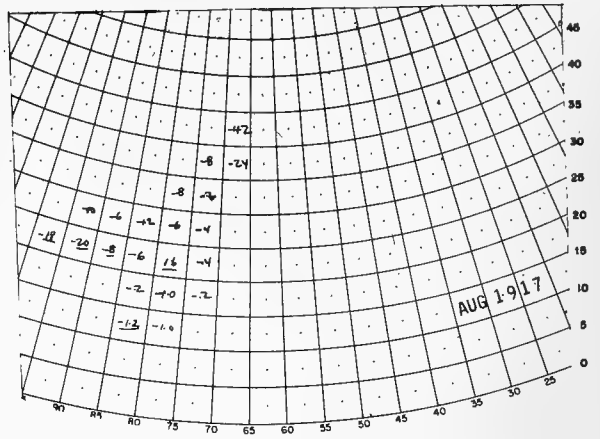
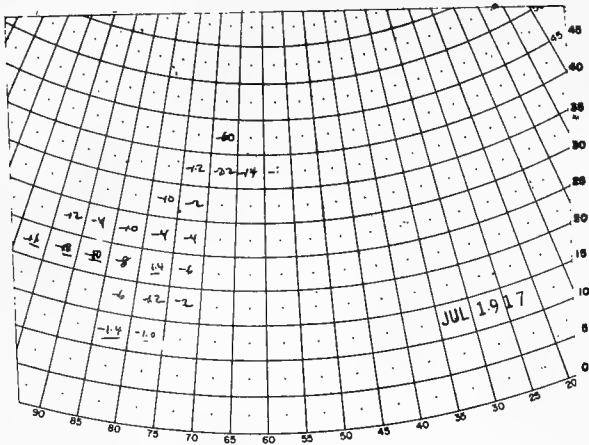


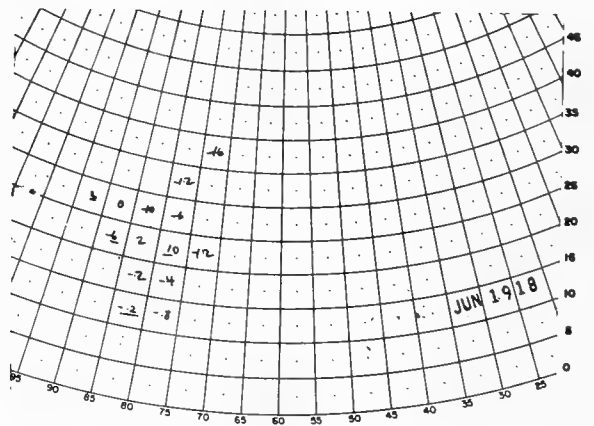
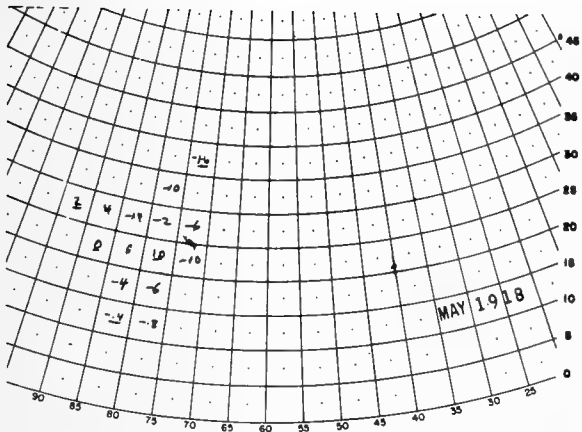
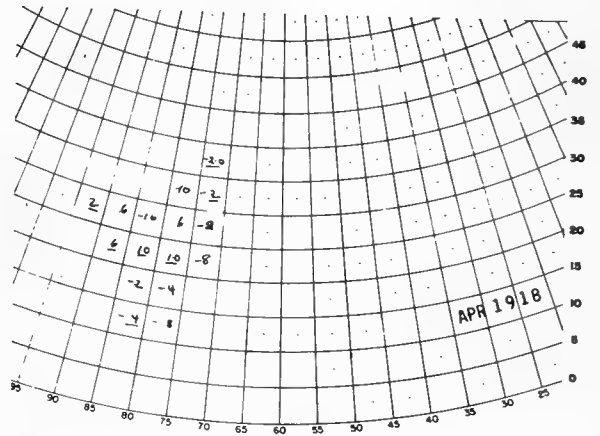
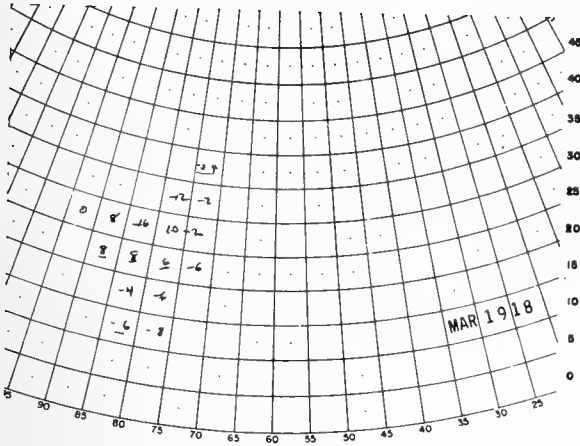
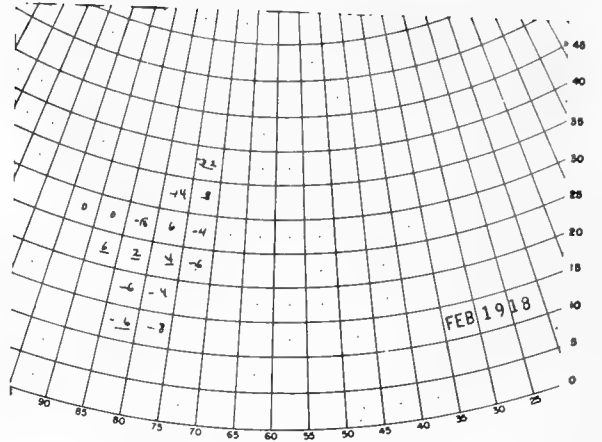
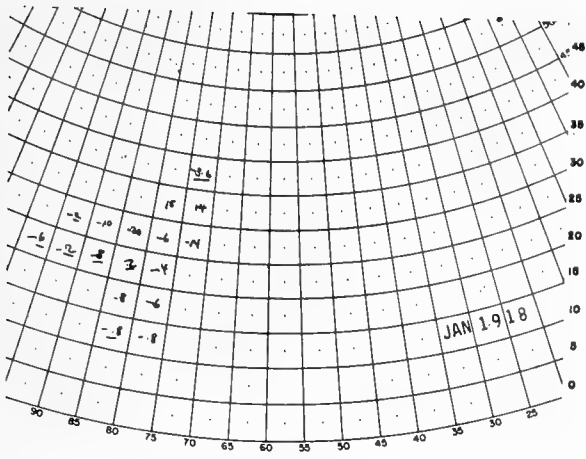


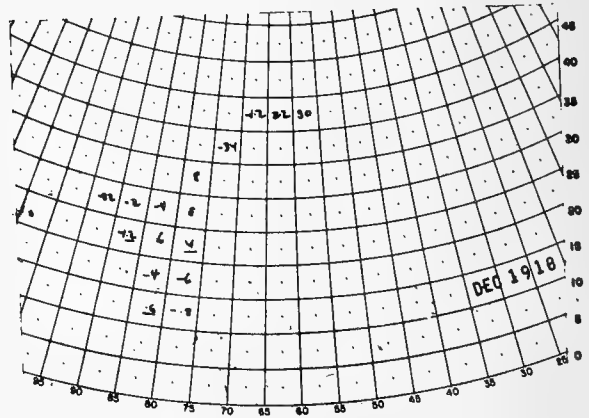
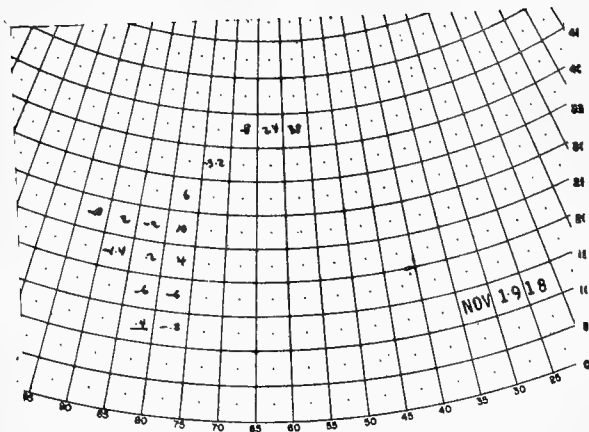
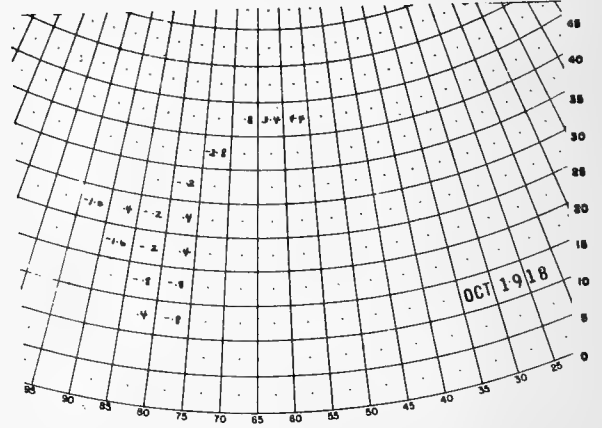
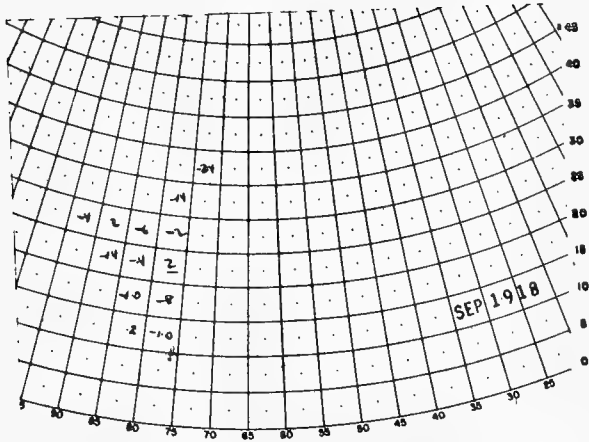
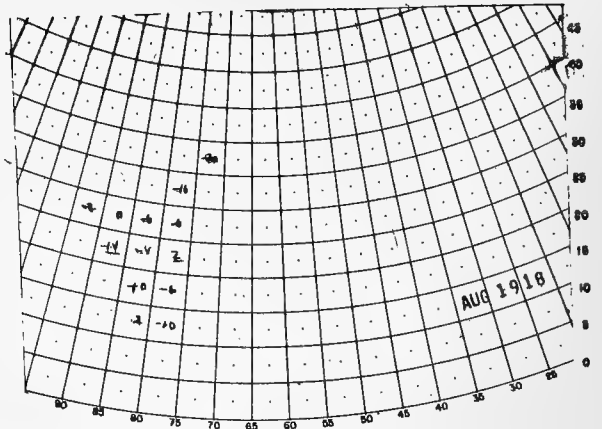
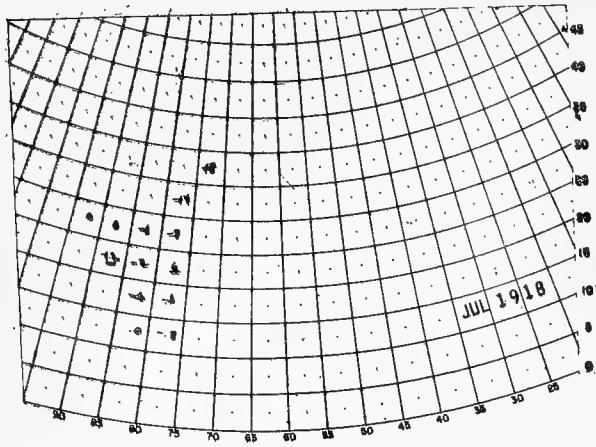


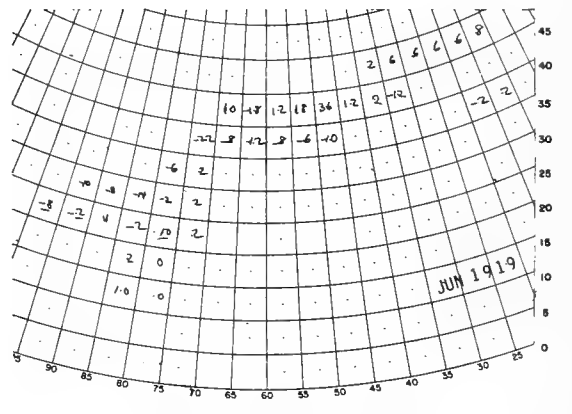
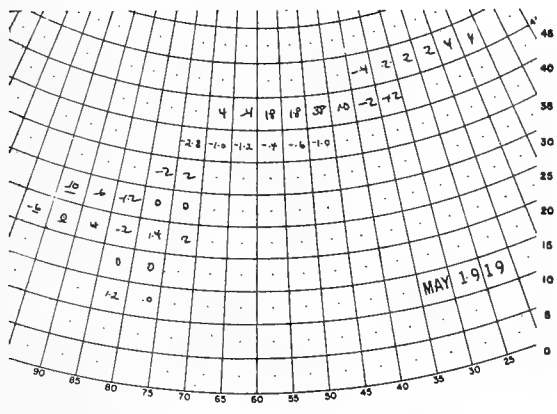
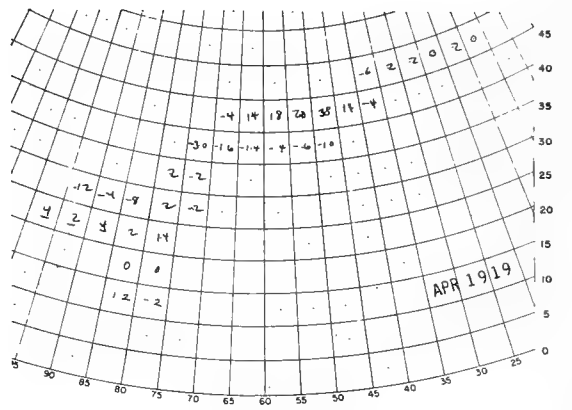
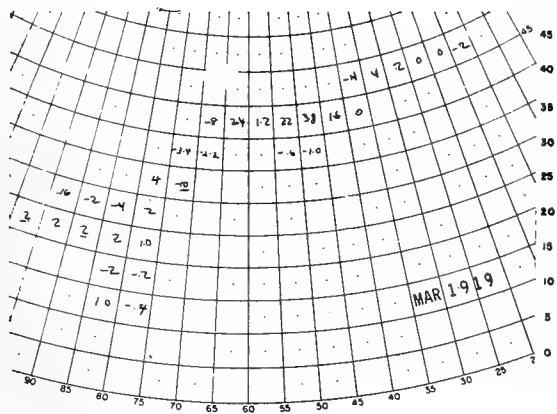
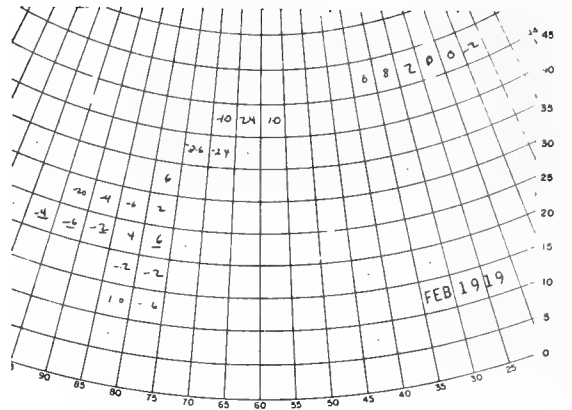
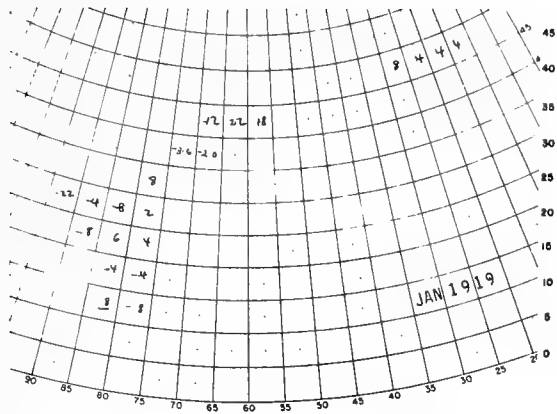


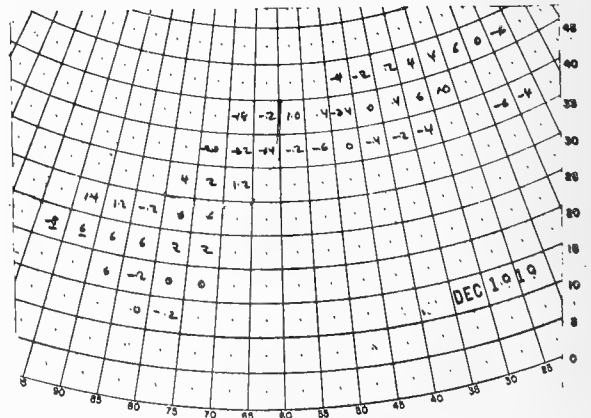
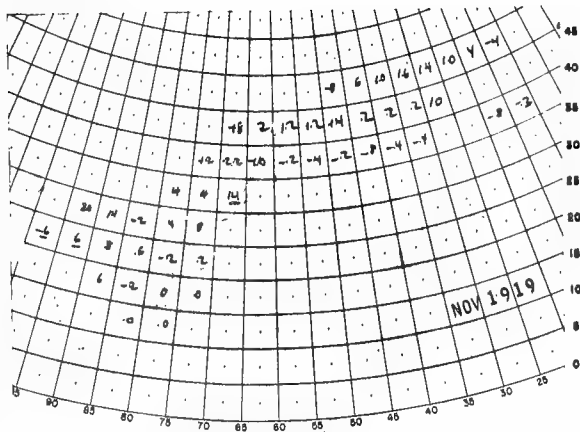
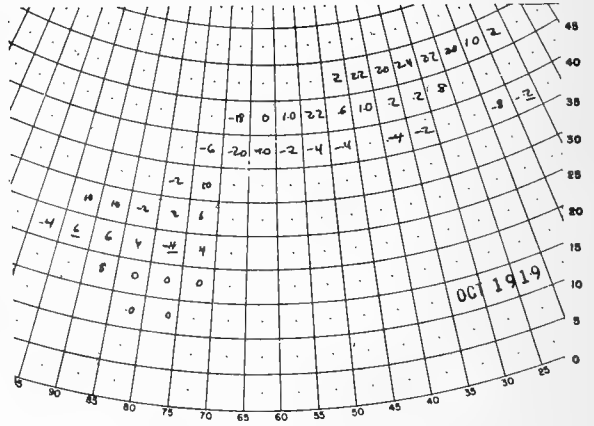
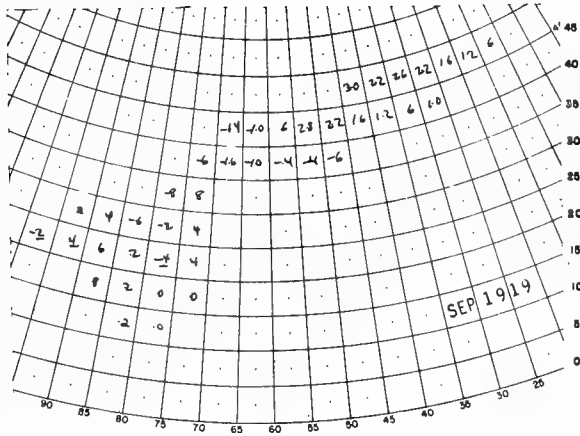
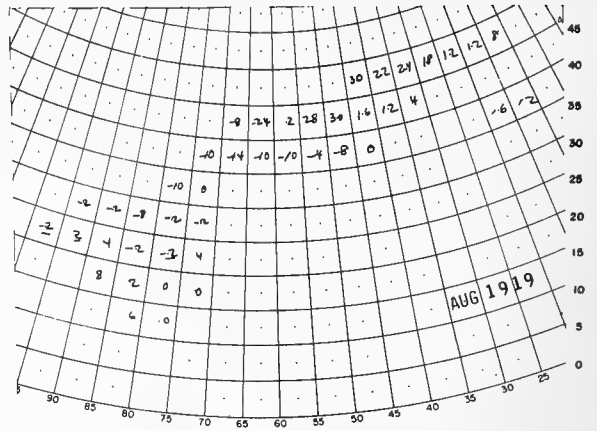
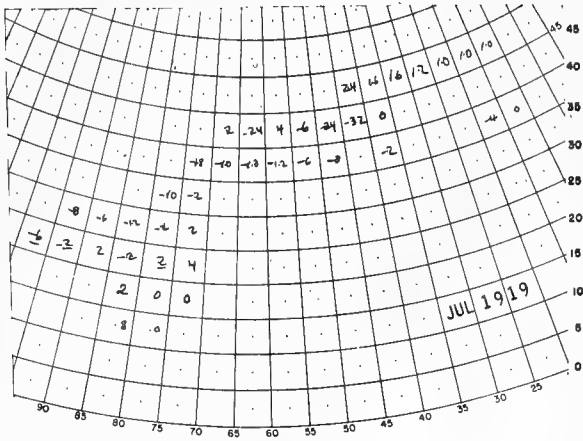


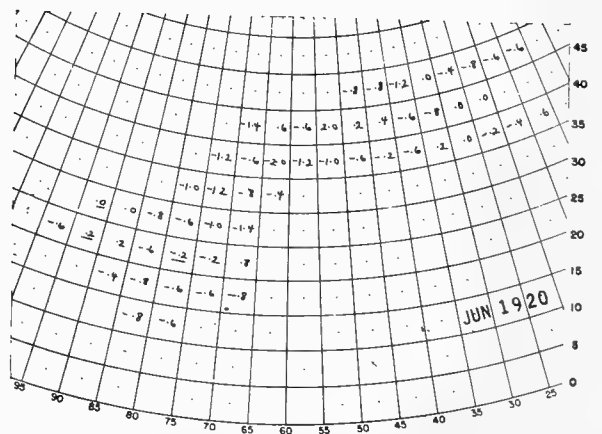
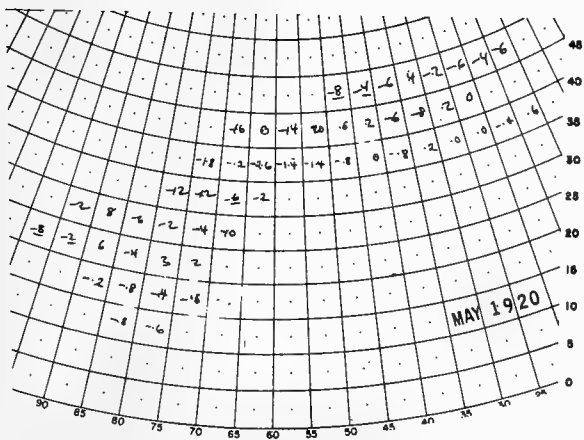
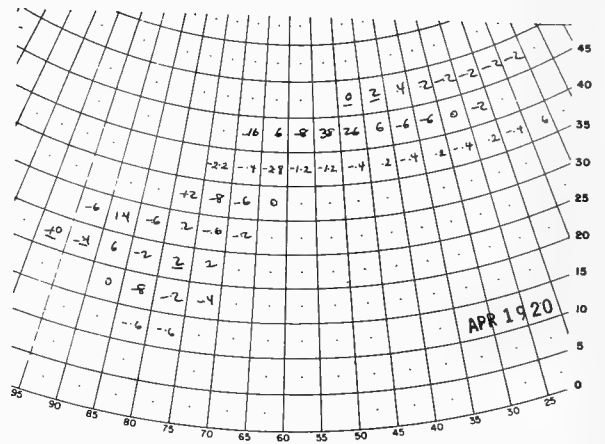
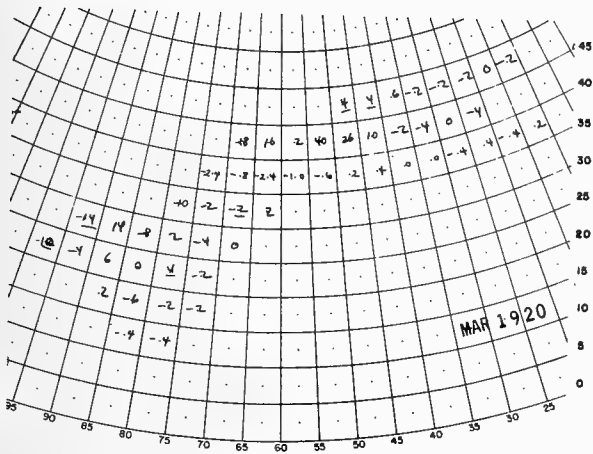
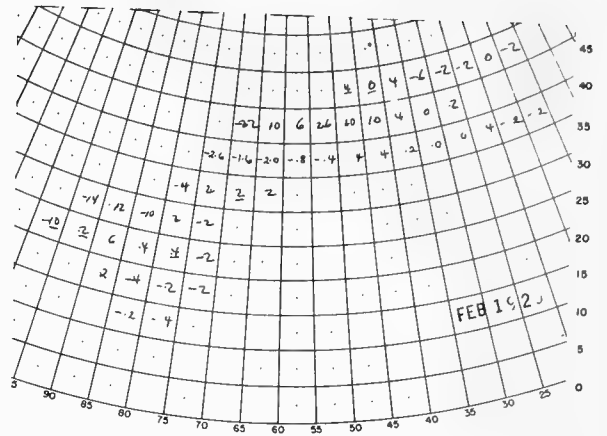
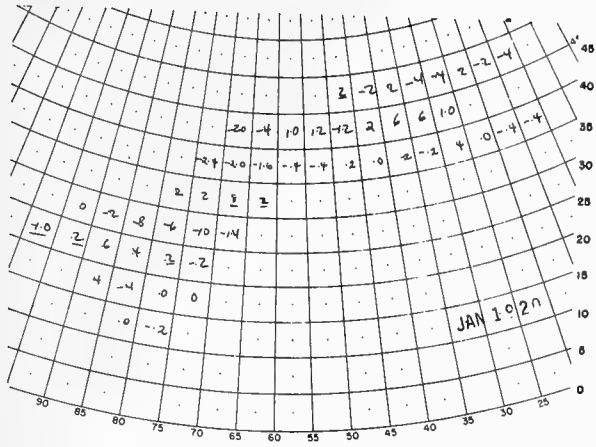


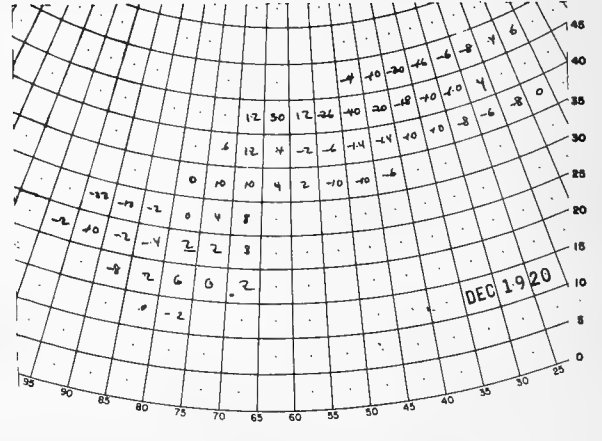
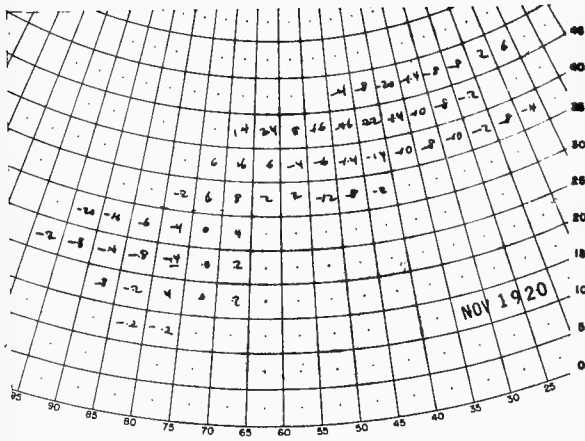
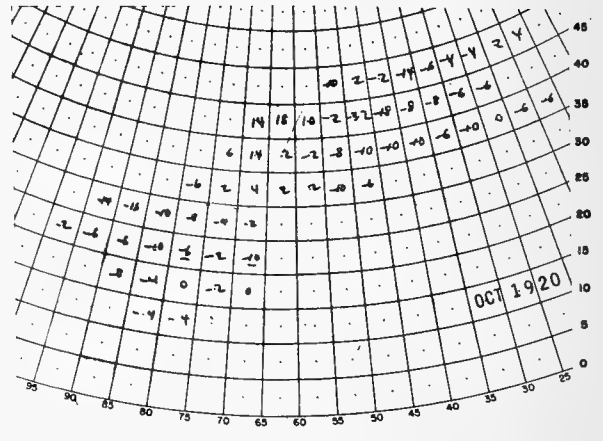
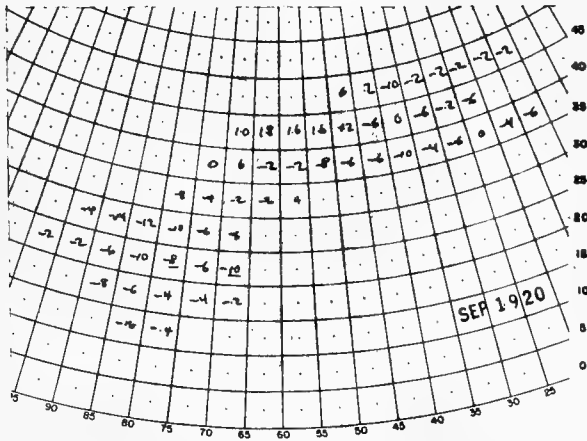
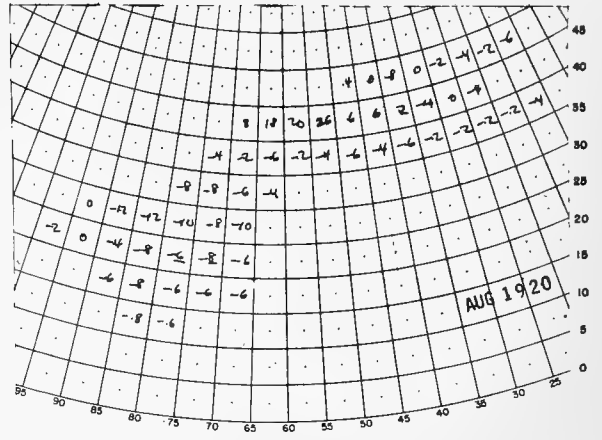
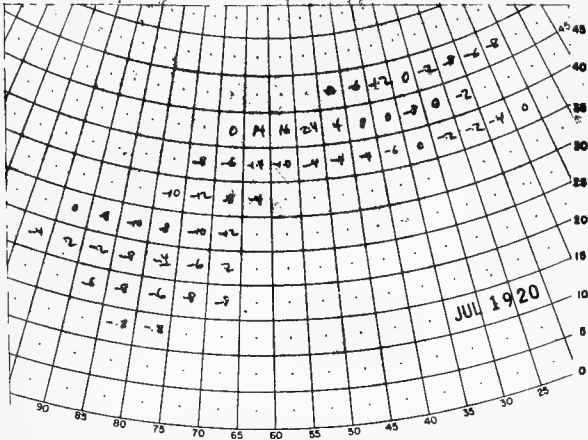


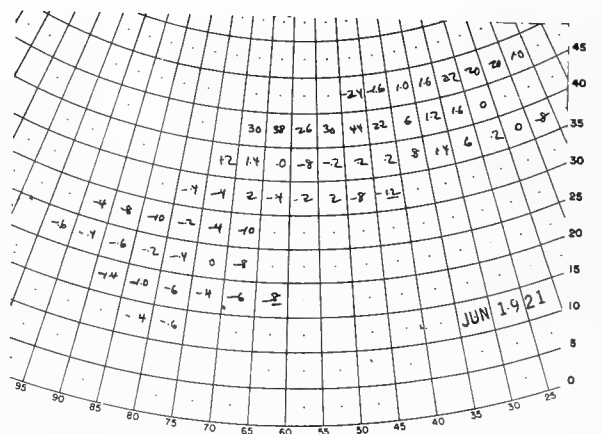
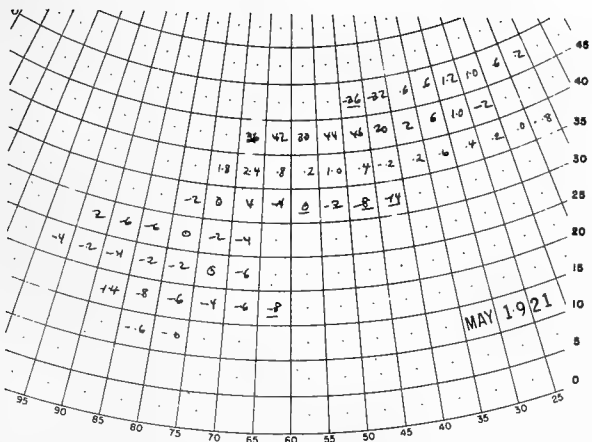
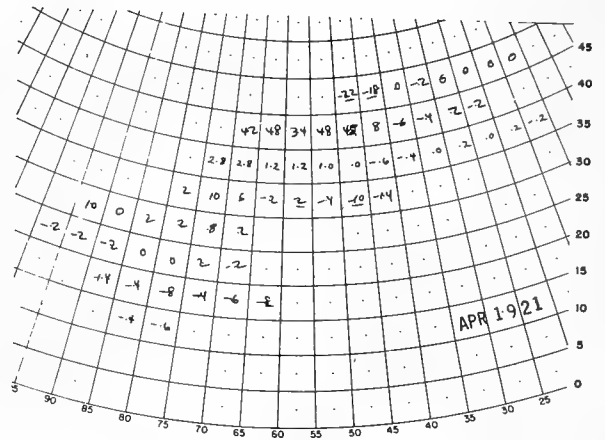
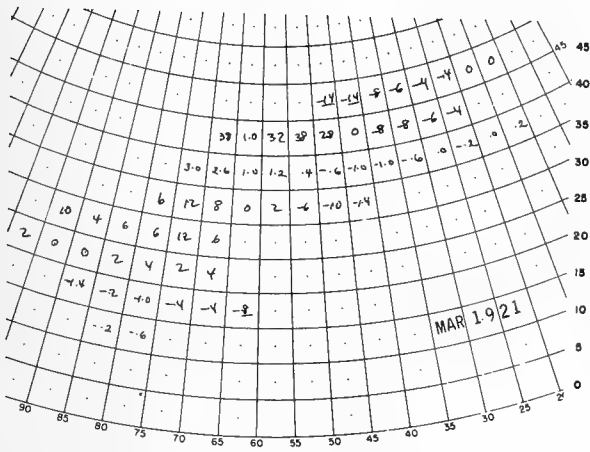
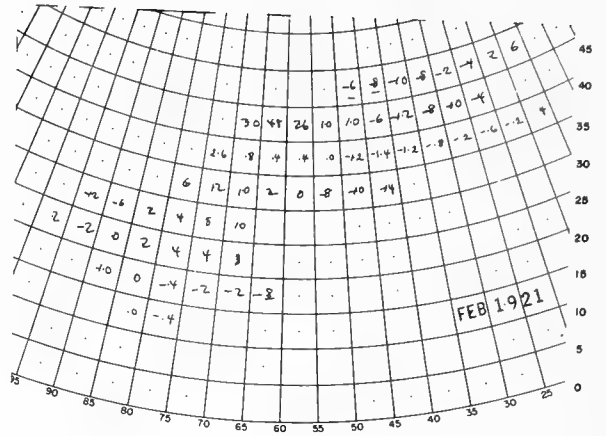
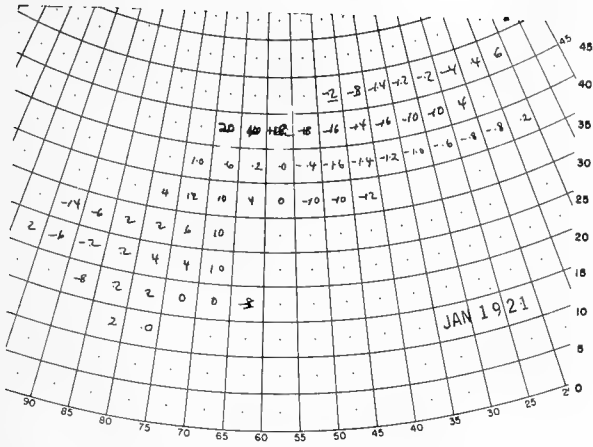


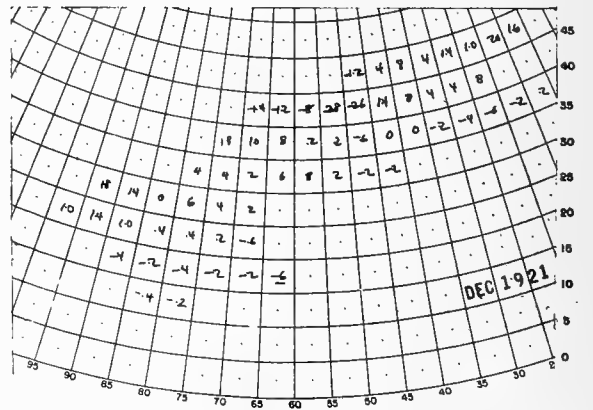
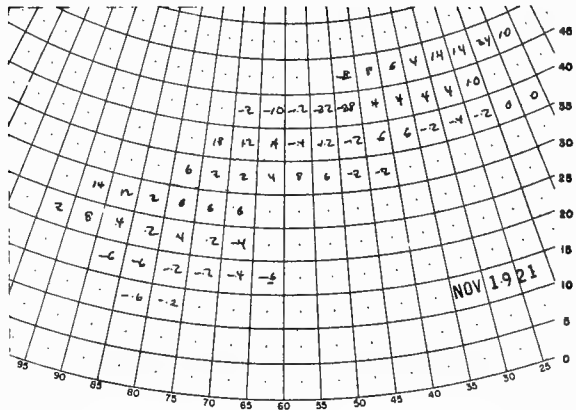
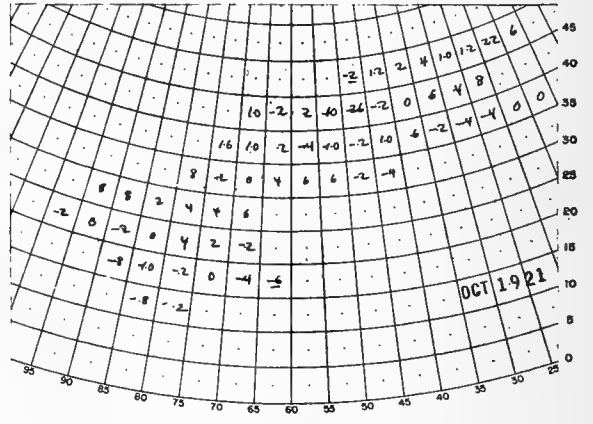
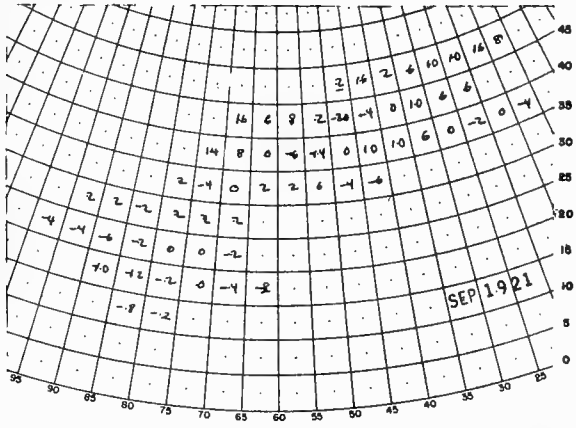
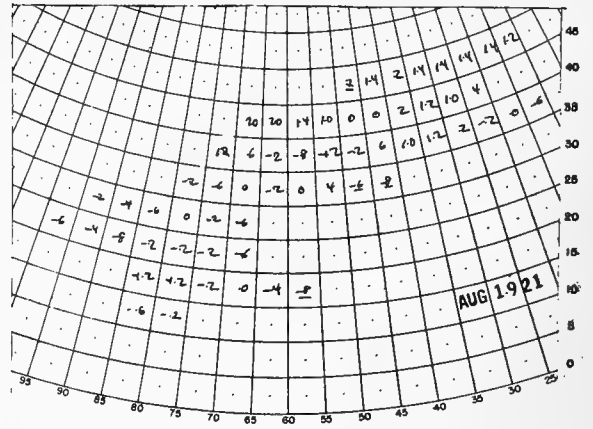
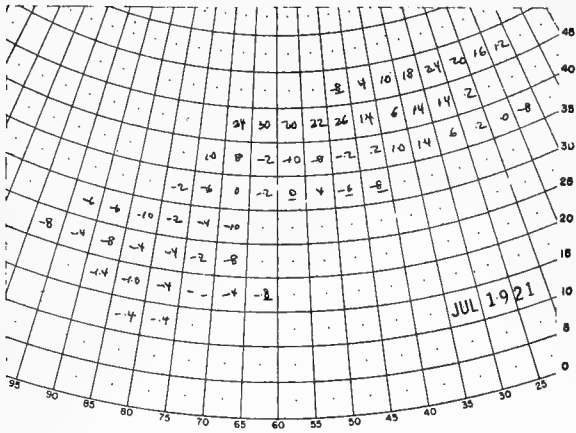


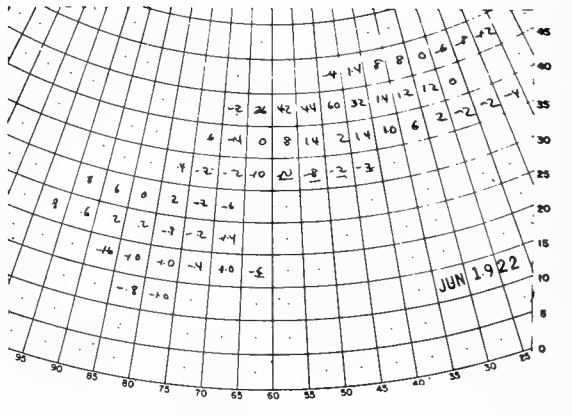
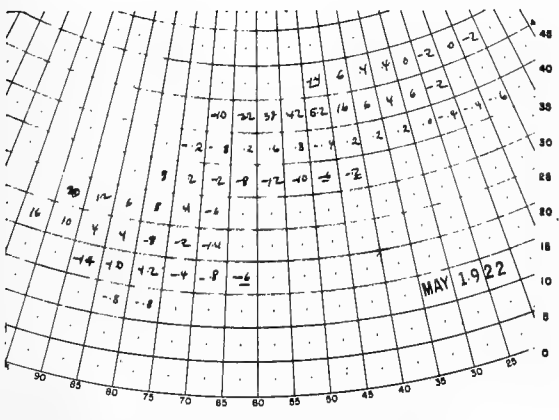
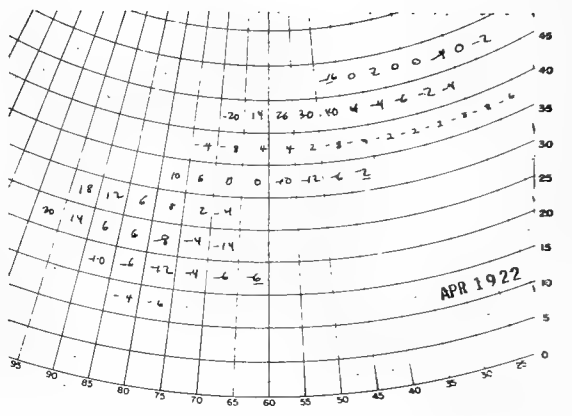
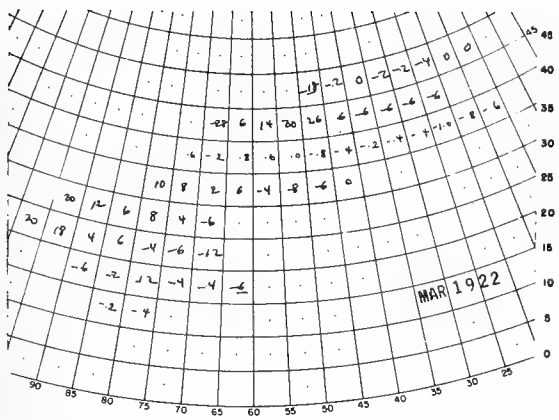
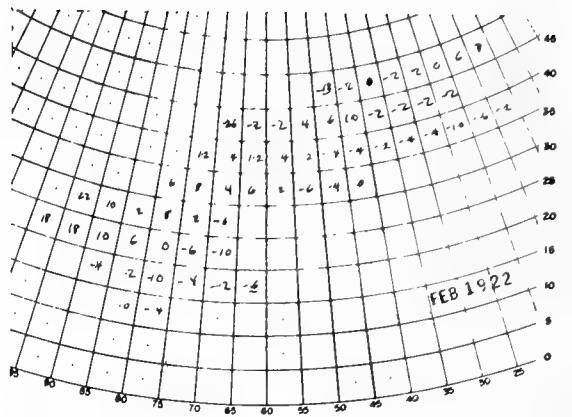
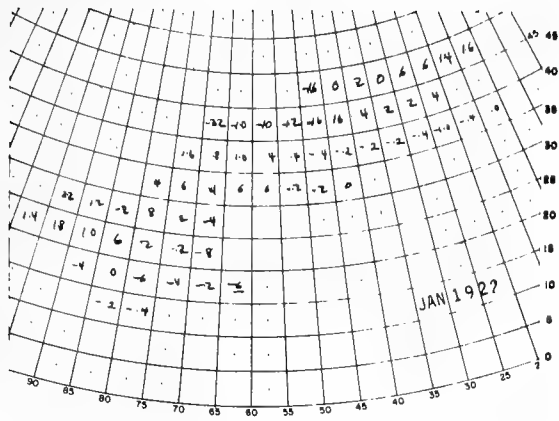


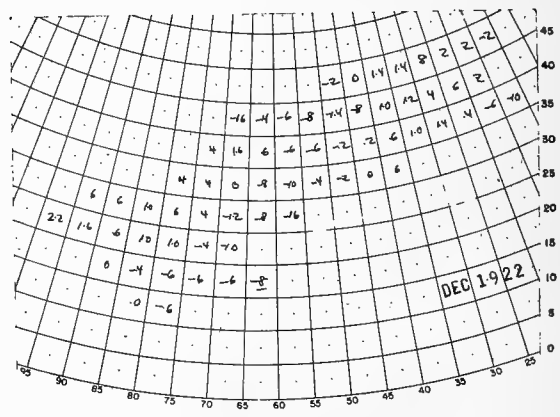
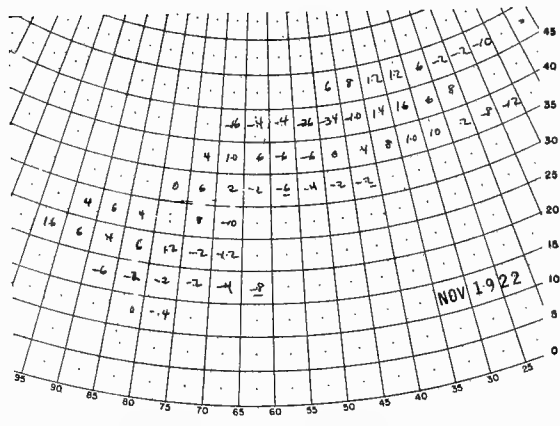
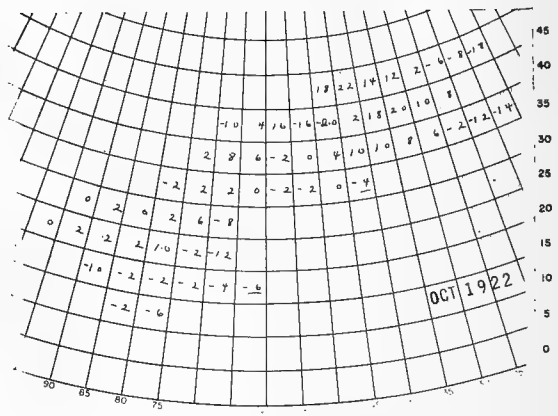
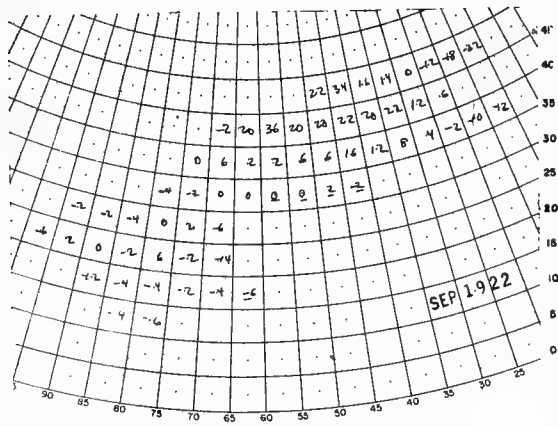
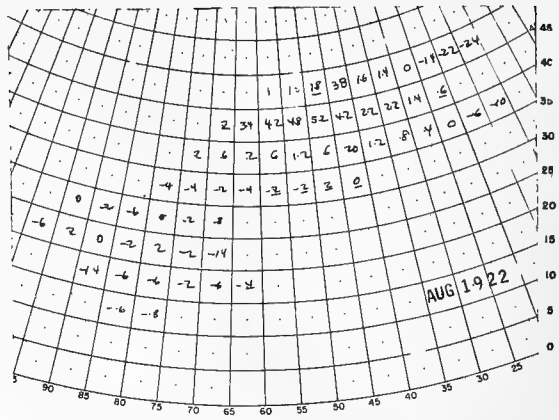
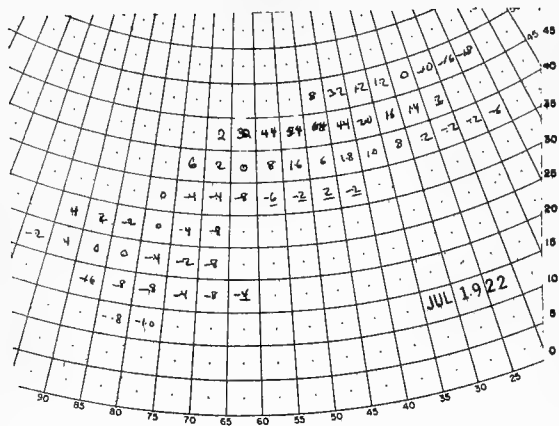


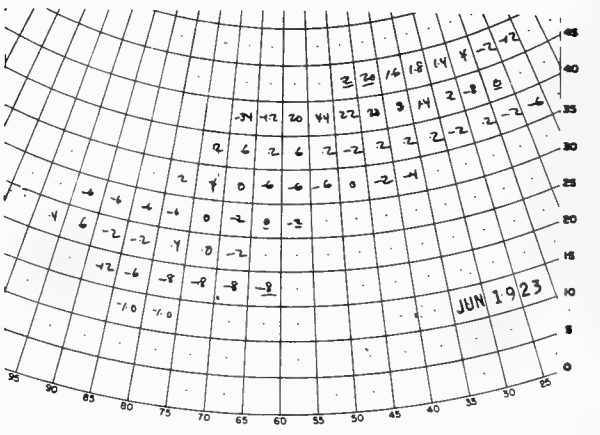
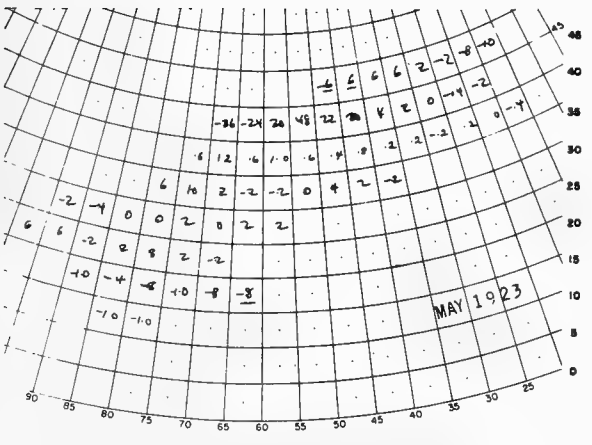
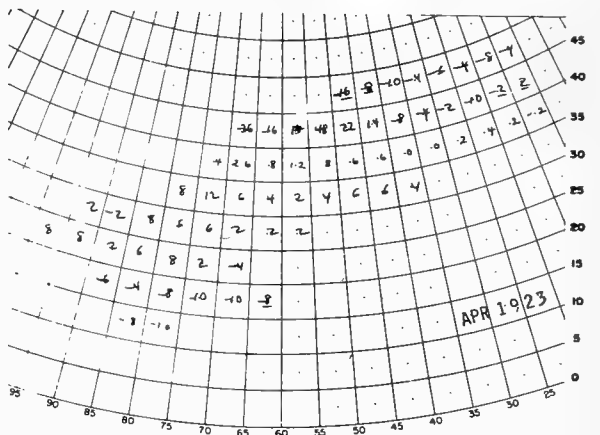
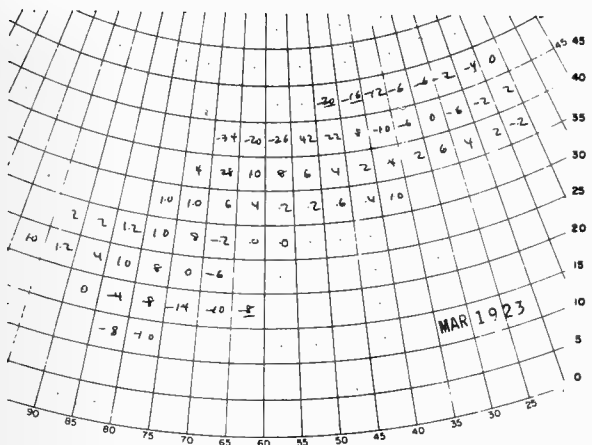
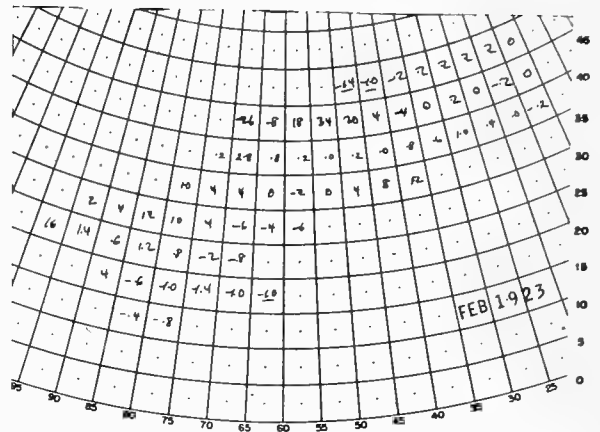
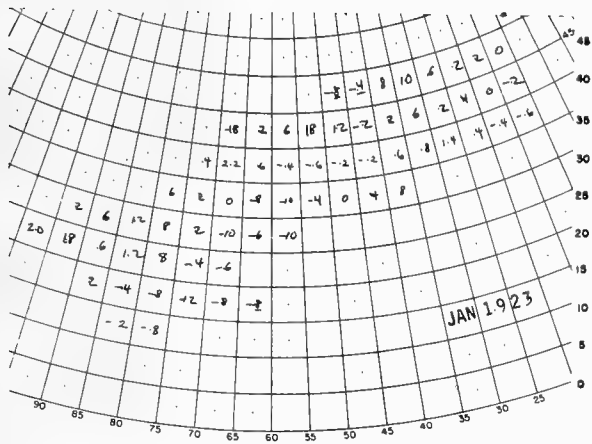


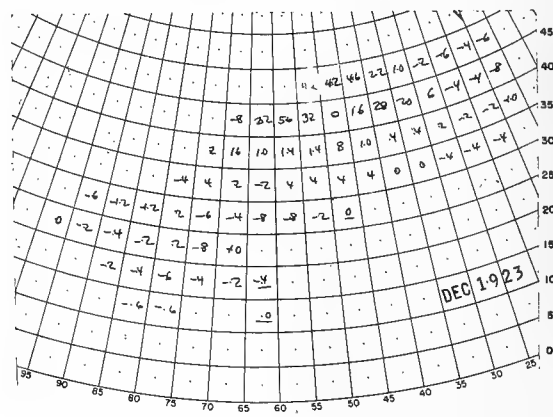
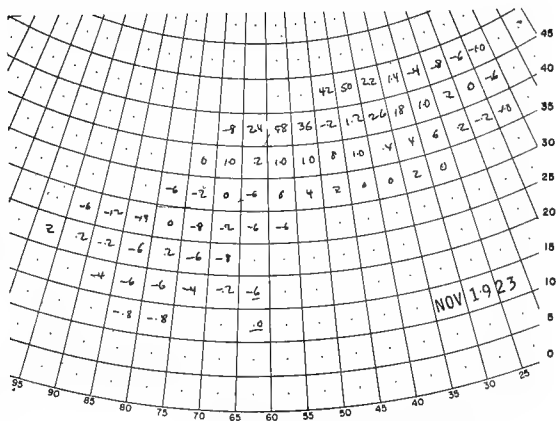
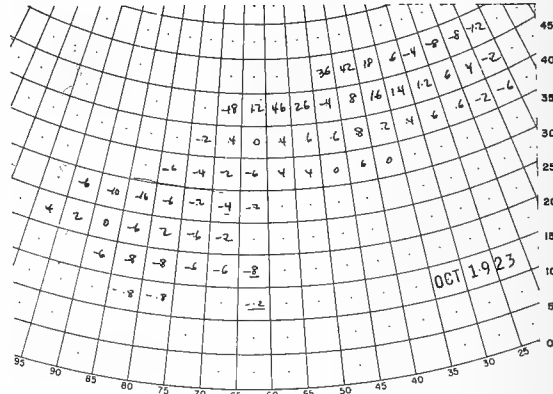
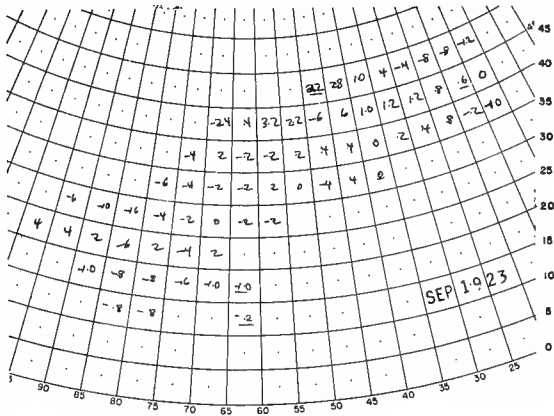
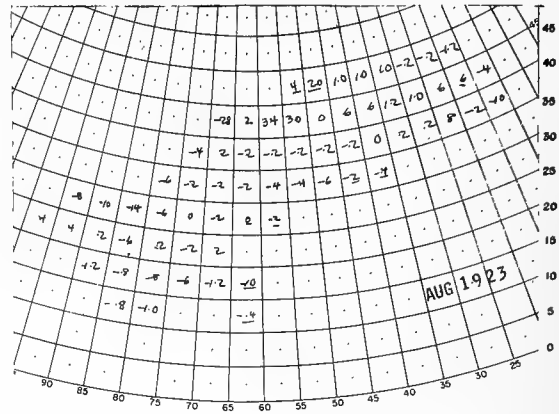
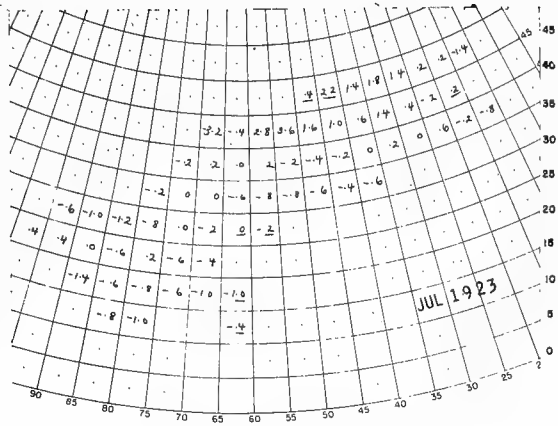


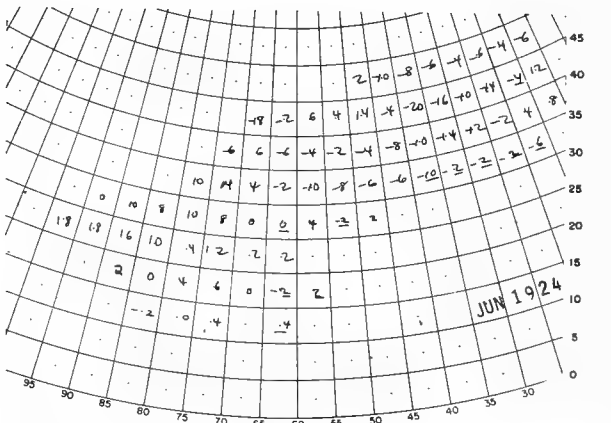
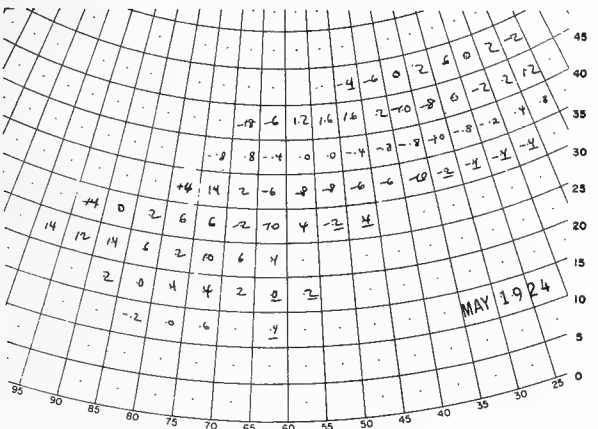
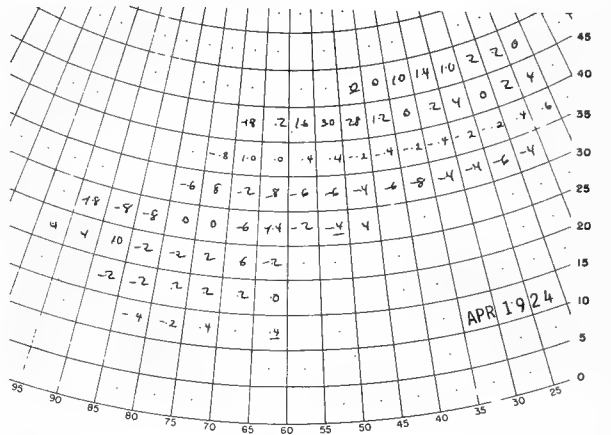
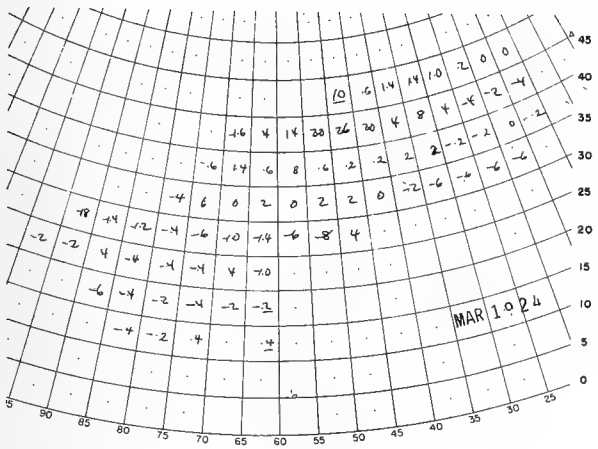
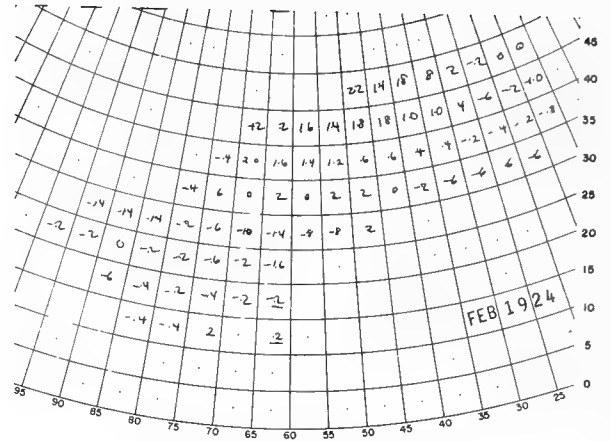
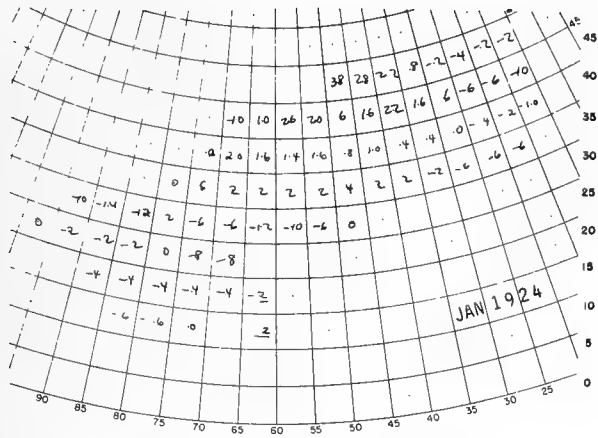


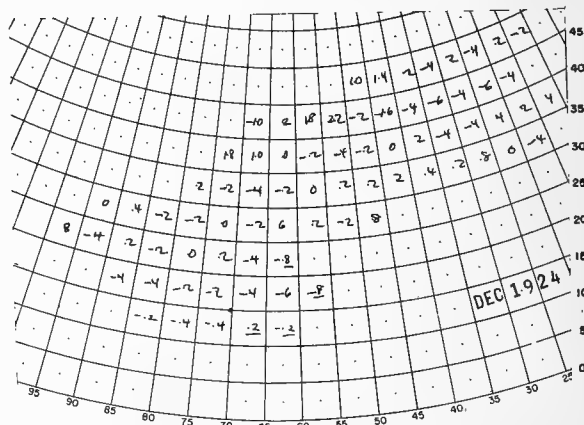
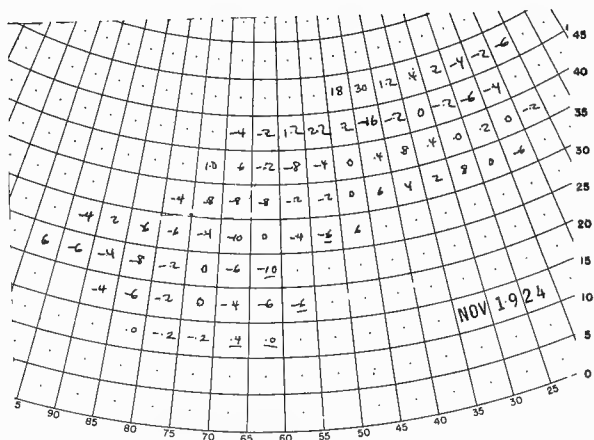
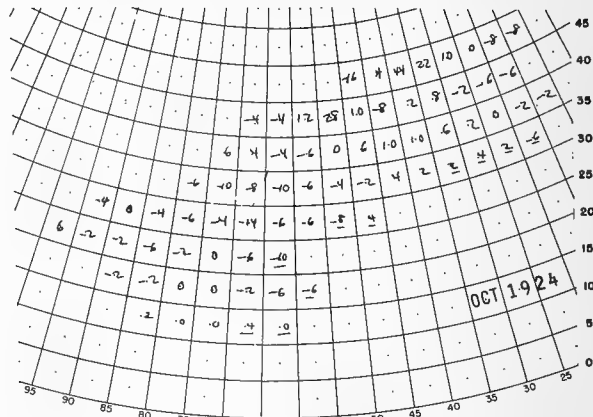
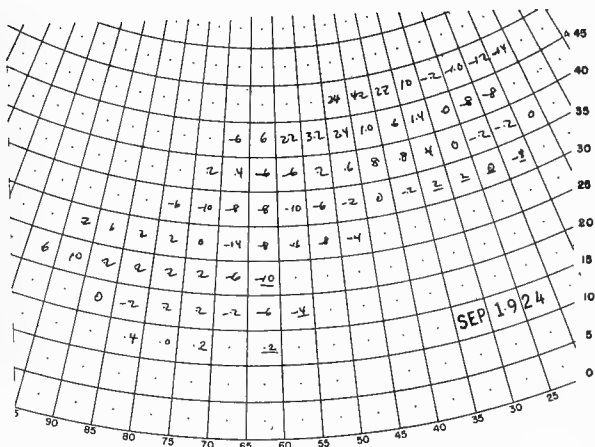
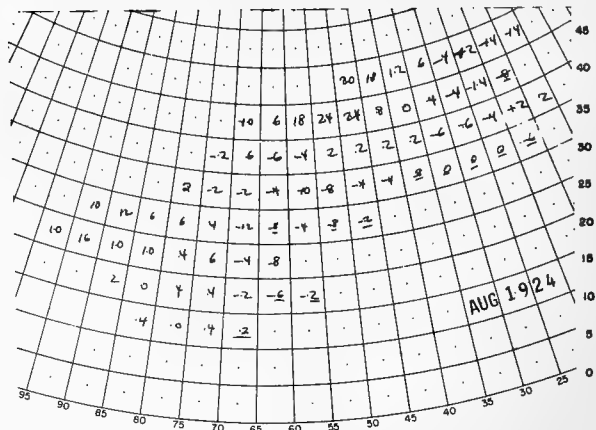
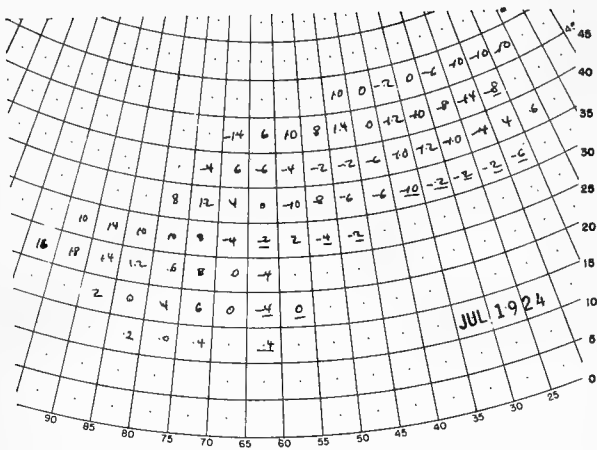


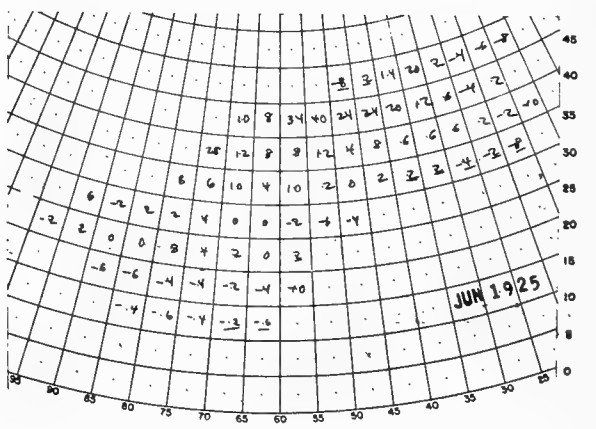
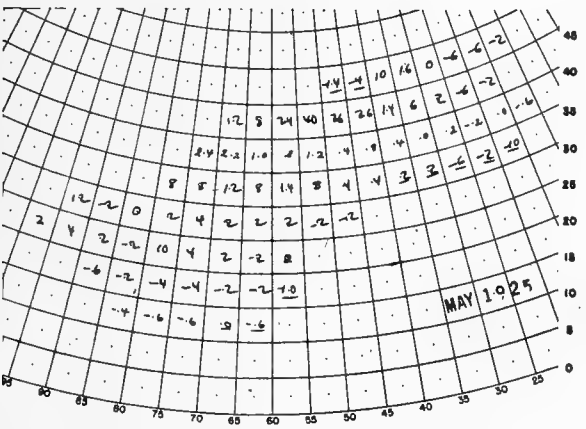
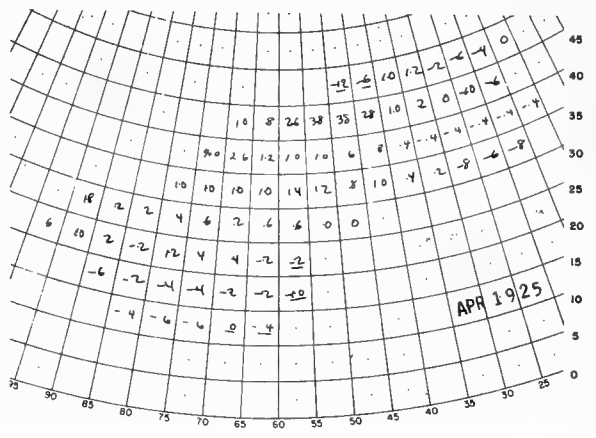
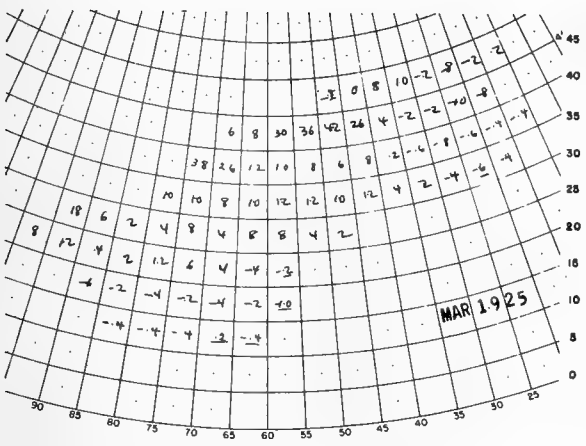
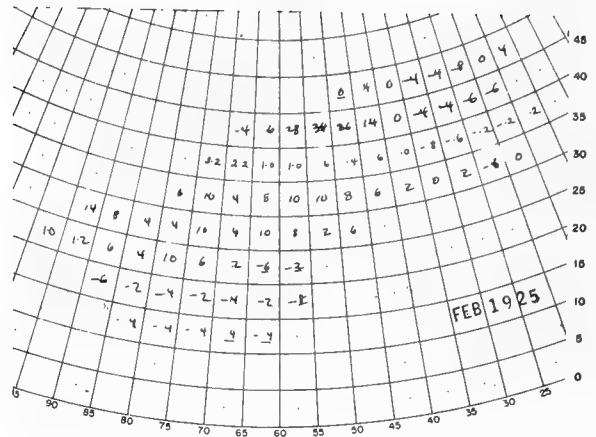
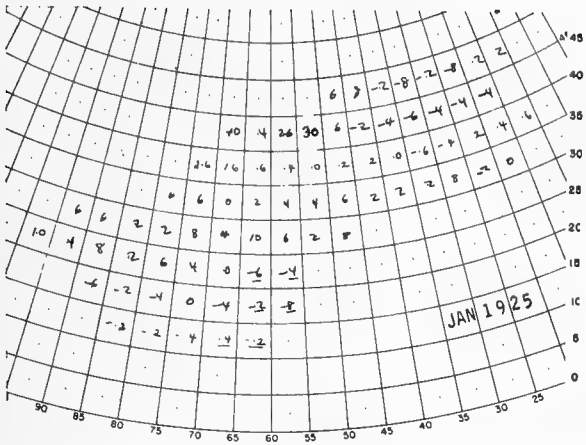


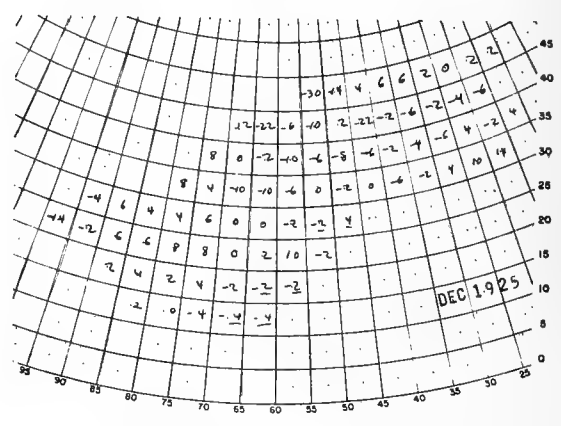
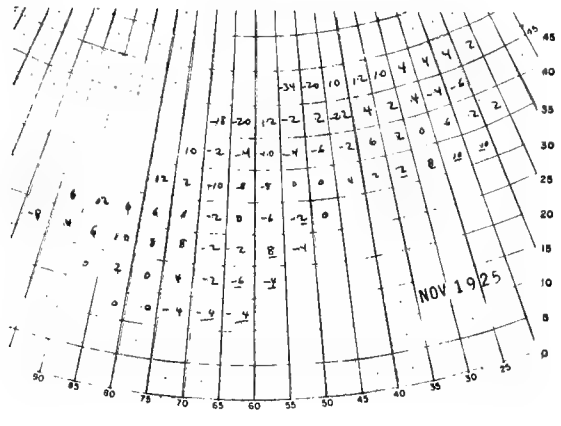
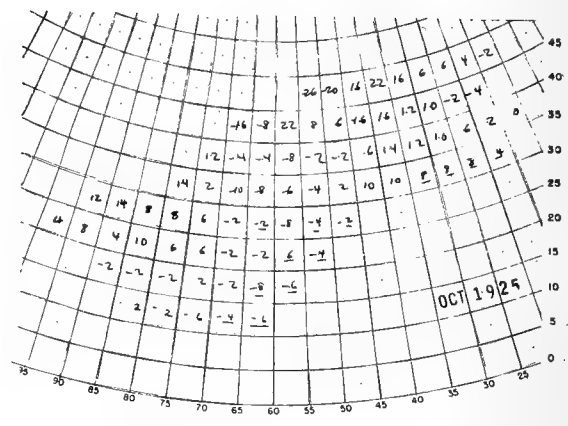
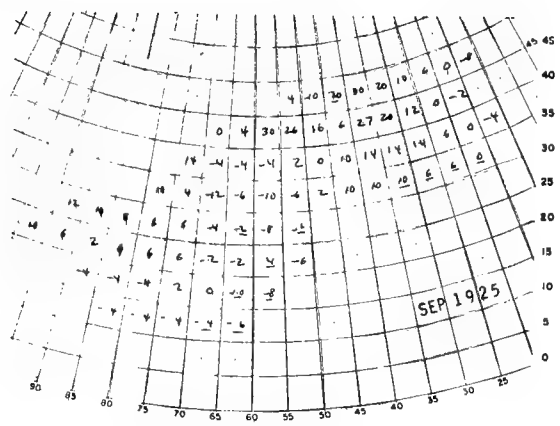
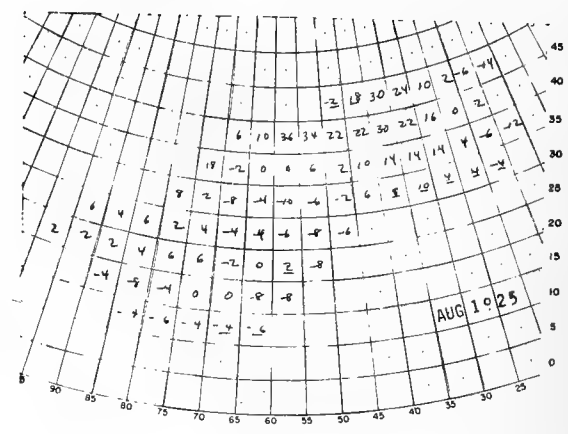
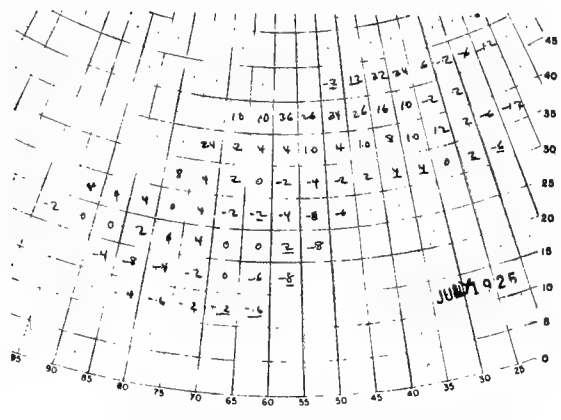


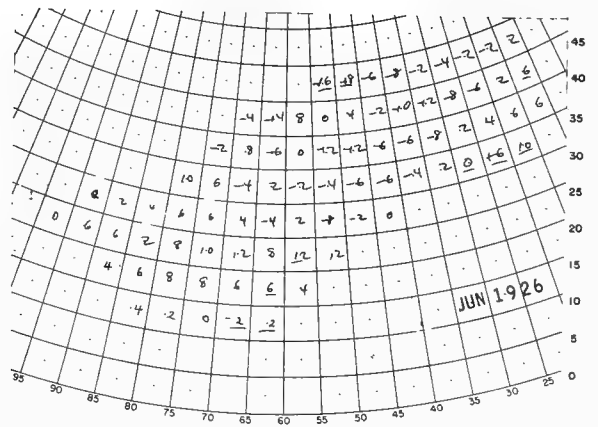
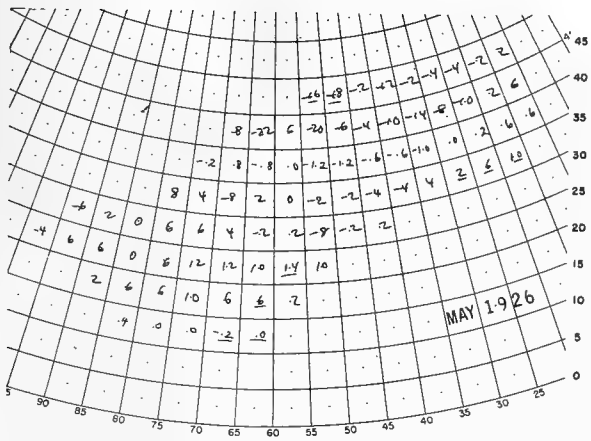
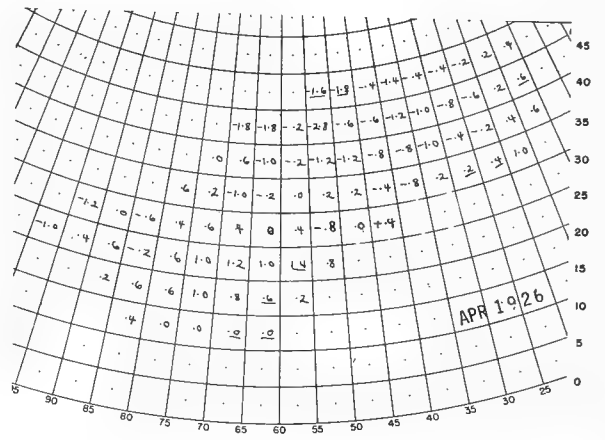
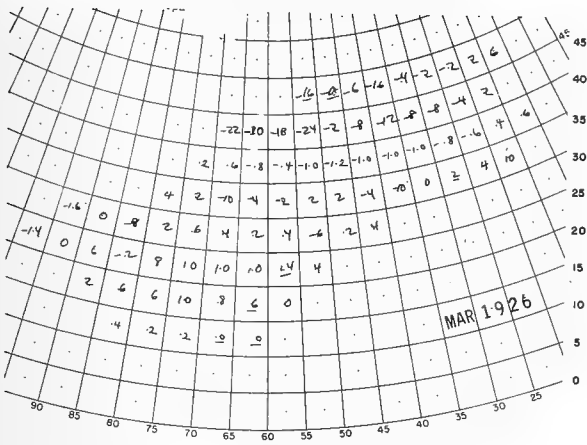
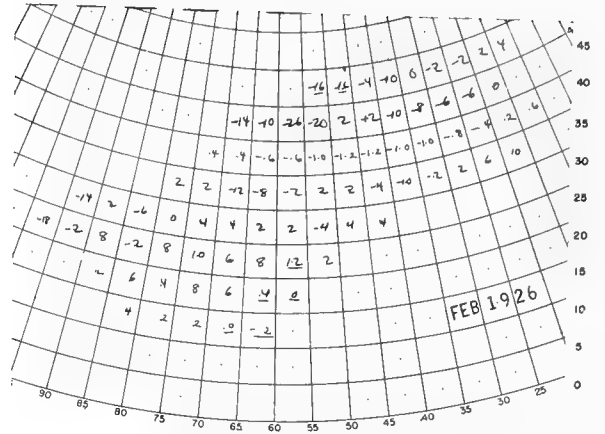
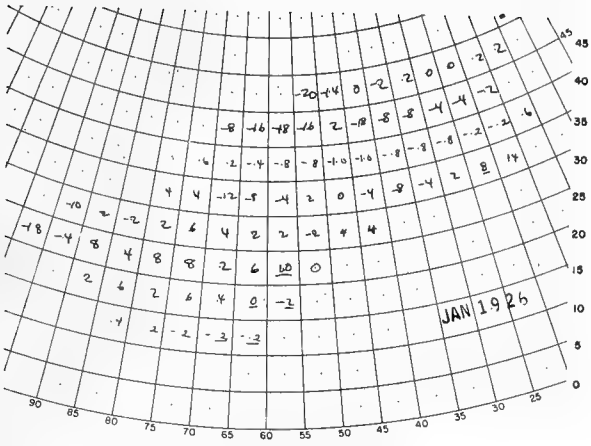


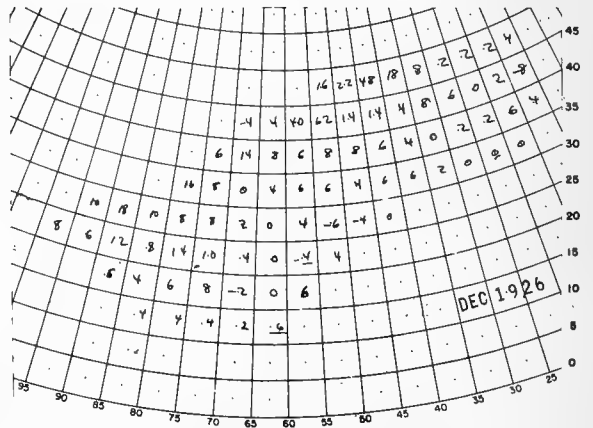
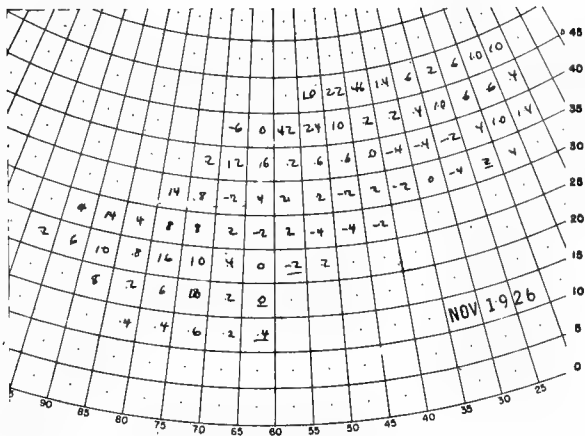
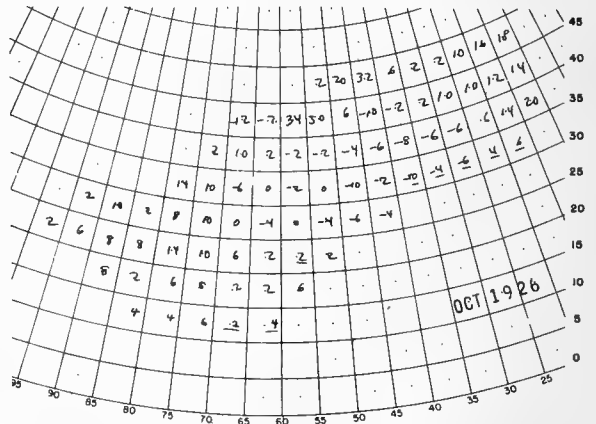
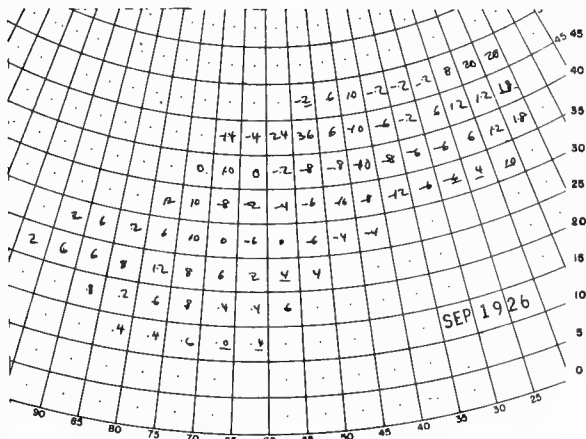
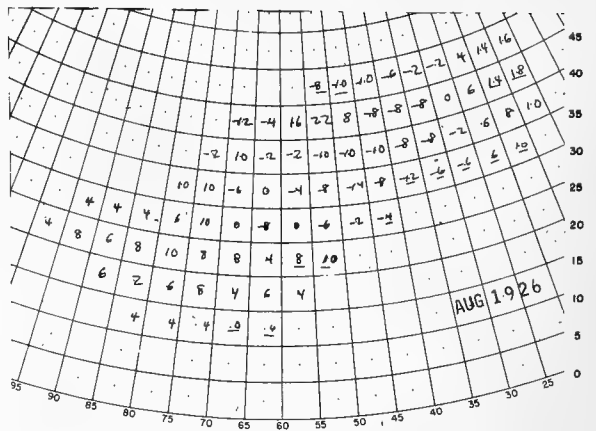
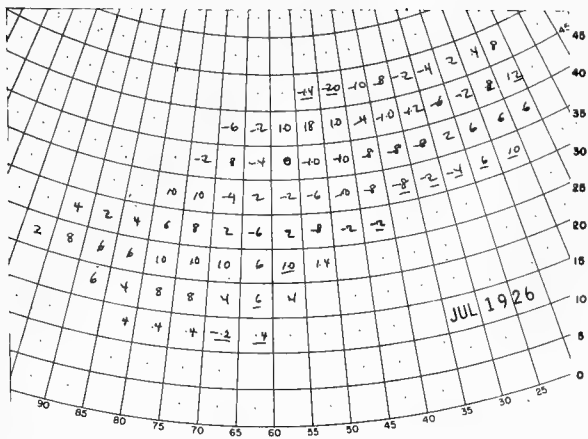


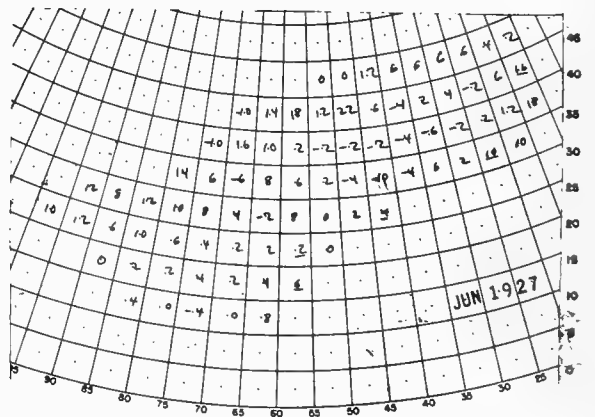
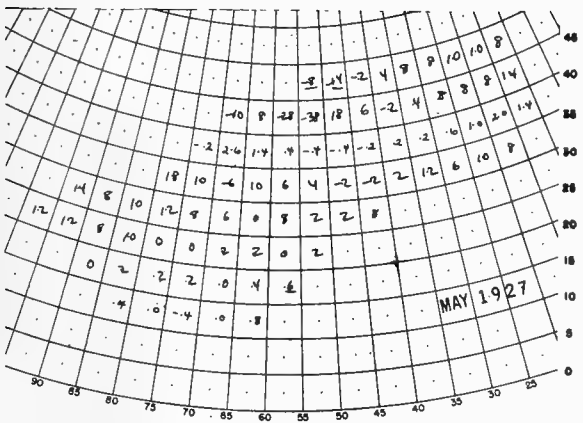
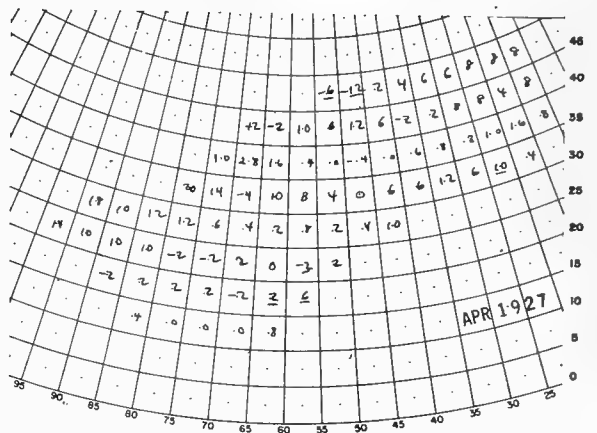
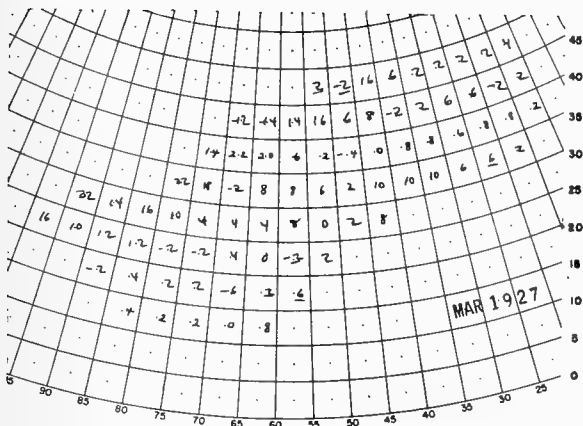
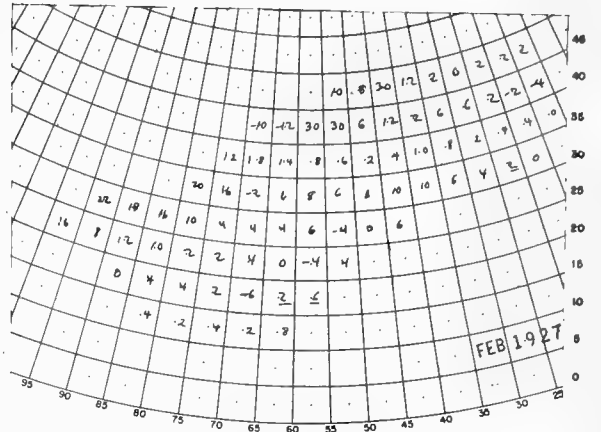
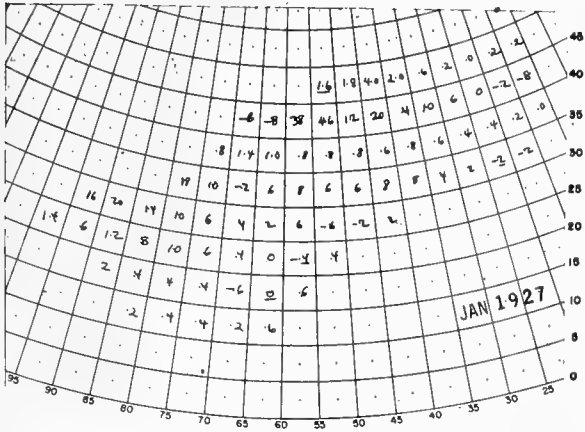


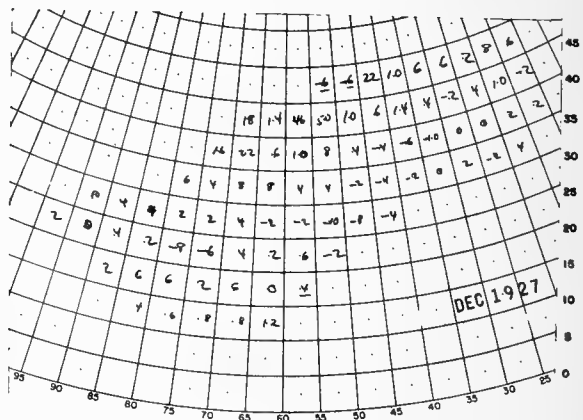
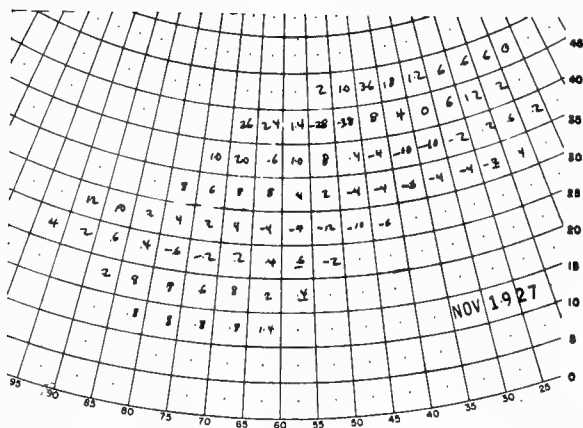
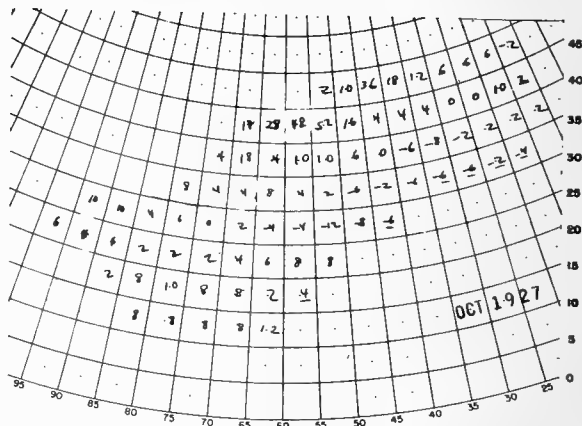
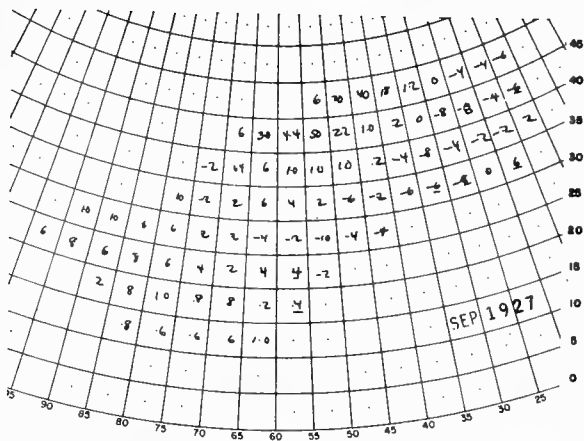
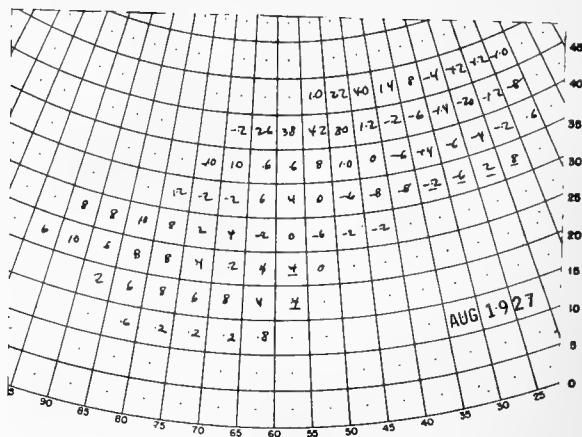
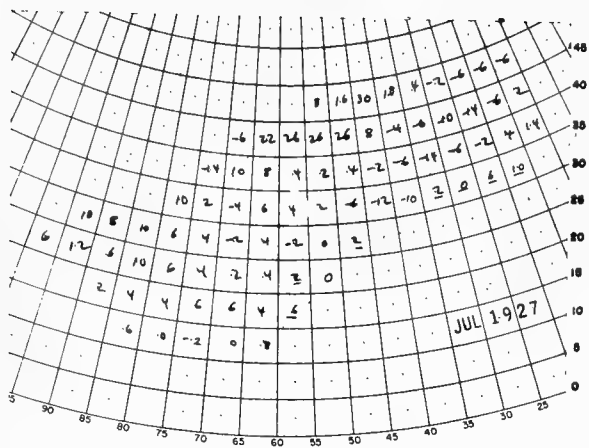


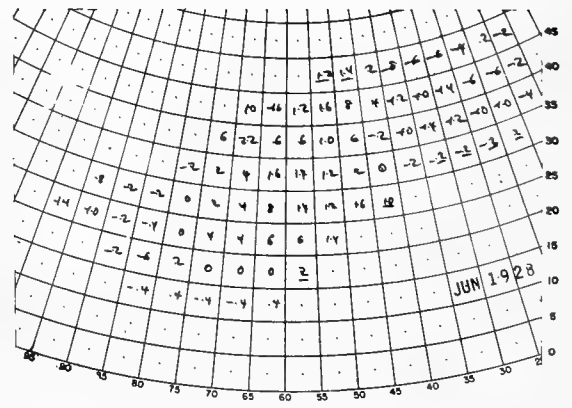
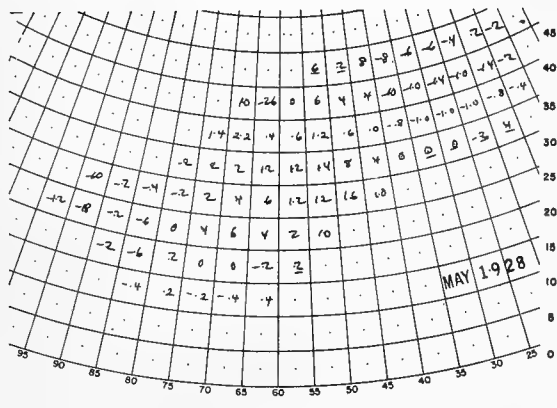
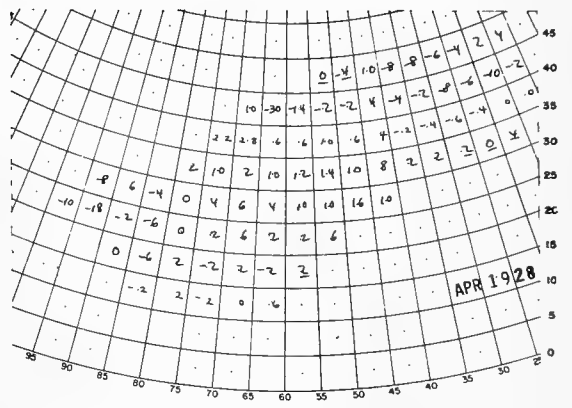
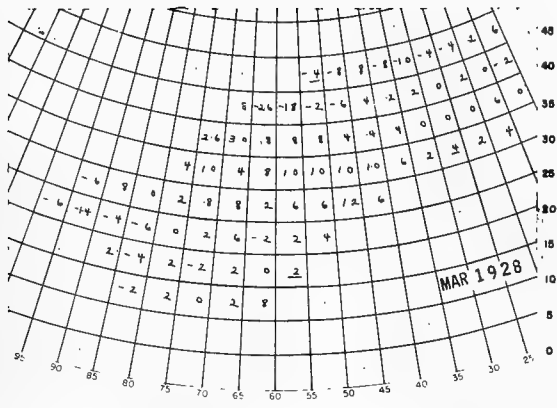
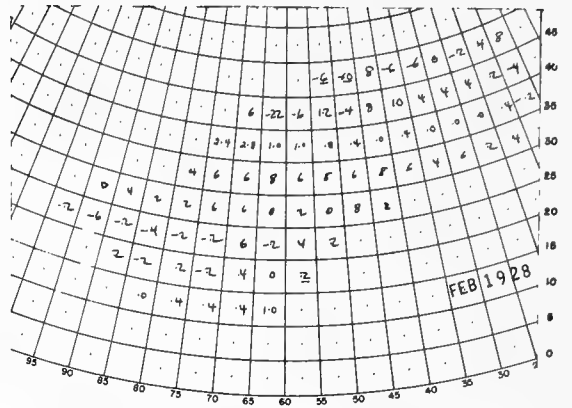
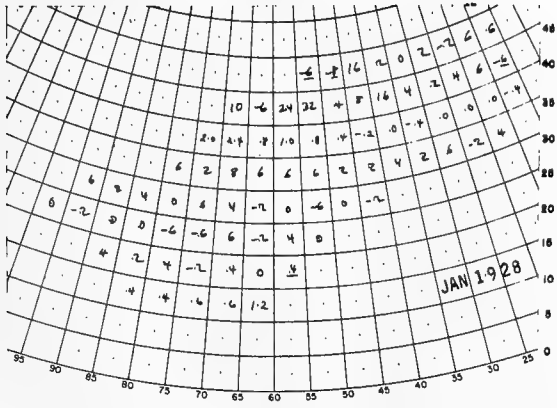


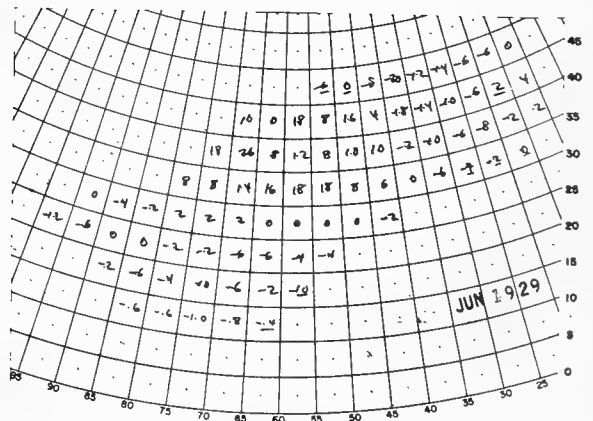
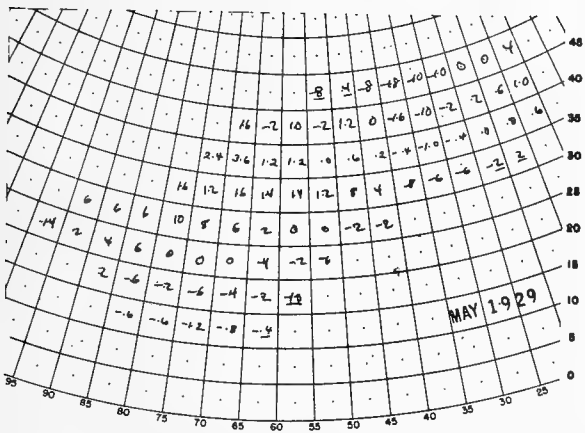
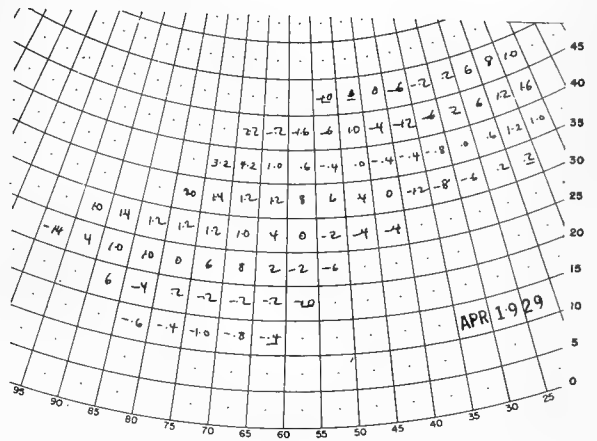
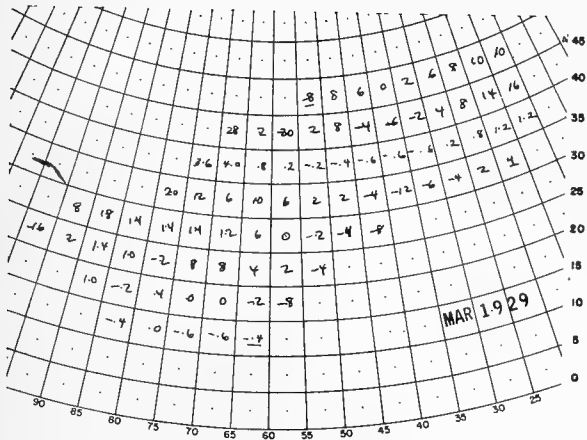
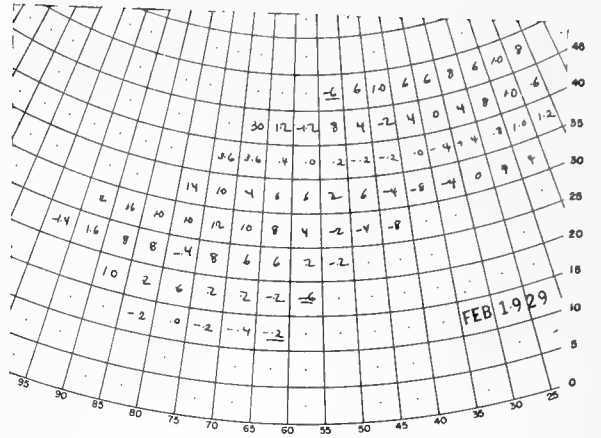
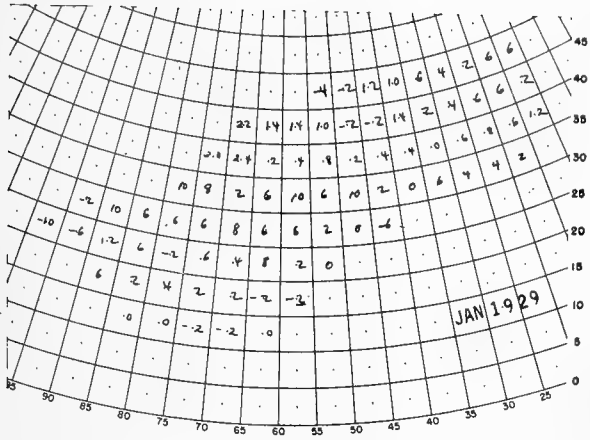


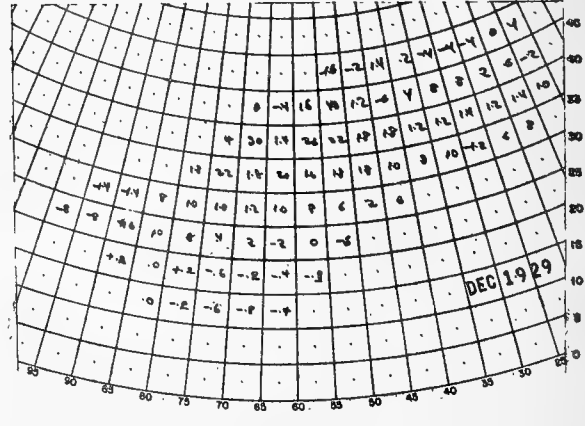
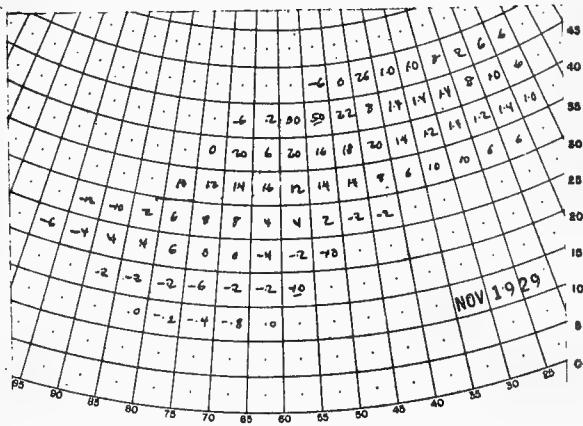
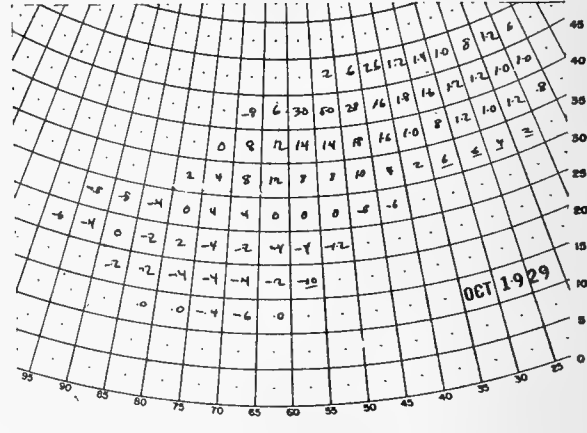
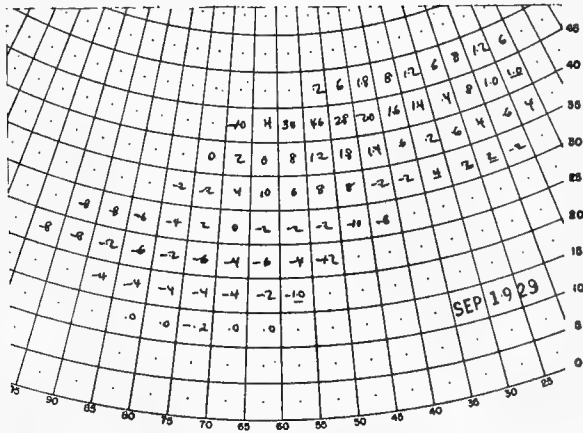
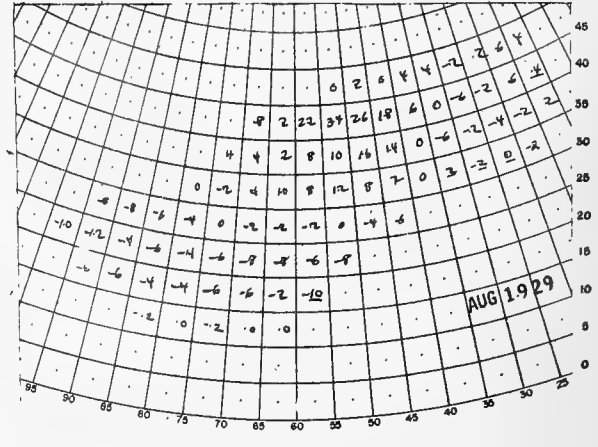
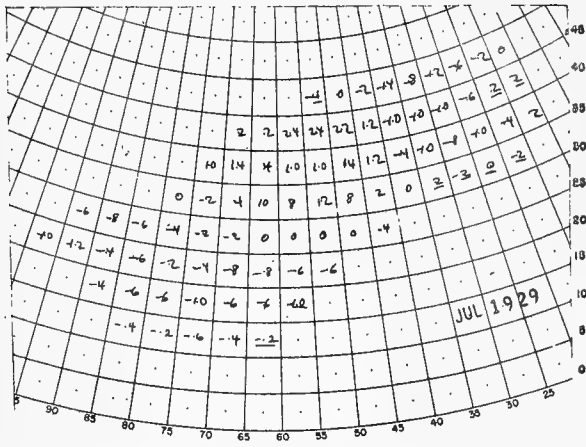


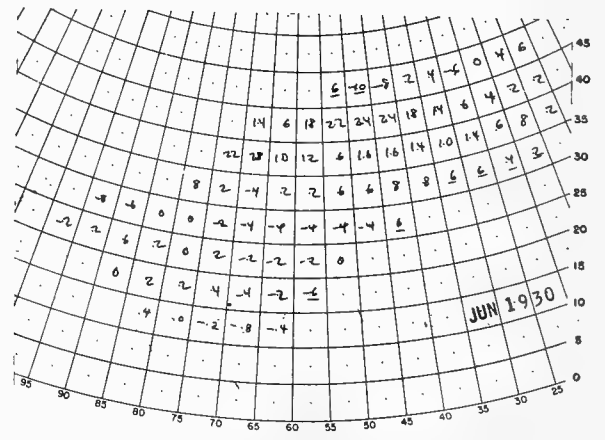
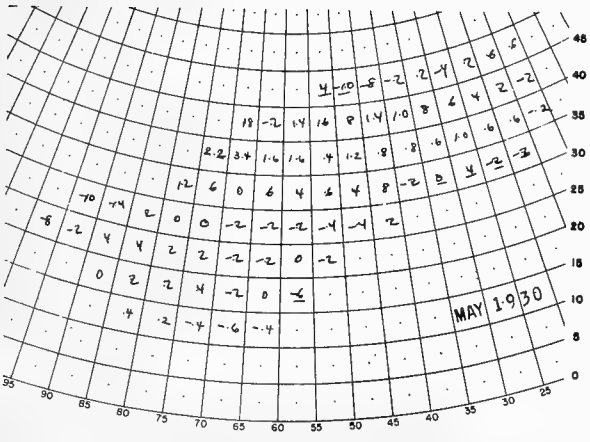
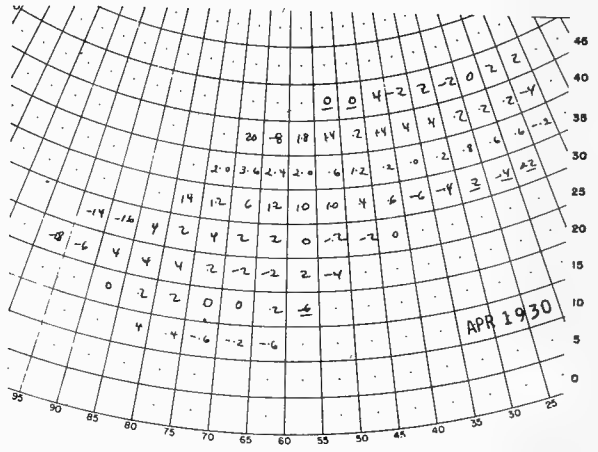
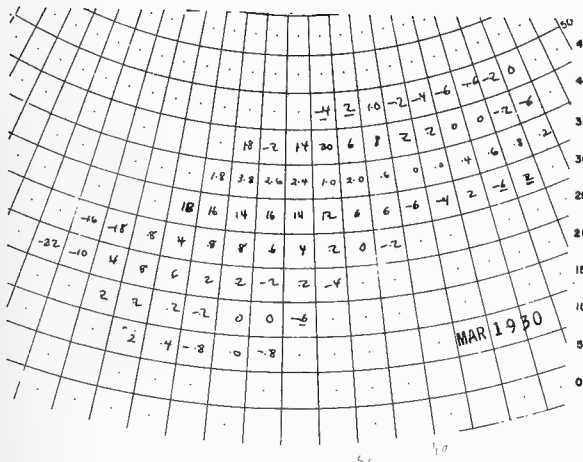
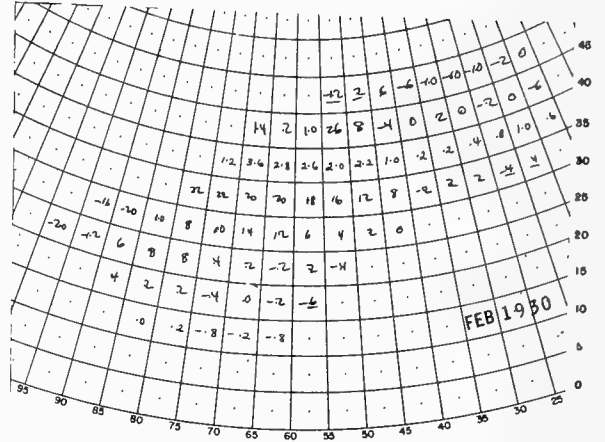
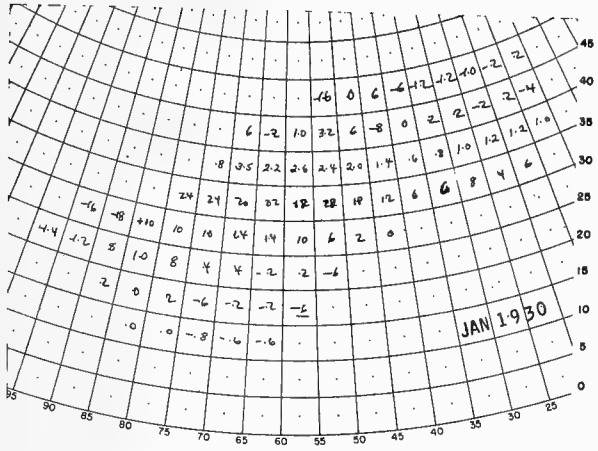


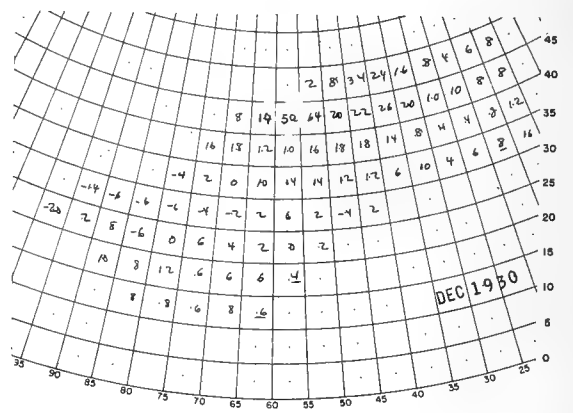
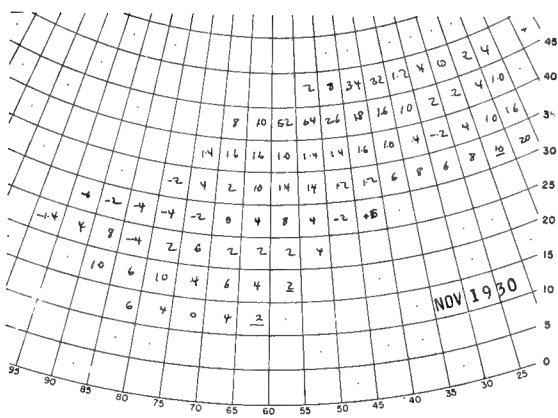
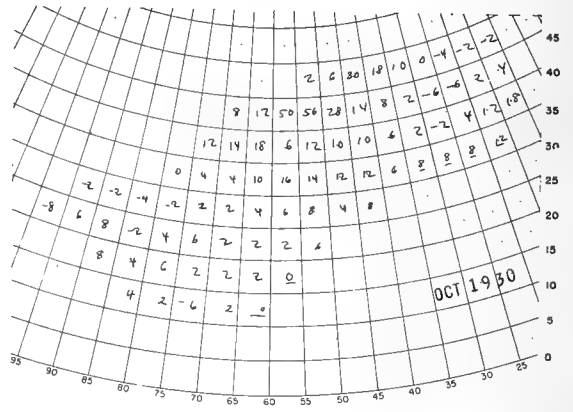
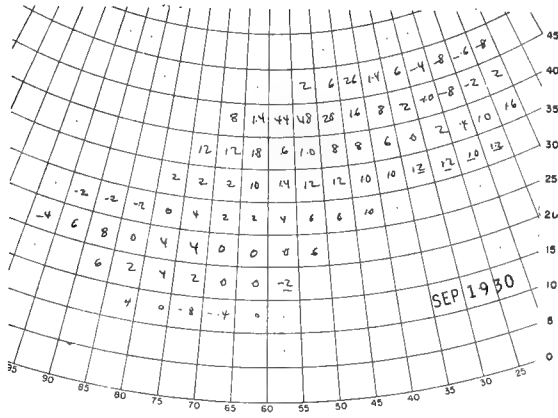
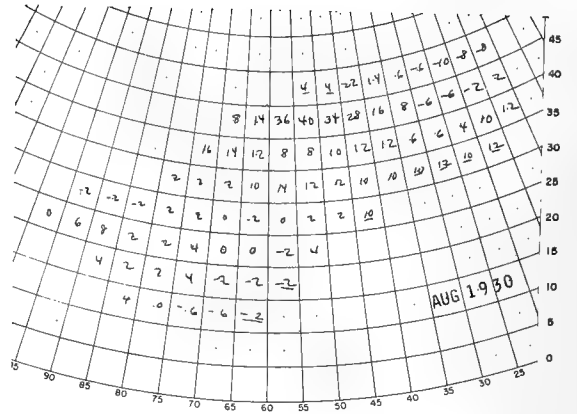
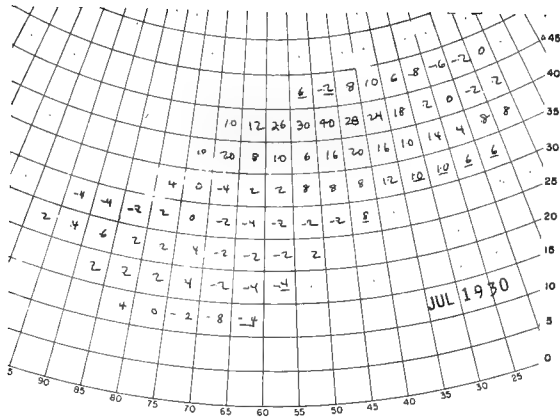


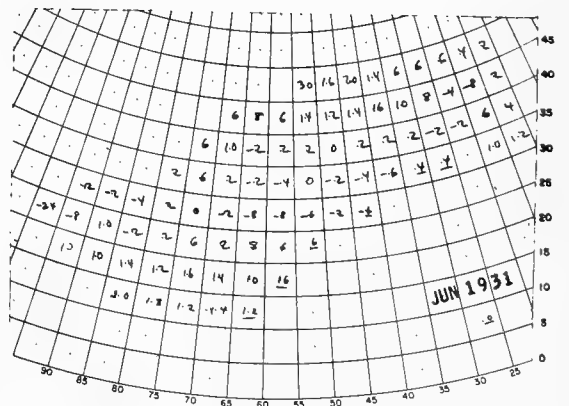
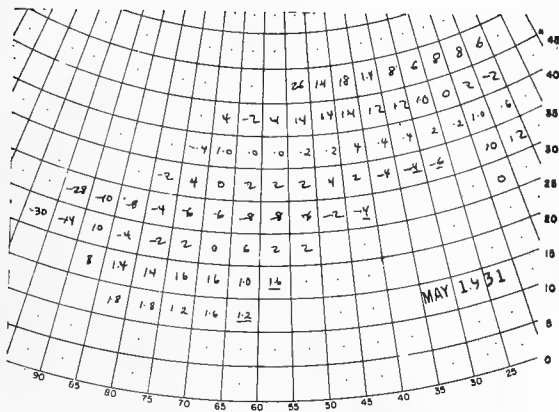
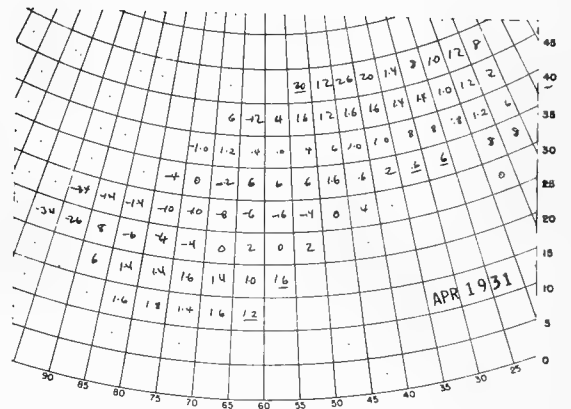
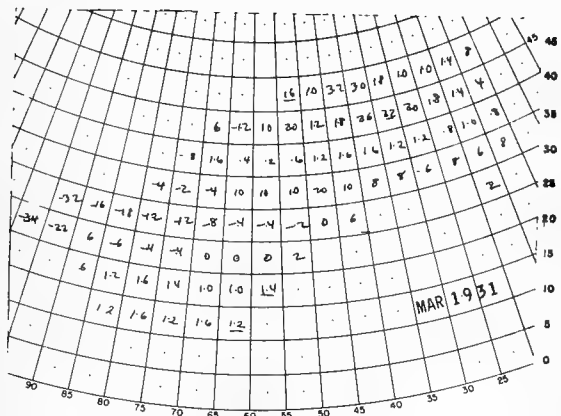
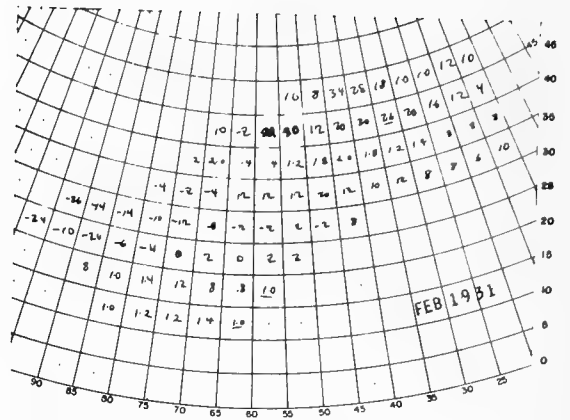
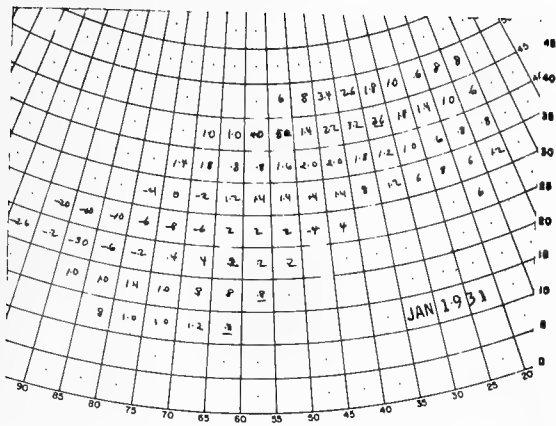


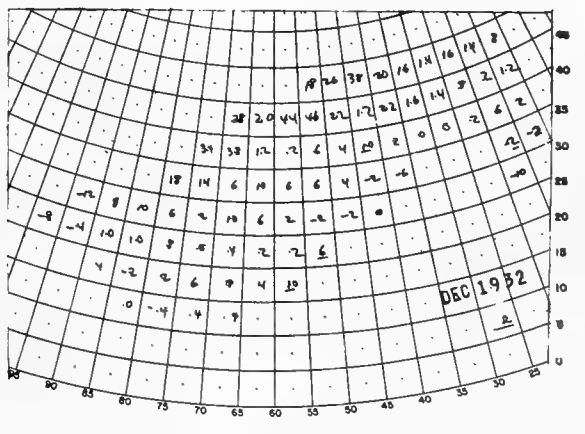
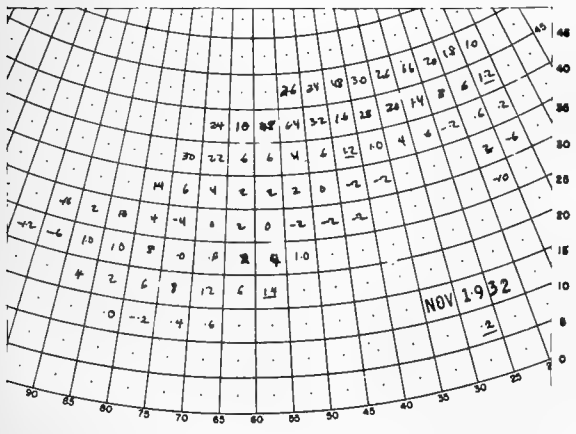
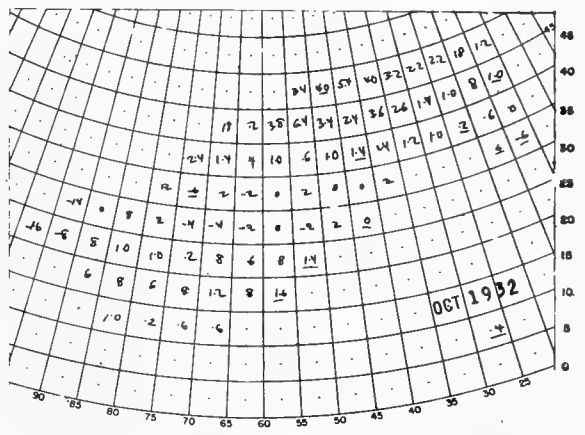
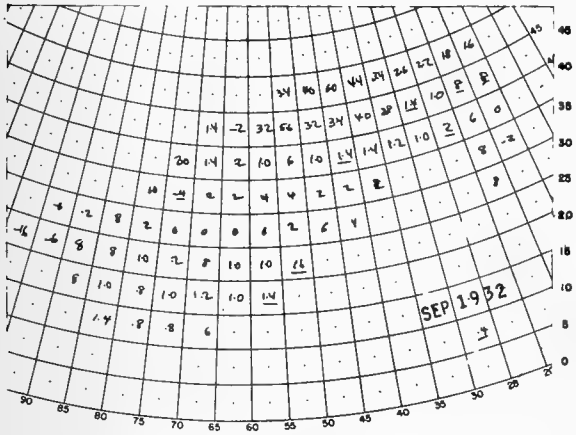
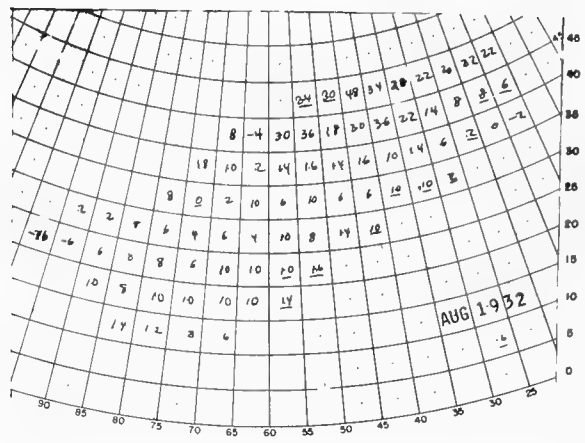
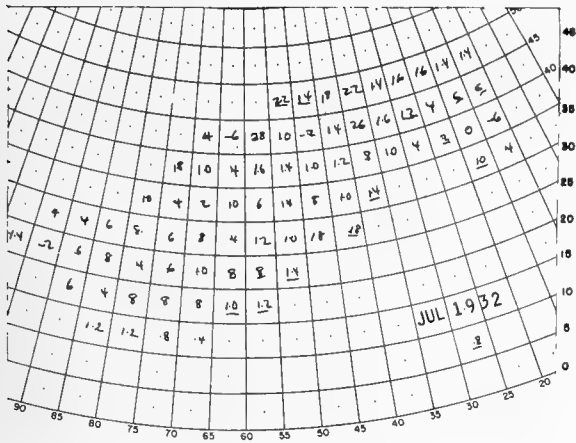












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