PREFACE

The maps reproduced in this volume are from the series of Historical Weather Maps furnished by the Army, Navy, and Weather Bureau, with the assistance of University meteorological students. These three series are:

- Northern Hemisphere Sea-Level Series, which has been issued for a long period as practicable, and for which the monthly range from August 1922 to be published by months. By April 1, 1924, 32 months of daily maps had been analyzed.
- North American High-Level Series (10, 13, and 16 kilometers), from about July 1920, to be published by months. By April 1, 1924, 8 months of such maps have been prepared.
- Northern Hemisphere Monthly Mean Series, for sea level and 3-kilometer altitude, several years of which will be combined for publication.

The program of making long series of carefully analyzed weather maps covering as much of the Northern Hemisphere as available data permit, and utilizing present-day techniques of weather analysis, was initiated by the Weather Bureau in the form of request based on wartime needs. Meteorologists have long needed such series of weather maps in the development of more accurate methods for forecasting than have been possible heretofore, and in extending the period for which reliable weather forecasts can be made. The maps contain a record of weather behavior in the Northern Hemisphere, presented in a readily usable form both for the meteorologist who is interested in improving the accuracy of his forecasts and for the research meteorologist who wants to test his theories as well as empirical forecasting techniques.

USING HISTORICAL MAPS

Many practical uses for the historical maps suggest themselves to the forecaster and the research meteorologist. The maps should be very useful in training new personnel in refreshing his memory of the changes in weather from season to season and from year to year.

Northern Hemispheric Series

The maps will aid him in becoming familiar with the synoptic meteorology of new regions and the seasonal changes of weather. They will show him the types of maps in connection with the series of upper-level charts will obtain a more accurate idea of the general weather conditions in the upper atmosphere, and the hemisphere, a view of weather in particular, to the young military meteorologists who must take over the responsibility for forecasting in new regions. For this reason, too, the National Oceanographic Committee has sponsored a study of air mass source regions, in basic investigations dealing with general circulation studies such as the life cycle of air masses, the impact of maps, and in other activities designed to improve the scope of forecasts.

Forecasts readily will assist the meteorologist in acquiring a better understanding of the three-dimensional behavior of the atmosphere and the manner in which the upper air processes are related to surface weather conditions. Therefore, it is believed that the Historical Maps will be an important additional tool in the work of forecasting.

PREPARATION OF HISTORICAL MAPS

The plotting of these various maps, including the reassembly and preparation of the Historical Maps, is done in a plotted unit at the Weather Bureau in Washington, DC. The plotted maps are assembled under the direction of the Assistant Director of the Weather Bureau. In the United States, the original plotted master sheets are retained for addition of basic data, which may later become available. Additional copies of the observational data without analysis can be made available for special research studies.

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OTHER SOURCES AND PREPARATION OF OBSERVATIONS

Observational data for the Northern Hemisphere synoptic sea-level charts are obtained from published charts and from unpublished maps furnished periodically by national meteorological services in the Northern Hemisphere. The Northern Hemisphere synoptic sea-level charts have been prepared by the Deutsche Wetterbureau in Germany, which has been chosen as a reliable source for a large area over a longer period of time. Some sources exist for some of the countries of Europe for periods of various lengths. The preparation of the maps has usually been given to publications of the nation governing the particular area. For areas not adequately covered by the primary source it has frequently been necessary to use other sources, such as periodicals and other publications. In such instances, sources a specific area may be mixed, with true conditions prevailing in some cases and others in the succeeding coverage. In such instances, sources in a specific area may be mixed, with true conditions prevailing in some cases and others in the succeeding coverage. In such instances, sources in a specific area may be mixed, with true conditions prevailing in some cases and others in the succeeding coverage.

In recognition of the greater relative importance in analysis and research of the data which are used for the preparation of the maps, the maps are verified by all isolated reports from those sources. From Siberia, Alaska, and Northern Canada, the verification of all isolated reports from those sources is used. From the sources used, contains all the monthly observations for two stations on each day. The three daily observations and the elements reported are printed vertically. Reading the wrong column

THEME OF OBSERVATION

The choice of the time of observation, 0000 GMT or Mean Time, was dictated by the much greater volume of data available at that hour as compared with other representative time choices. The GMT time is a constant in the charted region, and data are available for the observation at the place and time, as well as accurate for all regions of the world. The GMT time is as shown in the chart, and in the charts it is not as shown in the chart. The GMT time is as shown in the chart, and in the charts it is not as shown in the chart.

TIME OF OBSERVATION

The choice of the time of observation, 0000 GMT or Mean Time, as described in the previous section, and the use of the GMT time as shown in the chart, are the primary reasons for selecting the GMT time for the GMT time as shown in the chart, are the primary reasons for selecting the GMT time for the GMT time as shown in the chart, are the primary reasons for selecting the GMT time for the GMT time as shown in the chart, are the primary reasons for selecting the GMT time for the GMT time as shown in the chart. The GMT time is as shown in the chart, and in the charts it is not as shown in the chart.

CODE AND STATION MODEL

The International Plotting Code and Station Model of the Northern Historical Weather Maps are shown in the chart. Each map is included in the chart, and in the charts it is not as shown in the chart.

ORGANIZATION OF THE PLOTTING UNIT

The entry of observational data on the map for the Northern Historical Weather Maps is organized on a project basis, with a fairly stable personnel distribution. Certain facilitating functions, such as library, physical preparation of maps for plotting, and other technical and administrative functions are performed on a project basis and serve each of the projects. The work of plotting weather maps and analysis is divided into four major sections:

1. The plotting and verification of observed data on the map, and the entry of special data and post-analysis corrections of plotted reports.

2. Work assignments consisting of the execution of one of these functions for a group of maps or charts. This group is usually made up of different types of weather maps, such as isobaric, isotherm, etc.

3. Frontal analysis and isobatic analysis, which may be performed by the technical staff of the plotting unit, frequently in consultation with authorities who have served as advisors to the project.

For stations reporting only station pressure, or pressure reduced to some standard elevation other than sea level, the reported pressures were reduced to sea level, and then were averaged in the map. The reported sea pressure values were obtained from the raw sea pressure values at elevations not greater than 100 meters, a constant correction for each station was determined, and applied to station pressure values. Computation of such corrections for altitude bases were based on "Smethurst Meteorological Tables." For stations reporting pressures as sea-level pressure as a constant in the chart, the reported pressure values are higher than the sea-level pressure as a constant in the chart.

In some instances different altitudes were reported at various times by the data source, or from other evidence it appeared that the reported altitudes were in error, the reported altitudes were reduced to sea level, and then the sea-level pressure as a constant in the chart was determined, and by application of the corrections, the reported altitudes were determined, and the sea-level pressure as a constant in the chart was determined.

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VERIFICATION

The map preparation procedure includes verification of plotted data, with emphasis upon the detection and elimination of systematic errors.
**TABLE OF SYMBOLS**

**GENERAL REMARKS**

Special care has been given to the drawing of the isobars on the Northern Hemisphere maps, particularly in regions where the data were scarce.

**ISOBARIC ANALYSIS**

This sort of maps will be found occurring between: Two cold fronts, two occluded fronts, one cold and one occluded front, or two warm fronts. Transformation of occluded fronts. In numerous instances, an occluded front on one map was changed to a cold front or to a warm front on the subsequent map. In performing this transformation it has been assumed that one or the other of the frontal surfaces of the occlusion was destroyed and the remaining surface was intensified by renewed frontogenetical processes.

(c) Transition of cold fronts to occlusions. A number of cases will be found on these maps where a cold front has apparently transformed into an occluded front for a part of its extent. In most cases it is believed that a true occlusion process has taken place, but where the warm front or possibly two or more warm frontal surfaces were not distinguishable on the map as surface discontinuities and could have been indicated only in an arbitrary manner, accordingly, it was necessary to indicate the occlusion process to satisfy the existing weather phenomena, it was deemed best in such cases to omit the double warm fronts entirely from the analysis.

**SYMBOLS**

<table>
<thead>
<tr>
<th>SYMBOL cc — FORM OF HIGH CLOUD</th>
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<tbody>
<tr>
<td><strong>Characteristic of tendency during 8-hour period ending at observation.</strong></td>
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<tr>
<td><strong>Code</strong></td>
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**SYMBOL CC — FORM OF MIDDLE CLOUD**

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**SYMBOL Cc — FORM OF LOW CLOUD**

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**SYMBOL Cg — FORM OF HIGH CLOUD**

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**SYMBOL Dk — DIRECTION OF CLOUD MOVEMENT**

Direction of movement of low, middle and high cloud, respectively, is indicated by a small arrow in the direction of movement.

**SYMBOL Dd — DIRECTION OF WIND**

Wind direction is represented by the shaft of an arrow which has the station circle at its head. This shaft points away from the circle in the direction from which the wind is blowing.

**SYMBOL Dk — DIRECTION OF SWELL**

In the open sea, the direction in which swell is moving is given by the circle in the direction from which the wind is blowing.

**SYMBOL F — WIND FORCE, BEAUFORT SCALE**

A small arrow indicates the direction in which the ship is moving at the time of observation.

**SYMBOL Gk — GREENWICH MEAN TIME**

When the time of the report differs from the syntonic time of the area by more than one hour, it is recorded to the nearest hour.

**SYMBOL K — STATE OF SWELL IN OPEN SEA**

Direction of movement of low, middle and high cloud, respectively, is indicated by a small arrow in the direction of movement.

**SYMBOL P — TOTAL AMOUNT, ALL CLOUDS**

**SYMBOL N — AMOUNT OF CLOUDS WHOSE HEIGHT IS GIVEN BY "cc"**

**SYMBOL P — AMOUNT OF BAROMETRIC CHANGE**

The net change during the three hour period ending at time of observation is entered in tenths of millibars, decimal point omitted.
SYMBOL TT—AIR TEMPERATURE

SYMBOL T.T.—DEWPOINT TEMPERATURE

All temperatures are entered in whole degrees of the Fahrenheit scale. Missing air temperatures are indicated by "M" only if T.T. is also reported; otherwise no indication is made.

SYMBOL w—WATER TEMPERATURE

Water temperatures are entered in whole degrees of the Fahrenheit scale and are obtained directly from T.T., the coded difference between air and water temperatures. The following values are used for T.T.

<table>
<thead>
<tr>
<th>Code No. T.T.</th>
<th>Difference, °F</th>
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<td>1</td>
<td>-8</td>
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<td>2</td>
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The symbol w indicates air temperature to obtain water temperature.

SYMBOL V—HORIZONTAL VISIBILITY

The speed of ship's movement is entered in knots near the arrow indicating ship's direction (as). The symbol Δ indicates no movement, or "standing.

SYMBOL W—PAST WEATHER

Note.—In coding past weather the highest code figure in complete table applicable to weather at time of observation is used.

Figures 00 to 19: Abbreviated description of sky and special phenomena
00 Cloudless (from no clouds up to but including 1/10).
01 Partly cloudy (from exactly 1/10 to exactly 5/10).
02 Cloudy (over 5/10 up to and including exactly 9/10).
03 Overcast (over 9/10).
04 Low fog, whether on ground or at sea.
05 Haze (but visibility, 1000 meters, 1,100 yards or more).
06 Dust devils seen.
07 Distant lightning.
08 Light fog (visibility, 1000 meters, 1,100 yards or more).
09 Fog at a distance, but not at station or ship.
10 Precipitation within sight.
11 Thunder, without precipitation at station (or ship).
12 Duststorm within sight, but not at station or ship.
13 Light, threatening sky.
14 Squally weather.
15 Heavy squalls in last 2 hours.
16 Waterspouts seen in last 3 hours.
17 Visibility reduced by smoke.
18 Blowing dust (visibility, 1000 meters, 1,100 yards or more).
19 Signs of tropical storm or hurricane.

Figures 20 to 29: Precipitation in last hour (But not at time of observation)
20 Precipitation in any form.
21 Drizzle.
22 Continuous or intermittent rain.
23 Continuous or intermittent snow.
24 Continuous or intermittent rain and snow, mixed.
25 Rain showers.
26 Snow showers.
27 Hail, or rain and hail, showers.
28 Rain or moderate thunderstorm.
29 Heavy thunderstorm.

Figures 30 to 39: Duststorms and storms of drifting snow (Visibility less than 1000 meters, 1,100 yards)
30 Duststorm or sandstorm.
31 Duststorm or sandstorm has decreased.
32 Duststorm or sandstorm, no appreciable change.
33 Duststorm or sandstorm has increased.
34 Line of duststorms.
35 Storm of drifting snow.
36 Light or moderate storm of drifting snow.
37 Heavy storms of drifting snow—generally low.
38 Light or moderate storm of drifting snow—generally high.
39 Heavy storm of drifting snow.

Figures 40 to 49: Fog
40 fog.
41 Moderate fog in last hour.
42 Thick or dense fog in last hour.
43 Fog, sky discernible has become thinner during last hour.
44 Fog, sky discernible has become thicker during last hour.
45 Fog, sky not discernible has become thinner during last hour.
46 Fog, sky not discernible has become thicker during last hour.
47 Fog, sky not discernible during last hour.
48 Fog in patches.

Figures 50 to 59: Drizzle
50 Drizzle.
51 Continuous drizzle.
52 Continuous moderate drizzle.
53 Continuous heavy drizzle.
54 Continuous snow.
55 Continuous moderate drizzle.
56 Continuous heavy drizzle.
57 Drizzle and fog.
58 Light or moderate drizzle and rain.
59 Heavy drizzle and light rain.

Figures 60 to 69: Rain
60 Rain.
61 Continuous drizzle.
62 Continuous moderate drizzle.
63 Continuous heavy drizzle.
64 Continuous snow.
65 Continuous moderate drizzle.
66 Continuous heavy drizzle.
67 Rain and snow.
68 Light or moderate rain and snow, mixed.
69 Heavy rain.

Figures 70 to 79: Snow
70 Snow.
71 Continuous snow.
72 Continuous moderate snow.
73 Continuous heavy snow.
74 Continuous snow.
75 Continuous moderate snow.
76 Continuous heavy snow.
77 Snow and fog.
78 Snow grains.
79 Ice crystals; or sleet.

Figures 80 to 89: Showers
80 Showers.
81 Showers of light or moderate rain.
82 Showers of heavy rain.
83 Showers of light or moderate snow.
84 Showers of heavy snow.
85 Showers of light or moderate rain and snow.
86 Showers of heavy rain and snow.
87 Showers of snow pellets.
88 Showers of light or moderate hail, or rain.
89 Showers of light or moderate hail and rain.

SYMBOL BB—PRECIPITATION

The amount of precipitation is given in inches, to hundredths, for the 11 to 13-hour period ending at time of observation. Some sources report for other periods, as indicated in the description of specific sources.

ADDITIONAL SYMBOLS

1. Parentheses enclose pressure or temperatures obtained by interpolation from isobars drawn on previously prepared maps.
2. Brackets enclose pressure values for stations above 100 meters for which reduction to sea-level was made in the plotting unit.
3. The symbol (M) indicates reports from Cavit or similar wireless reports.
4. On ship reports the abbreviated name of the ship is entered below the report.

SYMBOLS USED FOR DESIGNATING FRONTS:

COLD FRONT
WARM FRONT
OCCCLUDED FRONT
STATIONARY FRONT
COLD FRONOTGENESIS
WARM FRONOTGENESIS
STATIONARY FRONOTGENESIS
COLD FRONTOLYSIS
WARM FRONTOLYSIS
OCCCLUDED FRONTOLYSIS
STATIONARY FRONTOLYSIS
COLD FRONT ALOFT
WARM FRONT ALOFT
OCCCLUDED FRONT ALOFT
STATIONARY FRONT ALOFT
COLD FRONT ALOFT