

Global Synoptic Maps *

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ABSTRACT

Synoptic map analysis of the Earth from the North Pole to the shores of the Antarctic Continent is now attained by combining the Southern Hemisphere map analysis of the U. S. Weather Bureau-M.I.T. Southern Hemisphere Map Analysis Project, and the Northern Hemisphere map analysis of the published *Daily Historical Weather Maps*. Sample synoptic maps of the Earth for 19 and 20 March 1949 are presented.

METEOROLOGISTS have known for many years that world-wide synoptic map analysis is necessary before reliable concepts of the general and secondary circulations of the atmosphere can be attained, and before an answer can be given to such an important question as to what extent the primary cause of the large-scale anomalies of the general circulation lies in the internal mechanism of that circulation itself or in the external impulses of variable solar activity.

In the past, several attempts have been made to prepare synoptic maps of the Earth by combining the analyses from different weather services throughout the world. One notable attempt to prepare such maps was the series of maps for 36 days of the International Year 1923 prepared for the International Commission for the Exploration of the Upper Air. The map for February 14, 1923 titled "Synchronous Charts of the World Cyclones and Anticyclones" was illustrated by Shaw in his *Manual of Meteorology* [2]. Shaw stated that the maps were believed to be the first examples of synchronous charts of pressure for the whole globe. However, the analysis is lacking over more than half of the surface of the Earth. Large gaps are present over the North Polar areas, interior Asia, much of Africa, northern South America, the Antarctic Continent, and all the oceans of the world except the northern half of the North Atlantic and North Pacific Oceans.

Only recently has it been possible to achieve what can be considered to be a truly global analysis by combining the map analyses of the Northern and Southern Hemisphere. A reasonably complete and reliable daily sea-level synoptic analysis of the Southern Hemisphere from the Equator to the shores of the Antarctic Continent is now being prepared for the U. S. Weather Bureau-

M.I.T. Southern Hemisphere Map Analysis Project [1]. In addition, a more or less complete and reliable daily synoptic analysis of the Northern Hemisphere from the North Pole to the Equator has been regularly available in the *Daily Historical Weather Maps* of the Northern Hemisphere [3]. The only large gap in the analysis is over the Antarctic Continent.

The map analyses for 19 March 1952 (FIG. 1) and 20 March 1949 (FIG. 2) have been selected for presentation because good coverage was available and the synoptic patterns are typical of the transition period between winter and summer conditions, when continentality effects are minimized.

FIGURE 1 shows the situation on 19 March 1949. The isobars are shown as light lines, fronts as heavy lines, and the intertropical convergence zone as a dotted line. Significant differences in the synoptic patterns of the two hemispheres are readily apparent. The most striking feature is the strong zonal westerly circulation of the Southern Hemisphere in contrast with the weak westerly circulation in the Northern Hemisphere. The Southern Hemisphere average zonal westerly index (6.86) is much larger than the Northern Hemisphere average zonal westerly index (-0.07). The latitude belt 40° -70°S is truly the zone of the "brave" westerlies.

The circulation of the Southern Hemisphere is characterized by a series of low pressure centers all around the hemisphere polarward of the subtropical high pressure belt. The Northern Hemisphere circulation, on the other hand, is meridional rather than zonal. An irregular pattern of high and low pressure centers alternating as one goes around the hemisphere. The low and high pressure centers are closely associated with the location of the large ocean and land masses, respectively.

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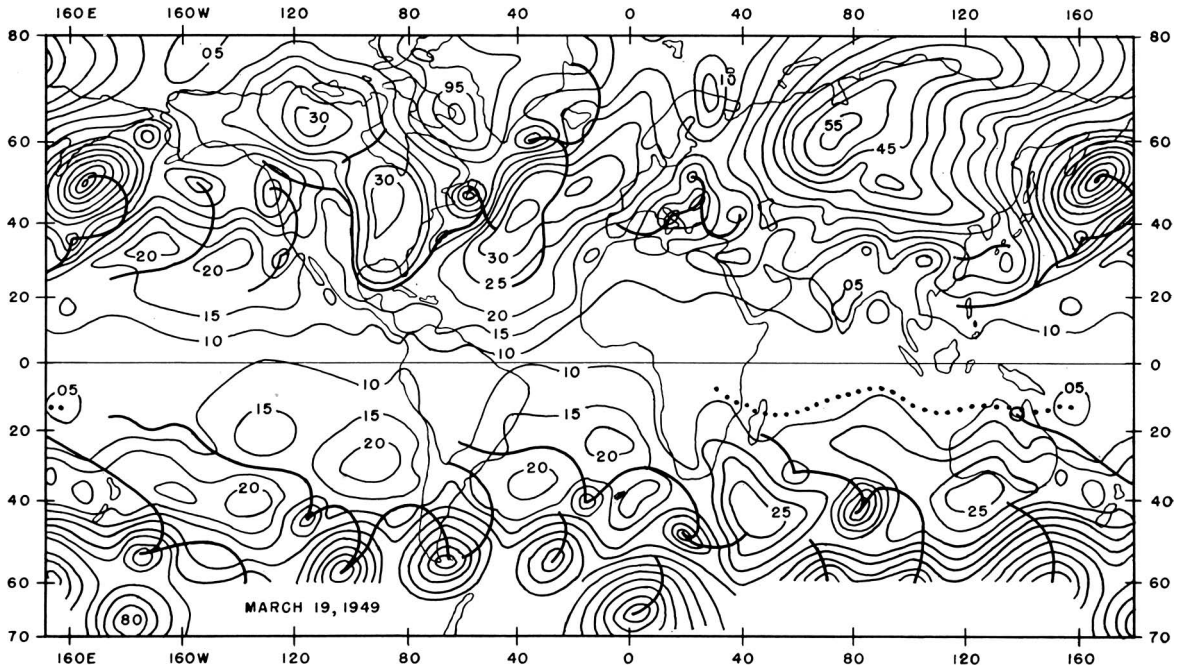


FIG. 1. Surface synoptic map of the earth, March 19, 1949.

The pattern for the 20th of March (FIG. 2) is similar to that of the 19th (FIG. 1). Generally, the fronts have moved eastward. High pressure centers of the Northern Hemisphere land masses far exceed those of the Southern Hemisphere in

size and intensity. The Siberian High has no counterpart in the Southern Hemisphere. The patterns of the low pressure centers are more alike. The deep lows have a central pressure of 970 to 980 mb. The Southern Hemisphere average

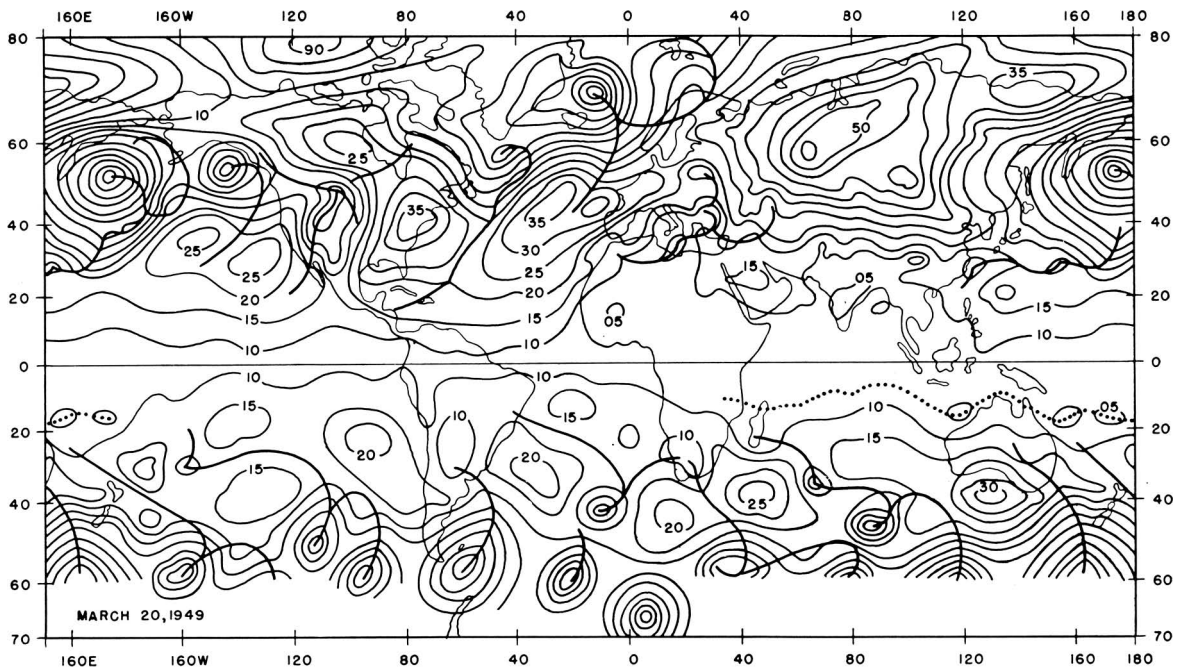


FIG. 2. Surface synoptic map of the earth, March 20, 1949.

zonal westerly index is seven times larger than the Northern Hemisphere average zonal westerly index, 6.34 vs. 0.84.

The analysis is not too reliable nor detailed in many areas. Reduction of pressure to sea level in the many highland areas throughout the world introduces inaccuracies in the surface pattern. Over central and eastern Siberia and over the oceans in middle and high latitudes in both hemispheres, the analysis is based upon a sparse network of stations. The map analysis is also questionable in the tropics where data are sparse, the pressure gradient is flat, the 5-milibar isobars are inadequate for portraying details of the pressure patterns, and techniques and experience in map analysis leave much to be desired. In many areas in the tropics, the isobars are entered merely for completeness of the analysis and few tropical features aside from hurricanes are entered on the map.

Upper-level maps of the entire earth are needed for portraying the upper-air patterns associated with those at sea level and relating changes in the surface pattern with the patterns aloft. The 500-millibar map for the Northern Hemisphere is now available in the published *Daily Historical Weather Maps* of the Northern Hemisphere [3]. Maps for other levels are analyzed at many weather centrals. However, data are not sufficient to prepare corresponding upper-level maps for the Southern Hemisphere. It is hoped that this deficiency in the upper-air synoptic analysis of the Earth can be overcome soon so that at least a global 500-millibar map can be prepared daily.

The selection of a suitable map projection to show world-wide distribution of any element is an important matter which is frequently overlooked. Gall's Stereographic Projection has been used in

FIGURES 1 and 2 because of the pictorial qualities of the projection and ease of cartographic presentation. In contrast to the Mercator Projection, the exaggeration in the high latitudes is reduced. In mid-latitudes the patterns are reasonably well shown as distortion of area is at a minimum at latitudes 45°N and 45°S. However, Gall's Projection is neither conformal nor equal area. For some purposes a base map which has even less distortion in high latitudes and is approximately equal area would be desirable.

Insufficient research has been done with these maps to present any new conclusions about the general circulation and related subjects; however, the potentialities of these maps are readily apparent.

ACKNOWLEDGMENTS

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REFERENCES

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- [2] Shaw, N.: *Manual of Meteorology*, Vol. II, Comparative Meteorology, Cambridge, Second Edition, 1936.
- [3] Wexler, H., and Tepper, M.: Results of the War-time Historical and Normal Map Program, *Bull. Amer. Met. Soc.*, Vol. 28, No. 4, April 1947, pp. 175-178. The *Daily Series, Synoptic Weather Maps, Northern Hemisphere Sea Level* for the period 1899-1939 were published by the U. S. Weather Bureau; the *Sea Level and 500-Millibar Charts with Synoptic Data Tabulations* for October 1945 through December 1948 are being prepared and published by U. S. Air Forces (obtainable from U. S. Weather Bureau only); those for 1949 and subsequent years are being prepared and published by the U. S. Weather Bureau.

NEWS AND NOTES

Eastern Snow Conference, February 12-13

The Eastern Snow Conference will be held on February 12 and 13, 1953, at the Ten Eyck Hotel, Albany, New York. Members of the American Meteorological Society

are invited to attend the meetings. One of the features will be a tour of the General Electric Research Laboratory at which time the group will be addressed by Dr. Irving Langmuir. Further details may be obtained from Dean B. Bogart, Secretary, Eastern Snow Conference, c/o U. S. Department of the Interior, Geological Survey, 526 Federal Building, P. O. Box 948, Albany 1, N. Y.

K. C. S., Exec. Secy.