

in its appropriate subdivision, and the same is true of any other high area, no matter in what part of the United States it is located. In the subdivisions the maps are arranged according to type, and the total number of dates, as indicated by the number of maps, shows at a glance the prominent features of the pressure distribution for all past Januaries. Arranged in two small boxes, highs in one and lows in the other, with cards to indicate the different subdivisions, it is a matter of only a few moments to learn whether any particular type of map is rare or common during January and whether pronounced conditions follow.

Since the Washington maps must be referred to for information as to the conditions that obtained more than twenty-four hours after, it is very desirable that they be conveniently arranged. It has been found best to bind three months, say January, 1892, 1893, 1894, in one cover, thus making only three or four books for the entire period. Study of the temperature is facilitated if the changes as shown by the table on the map of the next day are written near the respective stations on the map under consideration. As the number of stations with changes equaling or exceeding the stationary limit is small as a rule, one is well repaid for the work of entering the data, red figures being used to indicate plus changes, and blue figures minus changes.

Since the current distribution of pressure, and whatever important conditions it brought about as regards temperature and rainfall, are graphically shown on each small map, I am of the opinion that the use of this system will facilitate the study of all types and will necessarily cause a general improvement in the daily forecasts; for no mind is capable of retaining without constant study a clear impression of the weather changes peculiar to each of the twelve months in the different topographical divisions of the United States.

ward similarity in the maps next following; this similarity sometimes persists for three or four days before being gradually lost, it sometimes extends to the most minute and exact degree, and in any case it ought to be reckoned with in the making of weather predictions.

I understand that Mr. F. H. Brandenburg, Forecast Official in charge of the Weather Bureau office at Denver, read a paper before the Milwaukee Convention on this same subject. As Mr. Brandenburg's paper has not yet appeared in print I am unable to judge how far we have worked on the same problem, or on parallel lines.

In illustration of the proposition advanced above, three cases are submitted, involving, respectively, precipitation, change of temperature, and a cold wave. These are not given as the best instances found, but are simply three out of the first five or six types that have been studied.

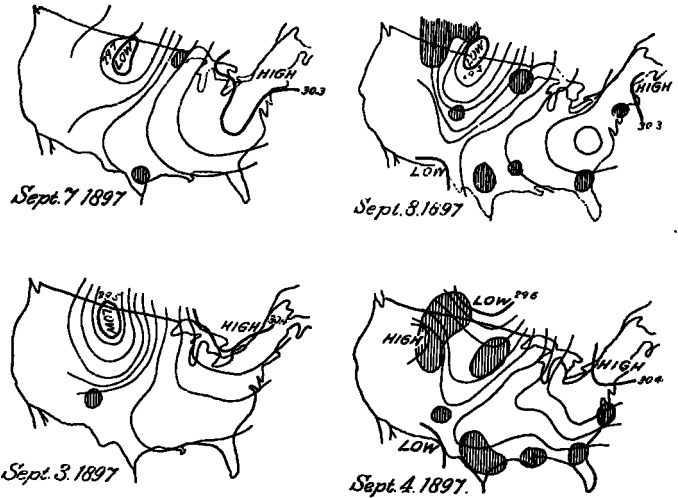


FIG. 1.—Precipitation types.

In fig. 1 we find on September 7, 1897, an approximate repetition of the conditions of September 3, and attention is called to the duplication on September 8 of the map of September 4. There is in each case a low north of Dakota, a second low south of Arizona, a high over northeastern New England, and seven rain areas alike in distribution and magnitude, (the far Northwest, the western point of Lake Superior, the middle slope of the Rocky Mountains, Texas, the vicinity of New Orleans, Jacksonville, and the middle Atlantic coast).

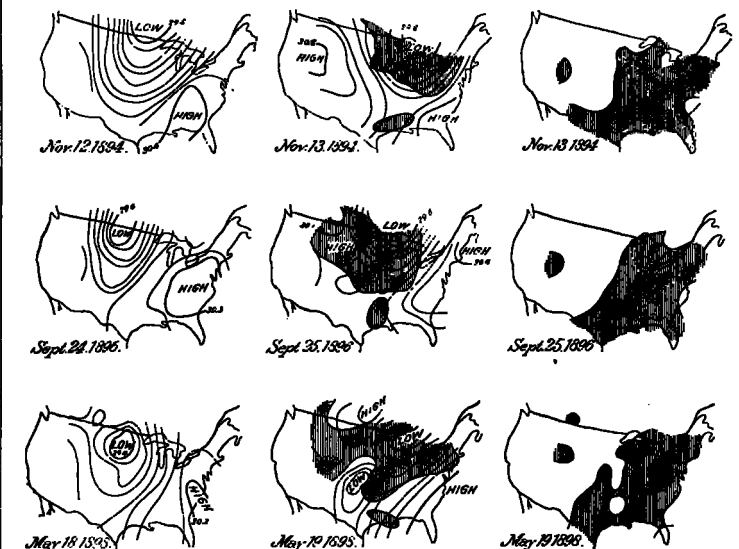


FIG. 2.—Precipitation and temperature types.

Fig. 2 gives, in the first vertical column, the maps of the

A PROPOSED CLASSIFICATION AND INDEX OF WEATHER MAPS AS AN AID IN WEATHER FORECASTING.

By PROF. W. V. BROWN, Voluntary Observer, United States Weather Bureau, De Pauw University.

The writer has, since August 1894, been preserving the daily weather maps issued by the Indianapolis office of the Weather Bureau. They now constitute a file of nearly twenty-two hundred, and are arranged in a purely empirical system of classification which serves to bring together maps that present the same distribution of barometric conditions. The method of classification, together with an index of the maps, enables one to immediately find a map presenting any given combination of highs and lows, together with all maps bordering on the required one, and also the map of any given date.

The formation of the file was undertaken in the hope that a certain degree of uniformity might be found in the sequence of the maps belonging to any type.

Weather conditions are almost kaleidoscopic, yet in the twenty-two hundred maps there are found a great many instances where a type recurs several times, the maps of the different dates bearing a very close resemblance to each other.

It seems not unreasonable, in those cases where approximately identical conditions have been restored, to expect that like conditions would produce like effects, and the maps of the next succeeding day would, in each instance, also show resemblances.

This idea must not be pushed too far, or the attempt be made to prove too much. This paper has no reference to any cycle or periodicity in the weather, and no hypothesis is to be advocated; but the claim is made that in the file described above there is abundant evidence that when a condition or type does, through any causes whatever, recur, there is a tendency to-

three dates, November 12, 1894, September 24, 1896, and May 18, 1898. These have each an energetic low over North Dakota, with a much less pronounced high over the south Atlantic coast; the difference between adjacent high and lows is nine-tenths of an inch in the first and second cases, and eight-tenths in the third. In the second column are the maps of the next succeeding days showing the distribution of rainfall. A large rain area has developed over the Lake region, but the small detached area of rainfall over New Orleans is to be especially noted. The variation in the shading is proportional to the amount of the rainfall. The third column gives the change of temperature for the same dates. The areas shaded with vertical lines represent those with rising temperature. The rest have falling temperature. The detached area of rising temperature at Denver is to be noted, also a small area on the Atlantic coast having falling temperature; in the first and second cases it occurs at Norfolk, and in the third case is over Florida. The main line of separation between the shaded and unshaded parts crosses Lake Superior at the north and western Texas at the south, with less than a hundred miles variation. Over Lakes Huron and Ontario there is in two cases an area with falling temperature penetrating the region having a rise.

CLASSIFIED WEATHER TYPES.

By E. B. GARRIOTT, Professor of Meteorology.

Classified weather types have been a recognized aid to forecasting for many years. Unfortunately, however, the work of classification has not, until recently, been systematically attempted, and the results obtained have, therefore, formed a part of the personal experience of individual forecasters, rather than a fund of information compiled and preserved in a form for ready reference. The failure to record in a permanent form the results of studies of weather types has been largely due to the fact, that previous to the last twelve months, the region covered by telegraphic reports was too limited in area to admit of a satisfactory classification of weather types for use in the current work of forecasting, and also, in part, to the great amount of time and labor involved in making these records.

During the entire history of the Weather Bureau (at least since July, 1872), forecasters have been assigned to certain months in advance with instructions to make special preparations for the work by a diligent study of weather conditions for corresponding months and seasons of previous years. These instructions have, as a rule, been faithfully followed,

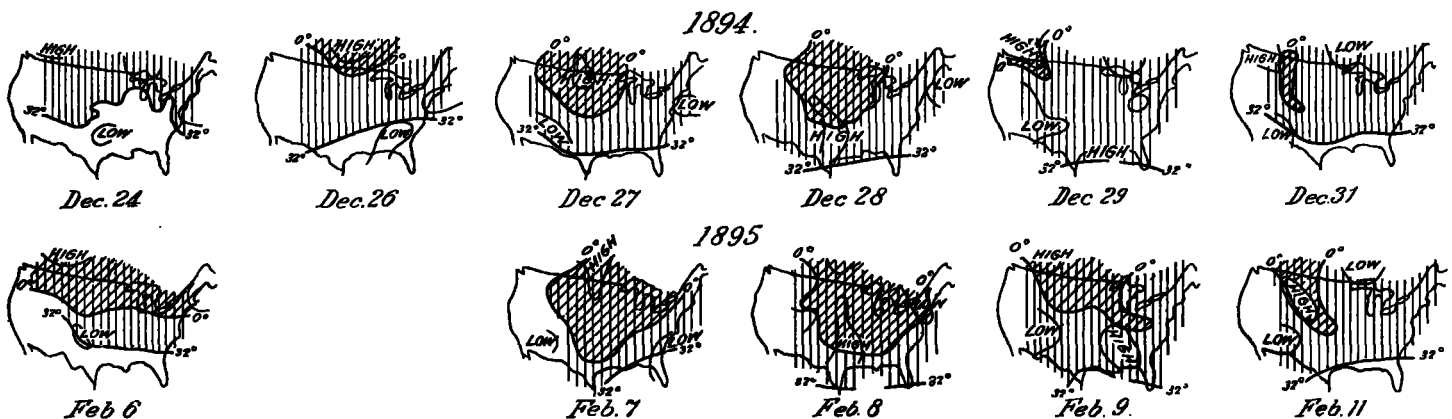


FIG. 3.—Cold wave types.

Fig. 3 gives two series of maps beginning, respectively, Monday, December 24, 1894, and Wednesday, February 6, 1895. These will be recognized as the two cold waves that brought such destruction to the orange groves of Florida. The maps are arranged so that each one of the second series falls under the analogous map of the first series.

The vertical shading shows the territory having temperatures between 32° and zero, while the cross hatching shows the region having zero and lower.

The close repetition of the first series that is presented in the second can not fail to impress itself, and the persistence of this likeness through five consecutive days becomes most remarkable. As is well known, in this type of cold wave a low moves from Dakota southward to Texas, then to the east along the Gulf coast, and along the Atlantic coast to the northeast, and is followed in the same track by a strongly-marked high. On February 6, 1895, anyone with the first series before him could not have failed to perceive that a great cold wave was coming, and on February 7 he would have known that the great freeze of the preceding December was going to be repeated.

The Weather Bureau has attained a high percentage of success in the forecasts, and anything which will aid in reducing the percentage of failures is worth the effort. The writer believes that, in support of the index or system outlined here, enough corroborative cases can be furnished to constitute a demonstration of its usefulness as an aid and check in weather forecasting.

and during the months of their assignment the forecasters have been alert to discover in past records types of weather of a character to aid them in their current work.

With increased experience, forecasters learn that satisfactory forecasts can not be made from single maps, or from a single set of maps. They learn that successful forecasting requires that the history of the conditions which single maps present must be studied and considered, and that for use in forecasting this information must be obtained from personal experience with similar types, strengthened by reference to past records. They discover that dissimilar changes and conditions frequently result from apparently similar maps, and, therefore, that apparently similar maps, as regards pressure and temperature distribution, do not, necessarily, belong to the same type.

Corresponding weather types must present atmospheric formations and movements of the same general character extending over periods of several days. When types of this character can be found in past records which correspond with current conditions, forecasts can be safely made for several days in advance. The possibility of making forecasts of this kind was recognized some years ago, when the writer was engaged in compiling and charting international observations and storm tracks of the Northern Hemisphere. Proof of the feasibility of making forecasts for periods of several days by the aid of classified maps has been secured in experimental work during the past year.

The experimental work referred to has been conducted by