In reply to your inquiry regarding the loss of the anemometer cups, I have the honor to say that I delayed further report upon this matter with the hope that in the meantime I could find the cups and from their condition report definitely as to how they gave way; however, the cups can not be found and the defect that resulted in their loss must therefore remain a theory. The miles of wind were recorded with such rapidity and regularity up to the very moment of the loss of the cups as to show that the screw that holds the cups to the spindle was constantly tight, which dispels the theory that this screw had worked loose, thereby allowing the cups to be lifted off; therefore, my only remaining theory is that under the terrific and long-continued strain one or more of the cross arms gave way and probably bent upward, which gave the wind a sudden, highly increased power on the cups that snapped the screw above referred to and instantly released the cups from the spindle. The anemometer was not injured, aside from the loss of the cups, and in order to expedite the resumption of the record, I left it exposed, simply putting on a new set of cups.

The 20 miles of wind interpolated at the time of the break (9:19–9:36 p. m.) have been added to the dial, so that the dial readings correspond to the record.

Under date of June 5, 1902, and in reply to the preceding, Prof. C. F. Marvin wrote, as follows:

Inasmuch as the spindle of the anemometer was intact and the cups entirely removed, I am inclined to think the only plausible explanation is that the cups, by the action of the storm, were detached from the spindle, either because the screws binding the cups to the spindle were not secured tight enough, or because of action from the storm the screw backed off a little and permitted an upward gust to lift the cups from the spindle. From the photograph inclosed with the report it is obvious that there must be a very pronounced upwardly inclined direction to the wind at the point of exposure of the anemometer, thus facilitating the lifting of the cups from the spindle. I would remark in regard to Mr. Thomas's conclusions, that the cups must have been tight on the spindle because the movement of the wind is registered regularly up to the very moment of the loss of the cups, that this is not necessarily the only one to be drawn. The spindle of the anemometer turns with such extreme freedom in its bearings that the very much greater friction between the cups and the spindle, even when the clamping screw is not tightened, is generally sufficient to keep the cups in continuous rotation, and it seems probable that the cups might have been working loose on the spindle for some time before the moment they were actually carried away.

Under date of June 27, 1902, Professor McAdie says:

It is doubtful if these high winds experienced at Point Reyes Light and at other points along the coast are really forced draughts. We have been in the habit of considering that this was so, but the truth can only be established by a set of comparative readings. If we may rely upon the reports of vessel masters these strong winds prevail at sea level and at some distance from the shore. While the topography is such as to accentuate air movement, the effect can not be justly described as a funnel effect because the velocities attained when the wind veers from the southeast to the northwest are equally high and this should not be the case if topography controlled the velocity. At San Francisco, with our so-called southeasters, the wind has been known to reach a velocity of over 50 miles an hour from the southeast and within a few moments an equal velocity from the northwest.

On the dates under consideration (May 16–19) it will be remembered that there was an unusually high velocity reported at nearly all points along the coast, and also at a number of interior points.

NOTE ON THE ANEMOMETER EXPOSURE AT POINT REYES LIGHT, CAL.

By C. F. MARVIN, Professor of Meteorology, dated February, 1903.

Prior to the erection of the Weather Bureau building to accommodate the station at Point Reyes Light the anemometer was exposed on a water tank located on the side of the bluff. A view of this location is shown in fig. 5. The excessive wind movement recorded at this locality, as set forth in Professor McAdie's paper, preceding, led us to question whether this was not due, at least partially, to a faulty exposure and to a strong draft of wind around the point of the bluff. In order to secure information on this point, extensive comparisons of wind movement have been conducted by installing a duplicate anemometer exposed on an attachment to the storm-warning tower erected very nearly on the summit of the bluff, as indicated in figs. 3 and 6. The anemometer cups were about 53 feet above the ground at the base of the tower—that is, about 593 feet above sea level. The anemometer on the tank had an elevation of about 490 feet above sea level. The relative location of these anemometers is more clearly indicated in figs. 7 and 8, which give the approximate plan and contour of the bluff.

The two anemometers were in all respects alike and recorded automatically side by side on a special two-magnet register. Comparative readings extended from noon, September 19, 1902, to noon, February 1, 1903. The following table gives the total monthly movements for the two anemometers:

Months.	Total monthly movement.		Maximum hourly movement.		Ratio.	Average hourly movement.		Relative monthly movement. Tank ÷ tower.
	Tank.	Tower.	Tank.	Tower.		Tank.	Tower.	
1902.								
October	14,466	13,519	62	59	1.05	19.4	18.2	1.07
November	15.393	14,792	77	74	1.05	21.4	20.5	1.05
December	12,385	12,225	58	53	1.09	16.6	16.4	1.01
1903.								
January	12,112	11,764	74	67	1.10	16.3	15.3	1.03

The hourly readings were tabulated for the entire period, but a careful examination of these fails to disclose any important results that are not also presented by the total monthly movements. It is apparent, from the tables, that the anemometer on the tank recorded from 1 to 7 per cent greater monthly movements than the anemometer on the tower.

Extended comparisons of anemometers at the Weather Bureau have demonstrated that differences in the indications of instruments that are of similar design and construction are caused principally by inaccuracies in the lengths of the arms of the anemometer cups, that is, by differences in the mean distance of the centers of the cups from the center of the axis of revolution.

In the case of the anemometer cups used in the present comparisons at Point Reyes Light, careful measurements show that the arms of the tank anemometer are 0.015 of an inch shorter than those of the tower anemometer. This is a difference of only 0.22 per cent, that is, we should expect the tank anemometer to show one-fifth of 1 per cent more wind movement than the tower anemometer.

The actual difference found from comparisons of the records at these two stations amounts to from 5 to 10 per cent for the maximum winds and from 4 to 6 per cent for the monthly movements, and must be attributed to some peculiarity of the exposure on the tank and to the variation in the direction of the wind.

From the foregoing it may be assumed that the extraordinary wind velocities recorded during the storms reported by Professor McAdie were fairly well indicated by means of the anemometer on the tank. In this connection, however, it is necessary to remark that accurate studies of the Weather Bureau type of Robinson's anemometer have never been extended to velocities above 50 miles per hour, at which speed the velocity indicated by the instrument is 9.2 miles or 18 per cent too high, so it is very probable that the wind movement producing an indicated velocity of from 100 to 120 miles per hour on the Weather Bureau anemometer was actually much less than 100 miles per hour. It is very greatly to be desired that researches should be undertaken to evaluate the indications of our anemometers at the very highest velocities ever indicated.

COMPOSITE AND OTHER ARRANGEMENTS OF WEATHER TYPES.

By H. W. RICHARDSON, Local Forecast Official, Duluth, Minn., dated March 17, 1903.

During recent years considerable attention has been devoted to the classification and indexing of weather maps and types as an aid to the forecasting, the most prominent contributors

to this special literature being Profs. Thos. Russell, E. B. Garriott, and M. V. Brown, Mr. F. H. Brandenburg, and Rev. F. L. Odenbach, S. J., all of whom have placed before us very valuable information and suggestions. One might also include in the above list Prof. F. H. Bigelow's Storms and Storm Tracks.

No one will dispute Professor Garriott's statement that "types of formations and movements of the same general character, extending over periods of several days, are much more important than types of individual conditions," nor that of Professor Brown to the effect that the idea of individual types must not be pushed too far, in the expectation that conditions apparently alike will always produce like results. On the other hand there is no question but that the study of individual types is very profitable, for, in many cases, certain characteristic conditions are a safe guide to the forecaster.

The writer has given the subject considerable attention, and, perhaps, some of the methods evolved and followed may prove of interest to others. For over four years past it has been my daily habit to enter upon each "pencil" map the local forecasts and the actual conditions that prevailed at Duluth in the succeeding twenty-four and thirty-six hours, that is, during "to-night and to-morrow" as regards weather, temperature, and wind. This systematic record has proved valuable as facilitating the study of types in their relation to local forecasting, especially as one does not need to refer to any other source to obtain precise information as to results when examining maps. This method permits easy separation and arrangement of types in a variety of ways. Up to the present time three methods of classification have been attempted, as follows:

A. Composite types.
B. Associated types.
C. Scrap-book arrangement. Chronological order.

(A.) The composite is an extremely interesting method. This is a chart compiled from a large number of maps, each of which produced certain similar effects, the final result being an average of the data for each station from which reports were received on the several dates. By this means one obtains a purely ideal map for a large district or locality as regards any stated phase of weather, temperature, or wind, separately or combined. The chief value to the forecaster is the knowledge gained as to average conditions producing a type. After the composite is prepared it should be compared with each of the relative or contributing maps in order to note variations in position, movement and strength of the highs and lows, pressure and temperature changes, precipitation areas, etc. To secure the best results, composites or other methods of studying types should cover not less than a year on account of the changes attending the procession of the seasons, but periods of five or ten years would be more satisfactory because of other variations that occur from year to year.

Quite a complete set of composites (8 a. m.) have been prepared for the month of March, those for other months are in course of preparation. These refer to the following conditions: Brisk and high northeast winds; light and fresh northeast winds; fresh northerly winds; fresh westerly winds; brisk and high northwest winds; fair weather; snow or rain; stationary temperature; warmer to-night, colder to-morrow; colder to-night, stationary temperature to-morrow; colder (also cold waves); warmer.

Two of the above types are illustrated by the accompanying figs. 1, 2, 3, and 4, viz: Brisk and high northeast winds to-night and to-morrow, by figs. 1 and 2; and fair weather to-night and to-morrow, by figs. 3 and 4. The former is about the most important of all in this locality (excepting the high northwest wind type that is usually confined to the colder months in its greater severity), for it is experienced in varied moods during about eight months in the year. In its lighter phases it is quite frequently accompanied by fine and delightfully cool weather, but when fully developed there is much wind, fog, rain or snow, heavy sea and disagreeably cool temperature. The low shown near Omaha, see fig. 2, moved oftenest from the Alberta or Montana region in twenty-four hours. By 8 a. m. of the succeeding date it had generally moved between three hundred and four hundred miles farther eastward, and thence its path was northeastwardly across the Lake region. Of course there were numerous instances where this low was farther west than Omaha as regards like effects, and where it moved to Nebraska from either the west or southwest. During the twenty-four hours following, the Pacific, Atlantic, and Manitoba highs usually remained about stationary, the latter taking an eastward course after the low entered the Lake region. The high northeast type is 80 per cent in favor of rain to-night and about 90 per cent for rain to-morrow, the amounts of precipitation averaging heaviest during the day hours. The local temperature changes were generally slight, inclining toward colder by 8 p. m. the next day, and the average maximum velocities ranged from forty miles for to-night to about forty-five for to-morrow.

In the fair weather type, see figs. 3 and 4, in the great majority of instances the barometer was high in districts north of the Dakotas and over the Rocky Mountains, and low in either the Lake region, New England, the extreme Southwest or Alberta. The temperature changes were usually unimportant and the winds variable.

(B.) The associated types cover the the same field as the composite only not as averages. The printed maps (Form E) are utilized. Three separate divisions are followed, viz:

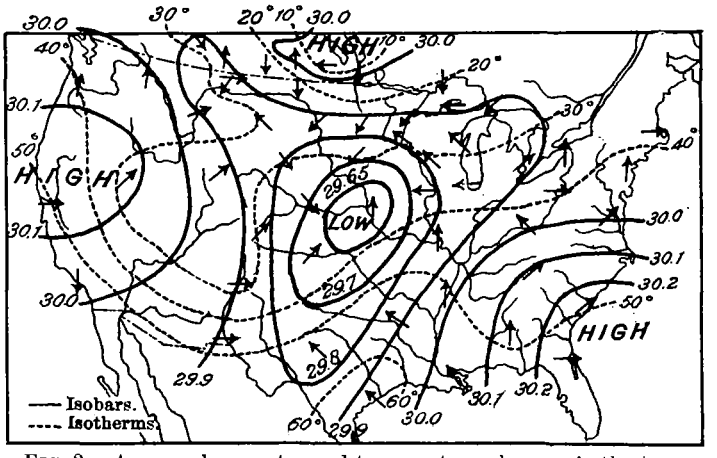

FIG. 2.—Average barometer and temperature changes in the type causing brisk to high northeast winds at Duluth during March.

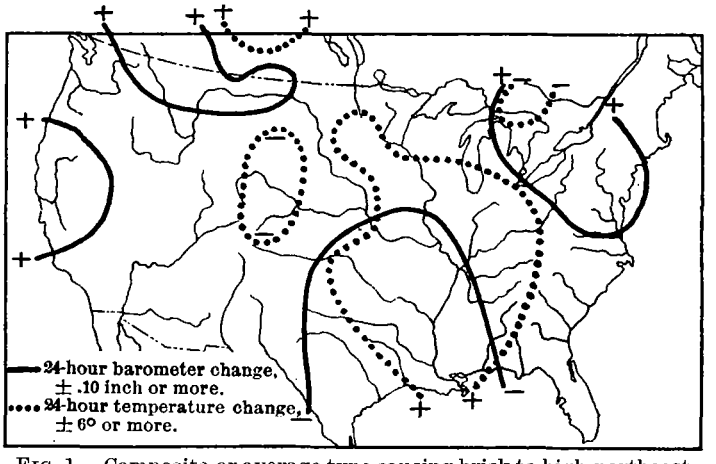

FIG. 1.—Composite or average type causing brisk to high northeast winds at Duluth during March.

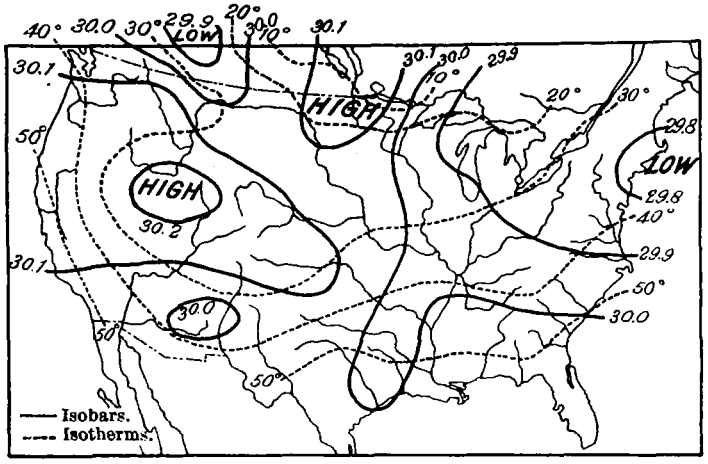

FIG. 4.—Average barometer and temperature changes and precipitation areas in the type causing fair weather "to-night and to-morrow" at Duluth during March.

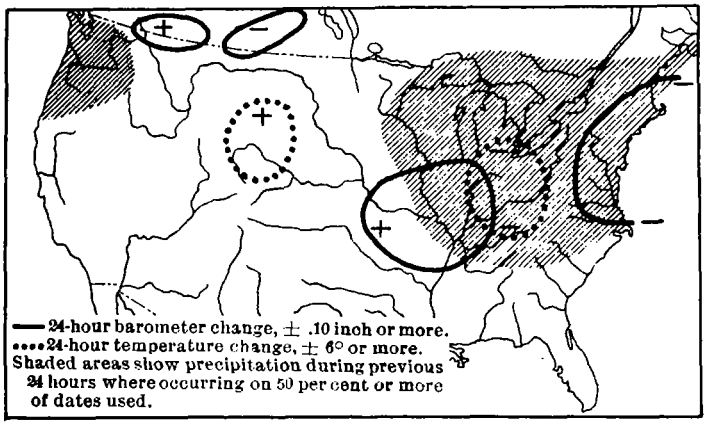

FIG. 3.—Composite or average type causing fair weather "to-night and to-morrow" at Duluth during March.

Weather, temperature, and wind, and three maps are used daily (except Sundays and holidays), one for each condition. Each map includes precipitation, pressure, and temperature change areas in black, red, and blue pencil, respectively, and the paths of the pressure areas are also indicated. On each map are also brief notations covering weather, temperature, and wind for to-night and to-morrow; thus each individual map contains a complete history of the conditions that followed during the succeeding twenty-four and thirty-six hours and their relation to a particular type. As the types accumulate they are pasted together and each group is plainly marked. Thus we have all the fair weather maps together, and the same for rain or snow, cold waves, colder, warmer, stationary temperature, high or light winds, etc. A complete set of these types has been arranged for each month of 1902, the labor requiring but a little time each day.

(C.) In the scrapbook plan a conveniently large blank book is used. A year's supply of 2 by 4-inch maps of the United States and Canada were milliographed. Two of these maps are used daily (including Sundays and holidays). The maps are of a size that permits four being used on a page. On the left-hand page are pasted (in chronological order) the maps containing isobars and isotherms, and on the opposite or right-hand page are pasted maps showing precipitation, areas of pressure and temperature changes for dates corresponding to maps on the left. Progressive movements of the highs and lows are indicated. The local and State forecasts are entered opposite the appropriate map, and likewise data as to weather, temperature, and wind conditions that resulted "to-night and to-morrow." The arrangement is such that when the book is open eight maps for four dates are at once in view. Besides preparing the maps in the manner described, a system of indexing is also followed. In the front part of the book are pages devoted to the various types of weather, temperature, and wind, each map (or date) being given a number. This shows the frequency and continuity of each type. It not only affords a study of individual types, but also furnishes a method of studying those whose movements extend over periods of several days.

In all the foregoing arrangements of types the 24-hour pressure changes were used, instead of those for twelve hours. This was rendered necessary by reason of the fact that the 12-hour changes were available only for the Northwest; therefore they were of little value.

Among the features developed by these studies is the apparent tendency of the highs and lows to move from near the center of a pressure change area to the edge of the same area or to a point between the plus and minus areas in twenty-four hours. When the highs and lows lie between plus and minus areas they frequently move to near the center of the pressure change areas in twenty-four hours. As these areas are generally of irregular size and conformation, so, also, the movements of the highs and lows become little or great accordingly. While the rules do not always obtain, yet the occurrence is so frequent as to be of some value in forecasting when considered in connection with the other laws governing atmospheric motion.

METEOROLOGY IN THE NATIONAL AGRICULTURAL INSTITUTE OF FRANCE.

By Miss R. A. EDWARDS, Library, Weather Bureau.

The National Agricultural Institute of France has recently issued the first volume of the second series of its Annales, which appears on the occasion of the twenty-fifth anniversary of the Institute. From the introduction we learn that the special purpose of this volume is to present to the agricultural and scientific world the history, the work, and the organization of this institution. Condensed accounts are given of the various courses of instruction offered, among which we notice meteorology. Teachers in general, and especially those in the colleges and technical schools of this country, may be interested to know to what extent meteorology receives attention in other countries. This course consists of twenty-five lectures delivered by Prof. Alfred Angot, the well-known meteorologist of the Bureau Central, who also holds the chair of physics and meteorology in the National Agricultural Institute of France. The following is a translation of the syllabus of his lectures.

Object and subdivisions of meteorology. Relations of meteorology to the other sciences, e. g., geography, agriculture, hygiene, history.

General methods of calculation. Averages; discussion of their value; application of graphic methods to the representation of phenomena.

Actinometry. Annual and diurnal variation of the quantity of heat received in different latitudes; influence of the atmosphere and the atmospheric absorption of solar rays; measure of the quantity of heat and of light which reach the soil; actinometers.

Temperature of the soil. Diurnal and annual variations of the temperature of the soil at different depths; effect of sod covering; of snow covering; variation of average temperature with depth.

Temperature of waters. Springs, rivers, lakes; annual variation; temperature of the sea at surface and at depths; of ocean currents; limits of icebergs.

Temperature of air. Methods of observation; thermometers, maximum, self-registering, sling; installation of thermometers.

Diurnal variations of the temperature of the air; influence of seasons; of latitude; of topographical conditions. Annual variation of temperature; climates, equable, temperate, extreme; variation of temperature of atmosphere with altitude.

General distribution of temperature at the surface of the globe by the annual averages and by the different seasons; extreme temperatures observed in different regions.

Influence of temperatures on phenomena of vegetation; effect of frosts; of altitude; limits of different vegetations; influence of temperature on animal life.