X positive north,
Y positive east,
Z positive vertical,

the latter ordinate, whether positive to the zenith or to the nadir, apparently being undefined in the preliminary report. This decision seems to be of doubtful validity, (1) since in case the vertical direction is positive to the nadir the second convention is disregarded, and (2) if positive toward the zenith, then the third convention is not observed.

There are other reasons for adhering to a system of coordinates embracing the three conventions above recommended, as (1) the usual scheme of trigonometric instruction, (2) the agreement with the cyclonic circulation, when taken positive and right handed in the Northern Hemisphere, (3) the convenience of recording movements of clouds as vectors which are tangent to the stream lines, "as the arrow flies," instead of in the improper, even if popular, notation of the direction from which the wind blows.

Although the meteorological system develops naturally, and by general usage, from the north pole, but the magnetic system from the south pole of the earth, yet some authors may prefer to count from the south point in both systems; in this case the potential and the coordinate forces in terrestrial magnetism will be:

$$V = + \Sigma \frac{m}{r}$$

$$X = -\frac{dV}{dx} = -\frac{dV}{rd\theta}, \text{ positive south.}$$

$$Y = -\frac{dV}{dy} = -\frac{dV}{r \sin \theta \, d\lambda}, \text{ positive east.}$$

$$Z = -\frac{dV}{dz} = -\frac{dV}{dr}, \text{ positive upward.}$$

It is contended in this paper that all discussions and records of observations should conform to the three standard conventions. If terrestrial magnetism can not be brought into full harmony with the accepted meteorological system, then, at least, the only difference allowable should be that the magnetic rotation starts with zero at the north point and increases westward, while the meteorological zero is at the south point and the rotation is positive eastward; in both systems the positive rotation is in the direction north, west, south, east.

AURORA AUSTRALIS OF APRIL 20.

By M. W. CAMPBELL-HEPWORTH, F. R. A. S., Lieutenant Royal Naval Reserves.

The Chief of the Weather Bureau is indebted to Commander J. E. Craig, United States Navy, Hydrographer, in charge of United States Hydrographic Office, for the following copy of a description of an aurora australis observed on board the Canadian Australian Royal Mail Steamship Company's steamer *Aorangi*:

On April 20, in latitude 47° 30′ S., longitude 96° 15′ E., at 6:30 p. m., a diffused light, bearing resemblance to that which may be observed at night over a city strongly lighted by electricity, was observed over the southern arc of the horizon. Horizontal flashes soon spread and flared in every direction from this light above the horizon, increasing in length and brilliancy until at 7:30 p. m. they were shooting across the sky to within 30° of the northern arc of the horizon.

Cones and circles of light traveled rapidly over the whole sky, flashing beams of intense brilliancy from one to the other. This continued until 8:30 p. m. A remarkable change then took place; the sky being cloudless, moon and stars shining brightly, an arch of bright green light fading off into yellow formed over the southern horizon, rose rapidly to a higher and yet higher altitude and was followed by similar arches in regular sequence until there were six distinct arches, their apices being from 10° above the southern horizon to 60° above the northern horizon. These were formed of narrow vertical bands of light from 5° to 20° deep, bright green, and yellow at the upper edges and of a rosy hue at their bases. Subsequently, these arches rapidly changed their shapes in all parts of the sky, others forming, but some kind of luminous curve was always preserved, except in one or two cases, when perfect right angles were formed. At 9 o'clock a brilliant circle formed around the zenith, composed of narrow bundles of light, similar to those already described, but pendent overhead, and having a rotary motion; this circular motion having been apparent in all the formations hitherto mentioned. The circle was about 30° in diameter and the rays of colored light or narrow bands of colored light, as I have elsewhere termed them, were not quite vertical but slightly inclined, thus producing an effect which gave the impression of what one might suppose would occur in the vortex of an electrical cyclone. A cloudless sky showed through the center of this ring-shaped tassel of colored light. It then traveled to the westward. Later, a spiral cord of light formed, having its center at the zenith, exhibiting three distinct turns of a coil. Two intensely bright formations, resembling waterspouts brilliantly illuminated, flared in the west, and a remarkably bright meteor, starting from Canis Major, traveled slowly across the sky, discharging at intervals fragments of color, and thus adding to the splendor of the scene.

Prior to 8:30 p. m., all flashes of light had been horizontal. After that time, they were all vertical. A special feature in this display should be mentioned; these formations had all a westward movement.

After 9:15 p. m., the aurora was less brilliant, but burst into greater activity a few moments afterwards, more especially in the northern semicircle. This display lasted until 9:45 p. m. Atmospheric pressure for the past forty-eight hours had been abnormally low, the barometer remaining below 29.00 inches. At the time of the display it stood at 28.80 inches by "B. T." barometer 244, and was slowly rising. The temperature of the air was 43° F.; the wet bulb reading was 41° F. The wind was west-northwest (true), force from 5 to 4. It had been northwest throughout the day, force 7, and on the day previous, northwest, force from 6 to 8. Squally weather, accompanied by rain, hail, thunder, and lightning, has been experienced from the 18th until noon of the 20th.

On the night of April 22–23, in latitude 45° S., longitude 118° W. to 120° E., from 7 p. m. to 4 a. m., another auroral display was observed exhibiting the phenomena of the arches. At 9 p. m. (about), two arches, one after the other, rose slowly above the horizon, but on this occasion the sky became frequently clouded and the spectacle, although magnificent, had not that awe-inspiring grandeur which startled the eyes of the observer on the night of the 20th.

WIND-BAROMETER TABLE.

By E. B. GARRIOTT, Professor, Weather Bureau.

The following table presents, in form for ready reference, atmospheric signs which have been found to presage certain weather changes and conditions over the middle and upper Mississippi and lower Missouri valleys, the Great Lakes, the Ohio Valley, and the Middle Atlantic and New England States:

Barometer (reduced to sea level).	Wind direction.	Character of weather indicated.
30.00 to 30.20, and steady.....	westerly ...	Fair, with slight changes in temperature, for one to two days.
30.00 to 30.20, and rising rapidly	westerly ...	Fair, followed within two days by warmer and rain.
30.00 to 30.20, and falling rapidly....	s. to e.....	Warmer, and rain within 24 hours.
30.20, or above, and falling rapidly..	s. to e.....	Warmer, and rain within 36 hours.
30.20, or above, and falling rapidly..	w. to n.....	Cold and clear, quickly followed by warmer and rain.
30.20, or above, and steady	variable....	No early change.
30.00, or below, and falling slowly...	s. to e.....	Rain within 18 hours that will continue a day or two.
30.00, or below, and falling rapidly..	se. to ne. ..	Rain, with high wind, followed within two days by clearing, colder.
30.00, or below, and rising	s. to w.....	Clearing and colder within 12 hours.
29.80, or below, and falling rapidly..	se. to ne....	Severe storm of wind and rain imminent. In winter, snow and cold wave within 24 hours.
29.80, or below, and falling rapidly..	e. to n.....	Severe northeast gales and heavy rain or snow, followed, in winter, by cold wave.
29.80, or below, and rising rapidly...	Going to w.	Clearing and colder.

The character of the precipitation, whether rain or snow, is governed by the temperature.

Weather wisdom, gained by an observance of local atmospheric signs and conditions, has been possessed by man from time immemorial. Much of this wisdom has been embodied in proverbs which possess considerable merit for the sections and localities in which they originated. In farming communities sayings regarding the wind, the temperature, the clouds, and evidences of atmospheric moisture have been handed down from generation to generation; and in mari-

time circles, where experience over a wider territory is had, these observed conditions have been supplemented with barometric observations.

Local signs and observations, however, rarely indicate the duration and intensity of threatened atmospheric disturbances save in the immediate presence of a storm, and barometric readings are ofttimes misleading, unless considered in connection with the readings taken at points remote from the place of observation.

By the modern system of weather services reports of local observations are collected by telegraph, collated, and charted, and the forecaster has for his consideration not only the signs and conditions noted in the various localities, but also a general graphic presentation of atmospheric conditions over the entire region covered by the stations of observation.

Without at this time considering original causes the unequal air distribution over the surface of the earth may be recognized in the areas of high and low barometer which appear on the weather map. These areas of high and low barometer have a progressive movement, which in the middle latitudes is from west to east at an average rate of 20 to 40 miles an hour. The high areas are usually attended by settled, fair, and seasonably cool weather, and the low areas by unsettled, stormy, and warm weather. The weather maps show that the low areas are vast atmospheric whirls or eddies with the wind blowing spirally and contra-clock wise, inward toward the center of the whirl, where the lowest barometer is found. The areas of high pressure show winds blowing spirally outward from the center of highest barometer, the circling movement being in a direction contrary to that observed within the areas of low barometer. A consideration of the progressive and circling movements of the high and low areas will reveal the causes which produce local weather signs and conditions.

In weather calculations the barometer is the pulse, and the wind is the breath of storms, and the thermometer registers the variation of the vital function heat. A consideration of these elements, or symptoms, in their various phases constitutes a diagnosis by means of which weather changes of the near future may, as a rule, be approximately determined. Rapid oscillations or changes in the barometer indicate early and marked changes in the weather. When barometric changes of this character occur during fair weather, and are downward, and the wind and temperature respond and cooperate in accordance with recognized rules and laws, foul weather may be expected; when the barometer has a decided upward inclination, and is supported by certain winds and thermal conditions, fair weather, or a return to fair weather, is indicated.

The contents of the table herewith are a key for the determination of weather changes indicated by the barometer and the direction and shifts of the wind. In sections of the United States named at the head of the table the advance of an area of low barometer, or a general storm area, is indicated by the wind going to points between south and east, and when the storm center is approaching from the southwest the winds will change to east or northeast. This shift of wind, if accompanied by falling barometer, will be attended by increasing cloudiness, and the southerly winds will bring the warmth of lower latitudes; and, as warm air has a greater capacity for moisture than cool air, the amount of moisture in the atmosphere will increase. The amount and rapidity of the fall in the barometer will usually indicate the nearness and intensity of the approaching storm. When the center of the low barometer has passed over a given locality the barometer will begin to rise, the wind, still blowing and circulating toward the center of the atmospheric whirl, will shift to west and northwest, the temperature, brought from colder latitudes by the winds west of the center, will be lower, and the weather will clear under the influence of an area of high pressure, which always follows in the wake of an area of low atmospheric pressure.

NOTES BY THE EDITOR.

WEATHER TELEGRAPHY IN ENGLAND AND AMERICA.

It is well known that the first weather maps for the United States, as compiled daily by means of telegraphic reports, were made by the Smithsonian Institution. In 1843 Espy had been engaged by the United States Government as meteorologist; he was assigned to duty, at first under the Surgeon-General of the Army, afterwards, to the Secretary of the Navy and, finally, 1848, under the Secretary of the Smithsonian. During the first years of his work he compiled many daily maps from the monthly returns of the meteorological observers scattered over the country, and he published a liberal selection in his four successive meteorological reports. In 1847 Professor Henry began to devote special attention to this subject, and, during the subsequent years, in cooperation with Professor Espy, the Smithsonian system of observers was largely extended, special investigations were made, the telegraph offices were supplied with instruments and reports secured for the compilation of daily maps; the prediction of storms was definitely proposed as the ultimate object of the work in hand. The telegraphic reports seem to have begun in 1849, at least experimental maps were then made for July 19th and 20th for Professor Henry by Dr. A. Jones, in New York, and sent to Washington as samples. Dr. Jones wished to have New York made the central collecting point.

Simultaneously with the work of Espy and Henry and their colaborers, Redfield, Loomis, Coffin, and Guyot, a similar development was going on in England. The electric telegraph company (using Wheatstone's system) had been incorporated in England in 1846, and by 1851 it had erected about 2,000 miles of wire. At the first great World's Fair, at the Crystal Palace near London, in 1851, weather reports were received by telegraph from many points and a daily weather map published by lithography, beginning with August 8, 1851. A facsimile of this map is reproduced in Symons' Monthly Meteorological Magazine, September, 1896.

The last number of Symons' magazine (April, 1897) contains further interesting information with regard to similar work in 1849 and 1850. Just before receiving that number of this magazine, the present Editor had discovered and copied the following interesting letter from Mr. James Glaisher which has been, fortunately, preserved among the fragments of correspondence saved from the destruction of the records of the Smithsonian at the disastrous fire of January, 1865. These records are now accessible to the student, and the letter here reprinted, taken in connection with the important and authoritative sketch published by Mr. Symons, shows that Mr. James Glaisher, the nestor of meteorologists, who is still living at an advanced age in London, was, so far as we know, the first to organize a system of strictly simultaneous observations and to compile the corresponding daily bulletins and weather maps. According to Mr. Symons, Glaisher's first map was that for June 14, 1849, or five weeks before that of Dr. Jones in New York. He does not appear to have utilized the expensive assistance of the electric telegraph, but by the cooperation of the railroad companies, and at the expense of the proprietors of the Daily News he was