DENVER FORECAST DISTRICT.*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

The feature of the month was the heavy precipitation in western Wyoming, northwestern Colorado, and the eastern counties of Colorado. In the plains region of Colorado the rainfall was excessive on the 18th and 19th. Considerable damage by flood was caused in the southeastern portion of the State by the overflow of the Arkansas River below the mouth of the Picketwire. Warnings of the flood were issued on the morning of the 19th. Temperature averaged lower than usual thruout the district.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

The month as a whole was one of pleasant weather, with rather less rain than usual. There were no especially noteworthy features.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

Temperature was slightly below the normal, and precipitation, except in a few localities, was in excess of the normal. Frosts in the western sections, altho not more frequent, were heavier than usual. There were three storm periods, but the winds attending them were not severe. The warnings for high winds were timely and beneficial, and warnings were issued for all important frosts.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The drought conditions that persisted during the first three weeks of the months over the middle and northern districts east of the Rocky Mountains held the rivers to their abnormally low stages, and the effects of the rains that fell late in the month were scarcely noticeable. As in September, the effects of the drought were most noticeable in the Ohio River where there was no hope of an early resumption of navigation. At Parkersburg, W. Va., the low-water stage of —0.3 foot was the lowest on record.

There was a moderate flood in the upper Arkansas River, beginning on the 19th in southeastern Colorado, and reaching Wichita, Kans., on the 23d. At the same time there was a decided rise in the lower Arkansas River and its tributaries, with flood stages in the Neosho River, and in the Arkansas in the vicinity of Fort Smith, Ark. At the end of the month the lower river was still rising, but with no prospect of serious flood. Warnings were issued wherever possible and they were, as usual, valuable and timely.

These floods were caused by heavy rains that extended over eastern Colorado, Kansas, and Oklahoma, beginning on the 18th in Colorado, and reaching a maximum in Oklahoma and eastern Kansas from the 20th to the 22d, inclusive. In the State of Oklahoma, where the rainfall was probably heaviest, the floods were more pronounced and great damage was done; the losses will probably run into millions, but it has thus far been impossible to obtain detailed estimates. Effort will be made, however, to secure data for publication in a later edition of the MONTHLY WEATHER REVIEW.

On the Neosho and lower Arkansas rivers the damage was small, probably amounting to not more than $25,000.

The heavy rain area extended also into northern Texas, causing a moderate rise in the upper Trinity River; due notice was given and no damage resulted.

Heavy rains in South Carolina on the 22d and 28th were followed by rapid rises in all the rivers of the State; the floods were moderate. Warnings were issued promptly and no damage of consequence resulted.

The highest and lowest water, mean stage, and monthly range at 208 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

DEFLECTING FORCE DUE TO THE EARTH'S ROTATION.

By R. A. HARRIS. Dated Washington, D. C., September 1, 1908.

In connection with Mr. Okada's recent paper[1] it may be of interest to show how the deflecting force can be obtained by aid of the usual two-dimensional expressions for the acceleration resolved along and perpendicular to the radius vector.

If a material point move in any plane curve, and if ρ and ψ denote its polar coordinates, then the acceleration along ρ increasing will be

$$\text{Acceleration}_\rho = \frac{d^2\rho}{dt^2} - \rho\left(\frac{d\psi}{dt}\right)^2,$$

and that perpendicular to ρ, ψ increasing, will be

$$\text{Acceleration}_\psi = \rho\frac{d^2\psi}{dt^2} + 2\frac{d\rho}{dt}\frac{d\psi}{dt}.$$

These fundamental expressions are readily obtained either by considering the velocities resolved with reference to polar coordinates at two successive instants of time, or by combining accelerations along the x and y directions, the same having been first exprest in polar coordinates.

Next suppose this plane to be tangent to a sphere, the moving point marking, or coinciding with, the point of contact for the short interval considered. Let r, θ, and φ, denote the polar coordinates of this point (θ being north polar distance and φ east longitude from a meridian fixt in space), and let the origin of its plane coordinates (ρ, ψ) be taken at the point where the axis of the sphere from which θ is reckoned pierces the tangent plane; then

$$\rho = r\tan\theta,\quad d\rho = r\,d\theta;$$

$$d\psi = \frac{r\sin\theta}{r\tan\theta}d\varphi = \cos\theta\,d\varphi.$$

Now suppose the velocity along the path to be uniform for the short time considered.

$$\text{Acceleration}_\theta = -r\sin\theta\cos\theta\left(\frac{d\varphi}{dt}\right)^2 = -\frac{\cos\theta}{r\sin\theta}v_\phi^2$$

$$\text{Acceleration}_\phi = 2r\cos\theta\frac{d\theta}{dt}\frac{d\varphi}{dt} = 2\frac{\cos\theta}{r\sin\theta}v_\phi v_\theta$$

where, of course, the velocities are absolute velocities in space.

On the earth, which rotates from west to east with an angular velocity k_1, we have

$$v_\theta = v_s$$
$$v_\phi = r\,k_1\sin\theta + v_e,$$

where v_s and v_e denote velocities relative to the earth's surface.

Hence, acceleration$_\theta$ of particle moving with reference to the earth's surface — acceleration$_\theta$ of particle at rest upon the earth's surface $= -2k_1v_e\cos\theta$.

Similarly, Acceleration$_\phi = 2k_1v_s\cos\theta$.

Hence, the material point is capable of exerting deflecting forces such that

[1] Monthly Weather Review, May, 1908, XXXVI, p. 147.

	Southward force	=	$2k_1 v_e \cos\theta$.
	Eastward force	=	$-2k_1 v_s \cos\theta$.
Hence,	Total force	=	$2k_1 v \cos\theta$.

The tangent of the direction of the action of this force (from south via east) is

$$-\frac{v_s}{v_e}=\frac{v_s}{v_w},$$

while the tangent of the direction of the moving particle is, of course,

$$-\frac{v_e}{v_n}=\frac{v_e}{v_s}.$$

The force, therefore, acts at right angles to the instantaneous path of the particle, and so is a deflecting force. (*Cf.* Coast and Geodetic Survey Reports, 1900, p. 571; 1904, p. 332.)

STUDIES ON THE VORTICES OF THE ATMOSPHERE OF THE EARTH.

By Prof. FRANK H. BIGELOW. Dated Washington, D. C., March 16, 1908.

IV.—THE DEWITTE TYPHOON, AUGUST 1-3, 1901.

THE METEOROLOGICAL DATA.

In order to illustrate the structure of a hurricane as analyzed by the theory of the dumb-bell-shaped vortex, I have chosen the DeWitte typhoon which occurred in the China Sea August 1-6, 1901. This hurricane is specially valuable for our studies, because the observations at observatories on the coast of China and on the outlying islands afford an unusually large amount of suitably published data. A paper by Rev. Louis Froc, S. J.,[1] and some notes by Rev. José Algué, S. J.,[2] give the isobars, wind directions and velocities at midnight of August 2, 1901. In Table 52 will be found other data extracted from the China Coast Meteorological Register and the Monthly Report of the Central Meteorological Observatory of Japan.

The isobars of August 2, 10 a. m., 10 p. m., August 3, 5 a. m., are reproduced in Chart IX, figs. 9, 10, and 11, respectively. The isobars of August 2, 10 p. m., fig. 10, have been made the basis of the computation, because the typhoon was then at its greatest intensity, the barometer at the center having fallen to about 690 millimeters. Chart IX, fig. 12, shows upon an adopted system of isobars constructed from the vortex data, the wind direction and velocity located according to circumstances within the diagram so as to give a composite view of the vectors on all sides of the axis and at the proper distances from it. The temperatures, fig. 13, and the relative humidity, fig. 14, have been plotted in a similar manner. An inspection of the temperature and relative humidity diagrams, shows that in this case there is no important difference between the western and the eastern quadrants, such as is always found in ordinary cyclones as distinguished from hurricanes. The relative humidity, however, seems to be somewhat higher in the southwest quadrant than in the others, due probably to the excess of the tendency to precipitation in that region. It is very evident that no temperature differences exist in the sea-level horizontal section of the hurricane, such as can account for its energy thru rotations generated by two masses at different temperatures lying side by side on the same level. It is probable that these temperature differences exist in higher levels where a cold sheet overlays a warm sheet, the surface of separation being horizontal rather than vertical.

CONSTRUCTION OF THE AVERAGE HURRICANE VORTEX.

It is our purpose to construct the average vortex which underlies the actual hurricane with all its divergencies due to local conditions. The vortices in the atmosphere are seldom symmetrical, tho the principles of vortex action prevail with more or less perturbation. It is our first study to obtain the symmetrical vortex with all its velocities, angles, and pressures; we can then find the forces which produce the actual vortex, thru a series of differences obtained by subtracting the symmetrical system from the observed data. Thus the progressive northwestward motion of the typhoon makes the wind-angles greater southwest of the center than to the northwest. This angular difference is eliminated as follows: At the northern, eastern, southern, and western points of each isobar construct the appropriate wind vector (the heavy dotted arrows of fig. 12) as accurately as possible from the wind observations taken in the region and plotted on the composite diagram, fig. 12. Then take the mean velocity and the mean angle on each isobar, i. e., the mean values of the four average vectors of each isobar. In the present study the angle 30° has been assumed thruout this horizontal section, whence $i=-30°$ and $az=60°$, the angular height at which the general vortex is truncated by the sea-level plane, whatever its actual height in meters may be.

TABLE 52.—*Meteorological data*[3] *of the DeWitte typhoon, August 1-3, 1901.*

Station.	Latitude. North.	Longitude. East.	Date.	Hour.	*B.*	*t.*	Relative humidity.	Wind.	
	°	°			*Mm.*	°C.	*Percent.*	*M.p.s.*	*Dir.*
Gutzlaff	30.49	122.10	Aug. 1	3 p.m.	757.2	28.9	87	7	ese.
			2	9 a.m.	754.9	26.7	80	11	ene.
			2	3 p.m.	......	......	......	......	......
			3	9 a.m.	750.8	26.1	95	25	ese.
Sharp Peak	26.7	119.40	Aug. 1	3 p.m.	753.1	28.9	85	11	ne.
			2	9 a.m.	748.3	30.0	86	7	nnw.
			2	3 p.m.	743.5	82.3	91	7	nnw.
			3	9 a.m.	728.5	26.7	78	25	ssw.
Amoy	24.27	118.5	Aug. 1	3 p.m.	753.9	31.6	80	9	se.
			2	9 a.m.	751.1	28.3	83	7	wsw.
			2	3 p.m.	747.5	34.4	94	9	w.
			3	9 a.m.	742.2	30.3	96	16	sw.
Taihoku	25.4	121.28	Aug. 1	10 p.m.	750.4	26.8	91	4	nw.
			2	10 a.m.	742.6	26.2	93	21	nw.
			2	10 p.m.	732.7	24.3	99	27	nw.
			3	5 a.m.	736.8	25.2	86	17	sw.
Taichu	24.2	120.40	Aug. 1	10 p.m.	744.9	25.1	91	4	n.
			2	10 a.m.	738.7	26.1	93	16	nw.
			2	10 p.m.	736.3	24.1	98	6	n.
			3	5 a.m.	734.4	26.9	97	15	sw.
Hokoto	23.33	119.34	Aug. 1	10 p.m.	751.7	28.0	85	10	nw.
			2	10 a.m.	747.6	29.5	76	16	nw.
			2	10 p.m.	742.5	28.8	87	12	wsw.
			3	5 a.m.	740.5	28.6	91	17	nw.
Tainau	22.59	120.12	Aug. 1	10 p.m.	750.2	28.1	80	6	nw.
			2	10 a.m.	746.3	28.8	71	12	nw.
			2	10 p.m.	742.7	25.9	100	10	w.
			3	5 a.m.	742.1	28.2	87	17	sw.
Taito	22.45	121.8	Aug. 1	10 p.m.	747.3	27.4	76	4	w.
			2	10 a.m.	739.8	26.0	92	8	sw.
			2	10 p.m.	738.5	27.4	74	21	ssw.
			3	5 a.m.	739.7	27.3	87	17	sw.
Ishigakijima	24.20	124.7	Aug. 1	10 p.m.	740.6	25.8	93	17	n.
			2	10 a.m.	725.5	26.0	100	22	n.
			2	10 p.m.	737.2	27.0	91	37	s.
			3	5 a.m.	744.7	28.7	83	26	s.
Naha	26.13	127.41	Aug. 1	10 p.m.	741.0	25.6	83	21	e.
			2	10 a.m.	742.5	25.5	91	24	ese.
			2	10 p.m.	751.5	26.8	90	10	se.
			3	5 a.m.	752.6	26.5	83	9	se.
Oshima	28.23	129.30	Aug. 1	10 p.m.	753.6	27.9	80	4	e.
			2	10 a.m.	753.7	28.0	76	14	se.
			2	10 p.m.	757.4	27.4	80	10	se.
			3	5 a.m.	758.0	26.6	85	7	ese.

For the mean isobars of the vortex the procedure is as follows: Scale off the distance of the isobars from the center on the north, east, south, and west lines and take the mean of these four as the observed radius, ϖ, of the appropriate vortex tube. Look out the log ϖ of the successive radii and take the successive differences, $\log \rho = \log \varpi_n - \log \varpi_{n+1}$. Finally, take the mean, $\log \rho_m$, and reconstruct the computed $\log \varpi_n$ by

[1] The DeWitte Typhoon, August 1-6, 1901. Annals Zi-ka-wei Observatory.

[2] The Cyclones of the Far East. Manila Observatory. p. 31.

[3] Extracted from the China Coast Meteorological Register and the Monthly Report of Central Meteorological Observatory of Japan.