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.

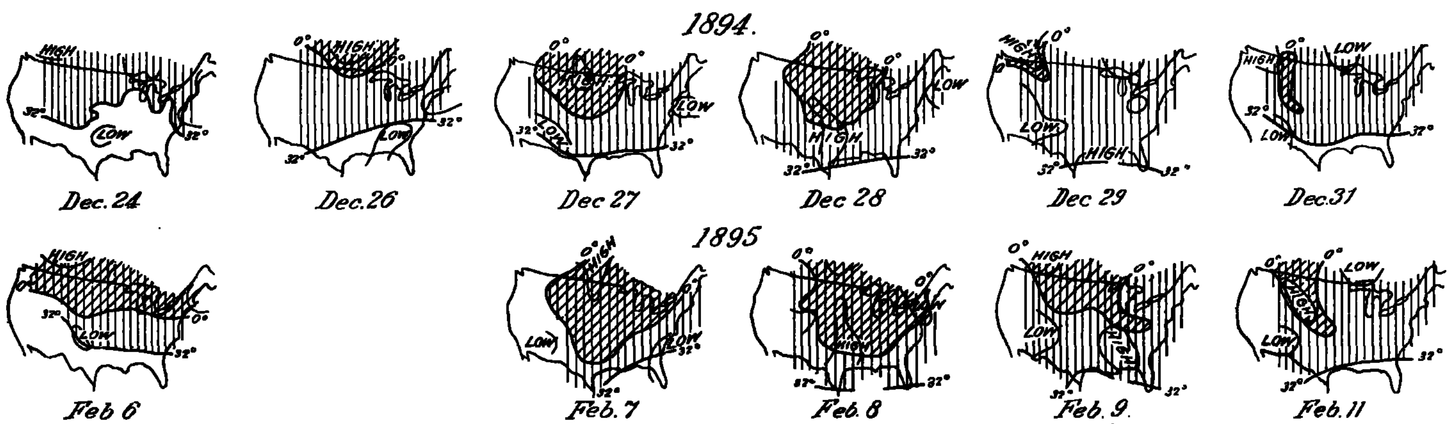

FIG. 3.—Cold wave types.

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.

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, 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 the aid of telegraphic reports received from western Europe, islands of the North Atlantic Ocean, and North America, and by a classification of types prepared by the aid of Weather Bureau and international reports. These preliminary studies appear to indicate recurring periods during which similar weather conditions and changes obtain generally over the middle latitudes of the Northern Hemisphere. A determination of these periods, with the data available, may not be possible.

The increased accuracy of the forecasts and the lengthening of the period for which they are made, which will surely follow a vigorous prosecution of this line of work, will, however, justify the great expenditure of time, labor, and skill which the preparation of reference charts and their classification will demand.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

Meteorological observations at Honolulu, December, 1901.

The station is at 21° 18′ N., 157° 50′ W.

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m, Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time.									Total rainfall at 9 a. m., local time.
				Temperature.		Moisture.		Wind.		Average cloudiness.	Sea-level pressures.		
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	30.01	64	63.3	79	63	64.0	80	sw.	1-0	3-0	30.03	29.94	0.00
2	29.95	70	68.7	82	68	66.5	80	n.	1-0	1-9	30.05	29.91	0.00
3	29.98	74	67	81	68	68.5	82	sw.	1 0	5	30.04	29.93	0.00
4	29.99	74	67.5	80	66	68.7	67	ne	2-0	4	30.05	29.95	0.00
5	30.01	74	67	79	72	64.8	67	ne.	2	6	30.06	29.97	0.00
6	29.96	73	65.5	80	73	63.0	64	ne.	4	3	30.04	29 95	0.00
7	29.88	70	66	79	72	63 3	66	ne.	4-0	3	29.99	29.86	0.00
8	29.82	69	66	80	66	65.5	75	e-se.	1-0	1-3	29.90	29.80	0.09
9	29.81	64	63.3	74	66	65.7	88	w.	1-0	10-8	29.92	29.80	0 21
10	29.77	65	64	79	63	65.5	84	sw-n.	0	1-5	29.85	29.75	0.00
11	29.80	70	62	78	64	65.0	84	sw-w.	0-1	2	29.82	29.73	0.00
12	29.91	69	60	76	64	56.5	58	nw-n.	1-5	1	29.93	29.83	0.00
13	29.88	60	58	75	67	55.0	61	n	3-0	1-0	29.97	29.87	0.00
14	29.77	74	68	77	59	61.0	74	n-sw.	1-3	0-10	29.90	29.78	0.00
15	29.85	74	69	80	73	66.7	74	wsw.	3-4	5	29.87	29.76	0.00
16	29.86	75	69	80	72	67.5	75	wsw.	2	5	29.93	29.84	0.00
17	29.81	75	69	80	74	65.7	68	sw.	3	6	29 91	29.80	0.01
18	29.80	73	71	79	73	66.5	72	sw.	3-4	7-10	29.86	29.76	1.04
19	29.94	72	69.5	77	71	70.5	92	w-var.	0	10-8	29.94	29.80	0.22
20	30.05	67	65	79	68	68.0	84	se.	1-0	5-0	30.07	29.92	0.00
21	30.00	65	64	80	64	67.7	83	se.	1-0	0-5	30.09	29.98	0.00
22	29.86	69	66	79	64	66.7	85	sw.	1-0	1-7	30.03	29.86	0.04
23	29.80	65	64.7	70	67	64.5	91	w-n.	3-0	8-10	29.88	29.74	1.73
24	29.81	71	69	78	64	65.3	80	ne.	0-2	5-10	29.86	29.73	0.46
25	30.01	69	66.5	76	68	67.7	92	se-e.	3-0	10	30.06	29.78	5.76
26	30 00	68	67.3	78	64	65.5	81	nne.	1-0	10-8	30.11	29.96	0.01
27	29.97	69	68.3	79	67	67.0	85	ne	0-3	8-4	30.06	29.94	0.10
28	29.91	69	68.8	77	67	68.5	87	sw.	1	8-4	29.98	29.89	0.20
29	29.97	68	61	73	67	64.0	84	nw-n.	1-6	10-2	29.99	29.89	0.10
30	30.06	67	59	72	65	56.5	65	nne.	5-7	3	30.06	29.95	0.00
31	30.11	66	59	71	65	52.3	56	n.	3-2	3	30.13	30.04	0.01
Sums.	......	......	......	......	......	......	......	....	......	......	......	......	9.98
Means.	29.926	69.4	65.5	77.4	67.1	64.1	76.2	....	1.7	5.0	29.980	29.862	......
Departure.	—0.047	......	......	......	......	+1.1	+1.2	....	......	+0.6	......	......	+6.06

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:31 p. m., Greenwich time. ‡These values are the means of (6 + 9 + 2 + 9) ÷ 4. §Beaufort scale.

Mean temperature for December, 1901, 72.1°; normal is 71.5°. Mean pressure for December, 1901, 29.923; normal is 29.970.

GENERAL SUMMARY FOR NOVEMBER, 1901.

Temperature mean for the month, 73.9°; normal, 73.8°; average daily maximum, 78.9°; average daily minimum, 69.0°; average daily range, 9.9°; greatest daily range, 16°; least daily range, 3°; highest temperature, 82°; lowest, 63°.

Barometer average, 29.983; normal, 29.957 (corrected for gravity by —.06); highest, 30.18, on the 15th; lowest, 29.85, on the 27th; greatest 24-hour change, i. e., from any hour on one day to the same hour on the next, .09. Lows passed this point on the 7th and 27th; highs, on the 15th and 23d.

Relative humidity, 76.5 per cent; normal, 76.0; mean dew-point, 66.2; normal, 65.7; mean absolute moisture, 7.08 grains to the cubic foot; normal, 6.93.

Rainfall, 3.34 inches; normal, 5.52; rain record days, 18; normal, 17; greatest rainfall in one day, 0.80, on the 7th; total at Luakaha (Nuuanu near Pali) 14.76; at Kapiolani Park, 1.63. Total rainfall since January 1, 32.30; normal, 32.76.

Rainfall data.

Stations.	Elevation.	Nov., 1901.	Stations.	Elevation.	Nov., 1901.
HAWAII.			MAUI—*Continued.*	*Feet.*	*Inches.*
HILO, e. and ne.	*Feet.*	*Inches.*	Haleakala Ranch, n	2,000	10.56
Waiakea	50	36.09	Wailuku, ne	200	3.56
Hilo (town)	100	38.89	LANAI.		
Kaumana	1,250	44.69	Keomuku, e.	......	......
Pepeekeo	100	25.56	OAHU.		
Hakalau	200	29.16	Punahou (W. B.), sw.	47	3.34
Honohina	300	35.86	Kulaokahua, sw.	50	2.90
Laupahoehoe	500	28.30	Makiki Reservoir	120	3.98
Ookala	400	21.47	Kewalo (King street), sw.	15	2.99
HAMAKUA, ne			U. S. Naval Station, sw	6	1.95
Kukaiau	250	13 35	Kapiolani Park, sw.	10	1.63
Paauilo	750	17.67	Manoa (Woodlawn Dairy), c.	285	7.07
Paauhau (Mill)	300	10.39	School street (Bishop), sw.	50	4.42
Paauhau (Greig)	1,150	......	Pacific Heights, sw.	700	7.15
Honokaa (Muir)	425	10.15	Insane Asylum, sw.	30	3.51
Honokaa (Rickard)	1,900	......	Kalihi-uka	......	......
Kukuihaele	700	7.74	Kamehameha School	75	3.06
KOHALA, n.			Nuuanu (W. W. Hall), sw.	50	4.21
Awini Ranch	1,100	......	Nuuanu (Wyllie street), sw.	250	7.24
Niulii	200	8.41	Nuuanu (Elec. Station), sw.	405	6.33
Kohala (Mission)	521	6.90	Nuuanu (Luakaha) c.	850	14.76
Kohala (Sugar Co.)	235	......	Waimanalo, ne.	25	......
Hawi	300	......	Maunawili, ne	300	6.18
Hawi Mill	600	......	Kaneohe, ne	100	......
Waimea, c	2,720	2.95	Ahuimanu, ne.	350	......
KONA, w.			Kahuku, n	25	2.80
Kailua	950	6.72	Waialua, n	20	1.39
Holualoa	1,350	9.40	Wahiawa, c.	900	1.86
Kealakekua	1,580	6.99	Ewa Plantation, s.	60	0.72
Napoopoo	25	.59	Waipahu, s.	200	1.71
KAU, se.			Moanalua, sw.	15	2.72
Kahuku Ranch	1,680	......	KAUAI.		
Honuapo	15	10.43	Lihue (Grove Farm), e.	200	4.95
Naalehu	650	11.29	Lihue (Molokoa), e.	300	4.44
Hilea	310	10.10	Lihue (Kukaua), e.	1,000	8.66
Pahala	850	6.35	Kealia, e.	15	2.88
Moaula	1,700	12.58	Kilauea, ne.	325	6.01
PUNA, e.			Hanalei, n	10	14.15
Volcano House	4,000	17.72	Waiawa, sw	82	1.09
Olaa (Sugar Company)	221	31.47	Eleele, s.	200	3.42
Olaa (Mountain View)	1,690	45.86	Waiawa, Mountain, s.	2,100	21.35
Kapoho	110	14 80	McBryde (Residence)	850	9.78
Kalapana, se.	8	......	Lawai	450	0.03
MAUI.					
Lahaina	.....	......	*Delayed October reports.*		
Waiopae Ranch	700	5.49	Haleakala Ranch	......	0.65
Kaupo (Mokulau), s	285	18.48	Kipahulu	......	4.86
Kipahulu, s.	300	18.01	Waiopae Ranch	......	1.99
Kahikinui	1,550	......	Ewa Plantation	......	3.85
Hamoa Plantation, se	60	11.85	Paauilo	......	5.10
Nahiku (Anderson), ne.	60	13.59	Laupahoehoe	......	10.01
Nahiku, (Nishwitz), ne.	850	20.78	Napoopoo	......	0.57
Haiku, n	700	7.94	Nuuanu (Wyllie Street)	......	5.40
Kula (Erehwon), n	4,500	2.89	Kapoho	......	5.09
Kula (Waiakoa)	2,700	3.17	Hakalau	......	8.70
Puuomalei, n	1,400	......	Honohina	......	13.79
Paia, n	180	2.98			

The artesian well water has risen during the month from 33.12 to 33.56 feet above mean sea-level. On December 1, 1900 it stood at 33.62. The average daily mean sea level for November was 10.21 feet on the scale, 10.00 representing an assumed annual mean, and 9.82 the actual annual mean for nine years previous to 1901.

Trade wind days, 23 (5 of north-northeast), normal, 17; average force (during daylight) Beaufort scale, 2.6. Cloudiness, tenths of sky, 5.5; normal, 4.6.

Approximate percentages of district rainfall as compared with normal: Hilo, 300 per cent; Hamakua, 180; Kohala, 180; Waimea, 150; Kona, 125; Kau, 175; Puna, 170; Maui, east