tables with the proper mean temperature, viz, 53.8°, and mean dew-point, 47.5°, one gets for the humidity 79.8 per cent, which agrees with the published mean within less than one-half of one per cent.

The monthly means of the dew-point, relative humidity, and vapor pressure are given in the annual volumes as computed directly from the daily observations.—A. J. H.]

Annual record of observations for dew-point only during 1898, *by Curtis J. Lyons, at Honolulu,*

Lat. 21° 18′, long. 157° 50′; ground above sea, 43 ft; thermometer above ground, 9 ft.

Day of month.	January.				February.				March.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	60	62	67	64	62	66	66	66	58	54	56	57
2	66	66	61	63	66	70	67	70	55	59	*40	50
3	57	61	64	63	68	69	67	61	52	52	52	54
4	62	65	63	62	57	61	64	61	57	60	58	57
5	61	61	61	61	55	61	62	66	57	56	56	57
6	62	63	66	64	58	65	68	63	61	59	59	58
7	63	64	64	65	59	64	68	64	59	58	58	59
8	61	65	64	59	59	66	63	59	58	61	61	61
9	58	63	63	60	62	68	68	64	59	61	62	59
10	59	62	64	63	60	66	66	62	62	62	62	61
11	61	63	65	64	66	68	69	67	61	62	62	60
12	60	68	65	63	61	61	64	62	63	65	62	63
13	56	65	65	67	61	62	64	59	68	68	66	67
14	62	64	67	64	55	55	59	57	67	70	68	68
15	61	63	61	59	[57]	58	62	57	68	69	69	68
16	61	61	66	64	58	62	65	62	68	69	70	71
17	59	65	66	63	63	67	66	66	68	69	71	69
18	59	63	67	61	64	70	68	64	68	69	68	66
19	66	67	68	64	65	66	67	62	68	69	68	68
20	61	67	69	67	[64]	65	66	67	67	69	66	66
21	59	67	67	69	[67]	69	64	65	66	66	62	64
22	64	67	67	64	62	62	63	61	66	64	65	63
23	64	62	64	61	63	68	68	66	66	64	64	64
24	61	64	66	63	67	66	61	63	63	63	62	62
25	59	62	62	62	64	67	66	61	63	62	64	62
26	64	67	67	67	58	59	58	53	64	64	65	65
27	61	63	63	62	55	58	62	55	67	65	66	66
28	59	58	59	59	54	50	55	53	67	63	63	62
29	60	61	63	60	.....	.....	.....	.....	61	59	61	60
30	56	59	62	60	.....	.....	.....	.....	60	59	61	60
31	61	63	63	66	.....	.....	.....	.....	57	59	59	57
Means	60.7	63.6	64.5	63.0	61.0	63.9	64.1	62.0	62.7	62.9	62.1	61.7
Monthly m's	62.9				62.5				62.3			

Day of month.	April.				May.				June.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	58	57	57	59	66	66	64	62	63	63	62	65
2	59	56	59	59	63	63	64	65	65	65	64	64
3	58	59	59	60	66	66	65	64	66	63	63	66
4	59	56	58	60	63	62	64	64	63	63	63	63
5	59	59	58	60	64	63	62	65	62	63	61	63
6	57	57	58	59	66	67	62	62	64	64	66	64
7	58	58	62	62	64	62	65	63	65	64	68	68
8	59	59	60	61	61	60	59	61	69	69	69	66
9	62	62	61	62	65	63	64	62	66	67	66	65
10	62	61	62	61	61	62	60	63	66	68	65	65
11	62	62	63	62	63	63	61	62	63	62	62	64
12	65	63	63	64	65	63	62	61	64	63	64	63
13	63	62	62	62	61	61	60	60	64	66	65	66
14	63	63	63	61	61	61	60	60	65	65	62	63
15	63	63	64	62	65	67	61	63	67	68	65	67
16	62	60	61	63	63	62	64	64	64	64	65	64
17	63	64	62	63	63	65	65	65	64	66	67	68
18	60	62	61	62	63	62	64	66	66	66	64	64
19	62	61	61	60	62	63	64	64	67	68	66	66
20	61	63	59	62	62	63	64	64	64	62	64	66
21	65	63	62	61	62	62	63	62	65	66	64	67
22	64	64	64	65	62	62	62	62	67	70	73	71
23	65	64	65	65	61	61	61	64	69	70	68	66
24	66	66	65	64	65	64	63	64	66	68	64	68
25	65	65	61	64	68	66	63	68	66	67	67	66
26	64	63	62	64	66	65	66	66	70	68	68	66
27	66	64	63	64	64	65	64	65	65	65	65	63
28	63	67	64	66	66	64	64	63	63	61	64	63
29	66	65	67	66	67	66	64	65	66	62	62	65
30	66	66	65	64	66	66	66	65	64	66	65	67
31	.....	.....	.....	.....	64	65	65	65	.....	.....	.....	.....
Means	62.2	60.8	61.4	61.9	63.8	63.5	63.4	63.5	65.4	65.4	65.0	65.2
Monthly m'n	61.6				63.5				65.2			

*This extreme is correct. Bracketed figures are interpolated.

Annual record of observations for dew-point at Honolulu—Continued.

Day of month.	July.				August.				September.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	66	65	68	67	64	65	66	65	64	66	64	65
2	65	69	70	69	64	64	65	66	63	65	64	65
3	65	66	66	68	65	66	69	69	65	65	64	66
4	67	67	69	67	68	69	67	67	67	65	65	66
5	67	66	65	68	66	66	68	68	65	65	64	65
6	66	65	63	66	69	69	68	68	07	67	67	65
7	66	65	66	66	68	68	69	68	65	64	63	65
8	66	68	66	67	64	65	67	66	67	66	65	65
9	66	64	68	66	65	67	64	66	67	63	64	64
10	68	69	66	65	64	65	66	64	66	67	67	66
11	65	65	67	65	65	55	65	65	66	68	67	65
12	67	67	66	65	69	68	65	65	62	64	64	65
13	65	66	67	66	64	64	63	68	67	70	69	68
14	67	67	69	64	66	64	66	66	64	63	66	67
15	65	65	63	64	67	69	67	69	64	65	67	66
16	64	65	67	67	68	69	69	67	68	67	67	67
17	68	70	68	68	68	68	65	64	65	65	63	66
18	63	64	65	67	66	67	63	63	65	65	65	66
19	66	66	66	67	61	61	62	63	65	66	66	65
20	66	64	66	67	64	64	64	66	65	66	64	66
21	64	67	69	69	65	67	67	67	67	64	65	68
22	67	66	68	66	64	65	67	69	65	62	66	67
23	66	66	68	68	64	65	67	65	65	64	66	64
24	68	66	66	66	64	66	66	68	69	64	64	66
25	64	66	65	66	65	66	66	66	65	64	68	68
26	64	65	65	65	66	63	64	64	65	68	69	67
27	65	65	64	66	66	65	63	65	67	68	68	69
28	64	65	65	65	64	71	65	64	65	68	70	69
29	66	64	65	69	65	65	67	64	68	68	68	65
30	68	68	69	68	64	68	66	65	67	68	66	68
31	68	68	69	68	65	65	66	65	63	65	67	63
Means	65.9	66.1	66.6	66.5	65.4	66.1	65.9	66.0	65.5	65.5	65.6	65.9
Monthly m'n	66.3				65.8				65.6			

Day of month.	October.				November.				December.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	66	68	69	67	63	62	64	65	61	64	66	65
2	66	69	67	66	63	63	66	60	62	63	64	66
3	67	66	66	67	63	65	65	65	64	65	63	65
4	67	69	68	67	65	64	64	63	65	65	62	63
5	68	66	67	66	63	61	63	62	62	65	64	66
6	68	66	68	67	65	63	66	64	69	71	70	70
7	69	67	67	68	64	64	64	66	68	69	68	65
8	67	68	66	66	64	65	65	62	62	65	67	56
9	67	67	66	66	66	64	65	63	56	56	55	54
10	66	68	67	66	65	63	63	65	53	55	56	61
11	65	66	67	66	66	65	61	67	60	68	65	64
12	66	66	67	64	64	65	64	63	62	64	66	64
13	63	67	68	68	67	69	67	68	61	64	65	70
14	66	67	66	68	66	67	67	66	67	68	69	66
15	65	65	68	68	61	70	69	66	60	61	61	59
16	68	65	67	65	67	68	66	64	55	56	58	59
17	65	65	65	65	65	66	64	64	59	60	57	62
18	64	64	66	66	65	65	64	64	61	61	64	62
19	64	65	63	65	64	64	65	65	65	66	66	66
20	66	66	65	66	66	68	66	67	62	65	67	64
21	68	68	70	69	65	66	68	67	62	64	65	62
22	70	72	72	73	66	65	64	66	61	62	52	52
23	70	73	74	70	64	67	67	66	55	55	54	57
24	67	70	67	66	63	63	65	66	57	57	57	57
25	71	68	62	65	64	66	63	64	63	63	63	64
26	67	69	67	64	64	63	63	63	62	64	62	63
27	65	65	64	65	62	65	62	63	61	66	65	65
28	67	70	66	65	65	64	63	63	62	67	66	64
29	68	66	62	65	63	62	64	62	58	62	64	62
30	65	61	64	62	62	62	62	62	63	65	63	66
31	.....	.....	.....	.....	.....	.....	.....	.....	64	65	66	65
Means	66.5	67.0	66.7	66.3	64.6	65.0	64.6	64.4	61.3	63.3	62.9	62.6
Monthly m'n	66.7				64.7				62.5			

Mean dew-point for the year, 64.13° F.

THE WEATHER AND THE LIVE STOCK INDUSTRY.[1]

By F. H. BRANDENBURG, Local Forecast Official and Section Director.

Last year I had the pleasure of appearing before you and outlining a plan for promoting a closer relationship between the Weather Bureau of the Department of Agriculture and

[1] The above address was delivered January 18, 1900, at Fort Worth, Tex., at the annual convention of the National Live Stock Association.

the stockmen of the West. Acting on the suggestion offered, your secretary, Mr. Martin, obtained through the different local associations definite information as to the character of warnings desired in different parts of the vast region devoted to the live stock industry. The necessity for this action becomes apparent when we consider that weather conditions recognized as severe and destructive in southern latitudes would probably pass unnoticed a thousand miles farther north.

As promised a year ago, the Weather Bureau has been strengthened in the West, where the majority of our storms originate and gather energy while being held practically stationary by the mountains. When they finally reach the plains it is comparatively easy to foretell their course, since they commonly move rapidly eastward with the general circulation. The Weather Bureau officials stationed throughout the country are constantly upon the alert to detect the first signs of these disturbances, and, notwithstanding the difficulties which beset the forecasting of storms for points on the great plains, while the storm center is still under the influence exerted by the mountains, a high percentage of the forecasts of blizzards and kindred phenomena is verified, thus saving thousands upon thousands of dollars.

It is recognized that the ordinary cold wave, unaccompanied by high winds and snow, and lasting only a day or two, is of little concern to the stockman, even though a temperature 20° or 25° below the average be reached. This class of information is, however, of great importance to commercial interests. To give stockmen the fullest benefit of the information in possession of the Bureau, Professor Moore recently directed that when a prolonged spell of abnormally cold weather, high northerly winds with snow, heavy falls of snow, unseasonable or abnormally heavy rain is indicated for any section, notice thereof be given wide distribution. Messages of this character are known as emergency warnings, and are issued from the Central Office in Washington, D. C., and the station at Chicago, Ill.

During the spring of 1899 circular letters were sent to all postmasters in the West inquiring as to the interests in their respective localities, and asking their assistance in the dissemination of information. These letters naturally brought many offers of cooperation, and large additions have been made to the telegraph lists for the Western States. To give you an idea of how thoroughly such information is distributed, I would say that, exclusive of the hundreds of post offices receiving the daily forecasts by mail and cold-wave warnings by telegraph, messages relative to the approach of severe weather conditions are telegraphed to 30 points in Montana; 130 in North Dakota; 243 in Minnesota; 206 in Iowa; 133 in South Dakota; 8 in Wyoming; 80 in Colorado; 265 in Nebraska; 99 in Missouri; 238 in Kansas; 38 in Oklahoma; 5 in the Indian Territory; and 219 in Texas. These figures represent an increase of more than 30 per cent during the past year, and though the lists are large, it is doubtful whether all interested localities having telegraph facilities are included. In order that you may consult the lists, *copies have been posted convenient for your inspection*, and should you find that places important as regards live stock interests are not included, application should be made to the section director of your State, stating such facts as are pertinent thereto. I feel safe in saying that your request will receive prompt attention. For points in Montana, application should be made to the Weather Bureau official at Helena, and the other section centers are as follows: North Dakota, Bismarck; Minnesota, St. Paul; Iowa, Des Moines; South Dakota, Huron; Wyoming, Cheyenne; Colorado, Denver; Nebraska, Lincoln; Missouri, Columbia; Kansas, Topeka; Oklahoma and Indian Territory, Oklahoma; Texas, Galveston. West of the mountains the section centers are located at Boise, Idaho; Salt Lake City, Utah; Carson City, Nev.; Santa Fe, New Mex.; and Phenix, Ariz.

There is no industry, except agriculture, so materially affected by the weather conditions as that of live stock. It therefore appears to me that, in so far as it lies in his power, the stockman should avail himself of, and profit by the forecasts. Even though one may be provided with plenty of hay and shelter, notices of sharp changes are valuable to all branches of the industry, whether that of breeder or feeder. I realize that the success of your business depends upon grass, and plenty of it, as well as water, shelter, etc.—essentials that are often many miles from a town. This, however, is the age of the telegraph and telephone, facilities for the dissemination of information which twenty or thirty years ago were scarcely thought of in connection with your business. It rests with you gentlemen, to avail yourselves of the benefits to be derived from this information.

Another matter; there is probably no daily newspaper of importance that does not publish the weather forecasts, and, since the first editions are quickly despatched on fast trains, hundreds of small post offices are promptly reached. The press has been, and is invaluable in this particular. Many of the newspapers issued in cities where there is a regular station of the Weather Bureau publish meteorological tables showing the barometric pressure, temperature, rainfall, and state of weather at a great many points in the States lying between the British Possessions and the Gulf, or the Lakes in the East and the Pacific in the West. These reports can be utilized to advantage by the stockman, especially during the winter, if he will take the trouble to inform himself in regard thereto. This is easily done, since there is nothing mysterious about them any more than there is in connection with a list of sales reported from the stockyards at Kansas City, Mo., or Chicago, Ill.

The daily weather map is the means employed to show in full the conditions that prevail throughout the country at the time of the regular morning observation. With this publication one can keep himself informed as to the weather that is being experienced elsewhere. In brief, the map shows where the preceding twenty-four hours have been wet or dry, as well as the degree of heat or cold and all the other features of the weather about which an owner of live stock is sure to be concerned. It is our aim to furnish the map for display at all post offices that can be reached within a reasonable time after its issue.

It is fair to suppose that persons interested in live stock are more concerned about the character of the winters than they are about the character of any other season. All remember last winter only too well, and doubtless few care to see a repetition. A careful study of long records shows that a deficiency or excess of heat or moisture during a certain season or other period is eventually made good, but such compensating conditions generally take place so gradually as to be scarcely noticed. The character of the weather for a day, or month, or season, is controlled by the distribution of atmospheric pressure, or in other words, by the paths followed by the highs and lows shown on the weather map; since general and not local conditions exert the controlling influence, large areas are similarly affected. You have all at times noticed the persistency of stormy conditions, lasting perhaps for weeks; or a persistency of droughty conditions, which may continue for a month or two. When such conditions exist, it is found that there must be a marked and general change in the barometric pressure to effect a change of weather.

About fifteen years ago persons engaged in raising live stock on the public lands were exercised over the influx of settlers drawn westward by extensively circulated statements to the effect that the rainfall was increasing in the arid region, and that profitable agriculture was now possible without the aid

of irrigation. The records confirm the view held by live stock men at the time, which was that a successful prosecution of agriculture on the uplands would not be attained, except perhaps in a few localities where, by reason of the topography, the rainfall is ordinarily greater than on the plains. There is no reason to believe that the rainfall in recent years is any more or any less than it was before the disappearance of the buffalo from his great feeding ground. The stand of grass on the plains, however, might be taken by some persons as an indication of a diminishing instead of an increasing rainfall. We all know that during the past twenty years the ranges have been taxed to furnish sufficient pasturage, and, as a consequence of overstocking, the grass has been cropped too close. At present the arroyos carry off the bulk of the rainfall, but such would not be the case were the run-off checked by grass left from the preceding year. At the same time the old grass would reduce the rate of evaporation of such moisture as soaks into the ground. These facts, rather than any difference in the rainfall, are responsible for a poor stand of grass on so many of the ranges.

During recent years the stockmen of the far West have become more and more interested in farming operations, and such as do not themselves engage in the industry are only too glad to buy hay if it is to be had. The rainfall is very uncertain in the arid region, and the volume of water available for irrigation precludes any material extension of the agricultural districts. It is true storage reservoirs would improve the situation, but the expense of such undertakings would be too great for private enterprise. There is no doubt that the flow of our streams during summer and fall could be materially improved at a comparatively small cost. In the mountain districts there is a constant and generous flow under the ice in all the small streams during winter, no matter how cold the weather. To store this water for use during the following summer it is suggested that after suitable sheltered places have been selected the water be brought to the surface and allowed to spread over the ice. Even though only a small proportion of the flow be utilized, immense fields of ice could thus be formed, and if the site be protected from the west winds, the gradual melting would maintain a good flow throughout the season when water is generally scarce east of the mountains. It is believed that a concerted movement in this direction would prove profitable.

THE BAROGRAPH ON SHIPBOARD.

By JAMES PAGE.

On the pilot charts of the North Pacific and Atlantic oceans, respectively, for 1900, there is an excellent article by Mr. James Page, of the United States Hydrographic Office, explaining the use of the barograph at sea. The Richard self-registering aneroid barometer is now sold at a price equal to or less than the former prices for a thoroughly reliable simple aneroid itself; its mechanism is simple, it is handled more easily than the ordinary ship's barometer, and gives far less trouble in the matter of making and keeping records. We think it important to reproduce the diagram and the article by Mr. Page as an excellent illustration of the value of the instrument. Having used one ourselves for a long time on shipboard and having seen conservative old captains convinced of its value in the navigation of a vessel, we need only say that the experience of all justifies the statement that every sailing vessel and every steamer should have one of these self-registers in addition to its standard mercurial.

The accompanying diagram is a facsimile of a portion of the pressure curve drawn by the self-recording aneroid barometer on board the Alaska Commercial Company's S. S. *Portland*, Capt. C. E. Lindquist, during a voyage from San Francisco to St. Michael, Alaska, September 3-21, 1899. Owing to lack of space the diagram is limited to portions of the curve included between Monday, September 11, and Wednesday, September 13, the position of the vessel at each successive noon being given under the date at the top of the diagram. In the lower portion are entered for the indicated hours the direction and force of the wind and the character of the weather, the Beaufort system of notation being employed throughout. These entries are copied from the log of the vessel and are made after the sheet has been removed from the cylinder of the instrument.

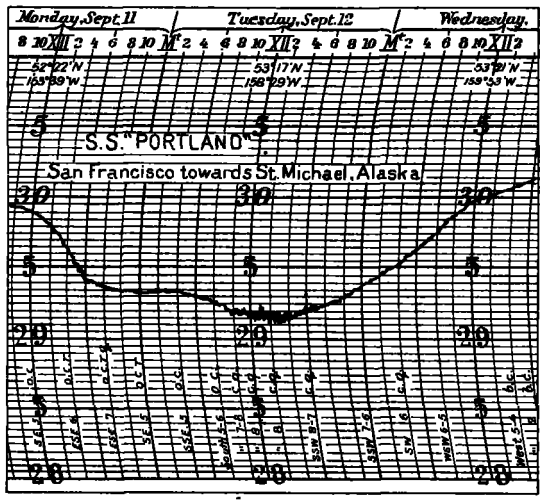

FIG. 1.

One of the most valuable results to be derived from the consideration of these barograms, as curves such as the present are called, is the evidence which they afford of the intimate relation existing between the state of the barometer and the direction and force of the wind. In the middle and higher latitudes of the North Pacific the direction of motion of the areas of low barometric pressure, which invariably accompany periods of stormy winds and foul weather, is in general eastward, the average path followed by the center of these areas being shown upon the Pilot Chart for the current month. Around the center of such an area, in accordance with the well-known principles of the law of storms, the winds circulate in a negative or anticlockwise direction. In advance of the center southerly and southeasterly winds will thus prevail, which will gradually shift to northwest as the center approaches and passes the observer's vessel, the shift taking place by way of north if the observer's position be to the north or left of the track, but through the south if it be to the south or right of the track. The barogram of the *Portland* and the accompanying wind and weather entries furnish an excellent example of the manner in which these shifts take place. At noon of Monday, September 11, in latitude 52° 22′ N., longitude 153° 39′ W., the *Portland* experienced a falling barometer and southeast winds of force 5, with overcast sky, all tending to show the existence of a center of low pressure to the westward. As the day advanced the barogram shows that the pressure diminished rapidly; that the weather became rainy and squally, and that the winds, while increasing in force, remained fairly constant in direction, conditions from which either one of two conclusions may be drawn, viz, either that the depression was for the time stationary but at the same time increasing rapidly in depth, or that the motion of the storm center was carrying it directly toward the position of the *Portland*. The reports of the storm received from other observers, however, confirm the second supposition. Thus the log of the U. S. revenue cutter *Thetis*, lying in Dutch Harbor, Unalaska Island (latitude 54° N., longitude 166° W.), shows that during the twenty-four hours intervening between 1 a. m. of September 11 and 1 a. m. of September 12 the barometer fell from 29.59 inches to 28.67 inches, the winds meanwhile backing from south-southeast, force 5, to east-northeast, force 10. At 6 a. m. of September 12, the barometer of the *Thetis* reached its lowest point, 28.55 inches, wind north, force 10, backing to northwest and west, showing that the center was steadily advancing, and also that the vessel lay to the north or on the left hand of the storm track.

At 8 p. m. the pressure, according to the *Portland's* self-registering aneroid, became almost stationary, and so continued, with winds of diminishing force, until 4 a. m. of the following day, at which time the decrease of pressure recommenced and continued until 3 p. m., when the minimum, 29.12 inches, was reached. From the hour at which this second fall set in the shifts of the increasing winds were steadily westward, passing through south about the time of lowest barometer, showing that the position of the *Portland* was to the southward or right of the line along which the center of the storm was traveling, just as the shifts observed by the *Thetis* showed that the latter vessel lay to the north or left of the track. Immediately after the minimum a