U. S. DEPARTMENT OF AGRICULTURE
WEATHER BUREAU AND
BUREAU OF CROP ESTIMATES

In Co-operation with the

IOWA WEATHER AND CROP SERVICE

Annual Report for 1920

CHARLES D. REED, M. Sc. Agr.

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THE STATE OF IOWA
Des Moines

LETTER OF TRANSMITTAL.

HON. N. E. KENDALL, *Governor.*

SIR: In compliance with the requirements of the law, I have the honor to submit herewith the thirty-first annual report of the Iowa Weather and Crop Service for the year 1920.

CHARLES D. REED, *Director.*

Des Moines, Iowa, January 20, 1921.

HISTORICAL.

The Iowa Weather and Crop Service was established by an Act passed by the Twenty-third General Assembly, and approved by the Governor April 25, 1890.

The object of the Service is to co-operate with the U. S. Weather Bureau in collecting crop statistics and meteorological data, and more widely disseminate the weather forecasts and storm and frost warnings for the producers and shippers of perishable products, and to promote general knowledge of meteorological science and the climatology of the State.

In accordance with the Act, on the recommendation of the directors of the State Agricultural Society, J. R. Sage was duly commissioned as director by Governor Boies on June 3, 1890, and General Greeley, then Chief Signal Officer, U. S. Army, detailed Dr. George M. Chappel to serve as assistant director of the State Service. Mr. J. R. Sage resigned as director December 31, 1907, and Dr. George M. Chappel was commissioned on January 1, 1908, as director, and served in that capacity until March 31, 1918, when he resigned and was succeeded by Charles D. Reed. Toward the close of the year, 1919, co-operation in estimating acreage and production of crops was begun with the U. S. Bureau of Crop Estimates of which Mr. Frank S. Pinney is Agricultural Statistician for Iowa.

OFFICE FORCE DECEMBER 31, 1920.

Charles D. Reed, M. Sc. Agr., Meteorologist and Director.
Reva G. Dutton, Stenographer and Clerk.

CO-OPERATING ORGANIZATIONS.

U. S. Weather Bureau.

Fred L. Disterdick, Meteorologist and First Assistant.
Arthur J. Haidle and Ethel D. Slaght, Assistants.
Harold A. Carnal, Apprentice.

U. S. Bureau of Crop Estimates.

Frank S. Pinney, Agricultural Statistician for Iowa.
Hilda Miller, Stenographer and Clerk.

ANNUAL REPORT, 1920.

For convenient reference and comparison with past and future years, this report contains the summaries of the weekly, monthly and annual bulletins of the Iowa Weather and Crop Service in co-operation with the U. S. Weather Bureau and the United States Bureau of Crop Estimates for the year 1920.

The regular meteorological, climatological and crop statistical work was maintained efficiently, though the general condition of unrest and post bellum adjustment among the people caused more than usual difficulty in maintaining the list of co-operative observers and crop reporters.

Publications were distributed as follows: Monthly Climatological Data, about 17,000 copies; Weekly Weather-Crop Bulletins, about 15,000; Daily Weather Forecast Cards, to 1,607 addresses; and five hundred copies of the monthly reports are distributed each month through the United States Department of Agriculture Weather Bureau to scientific institutions and libraries in this and foreign countries. In co-operation with the U. S. Bureau of Crop Estimates about 30,000 copies of special monthly crop bulletins were issued.

Daily weather forecasts were distributed by telegraph at the expense of the U. S. Weather Bureau to 73 towns. From these towns the forecasts are made available by free telephone to 39,042 rural subscribers, and 132,541 town subscribers. Much attention was given to accuracy and promptness in the transmission of forecasts by telegraph and telephone.

Frost warnings are sent when necessary during the fruit blooming season to all orchardists in the State prepared to use orchard heaters and who make application in advance for the service.

Increased transportation by automobile and motor truck has created a great demand for information as to the condition of roads. From April 1st to September 30th, daily rainfall reports are telegraphed at the expense of the U. S. Weather Bureau from 26 Iowa towns to the central station at Des Moines. Many local and long-distance calls are answered as to desirable detours to avoid wet areas. A special Highway Weather Service was maintained part of the year by the U. S. Weather Bureau Offices in Charles City,

Davenport, Dubuque, Des Moines and Sioux City. This proved very popular, but can not be conducted satisfactorily without more funds.

CLIMATOLOGY OF THE YEAR, 1920.

The mean temperature, 48.2°, is 0.8° above normal. February, March, June, September, October, November and December were above normal; the other months below. The highest temperature recorded was 102°, at Clarinda, on July 23. The lowest was —26°, at Elkader, on January 4, and at Inwood on December 24. The annual variation in temperature within the State was 128°. The total precipitation averaged 31.75 inches, or 0.22 inch below normal.

Spring work was very backward, particularly in the southern districts. Fruit blooms were beneficially retarded.

The mid-summer was cool and pleasant for human beings and animals and favorable for cool weather crops such as potatoes, but unfavorable for maturing corn. However, abnormally warm, dry weather September 10th-28th and through most of October matured the largest corn crop of record in Iowa, both in yield per acre, which was 46.0 bushels, and in total production which amounted to 473,800,000 bushels. It is unusual that a record breaking corn crop and a large potato crop are raised in the same year. In fact, all crops raised in the State were bountiful except spring wheat, which was nearly a failure.

Barometer (reduced to sea level). The average pressure of the atmosphere for the year was 30.03 inches. The highest pressure was 30.87 inches. at Sioux City, on January 24. The lowest pressure was 29.00 inches, at Dubuque, on December 13. The range for the State was 1.87 inches.

Temperature. The mean temperature for the State was 48.2° or 0.8° above normal. The highest annual mean was 52.3°, at Keokuk, Lee County. The lowest annual mean was 44.8° in Clayton County near Postville. The highest temperature reported was 102°, at Clarinda on July 23. The lowest temperature reported was -26° at Elkader, Clayton County, on January 4, and at Inwood, Lyon County on December 13. The range for the State was 128°.

Precipitation. The average amount of rainfall and melted snow for the year was 31.75 inches, or 0.22 inch less than the normal, and 5.01 inches less than the average for 1919. The greatest amount at any station was 44.00 inches, at Humboldt, Humboldt County, and the least amount was 20.95 inches, at Cedar Rapids, Linn County. The greatest monthly precipitation was 8.52 inches at Britt, Hancock County, in August. The least amount was a trace, at Denison, Crawford County, in January. The greatest amount in any 24 consecutive hours was 4.17 inches at Humboldt, on August 20. Measurable precipitation occurred on an average of 88 days, 4 days less than in 1919 and 3 days more than normal.

Snowfall. The average amount of snowfall was 21.7 inches. The greatest amount reported from any station was 49.3 inches at Northwood, North County, and the least amount was 6.5 inches at Murray, Clarke County. The greatest monthly snowfall was 19.3 inches at Northwood, North County, in December.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported was 72 miles an hour from the southwest Sioux City, Woodbury County, on June 8.

Sunshine and Cloudiness. The average number of clear days was 167; partly cloudy, 93; cloudy, 106; as against 169 clear; 94 partly cloudy, and cloudy days in 1919. The average percentage of the possible amount sunshine was 56 or about 5 per cent less than the normal.

MONTHLY SUMMARIES.

JANUARY.

For the State as a whole, the January temperature was below normal, though the deficiency was neither uniform nor general. Over a considerable area adjoining the Missouri River the temperature was above normal, and in the extreme southwest and extreme west-central portions the excess amounted to nearly 4 degrees. Eastward from this area the temperature gradually became colder and over the northeastern portion, along the Mississippi River, there was a deficiency of nearly 5 degrees. There were no protracted cold periods or very severe weather, neither was there any cold weather, except for short intervals. The usual January thaw was absent and as a result the snow cover remained during the entire month over about 75 per cent of the State, but at the close of the month bare ground was general over the southern tier of counties and along the Missouri River.

Stock were able to graze in corn fields during the greater portion of the month and favorable weather conditions permitted the usual farm work, but marketing of grain was hindered by a shortage of railroad cars.

Precipitation was deficient over the entire State, except a small area over the extreme north-central portion, and the average for the State, 0.42 inch, was with three exceptions the least for January in the past 31 years. Practically the entire amount fell in the form of snow or sleet but there was less drifting than usual and railroad traffic was hindered but little.

The snow cover was favorable for winter grain and it is thought that wheat and rye were uninjured at the end of the month except over a small area in the extreme southeastern portion. An unusually large crop of ice of fine quality was harvested.

Pressure. The mean pressure (reduced to sea level) for the State was 30.29 inches. The highest recorded was 30.87 inches, at Sioux City on the 24th, and the lowest was 29.61 inches at Des Moines on the 16th. The monthly range was 1.26 inches.

Temperature. The mean temperature for the State, as shown by the records of 99 stations, was 16.7°, or 1.2° lower than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 13.1°, or 1.5° lower than the normal; Central, 16.2°, or 2.0° lower than the normal; Southern 20.8°, or 0.1° lower than the normal. The highest monthly mean was 23.9°, at Glenwood and Thurman, and the lowest monthly mean was 10.0° at Charles City. The highest temperature reported was 58° at Thurman on the 29th, and the lowest was -26° at Elkader on the 4th. The temperature range for the State was 84°.

Humidity. The average relative humidity for the State at 7 a. m. was 86 per cent and at 7 p. m., 77 per cent. The mean for the month was 82 per cent, which is just normal. The highest mean was 88 per cent at Charles City, and the lowest, 72 per cent, at Keokuk.

Precipitation. The average precipitation for the State, as shown by the records of 106 stations, was 0.42 inch, or 0.63 inch less than normal. By divisions the averages were as follows: Northern, 0.46 inch, or 0.38 inch less than the normal; Central, 0.41 inch, or 0.70 inch less than the normal; Southern, 0.40 inch, or 0.79 inch less than the normal. The greatest amount, 1.05 inches, occurred at Northwood, and the least, a trace at Denison. The greatest amount in any 24 consecutive hours, 0.64 inch, occurred at Oskaloosa on the 24th.

Snow. The average snowfall for the State was 4.6 inches, or 2.3 inches below the normal. The greatest amount, 12.7 inches occurred at Forest City, and the least, a trace at Denison.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported from a regular Weather Bureau Station was at the rate of 56 miles per hour from the northwest, at Sioux City, on the 20th.

Sunshine and Cloudiness. The average percentage of the possible amount of sunshine was 47, or 3 per cent lower than the normal. The percentage of the possible amount at the several regular Weather Bureau Stations was as follows: Charles City, 40; Davenport, 54; Des Moines, 46; Dubuque, 55; Keokuk, 51; Sioux City, 35; Omaha, Neb., 49. Clear days average 12, partly cloudy 8, and cloudy 11.

Miscellaneous Phenomena. Fog, dense: 6th, 9th, 15th, 16th, 20th, 22d, 25th, and 31st. Glaze: 15th. Halos, lunar: 1st, 2d, 7th, 11th, 22d, 26th, 28th. Halos, solar: 8th, 22d, 26th, 28th. Sleet: 6th, 15th, 16th, 22d, 23d.

COMPARATIVE DATA FOR THE STATE—JANUARY

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 In. or more	Clear	Partly cloudy	Cloudy
1890	19.7	+1.8	61	−27	2.03	+0.98	3.46	0.35					
1891	26.0	+8.1	58	− 4	1.75	+0.70	3.89	0.61		4	13	7	11
1892	15.3	−2.6	76	−38	1.09	+0.04	3.13	0.10	6.9	5	16	9	6
1893	9.3	−8.6	54	−34	0.74	−0.31	3.30	0.13	6.9	6	11	9	11
1894	19.3	+1.4	69	−37	1.09	+0.04	2.24	0.31	6.0	5	14	9	8
1895	13.6	−4.3	68	−31	0.85	−0.20	2.65	0.09	8.7	4	15	7	9
1896	23.4	+5.5	68	−20	0.48	−0.57	2.10	T.	2.8	3	10	10	11
1897	17.2	−0.7	66	−30	2.01	+0.96	6.16	0.15	8.2	7	12	7	12
1898	23.4	+5.5	52	−11	1.60	+0.55	5.32	T.	12.6	5	15	6	10
1899	19.8	+1.9	68	−34	0.28	−0.77	1.15	T.	1.5	3	15	10	6
1900	25.6	+7.7	66	−20	0.53	−0.52	2.47	T.	2.3	3	16	7	8
1901	23.7	+5.8	60	−21	0.74	−0.31	2.34	0.04	6.2	4	14	9	8
1902	22.4	+4.5	63	−31	0.88	−0.17	2.83	0.19	9.4	4	17	8	6
1903	23.0	+5.1	60	−12	0.28	−0.77	1.46	T.	2.0	4	13	7	11
1904	14.0	−3.9	57	−32	1.18	+0.13	3.68	0.02	6.1	6	12	8	11
1905	11.2	−6.7	56	−30	0.91	−0.14	1.82	0.12	11.1	7	14	7	10
1906	24.6	+6.7	69	−19	1.52	+0.47	4.71	0.28	11.3	5	14	6	11
1907	18.8	+0.9	68	−22	1.52	+0.47	5.30	0.10	6.0	7	8	7	16
1908	24.9	+7.0	60	−18	0.44	−0.61	1.50	0.06	4.6	2	17	8	6
1909	21.2	+3.3	72	−25	1.66	+0.61	3.74	0.41	7.8	6	9	6	16
1910	18.1	+0.2	66	−35	1.57	+0.52	3.15	0.55	12.6	6	13	7	11
1911	20.2	+2.3	66	−25	0.97	−0.08	3.73	0.11	7.3	5	9	8	14
1912	4.2	−13.7	49	−47	0.53	−0.52	1.99	T.	5.5	5	14	7	10
1913	20.9	+3.0	62	−25	0.77	−0.28	2.05	0.04	7.2	5	14	9	8
1914	27.8	+9.9	64	−10	0.88	−0.17	2.34	0.27	5.1	5	11	8	12
1915	17.5	−0.4	59	−32	1.63	+0.58	3.15	0.10	7.3	8	13	8	10
1916	17.8	−0.1	63	−34	2.62	+1.57	6.07	0.85	7.2	10	12	6	13
1917	17.0	−0.9	60	−28	0.83	−0.22	2.07	0.17	7.2	4	17	8	6
1918	8.6	−9.3	53	−35	1.02	−0.03	2.79	0.26	11.2	7	13	8	10
1919	26.8	+8.9	64	−32	0.24	−0.81	0.86	T.	2.8	2	20	5	6
1920	16.7	−1.2	58	−26	0.42	−0.63	1.05	T.	4.6	4	12	8	11

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

FEBRUARY.

While the temperature averaged slightly above the normal during February there were no protracted warm spells and for the most part the month was uniformly cold. Zero weather was experienced throughout the State but over the southeastern portion zero, or below, was reached on but a single day. Another feature was the low maxima over the State. While the maximum for the State was 59° in the extreme southeastern portion, outside of a few southern counties, the maxima were well under 50°. The excess in temperature was pronounced in some of the southwestern counties and it gradually became less to the northeast until a deficiency was shown at a single station, Dubuque. An abnormal rise in temperature occurred on the 16th, from considerably below zero over most of the State in the morning, to well above 40° in the afternoon, making a range for the day more than 50° at a number of stations.

Precipitation was deficient, the average amount for the State being less than half the normal and the average for each division was practically the same. Only a few stations in each division reported a slight

excess. Most of the precipitation was in the form of snow or sleet. Glaze covered a large portion of the southern and central divisions on the 3d and 20th making travel on foot difficult and dangerous.

The month was free from severe storms, the snow that fell drifted less than usual, and at no time during the month was traffic impeded by snow blockades. The snow cover remained on the ground over most of the northern half of the State throughout the month, but over the southern half it began to disappear early in the month and corn husking and grazing were possible generally as the month advanced. During the most severe weather considerable areas were without snow cover in the southern division and wheat is thought to have suffered materially. The roads were better than usual for this season of the year.

Pressure. The mean pressure (reduced to sea level) for the State was 30.15 inches. The highest recorded was 30.74 inches, at Dubuque, on the 3d, and the lowest was 29.48, at Charles City and Dubuque, on the 17th. The monthly range was 1.26 inches.

Temperature. The mean temperature for the State, as shown by the records of 103 stations, was 24.0°, or 3.5° higher than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 20.8°, or 3.7° higher than the normal; Central, 23.7°, or 3.0° higher than the normal; Southern, 27.4°, or 3.8° higher than the normal. The highest monthly mean was 30.2°, at Clarinda, and the lowest monthly mean was 18.2°, at Postville. The highest temperature reported was 59°, at Keokuk on the 22d, the lowest was —22°, at Elkader, on the 16th. The temperature range for the State was 81°.

Humidity. The average relative humidity for the State at 7 a. m. was 85 per cent, and at 7 p. m. it was 76 per cent. The mean for the month was 81 per cent, or 1 per cent higher than the normal. The highest monthly mean was 88 per cent, at Charles City, and the least was 72 per cent, at Keokuk.

Precipitation. The average precipitation for the State, as shown by the records of 108 stations, was 0.56 inch, or 0.59 inch less than the normal. By divisions, the averages were as follows: Northern, 0.52 inch, or 0.39 inch less than the normal; Central, 0.57 inch, or 0.63 inch less than the normal; Southern, 0.58 inch, or 0.77 inch less than the normal. The greatest amount, 1.75 inches, occurred at Lacona, and the least, 0.04 inch, at Mason City. The greatest amount in any 24 consecutive hours, 0.75 inch, occurred at Earlham, on the 4th, and Little Sioux, on the 5th.

Snow. The average snowfall for the State was 4.1 inches, or 3.3 inches less than the normal. The greatest amount, 12.5 inches, occurred at West Bend, and the least, a trace, at Burlington, Corning, Lamoni and Mt. Pleasant.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported from a regular Weather Bureau Station was 42 miles an hour from the northwest at Sioux City on the 13th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 39, or about 17 per cent less than the normal. The per cent of the possible amount at the regular Weather Bureau stations was as follows: Charles City, 28; Davenport, 45; Des Moines, 43; Dubuque, 43; Keokuk, 48; Sioux City, 29; Omaha, Neb. 34.

Miscellaneous Phenomena. Fog: 1st, 2d, 3d, 6th, 7th, 8th, 13th, 20th, 21st, 22d. Halos, lunar: 11th, 12th, 27th. Halos, solar: 12th, 20th. Parhelia: 14th. Sleet: 3d, 4th, 5th, 8th, 9th, 17th, 20th, 21st, 22d. Zodiacal light: 16th, 18th.

COMPARATIVE DATA FOR THE STATE—FEBRUARY.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	26.0	+5.5	67	—24	0.83	—0.32	2.18	0.11	.....	.....	.....	.....	.....
1891	19.4	—1.1	70	—31	1.16	+0.01	2.41	0.55	.....	3	13	7	8
1892	28.1	+7.6	68	—20	1.20	+0.05	2.18	0.12	5.0	6	6	7	16
1893	16.4	—4.1	60	—28	1.39	+0.24	2.91	0.06	8.1	6	16	8	10
1894	19.7	—0.8	60	—19	0.89	—0.26	2.41	T.	8.4	3	16	8	4
1895	16.4	—4.1	73	—33	0.49	—0.66	1.34	0.02	3.3	4	13	9	6
1896	27.4	+6.9	78	—13	0.71	—0.44	2.40	0.04	5.4	4	12	9	8
1897	24.7	+4.2	61	—24	0.89	—0.26	1.81	0.22	8.0	5	6	10	12
1898	24.2	+3.7	62	—18	1.22	+0.06	3.65	0.10	7.8	5	10	9	9
1899	12.2	—8.3	75	—40	0.89	—0.26	4.32	0.12	7.1	5	11	10	7
1900	14.8	—5.7	60	—27	1.30	+0.15	4.57	0.18	9.9	6	10	8	10
1901	17.5	—3.0	49	—21	1.01	—0.14	3.00	0.12	9.7	4	15	7	6
1902	17.6	—2.9	62	—21	0.73	—0.42	2.39	0.02	2.6	4	13	8	7
1903	19.8	—0.7	56	—21	1.18	+0.03	3.25	0.30	7.9	4	13	7	8
1904	14.8	—5.7	70	—26	0.41	—0.74	1.99	T.	4.5	4	10	9	10
1905	12.8	—7.7	69	—41	1.57	+0.42	2.97	0.44	15.5	7	14	6	8
1906	23.6	+3.1	66	—32	1.29	+0.14	2.91	0.20	6.1	5	14	7	7
1907	25.0	+4.5	65	—31	0.71	—0.44	1.95	0.06	4.6	4	14	6	8
1908	24.3	+3.8	59	—16	1.60	+0.54	3.95	0.23	8.9	6	12	6	11
1909	26.2	+5.7	62	—26	1.54	+0.39	4.72	0.30	7.7	5	11	6	11
1910	17.8	—2.7	58	—21	0.46	—0.69	2.09	T.	4.0	3	14	8	6
1911	27.3	+6.8	71	—13	2.76	+1.61	5.46	0.50	7.0	6	12	6	10
1912	18.1	—2.4	57	—30	1.21	+0.06	3.25	0.04	11.2	5	10	9	10
1913	20.2	—0.3	70	—24	0.82	—0.33	2.39	0.07	7.3	4	14	7	7
1914	16.8	—3.7	59	—29	0.87	—0.28	1.99	0.32	9.2	6	10	9	9
1915	29.1	+8.6	62	— 8	2.93	+1.78	5.39	0.43	9.4	9	9	5	14
1916	19.0	—1.5	62	—32	0.55	—0.69	1.38	0.05	6.0	4	14	8	7
1917	15.2	—5.3	68	—37	0.36	—0.79	1.10	T.	3.5	3	14	8	6
1918	23.0	+2.5	70	—26	0.95	—0.20	2.10	0.09	6.0	5	14	7	7
1919	24.9	+4.4	65	—16	2.42	+1.27	4.12	1.32	9.9	8	11	5	12
1920	24.0	+3.5	59	—22	0.56	—0.59	1.75	0.04	4.1	5	9	6	14

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

THE WINTER OF 1919-20.

The mean temperature for the three winter months was 18.6°, which is 2.2° below the normal for the State, and 9.5° lower than the mean for 1918-1919, which is the warmest of the 30 winters of record. The highest temperature reported was 59° at Keokuk, Lee County, on February 22d. The lowest temperature reported was 36° below zero at Thurman, Fremont County, on December 10th.

The average monthly precipitation for the State was 0.51 inch, and the average total precipitation was 1.52 inches, or 1.90 inches less than the

winter normal, and the least amount recorded since State-wide records have been kept. The least amount recorded in any previous winter was 1.65 inches in the winter of 1898-1899. The precipitation was almost entirely in the form of snow and the greater portion of the State was continuously snow covered throughout the winter. The average total snowfall, unmelted, was 14.5 inches, or 6.0 inches less than the normal and 3.4 inches less than the average for the winter of 1918-1919.

The total number of days with .01 inch or more of precipitation was 13, or 5 less than the average for the winter of 1918-1919. The average number of clear days was 32, partly cloudy 21, cloudy 38, as compared with 40 clear, 18 partly cloudy, 32 cloudy days during the winter of 1918-1919.

MARCH.

March was warm, wet and windy. The month opened with the temperature above normal but this was followed by a cold spell that continued from the 4th to the 7th, inclusive, and during this period temperatures of zero, or lower, were recorded throughout the State. The rest of the month was warm but an occasional day with the temperature below normal. The ground thawed rapidly after the first week and by the end of the third week the frost was generally out of the ground.

For the state as a whole, this was the wettest March of record. Only a small area in the southwestern portion had a deficiency. The distribution both as to time and amount was uniform, and except a few points in the northwestern portion, the precipitation was mostly rain. The heavies amounts were recorded in the south-central portion.

The snow cover remained on the ground over the northern portion until about the middle of the second week and over a large portion of the northern section the ground was continuously snow covered since the last week in November. As a result of this heavy snow blanket some stations reported that there was no frost in the ground during the entire winter. The snow that occurred later in the month remained on the ground for only short periods.

Stormy weather was the outstanding feature, due to the passage of an unusual number of energetic general storm centers through, or near the boundaries of the State. The highest wind velocity and lowest barometer reading ever recorded in the State in March occurred at Sioux City, and the total wind movement was high for the entire State. Much damage resulted from the wind which in many cases blew in violent gusts. Many barns, wind mills, silos and telephone poles were blown down and in the cities many plate glass windows were broken. The greatest damage from the wind occurred in the northeast portion where the property loss was between $75,000 and $100,000. (See page 33).

Conditions were not favorable for farm work over most of the State, being too wet, but at the close of the month some progress had been made and considerable seeding of small grain had been accomplished. Roads were muddy and in poor condition the greater portion of the month.

Pressure. The mean pressure (reduced to sea level) for the State was 29.87 inches. The highest recorded was 30.60 inches, at Sioux City and Omaha, Neb., on the 6th; and the lowest was 28.85 inches, the lowest of record for the State for March, at Sioux City, on the 15th. The monthly range was 1.75 inches.

Temperature. The mean temperature for the State, as shown by the records of 100 stations, was 38.0°, 4.7° higher than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 34.5°, or 4.0° higher than the normal; Central, 38.6°, or 5.0° higher than the normal; Southern, 41.0°, or 5.1° higher than the normal. The highest monthly mean was 42.8°, at Clarinda, and the lowest monthly mean was 32.0°, at Northwood and Rock Rapids. The highest temperature reported was 80°, at Little Sioux and Onawa, on the 31st. The lowest temperature reported was —21°, at Inwood on the 5th. The temperature range for the State was 101°.

Humidity. The average relative humidity for the State at 7 a. m. was 79 per cent, and at 7 p. m. it was 65 per cent. The mean for the month was 72 per cent, or about 2 per cent lower than the normal. The highest monthly mean was 80 per cent, at Charles City, and the lowest was 64 per cent, at Keokuk.

Precipitation. The average precipitation for the State, as shown by the records of 104 stations, was 3.02 inches, or 1.25 inches more than the normal. By divisions the averages were as follows: Northern, 2.81 inches, or 1.28 inches more than the normal; Central, 2.79 inches, or 0.92 inch more than the normal; Southern, 3.46 inches, or 1.54 inches more than the normal. The greatest amount, 5.70 inches, occurred at Albia, and the least, 0.47 inch, at Omaha, Neb. The greatest amount in any 24 consecutive hours, 2.50 inches, occurred at Keosauqua, on the 24th-25th and at Lamoni on the 25th.

Snow. The average snowfall for the State was 2.4 inches, or 2.9 inches less than the normal. The greatest amount, 16.2 inches, occurred at Rock Rapids. Four stations reported no snow, and 24 stations reported only a trace.

Wind. The prevailing direction of the wind was from the southwest. The highest velocity reported from a regular Weather Bureau Station was at the rate of 65 miles per hour from the west, the highest of record for the month of March, at Sioux City, on the 16th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 60, or about 2 per cent higher than the normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 53; Davenport, 60; Des Moines, 64; Dubuque, 65; Keokuk, 59; Sioux City, 59; Omaha, Neb., 61.

Miscellaneous Phenomena. Aurora: 4th, 5th, 22d, 23d. (See page 33.) Birds: (migration of) Bedford, blue birds on the 10th; Boone, robins and blue birds on the 12th, ducks flying north on the 19th; Corydon, robins on the 19th; Earlham, robins on the 1st, blue birds on the 11th, wild geese, ducks and black birds on the 13th, meadow larks on the 20th; Elkader, robins on the 15th; Jefferson, robins on the 8th; Milford, robins and

meadow larks on the 18th, blue birds and red wing black birds 22d; Nora Springs, robins on the 22d; Oskaloosa, robins and blue birds on the 14th and 15th; Pocahontas, robins on the 9th; Postville, robins on the 14th; Rock Rapids, robins on the 13th; Whitten, robins on the 2d. Dust: (red) 15th, 18th. (See page 33.) Fog: 1st, 10th, 11th, 21st, 25th. Hail: 3d, 14th, 18th, 23d, 24th, 28th, 31st. Halos, lunar: 5th, 18th, 28th, 29th. Halos, solar: 4th, 5th, 6th, 7th, 8th, 10th, 13th, 14th, 17th, 19th, 21st, 25th, 28th. Thunderstorms: 11th, 14th, 17th, 18th, 23d, 24th, 25th, 27th, 28th, 29th, 31st. Sleet: 3d, 4th, 6th, 11th, 12th, 18th, 19th, 23d. Winds: (high) 2d, 4th, 12th, 14th, 15th, 16th, 17th, 18th, 22d, 23d, 25th, 27th, 28th, 29th, 31st.

Rivers. The interior rivers were frozen until toward the middle of the month a general break up occurring from the 12th to the 16th. Moderately high stages prevailed after the breakup but the flood stage was not reached except on the Des Moines below Tracy to some distance below Ottumwa, due to the formation of ice gorges. Heavy rains in the lower Des Moines watershed on March 24-25 caused flood stages from below Tracy to the mouth. At Ottumwa a crest stage of 12.3 feet, 2.3 feet above flood stage, occurred on the 26th. The Mississippi River was frozen until a break started on the 11th and by the 19th the ice had almost disappeared. During the first part the stages of this river were moderate but after the break occurred rising stages prevailed and by the end of the month the worst flood of record, so early in the season was approaching. Nearly stationary, but moderate stages prevailed on the Missouri the first of the month but during the last half there were rapid fluctuations with high stages for the season.

COMPARATIVE DATA FOR THE STATE—MARCH.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	28.0	−5.2	75	−24	1.57	−0.20	3.67	0.32	------	------	------	------	------
1891	26.8	−6.5	66	−19	2.60	+0.83	4.58	1.33	------	10	6	8	17
1892	31.9	−1.4	84	− 6	2.22	+0.45	4.58	0.57	3.9	6	11	8	12
1893	31.8	−1.5	84	− 8	2.14	+0.37	4.40	0.64	4.0	8	9	11	11
1894	41.0	+7.7	84	− 5	2.03	+0.26	4.52	0.26	2.7	6	13	10	8
1895	34.4	+1.1	94	−11	0.83	−0.94	2.60	0.22	2.9	4	16	8	7
1896	30.9	−2.4	81	−12	1.10	−0.67	3.99	0.16	5.4	5	12	9	10
1897	32.0	−1.3	72	−22	2.39	+0.62	6.16	0.29	5.5	8	9	8	14
1898	37.5	+4.2	72	− 2	1.94	+0.17	6.21	0.33	3.7	6	12	9	10
1899	23.0	−10.3	75	−16	1.62	−0.15	5.90	0.37	8.0	6	7	12	12
1900	30.7	−2.6	81	−13	2.06	+0.29	5.15	0.45	6.6	5	12	9	10
1901	34.2	+0.9	76	− 8	2.64	+0.87	5.25	0.70	12.6	7	10	8	13
1902	39.1	+5.8	79	−12	1.45	−0.32	4.33	0.13	1.3	7	9	11	11
1903	38.8	+5.5	82	6	1.38	−0.39	3.90	0.15	3.9	7	11	7	13
1904	34.8	+1.5	78	3	2.18	+0.41	4.57	0.50	4.4	7	8	8	15
1905	41.5	+8.2	84	1	2.04	+0.27	3.70	0.89	4.1	7	8	8	15
1906	27.1	−6.2	65	−14	2.34	+0.57	4.55	0.58	8.9	10	8	7	16
1907	40.6	+7.3	92	− 7	1.35	−0.42	5.05	0.32	4.1	6	14	7	10
1908	37.9	+4.6	85	− 8	1.58	−0.19	3.74	0.45	1.1	6	13	7	11
1909	32.5	−0.8	71	−15	1.53	−0.24	5.00	0.28	9.8	6	12	10	9
1910	48.9	+15.6	92	−10	0.17	−1.60	1.37	0.00	T.	1	22	6	2
1911	39.4	+6.1	83	2	0.93	−0.84	4.84	T.	1.9	5	16	9	6
1912	24.9	−8.4	70	−19	2.01	+0.24	5.25	0.60	19.1	7	15	6	10
1913	31.9	−1.4	78	−23	2.48	+0.71	5.88	0.74	5.3	9	11	10	10
1914	34.7	+1.4	78	− 5	1.69	−0.08	3.84	0.28	1.8	7	12	8	11
1915	39.3	+4.0	61	− 5	0.96	−0.81	2.12	0.17	8.8	5	8	9	14
1916	35.2	+1.9	80	−18	1.57	−0.20	5.80	0.23	2.9	6	11	9	11
1917	34.6	+1.3	85	−12	1.84	+0.07	4.35	0.57	6.2	6	14	8	9
1918	42.9	+9.6	85	0	0.63	−1.14	2.12	0.03	2.6	3	19	7	5
1919	37.5	+4.2	78	−11	2.33	+0.56	5.40	0.81	1.1	6	15	8	8
1920	38.0	+4.7	80	−21	3.02	+1.25	5.70	0.47	2.4	7	15	7	9

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

APRIL.

The month was cold and wet. Since 1890 there has been but one colder April and only four have had greater precipitation. The maximum temperature, 78° is the lowest record and the minimum, 1°, is within 1° of the record for April. Killing frosts or freezing temperatures occurred on a large number of days over most of the State and on the 28th freezing temperatures were general but owing to the backward season there was practically no damage from frost. At points in the southern portion of the State the lowest April temperature ever recorded occurred on the 5th.

Precipitation was much above normal over the entire State except a few small areas. An unusual feature was a heavy fall of snow on the 3d and 4th, over most of the southern third of the State. The snow drifted badly and it was the worst storm of the winter in that part of the State. Trains were much delayed. Sleet occurred on a large number of days but the storm that occurred on the 11th was the most damaging. Telephone companies were the chief sufferers and the storm appeared to be

the worst westward from Adair County to the Missouri River. Between Atlantic and Adair 215 telephone poles were reported down.

On the 19th between 3 and 4 p. m. an unusual downpour of rain in the vicinity of Leighton about 10 miles northwest of Oskaloosa raised the Skunk River 4.5 feet in 24 hours washed out 300 feet of the C. R. I. & P. R. R. track northwest of Evans station, washed fields clean of recently plowed soil and eroded deep ditches where none had been before. The rain did not fall in ordinary drops but more like the discharge from a hose. Thunder and lightning were absent. Darkness at Oskaloosa was such from 3 to 3:15 p. m. that persons distant 100 feet could not be recognized and artificial lights were used in stores and on automobiles. The darkness was not like that of an ordinary storm cloud but more like the advance of evening. Soon after 3:15 p. m. the clouds lifted from the northwest and in 10 minutes daylight was normal. The rainfall at Oskaloosa was light. Hail fell at Leighton.

The month was unfavorable from an agricultural standpoint, being too cold for plant growth and too wet for plowing and seeding. The rain was especially heavy on the 18th and 19th, and amounted to considerably more than an inch over most of the State. During the rest of the month fields were very muddy and farm work was practically at a standstill. The oat acreage was greatly reduced on account of the protracted unfavorable conditions at seeding time and this was particularly the case in the southern portion of the State. No corn had been planted at the close of the month. The cold weather beneficially retarded fruit buds which at the close of the month had barely begun to swell and no foliage had appeared.

Unusual, complex optical phenomena were observed at Miller's Bay, West Okoboji Lake on April 8.

Pressure. The mean pressure, (reduced to sea level), for the State was 29.85 inches. The highest recorded was 30.28 inches, at Dubuque on the 24th, and the lowest was 29.17 inches at Davenport and Dubuque on the 1st. The monthly range was 1.11 inches.

Temperature. The mean temperature for the State, as shown by the records of 103 stations, was 42.4°, or 6.3° lower than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 40.3°, or 6.4° lower than the normal; Central, 42.8°, or 6.1° lower than the normal; Southern, 44.1°, or 6.5° lower than the normal. The highest monthly mean was 46.8° at Centerville, and the lowest was 37.4°, at Estherville. The highest temperature reported was 78°, at Afton, Clinton, Keokuk and Olin, on the 21st, and the lowest was 2° at Bedford and Thurman on the 5th. The temperature range for the state was 76°.

Humidity. The average relative humidity for the State at 7 a. m. was 80 per cent, and at 7 p. m. it was 61 per cent. The mean for the month was 70 per cent, or 4 per cent above the normal. The highest monthly mean was 74 per cent at Sioux City, and the lowest was 66 per cent, at Dubuque.

Precipitation. The average precipitation for the State, as shown by the records of 107 stations, was 4.59 inches, or 1.73 inches more than normal. By divisions the averages were as follows: Northern, 4.26 inches, or 1.58 inches more than the normal; Central, 4.49 inches, or 1.63 inches more than the normal; Southern, 5.02 inches, or 1.97 inches more than the normal. The greatest amount, 7.23 inches, occurred at Oakland, and the least, 1.93 inches, occurred at Forest City. The greatest amount in any 24 consecutive hours, 3.34 inches, occurred at Pella, on the 19th.

Snow. The average snowfall for the State was 2.0 inches, or 0.2 inch more than the normal. The averages by divisions were: Northern, 0.9 inch; Central, 0.6 inch; Southern, 4.6 inches. The greatest amount, 12.00 inches, occurred at Bloomfield.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported from a regular Weather Bureau Station was at the rate of 44 miles an hour from the north at Sioux City on the 1st.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 45, or about 15 per cent below normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 36; Davenport, 44; Des Moines, 47; Dubuque, 57; Keokuk, 47; Sioux City, 43; Omaha, Neb., 45. Clear days averaged 8; partly cloudy, 9; cloudy, 13.

Miscellaneous Phenomena. Aurora: 14th. Birds, migration of: Earlham, mockingbirds and wrens, 28th. Fog: 20th. Hail, 1st, 4th, 11th, 14th, 15th, 17th, 18th, 20th, 21st, 28th. Halo, lunar or solar: 4th, 6th, 8th, 9th, 15th, 24th, 29th. Sleet: 1st, 2d, 3d, 11th, 17th, 19th, 20th, 21st, 26th, 29th, 30th. Thunderstorms, 1st, 10th, 11th, 12th, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 22d, 26th, 29th, 30th. Tornado: 1st.

COMPARATIVE DATA FOR THE STATE—APRIL.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	51.8	+3.1	88	2	1.89	—1.06	4.46	0.38	.....	6	14	9	7
1891	50.6	+1.9	93	13	2.15	—0.71	5.06	0.59	.....	8	14	7	9
1892	45.4	—3.3	88	14	4.75	+1.89	8.38	2.43	5.7	9	8	9	13
1893	45.5	—3.2	96	15	4.21	+1.35	8.51	1.24	6.0	10	8	9	13
1894	51.7	+3.0	93	12	3.07	+0.21	6.91	0.55	0.2	9	11	11	8
1895	54.2	+5.5	98	8	2.62	—0.24	5.88	0.28	2.1	5	14	8	8
1896	54.5	+5.8	94	10	5.02	+2.16	9.67	2.35	4.5	11	11	10	9
1897	47.9	—0.8	89	19	5.35	+2.49	9.86	2.22	T.	11	9	9	12
1898	48.1	—0.6	91	14	2.56	—0.30	4.82	0.27	T.	8	13	9	8
1899	48.9	+0.2	89	1	2.40	—0.46	5.76	0.56	2.0	7	12	11	7
1900	52.2	+3.5	89	19	2.67	—0.19	6.62	0.43	0.9	6	12	9	9
1901	49.9	+1.2	92	15	1.79	—1.07	3.47	0.66	2.0	5	14	8	8
1902	48.2	—0.5	96	9	1.71	—1.15	4.15	0.40	T.	5	14	11	5
1903	49.8	+1.1	86	17	2.98	+0.12	6.00	0.74	0.8	9	11	9	10
1904	44.1	—4.6	86	13	3.63	+0.77	8.97	1.52	1.4	7	15	6	9
1905	47.5	—1.2	90	10	3.63	+0.17	5.49	0.53	1.2	8	12	8	10
1906	52.5	+3.8	94	22	2.42	—0.44	5.55	0.53	0.5	8	14	9	7
1907	41.5	—7.2	80	10	1.32	—1.54	3.22	0.24	2.7	6	12	8	10
1908	50.5	+1.8	91	8	2.24	—0.62	4.59	0.67	0.3	8	14	8	8
1909	43.8	—4.9	86	14	4.58	+1.72	9.43	0.83	3.1	12	9	9	12
1910	52.5	+3.8	99	15	1.48	—1.38	4.86	0.10	3.0	7	14	7	9
1911	46.7	—2.0	86	3	3.09	+0.23	6.04	1.33	3.6	9	11	8	11
1912	49.9	+1.2	84	20	2.66	—0.20	5.66	0.78	1.1	8	13	8	9
1913	50.2	+1.5	88	16	3.28	+0.42	7.43	1.12	2.7	9	15	5	10
1914	48.6	—0.1	88	11	2.52	—0.34	5.03	0.37	0.3	8	10	8	12
1915	57.2	+8.5	95	18	1.41	—1.45	4.02	0.05	T.	7	15	10	5
1916	47.1	—1.6	90	11	2.02	—0.24	5.92	1.13	1.1	10	10	9	11
1917	45.5	—3.2	88	17	4.55	+1.69	7.84	2.05	3.8	11	9	7	14
1918	44.8	—3.9	79	12	2.32	—0.54	4.20	1.01	3.5	9	12	8	10
1919	48.4	—0.3	81	20	4.78	+1.92	9.00	1.94	0.7	14	8	8	14
1920	42.4	—6.3	78	22	4.59	+1.73	7.13	1.93	2.0	12	8	9	13

T. indicates an amount too small to measure, or less than .005 inch rainfall and less than .05 inch snowfall.

Rivers—The interior rivers did not reach flood stage, except the Des Moines from Ottumwa to the Mississippi. Very little damage resulted. The Missouri was high for the season during much of the month but the flood stage was not reached except for a very brief period on the 5th and 6th from Omaha southward. On the Mississippi one of the worst floods of record occurred. The following are the flood stages at stations on the Mississippi River and the stage reached during the April flood: Lansing flood stage 18.0 feet, highest stage reached 17.2 feet; Dubuque, flood stage 18.0 feet, highest stage reached 21.0 feet; Clinton, flood stage 16.0 feet, highest stage reached 19.0 feet; Le Claire, flood stage 10.0 feet, highest stage reached 13.4 feet; Davenport, flood stage 15.0 feet, highest stage reached 17.1 feet; Muscatine, flood stage 16.0 feet, highest stage reached 17.7 feet; Keokuk, flood stage 14.0 feet, highest stage reached 16.8 feet. The damage was reduced to a minimum by timely warnings. At Keokuk the damage was negligible, being principally inconvenience to railroads. A broken levee that protected Muscatine Island caused the inundation of about 23,000 acres of truck land. A complete report of the flood at Dubuque, where it was especially severe, is published below.

FLOOD OF MARCH-APRIL, 1920, DUBUQUE, IOWA DISTRICT.

By James H. Spencer, Meteorologist.

Weather Bureau Office, Dubuque, Iowa, May 25, 1920.

This Mississippi River flood was the worst in this district since 1888, and has been exceeded in the last 50 years only by the floods of June, 1880, and May, 1888. It was the earliest spring flood of such magnitude of which there is any record in this section. For rapidity of rise, it is comparable, only with the flood of June, 1880. The total rise in each of these two floods continued over a period of more than two weeks, and was between 13 and 14 feet, but slightly greater in 1920.

In the flood of June, 1880, the period of maximum rise was 6.0 feet in three days during the first half of the 15-day period, while in the flood of 1920 the period of maximum rise was also 6.0 feet in three days, but occurred during the last half of the 15-day period. There is no previous record of such a rise as occurred in 1920 during the week immediately preceding the peak of the flood.

Most of the flood waters came from the headquarters of the Mississippi. The Wisconsin River was above flood stage during the same period, a maximum stage of 15 feet being recorded at Portage on March 31. This flood added about 1.5 feet to the peak of the Mississippi River flood between Dubuque and Pr. du Chien. Heavy and general rains on April 1 also added 0.5 or 0.6 feet to the peak between Pr. du Chien and La Crosse. With these exceptions the flood waters came wholly from the region north of La Crosse.

The following table shows the progress of the flood in the Dubuque river district:

	Lansing,	Pr. du Chien,	Dubuque,	Portage
March 22	8.0	7.2	7.1	10.0
" 23	8.3	7.4	7.4	9.8
" 24	8.9	7.9	8.2	9.5
" 25	9.4	8.5	8.7	9.8
" 26	9.7	9.3	9.8	10.2
" 27	10.2	9.8	10.5	11.1
" 28	10.7	10.2	11.0	12.6
" 29	11.3	10.8	11.4	14.0
" 30	12.5	11.9	11.8	14.8
" 31	13.9	13.2	12.4	14.9
April 1	15.1	15.4	13.5	14.7
" 2	16.2	17.2	15.8	14.5
" 3	16.9	18.7	18.0	14.2
" 4	17.2	19.6	19.5	13.7
" 5	17.2	19.6	20.5	13.0
" 6	16.9	19.1	20.9	12.4
" 7	16.5	18.7	21.0	12.1
" 8	....	18.0	20.7	11.6

Flood stage at Lansing, Pr. du Chien, and Dubuque is 18.0 feet, and at Portage 14.0 feet.

In two particulars the floods of June, 1880, and March-April, 1920, were not comparable. The cause in 1880 was exceedingly heavy rains early in

June over the headwaters of both the Mississippi and Wisconsin rivers. The cause in 1920 is probably indicated by the following paragraph from the National Snow and Ice Bulletin, Minnesota report, March 23, 1920: "Latter part of week abnormally warm and snow disappearing rapidly." Warm weather, the disappearance of snow in northern Minnesota, and the appearance of the flood at St. Paul were almost simultaneous. From Pr. du Chien to La Crosse the flood peak in 1880 was much higher than in 1920, but at Dubuque it was only 0.7 of a foot higher. The following table illustrates the difference:

	La Crosse,	Lansing,	Pr. du Chien,	Dubuque
Peak, June, 1880.....	16.2	....	21.5	21.7
Peak, Mar.-Apr., 1920.....	14.2	17.2	19.6	21.0
Difference.....	2.0	....	1.9	0.7

WARNINGS—On Monday, March 29, nine days before the peak of the flood reached Dubuque, flood warnings were issued for the entire district from the vicinity of Dubuque, to immediately below La Crosse. On this date stage of water was 11.5 feet at Dubuque, 10.8 feet at Pr. du Chien, and 11.3 feet at Lansing. Warnings were generally heeded, and movable property, such as cord wood in large quantities, live stock, farm machinery, etc., was removed from the islands and lowlands of the Mississippi throughout the section.

Later in the week when it became certain that a flood of great magnitude was approaching whatever could be done to prevent damage was done. Upon advice from this office some of the factories raised machinery to higher levels and a number of firms within the wholesale district of Dubuque removed their stocks from cellars and basements.

This office was able to render valuable service over more than a 10-day period. Information was given daily over the telephone to several hundred people. On Sunday, April 4, the office was open from 6 a. m. until 10 p. m. and the telephone was in use every moment of the time. We were able to advise many families not to move and many business houses not to move stocks or machinery after ascertaining how many inches more of a rise they could stand. On this date a northeasterly gale added to the difficulties of the railroads on the west bank of the Mississippi. After that date winds were generally more favorable.

THE FLOOD AROUND DUBUQUE—The Seippel Lumber Company's plant at the extreme south end of the city, was badly flooded and lumber was saved only with difficulty. The Standard Oil plant in the same section also suffered some damage. The Jackson Vinegar Company, Schroeder-Kleine Company, Western Grocery Company, Ernsdorf Iron Company, International Harvester Company, Becker-Hazelton Company, and other firms in the lower end of town experienced flooded basements, necessitating the removal of stocks of merchandise.

For over a week the railroads fought the flood, and scores of carloads of material were used in building temporary dikes to keep the water from undermining the tracks. The same was true of the ice companies along the river bank, whose ice houses were threatened. While serious delays resulted, railroad traffic was not completely suspended, as trains ran through the water or detoured.

Water covered the tracks in front of the Illinois Central R. R. depot, and below the depot employees performed their duties in water half way to their knees or higher. The Mulgrew Ice and Coal plant east of the Illinois Central R. R. depot was deep in water and could not be used for about 10 days. Water covered half of Jones street as far west as the railroad tracks, and the buildings at the foot of Jones street were completely surrounded. The pressure from below forced up the concrete cellar floor of the Iowa Oil Company's building. The road on the south side of the harbor was a foot under water, and on the north side of the harbor all buildings of the Dubuque Boat & Boiler works were flooded above the first floor, necessitating the raising of machinery. The road immediately south and east of the C., M. & St. P. R. R. depot was flooded.

East of Washington street for practically the entire length sewers backed up and flooded the basements of scores of homes. The packing house region near the foot of 17th street was flooded, and partial suspension of business resulted. Water covered streets around the Metz Manufacturing Company's plant, but did not run over the curb. At Eagle Point the Pumping Station, the yards of the Dubuque Lumber Company, and the Bathing Beach Buildings were badly flooded. The water was several inches above the floor of Bathing Beach buildings. The road beyond the Eagle Point High Bridge was closed during the period of the flood, and a large amount of work had to be done to save it.

STATISTICS OF MONEY LOSS BY FLOOD OF MISSISSIPPI RIVER,

DUBUQUE RIVER DISTRICT, APRIL, 1920.

Tangible property that can only be restored by the outlay of cash, either to clean it up and to put in serviceable condition, or to restore the property where the loss was total. This item includes loss to buildings, factories, highways, bridges, etc. Total about	$ 70,000.00
Loss to railroads, chiefly expenditures in saving track or other property, about	18,000.00
Loss of crops that were housed, about	1,000.00
Loss of prospective crops, chiefly strawberries, about	500.00
Loss of live stock and other movable property, about	5,000.00
Loss due to suspension of business, including wages of employees, about	5,500.00
Total loss, approximately	$100,000.00
Money value of property saved by warnings, as reported to this office	$125,000.00

MAY.

For the State as a whole the temperature averaged slightly below the normal, the deficiency being uniform over each division, though several stations in each division showed an excess. Except a warm period from

the 7th to the 11th, the first 20 days were below the normal. Frost was general throughout the State on the 14th, with the temperature freezing or below over a large area but owing to the backward season very little damage resulted. After the 20th a warm period set in and all vegetation made rapid growth.

The precipitation was below normal over each division, the deficiency being slightly more than an inch in the northern division and nearly one and one-half inches in the central division. Most of the rainfall occurred as heavy downpours in three principal periods, 10th,-12th, 16th,-19th, and 22d and 23d. This condition greatly interfered with field work and at the close of the month much corn was still to be planted in the southern division. The rainfall of the 22d-23d was particularly heavy and damaging in the northern portion of Benton, Linn and Jones Counties and in the southern portions of Blackhawk, Buchanan and Delaware Counties. All railroads in the affected area suffered from washouts, the Rock Island being the chief sufferer. A serious freight wreck occurred near Vinton, resulting from a train attempting to go through a submerged area. The engine and a number of cars crossed safely but 10 cars in the middle of the train were wrecked when the track gave way. Traffic was held up on this line until the 26th. Much damage also resulted from corn fields being washed out, basements flooded as well as considerable loss to stock. The loss to transportation is estimated to exceed $100,000, and the loss to agricultural interests was much more. Many bridges and culverts were washed out. In Grant township, Linn county, every township bridge was washed out and to repair the damage will cost more than $100,000.

On the afternoon of the 8th a small tornado occurred in Washington township, Chickasaw county. Several barns and small buildings were wrecked. On the afternoon of the 22d severe local storms having marked tornadic characteristics occurred at places in Allamakee, Crawford, Harrison, Howard, Polk and Story counties and caused considerable loss to farm property. An unmistakable tornado moved from southwest to northeast across the northwest corner of New Oregon township, Howard county, some distance southwest of the town of Cresco. Three or four barns and small buildings and several trees were destroyed. No persons were killed or injured. A small tornado moved from northwest to southeast near Dunlap, Crawford county. Its path of destruction was 8 or 10 rods wide and between 5 and 6 miles long. Large trees were uprooted and corn cribs and outbuildings blown down. There was no loss of life but Karl Benedict was blown down and slightly injured.

Pressure. The mean pressure (reduced to sea level) for the State was 30.04 inches. The highest recorded was 30.50 inches, at Dubuque, on the 14th, and the lowest was 29.56 inches, at Sioux City, on the 18th. The monthly range was 0.94 inch.

Temperature. The mean temperature for the State, as shown by the records of 104 stations, was 59.4°, or 1.1° lower than the normal. By divisions, three tiers of counties to the divisions, the means were as follows: Northern, 58.3°, or 0.7° lower than the normal; Central, 59.6°, or 1.1° lower than the normal; Southern, 60.3°, or 1.4° lower than the normal.

The highest monthly mean was 61.8°, at Keokuk, and the lowest was 57.0° at Northwood. The highest temperature recorded was 89° at Afton, Cedar Rapids and Humboldt, on the 22d, and the lowest was 29°, at Clinton and Maquoketa, on the 14th. The temperature range for the state was 60°.

Humidity. The average relative humidity for the State at 7 a. m. was 75 per cent, and at 7 p. m., 55 per cent. The mean for the month was 65 per cent, or about 3 per cent below the normal. The highest monthly mean was 76 per cent at Omaha, Neb., and the lowest was 58 per cent, at Dubuque.

Precipitation. The average precipitation for the State, as shown by the records of 110 stations, was 3.26 inches, or 1.31 inches less than normal. By divisions the averages were as follows: Northern, 3.45 inches, or 1.03 inches less than the normal; Central, 3.11 inches, or 1.48 inches less than the normal; Southern, 3.23 inches, or 1.41 inches less than the normal. The greatest amount, 5.73 inches, occurred at Keosauqua, and the least, 0.63 inch, at Fort Dodge. The greatest amount in 24 consecutive hours, 4.12 inches, occurred at Keosauqua on the 11th and 12th.

Wind. The prevailing direction of the wind was from the southeast. The average hourly velocity was 7.8 miles, or 0.9 mile less than the normal. The highest velocity reported from a regular Weather Bureau Station was at the rate of 46 miles an hour from the northeast, at Davenport, on the 12th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 60, or about 2 per cent less than normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 64; Davenport, 62; Des Moines, 63; Dubuque, 71; Keokuk, 60; Sioux City, 52; Omaha, Neb., 51.

Miscellaneous Phenomena. Aurora: 12th. Fog: 17th, 25th, 31st. Frost: 1st, 2d, 5th, 14th, 15th. Hail: 2d, 11th, 14th, 21st, 22d, 26th. Halos, lunar or solar: 3d, 5th, 6th, 13th, 14th, 15th, 19th, 23d, 25th, 26th, 27th, 31st. Thunderstorms:, 1st 2d, 3d, 4th, 7th, 9th, 10th, 11th, 12th, 17th, 18th, 19th, 20th, 21st, 22d, 23d, 26th, 27th, 31st. Rainbow: 22d, 31st.

Rivers. Moderate stages prevailed on the Mississippi with but slight fluctuations and a general falling tendency; on the Missouri moderate stages prevailed until after the heavy rains of the 11th-12th when a sharp rise occurred with a crest stage of slightly below the flood stage at Sioux City on the 16th and stages above the flood stage at Omaha on the 17th, 18th and 19th. The flood stage was also reached on the Des Moines River from the heavy rains on the 11th-12th from Tracy down. A crest of 14.4 feet was reached at Tracy on the 14th and 11.4 feet at Ottumwa on the 15th. The heavy rain of the 22d-23d caused destructive floods in the small streams especially in Benton and Linn Counties and the Maquoketa River was out of its banks on the 22d.

COMPARATIVE DATA FOR THE STATE—MAY.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With precipitation .01 in	Clear	Partly cloudy	Cloudy
1890	57.7	−2.8	90	26	3.56	−1.01	6.44	1.61	------	9	10	13	8
1891	58.3	−2.2	94	21	3.18	−1.39	7.10	1.46	------	8	14	9	8
1892	54.0	−6.5	88	29	8.77	+4.20	12.64	4.87	T.	16	5	9	17
1893	56.6	−3.9	96	26	3.45	−1.12	5.82	1.65	0	9	13	9	9
1894	61.1	+0.6	96	22	1.87	−2.70	4.77	0.33	0	6	17	10	4
1895	61.7	+1.2	104	24	3.19	−1.38	5.79	0.84	0	9	11	12	8
1896	65.5	+5.0	100	34	6.69	+2.12	11.79	3.40	0	12	11	12	8
1897	58.5	−2.0	96	20	1.92	−2.65	3.59	0.21	0	5	16	10	5
1898	59.6	−0.9	92	26	4.67	+0.10	7.82	2.22	0	12	9	10	12
1899	60.2	−0.3	90	27	6.23	+1.66	11.47	3.09	0	13	9	12	10
1900	63.2	+2.7	98	22	3.31	−1.26	6.98	0.96	0	8	14	10	7
1901	60.7	+0.2	95	28	2.35	−2.22	4.57	0.72	0	7	16	9	6
1902	63.8	+3.3	97	25	5.39	+0.82	18.04	0.87	0	13	10	12	9
1903	61.6	+1.1	91	24	8.55	+3.98	15.45	2.88	0	16	9	12	10
1904	59.6	−0.9	93	27	3.78	−0.79	8.15	1.50	0	8	13	10	8
1905	58.3	−2.2	88	28	5.95	+1.38	10.83	2.57	0	14	12	11	8
1906	60.8	+0.3	95	24	3.54	−1.03	10.72	0.89	0	11	13	10	8
1907	53.5	−7.0	96	14	3.48	−1.09	7.68	0.71	1.0	10	11	10	10
1908	59.4	−1.1	93	13	8.34	+3.77	14.33	1.33	0	15	9	11	11
1909	57.9	−2.6	97	18	4.34	−0.23	7.85	1.86	0.1	9	12	12	7
1910	55.4	−5.1	89	18	3.41	−1.16	6.91	1.29	T.	10	15	7	9
1911	64.9	+4.4	98	23	3.76	−0.81	8.73	0.42	0.7	9	16	9	6
1912	62.7	+2.2	97	29	3.33	−1.24	6.41	0.72	0	10	14	11	6
1913	59.4	−1.1	102	30	6.24	+1.67	10.25	3.14	0	13	11	8	12
1914	62.2	+1.7	98	25	3.31	−1.26	6.90	0.30	T.	10	14	11	6
1915	56.1	−4.4	99	25	7.34	+2.77	13.21	3.82	T.	14	9	9	13
1916	59.9	−0.6	94	27	4.93	+0.36	10.44	2.14	T.	12	13	10	8
1917	55.1	−5.4	95	18	3.87	−0.70	7.33	1.69	0.6	10	15	8	8
1918	64.9	+4.4	98	9	6.87	+2.30	11.98	3.72	T.	13	13	11	7
1919	58.2	−2.3	93	30	3.11	−1.46	7.14	0.73	0	9	13	11	7
1920	59.4	−1.1	89	29	3.26	−1.31	5.73	0.62	0	8	14	9	8

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

JUNE.

June temperature averaged above the normal, though there was a slight deficiency in Jefferson, Wapello and Davis counties. There were four alternate cool and warm spells. The coldest weather of the month occurred at most stations on the 5th, and at a few stations in the northern division there was light frost. The most protracted warm spell began the latter part of the first week and continued till the first part of the third week. The second week of the month was the warmest June week since June 3-9, 1911, but humidities were 20 per cent lower than during a similar hot period last year, with the result that diseases of small grains were much less prevalent.

Precipitation averaged below normal for the State but there was a slight excess over the northern division and there were areas in the other two divisions that had an excess. The amounts were well distributed through the month but the greater portion occurred in two or three heavy showers over most of the State. The distribution as to amounts was uneven, stations relatively near each other showing wide positive and negative departures. The greatest deficiency occurred over the central and southwest portions and at the close of the month vegetation was needing rain badly over large areas in the drier sections, while at some points fields were too wet to be worked properly. Conditions generally were favorable and most field crops advanced to nearly normal by the end of the month.

Destructive winds occurred on the 1st, 8th, 9th and 15th. On the 1st high westerly winds caused slight damage in the vicinity of Plano and Centerville in Appanoose county. On the 8th strong southwest winds that reached hurricane force in places occurred generally in Plymouth county, the northern half of Woodbury county and portions of Cherokee, Sioux and O'Brien counties. The storm began about 10 or 11 p. m. and continued from one to two hours at many places. The most destructive wind was in the vicinity of Sioux City and around Pierson. Some crops were damaged but the principal loss was to buildings and machinery. At Sioux City the damage was estimated at $100,000, but estimates are not available at other places. Strong to high northwest winds swept Fayette and portions of Chickasaw, Bremer and Clayton counties during the early morning of the 9th, causing about $6,000 damage in western Fayette county and slight damage in other sections. High winds, of near hurricane force, at Anamosa, Jones county, on the 15th caused considerable damage.

A tornado occurred in the vicinity of Correctionville and Pierson, near the corners of Woodbury and Cherokee counties, from 11:00 to 11:30 p. m. of the 8th. The storm moved from southwest to northeast for a distance of about five miles and caused about $60,000 damage. Also on the morning of the 9th, a slight tornado occurred at Westgate, Fayette county, causing damage estimated at $8,000. No persons were killed or injured in either storm.

Hail occurred at many places during the month, mostly on the 7th and 8th.

Pressure. The mean pressure (reduced to sea level) for the State was 29.93 inches. The highest recorded was 30.33 inches at Charles City, on the 3d, and the lowest was 29.46 at Charles City and Sioux City on the 15th.

Temperature. The mean temperature for the State, as shown by the records of 99 stations, was 70.7°, or 1.6° higher than the normal. By division, three tiers of counties to the division, the means were as follows: Northern, 69.4°, or 1.8° higher than the normal; Central, 71.1°, or 1.8° higher than the normal; Southern, 71.5°, 1.2° higher than the normal. The highest monthly mean was 74.0°, at Burlington and Cedar Rapids, and the lowest was 67.4°, at Postville. The highest temperature was 99° at Cedar Rapids and Onawa, on the 13th, and the lowest was 40°, at Onawa on the 4th, Bedford, Earlham, Glenwood, Guthrie Center, Little Sioux and Thurman on the 5th, and Estherville on the 17th. The temperature range for the State was 59°.

Humidity. The average relative humidity for the State at 7 a. m. was 75 per cent, and at 7 p. m. was 55 per cent. The mean for the month was 65 per cent, or 5 per cent below the normal. The highest monthly mean was 68 per cent at Charles City and the lowest was 61 per cent at Des Moines and Keokuk.

Precipitation. The average precipitation for the State, as shown by the records for 107 stations, was 3.56 inches, or 0.82 inch less than the normal. By divisions the averages were as follows: Northern, 4.50 inches, or 0.07 inch more than the normal; Central, 3.14 inches, or 1.18 inches less than the normal; Southern, 3.04 inches, or 1.35 inches less than the normal. The greatest amount, 8.48 inches, occurred at Britt, and the least, 1.25 inches, at Des Moines. The greatest amount in 24 consecutive hours, 3.10 inches, occurred at Washta, on the 7th.

Wind. The prevailing direction of the wind was from the southwest. The highest velocity reported from a regular Weather Bureau Station was 72 miles an hour, from the southwest, at Sioux City, on the 8th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 69, or about normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 64; Davenport, 80; Des Moines, 64; Dubuque, 70; Keokuk, 83; Sioux City, 54; Omaha, Neb., 66.

Miscellaneous Phenomena. Fog: 2d, 22d, 23d. Frost: 3d, 5th, 18th. Hail: 1st, 6th, 7th, 8th, 9th, 10th, 15th, 16th, 21st, 22d, 26th, 29th, 30th. Halos, lunar or solar: 2d, 4th, 8th, 10th, 13th, 15th, 17th, 18th, 19th, 20th, 26th, 30th. Thunderstorms: All days during the month except on the 3d, 5th, 17th, 18th, 19th, 23d, 27th.

Rivers. Moderate stages prevailed on the Mississippi with a general falling tendency the first half of the month and rising stages the last half. On the Missouri moderate falling stages prevailed the first half and moderate to high increasing stages the last half of the month, the crest stage from the 27th to the 29th was about 1 foot below the flood stage. On the interior rivers low stages for the season prevailed.

COMPARATIVE DATA FOR THE STATE—JUNE.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With prs. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	72.7	+3.6	106	44	7.76	+3.38	16.53	1.57	.....	11	12	10	8
1891	69.1	0.0	99	37	5.39	+1.01	15.88	1.68	.....	11	8	10	12
1892	69.2	+0.1	102	42	5.19	+0.81	14.16	0.67	.....	10	12	11	7
1893	71.2	+2.1	100	40	3.91	−0.47	7.56	1.36	.....	8	15	11	4
1894	73.2	+4.1	104	34	2.67	−1.71	6.20	0.57	.....	7	16	10	4
1895	69.7	+0.6	102	34	4.32	−0.06	9.26	0.98	.....	10	11	11	8
1896	69.1	0.0	100	40	3.11	−1.27	7.89	0.81	.....	9	12	13	5
1897	69.1	0.0	103	29	3.81	−0.57	9.38	1.03	.....	10	10	12	8
1898	71.4	+2.3	99	42	4.72	+0.34	12.48	1.90	.....	9	13	10	7
1899	70.7	+1.6	100	42	5.04	+0.66	11.99	1.10	.....	10	12	13	5
1900	69.7	+0.6	102	38	3.58	−0.40	12.35	0.67	.....	5	17	10	3
1901	72.3	+3.2	106	30	3.71	−0.67	7.84	1.05	.....	9	15	11	4
1902	65.2	−3.9	97	32	7.16	+2.78	16.04	1.46	.....	14	8	11	11
1903	64.6	−4.5	96	30	2.86	−1.52	6.04	0.75	.....	10	13	10	7
1904	67.1	−2.0	94	35	3.45	−0.93	8.35	0.44	.....	7	13	10	7
1905	69.9	+0.8	100	36	5.53	+1.15	14.89	1.80	.....	10	12	11	7
1906	67.9	−1.2	99	37	3.92	−0.46	8.27	1.48	.....	8	15	10	5
1907	66.5	−2.6	98	36	5.35	+0.97	9.33	2.07	.....	11	14	9	7
1908	67.1	−2.0	94	35	5.66	+1.28	11.88	1.77	.....	13	12	10	8
1909	69.1	0.0	96	40	6.41	+2.03	13.30	2.80	.....	13	12	10	8
1910	69.5	+0.4	105	33	1.99	−2.39	5.51	0.05	.....	7	18	7	5
1911	75.7	+6.6	108	36	1.82	−2.56	6.28	0.06	.....	5	20	8	2
1912	66.2	−2.9	101	34	2.74	−1.64	5.71	0.78	.....	7	15	9	6
1913	71.5	+2.4	102	33	3.31	−1.07	8.95	0.74	.....	7	19	8	3
1914	72.2	+3.1	101	40	5.57	+1.19	13.24	1.17	.....	13	12	14	4
1915	65.1	−4.0	91	31	4.16	−0.22	9.99	1.72	.....	11	12	12	6
1916	64.5	−4.6	96	38	3.71	−0.67	7.96	1.41	.....	10	13	11	5
1917	66.0	−3.1	100	32	6.65	+2.27	13.82	3.04	.....	12	13	10	7
1918	70.8	+1.7	104	38	5.29	+0.91	10.19	1.55	.....	11	16	10	4
1919	71.9	+2.8	98	41	6.13	+1.75	12.25	1.82	.....	13	12	12	6
1920	70.7	+1.6	99	40	3.56	−0.82	8.48	1.25	.....	9	16	10	4

T. indicates an amount too small to measure, or less than .005 inch rainfall and less than .05 inch snowfall.

JULY.

The temperature averaged below normal the deficiency for each division being quite uniform, though a few stations in the western portion of the State showed a slight excess. The greatest deficiencies were confined almost entirely to the northeast section. The month was more pleasant than the average July, there being no protracted periods of hot, sultry weather and during the greater part of the month the temperature was below normal. Temperatures of 100°, or higher, were reported from but two stations.

The precipitation for the State as a whole showed a slight excess but the distribution was uneven, varying from slightly more than an inch to nearly 7.50 inches. The distribution as to time was also uneven, considerably more than half occurring during the first week and more than 80 per cent occurring during the first two weeks. During the last of the month only scattered thundershowers occurred and rain was needed at the close of the month over the State generally. In large areas bordering the Mississippi and Missouri rivers the drouth was becoming serious.

During the afternoon of the 1st, from about 5:45 till 6:10 p. m. a tornado occurred in the southern portion of Adams County. The storm moved first from the northwest to southeast then turned and moved to the northeast, the total path being about 20 miles. The width of the storm was narrow and at points the funnel did not reach the earth, but where it was in contact with the earth everything in its way was destroyed, the loss to crops and buildings amounted to about $100,000. There was no loss of lives but 4 persons were injured and the occupants of one residence had a remarkable escape from being burned to death in a wrecked house that caught fire and burned up.

Hail storms were unusually numerous, destructive and widely distributed over the State. The worst storm reported was in the northwest portion of Scott county on the 9th, and the damage there was estimated at about $100,000. The principal damage was in a strip about 12 miles long, varying from about one and three-fourths to about 9 miles wide, extending from 3 miles southeast of New Liberty to about 3 miles south of Maysville. The path of greatest damage was about 6 miles long and about one and one-half miles wide. The stones varied from about 0.2 inch to 0.7 inch in diameter but some were said to be 1.5 inches. The damage from hail in other portions of the State was large. The storms reported shows losses to crops approximating $1,000,000, but it is probable that the loss was considerably more than that amount.

Pressure. The mean pressure (reduced to sea level) for the State was 30.00 inches. The highest pressure recorded was 30.32 inches at Dubuque on the 26th, and the lowest was 29.64 at Des Moines on the 6th. The monthly range was 0.68 inch.

Temperature. The mean temperature for the State, as shown by the records of 97 stations, was 72.3°, or 1.8° lower than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 71.2°, or 1.5° lower than the normal; Central, 72.3°, or 2.0° lower than the normal; Southern, 73.5°, or 1.7° lower than the normal. The highest monthly mean was 76.4°, at Omaha, Neb., and the lowest was 67.6°, at Postville. The highest temperature reported was 102°, at Clarinda, on the 23d, and the lowest was 45°, at Earlham, on the 27th. The temperature range for the State was 57°.

Humidity. The average relative humidity for the State at 7 a. m. was 78 per cent, and at 7 p. m. it was 55 per cent. The mean for the State was 66 per cent, or 2 per cent lower than the normal. The highest monthly mean was 70 per cent, at Charles City and the lowest was 64 per cent at Keokuk.

Precipitation. The average precipitation for the State, as shown by the records of 104 stations, was 4.22 inches, or 0.26 inch more than the normal. By divisions the averages were as follows: Northern, 4.46 inches, or 0.58 inch more than the normal; Central, 3.59 inches, or 0.39 inch less than the normal; Southern, 4.61 inches, or 0.59 inch more than the normal. The greatest amount, 7.49 inches, occurred at Stockport, and the least, 1.11 inches at Dubuque. The greatest amount in 24 consecutive hours was 3.32 inches, at Albia, on the 13th.

Wind. The prevailing direction of the wind was from the southwest. The highest velocity reported from a regular Weather Bureau Station was 57 miles per hour, from the west, at Sioux City, on the 4th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 73, or about 1 per cent below the normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 69; Davenport, 83; Des Moines, 74; Dubuque, 72; Keokuk, 80; Sioux City, 64; Omaha, Neb., 77.

Miscellaneous Phenomena. Hail, 1st, 2d, 3d, 4th, 7th, 8th, 9th, 12th, 13th, 14th, 15th, 16th, 17th, 20th, 22d, 23d. Halos, (lunar or solar) 3d, 4th, 12th, 24th, 25th, 29th. Rainbows, 5th, 7th. Thunderstorms, all days except 11th, 24th, 26th, 27th, 28th.

Rivers. Moderately high stages prevailed in the principal rivers, with slight fluctuations during the first half of the month, after which generally falling stages prevailed with the lowest stage on the last day of the month. Rather high stages occurred in the interior rivers during the first half of the month and flood stages occurred at Ottumwa on the 14th, 15th and 16th.

COMPARATIVE DATA FOR THE STATE—JULY.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	75.6	+1.5	110	45	1.98	—1.98	5.00	0.37	------	3	18	8	5
1891	68.5	—5.6	99	41	4.22	+0.26	8.20	1.67	------	8	13	13	5
1892	73.0	—1.1	104	38	5.29	+1.33	12.86	1.71	------	9	16	10	5
1893	75.0	+0.9	102	47	3.33	—0.63	8.84	1.49	------	7	19	10	2
1894	76.4	+2.3	109	39	0.63	—3.33	3.50	T.	------	3	22	8	1
1895	72.1	—2.0	104	35	3.40	—0.56	10.10	0.45	------	7	15	12	4
1896	73.6	—0.5	104	42	6.00	+2.94	12.67	1.61	------	9	14	11	6
1897	75.6	+1.5	106	42	3.26	—0.70	7.60	1.01	------	6	18	10	3
1898	73.4	—0.7	102	42	2.98	—0.98	12.88	0.55	------	7	19	9	3
1899	73.1	—1.0	101	38	3.07	—0.89	8.66	0.42	------	7	16	10	5
1900	73.4	—0.7	102	37	6.15	+2.19	18.45	1.80	------	9	16	10	5
1901	82.4	+8.3	113	46	2.34	—1.62	5.97	0.27	------	5	21	9	1
1902	73.1	—1.0	99	41	8.67	+4.71	13.57	4.82	------	13	14	10	7
1903	72.9	—1.2	100	40	4.83	+0.87	12.72	0.94	------	9	17	9	5
1904	70.6	—3.5	100	38	4.41	+0.45	11.97	1.28	------	10	16	9	6
1905	70.6	—3.5	102	40	2.91	—1.05	7.08	0.69	------	9	14	10	7
1906	70.9	—3.2	102	42	3.04	—0.92	7.05	0.26	------	8	18	10	3
1907	73.7	+0.4	102	41	7.27	+3.31	13.66	3.97	------	13	16	11	4
1908	73.0	—1.1	100	42	3.66	—0.30	9.21	0.70	------	8	16	10	5
1909	72.3	—1.8	102	40	4.77	+0.81	12.20	1.20	------	10	15	8	8
1910	74.5	+0.4	108	43	1.86	—2.10	5.69	0.12	------	7	19	8	4
1911	75.5	+1.4	111	38	2.37	—1.69	6.62	0.08	------	7	18	10	3
1912	74.6	+0.5	103	38	3.71	—0.25	7.56	1.17	------	10	17	10	4
1913	76.1	+2.0	108	45	1.82	—2.14	6.23	T.	------	5	21	8	2
1914	76.6	+2.5	109	43	2.27	—1.69	6.59	0.44	------	5	20	8	3
1915	69.5	—4.6	92	40	8.32	+4.36	15.83	3.68	------	14	10	12	9
1916	79.7	+5.6	105	48	1.78	—2.18	6.87	0.10	------	5	23	7	1
1917	71.3	+0.2	106	28	2.27	—1.69	6.06	0.23	------	7	21	8	2
1918	73.1	—1.0	105	40	3.17	—0.79	8.05	0.26	------	8	19	8	4
1919	77.4	+3.3	104	41	2.86	—1.10	7.82	0.39	------	6	22	8	1
1920	72.3	—1.8	102	45	4.22	+0.26	7.49	1.11	------	9	19	9	3

T. indicates an amount too small to measure, or less than .005 inch rainfall and less than .05 inch snowfall.

AUGUST.

August, like July, was deficient in temperature and too cool for the proper development of corn and at the close of the month much of the crop had not advanced beyond the roasting-ear stage. The deficiency was quite uniform over each division though the range varied greatly along the Mississippi. The usual hot periods were absent and the temperature was above normal for but short intervals and the hottest weather occurred during the first ten days. At a number of stations in each division the maximum temperature did not reach 90°.

The precipitation, while averaging slightly below normal, was very unevenly distributed. A large number of stations over the northern division and a few in the central and southern had a decided excess of precipitation and many stations that were decidedly deficient in July, particularly in the southeastern and southwestern portions of the State, showed a pronounced deficiency with drouth becoming serious at the close of the month. The heavy rains of the 19th-20th caused serious loss to crops in Carroll, Greene, Humboldt and Hancock Counties. Hail damage occurred principally on the 6th and 8th in Plymouth, Union, Ringgold, Jasper, Iowa, Allamakee, Clayton, Linn, Johnson and Des Moines Counties. The worst storm occurred in Ringgold County, the loss to growing crops in about 25 sections in Lots Creek, Middle Park and Poe Townships amounted to from 25 to more than 50 per cent. The damage was extensive also in Allamakee County over the northeast corner of Iowa Township. A very heavy downpour of rain occurred in Carroll and Greene Counties between Scranton and Glidden, amounting to 5 inches in from two to three hours, causing small streams to get out of banks and doing great damage to bridges and culverts. The loss to bridges and culverts is estimated at $10,000 in each county and the loss to crops probably as great.

Pressure. The mean pressure (reduced to sea level) for the State was 30.02 inches. The highest recorded was 30.37 inches at Dubuque, on the 23d, and the lowest was 29.56 inches at Sioux City on the 28th. The monthly range was 0.81 of an inch.

Temperature. The mean temperature for the State, as shown by the records of 105 stations, was 69.3°, or 2.5° lower than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 67.7°, or 2.7° lower than the normal; Central, 69.4°, or 2.3° lower than the normal; Southern, 70.7°, or 2.5° lower than the normal. The highest monthly mean was 73.4° at Burlington and Keokuk, and the lowest was 65.4°, at Decorah and Spencer. The highest temperature recorded was 98° at Monroe on the 5th and Clarinda on the 10th, and the lowest was 39° at Decorah and Stockport, on the 24th. The temperature range for the State was 59°.

Precipitation. The average precipitation for the State, as shown by the records of 109 stations, was 3.35 inches, or 0.33 inch less than the normal. By divisions the averages were as follows: Northern, 3.98 inches, or 0.50 inch more than the normal; Central, 3.41 inches, or 0.36 inch less than the normal; Southern, 2.67 inches, or 1.11 inches less than the normal. The greatest amount, 8.52 inches occurred at Britt, and the least 0.44 inch, at Burlington. The greatest amount in 24 hours, 4.17 inches, occurred at Humboldt, on the 20th.

Humidity. The average relative humidity for the State at 7 a. m. was 81 per cent, and at 7 p. m. it was 58 per cent. The mean for the month was 70 per cent, or 2 per cent lower than the normal. The highest monthly mean was 74 per cent, at Charles City and Dubuque, and the lowest was 66 per cent at Keokuk.

Wind. The prevailing direction of the wind was from the southeast. The highest velocity reported from a regular Weather Bureau station was at the rate of 39 miles per hour, from the northwest, at Sioux City, on the 6th.

Sunshine. The average per cent of the possible amount of sunshine was 69, or 2 per cent less than the normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 64; Davenport, 73; Des Moines, 71; Dubuque, 65; Keokuk, 71; Sioux City, 73; Omaha, Neb., 66.

Miscellaneous Phenomena. Aurora, 21st. Fog, 4th, 6th, 8th, 9th, 14th, 15th, 20th, 24th. Frost, (light), 23d, 24th, 25th. Hail, 6th, 7th, 8th, 30th. Halos (lunar or solar), 7th, 10th, 22d, 28th, 30th, 31st. Haze, 16th. Rainbow, 19th. Thunderstorms, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 15th, 19th, 20th, 21st, 22d, 27th, 28th, 29th, 30th, 31st.

Rivers. Except for a few slight and unimportant rises, moderate, falling stages prevailed on the principal rivers. On the main streams of the interior rivers no unusually high stages prevailed but on the smaller streams in Carroll, Greene, Humboldt and Hancock County local floods occurred following the heavy rains of the 19th-20th.

COMPARATIVE DATA FOR THE STATE—AUGUST.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	68.4	—3.4	102	36	3.41	—0.27	6.44	1.02	.....	8	15	10	6
1891	69.1	—2.7	100	34	4.24	+0.56	13.02	1.23	.....	8	13	12	6
1892	71.4	—0.4	102	40	2.24	—1.44	4.69	0.65	.....	5	18	9	4
1893	69.4	—2.4	101	39	2.22	—1.26	6.22	0.40	.....	5	19	9	3
1894	74.6	+2.8	108	38	1.58	—2.10	4.53	T.	.....	4	21	8	2
1895	71.9	+0.1	103	37	4.43	+0.75	10.63	0.67	.....	7	17	9	5
1896	71.7	—0.1	104	34	2.32	—0.16	12.25	0.86	.....	8	15	11	5
1897	68.9	—2.9	104	35	1.86	—1.82	4.98	0.47	.....	6	15	11	5
1898	71.2	—0.6	103	40	3.44	—0.24	10.55	0.58	.....	6	17	9	5
1899	74.4	+2.6	100	41	3.68	0.00	10.45	1.12	.....	7	17	10	4
1900	77.4	+5.6	106	44	4.65	+0.97	10.43	1.26	.....	6	18	10	3
1901	73.8	+2.0	105	40	1.29	—2.39	4.46	T.	.....	5	29	9	2
1902	69.1	—2.7	98	37	6.58	+2.90	15.47	1.57	.....	11	11	11	9
1903	69.1	—2.7	101	41	6.64	+2.96	17.74	2.55	.....	11	12	10	9
1904	69.1	—2.7	97	35	3.43	—0.25	6.75	0.66	.....	7	17	8	6
1905	74.3	+2.5	104	44	4.05	+0.37	8.47	1.04	.....	9	16	9	6
1906	74.4	+2.3	101	33	3.95	+0.27	10.51	0.92	.....	9	17	9	5
1907	71.1	—0.7	99	37	4.33	+0.65	9.67	1.05	.....	9	17	9	5
1908	70.0	—1.8	101	38	4.77	+1.09	10.55	1.35	.....	9	17	9	5
1909	76.1	+4.3	103	33	1.81	—1.87	8.21	T.	.....	5	21	8	2
1910	71.9	+0.1	104	36	3.88	+0.20	11.22	0.37	.....	8	15	10	6
1911	71.7	—0.1	107	34	3.52	—0.36	9.47	0.44	.....	9	16	10	5
1912	71.0	—0.8	101	40	3.78	+0.10	7.90	0.89	.....	10	15	10	6
1913	76.6	+4.8	108	40	2.68	—1.00	7.13	0.08	.....	6	17	10	4
1914	73.7	+1.9	103	40	2.19	—1.49	4.90	0.42	.....	7	17	10	4
1915	65.9	—5.9	91	30	2.81	—0.87	9.14	0.27	.....	8	16	8	7
1916	74.0	+2.2	106	35	2.58	—1.10	6.23	0.49	.....	7	18	9	4
1917	69.4	—2.4	102	31	2.29	—1.39	6.31	0.70	.....	7	19	8	4
1918	76.0	+4.2	113	38	3.61	—0.07	8.38	0.54	.....	8	15	10	5
1919	71.5	—0.3	103	38	2.59	—1.09	5.72	0.97	.....	7	19	9	3
1920	69.3	—2.5	98	39	3.35	—0.33	8.52	0.44	.....	7	18	8	5

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

SEPTEMBER.

The outstanding feature of the weather for September was the unusually favorable condition that prevailed from the 10th to the 28th, inclusive. Aside from the first day, which was warm, the first nine days were cold and wet and the prospects for a normal amount of the corn crop maturing were discouraging, as both July and August were too cool for the normal development of that crop. However, on the 10th a warm period that resembled July weather, set in and it continued unbroken till the 28th, when it was brought to an abrupt ending, with heavy to killing frosts over most of the western and central portions and light to heavy frosts over the eastern portion. During this warm period corn made rapid progress toward maturity and when frost came about 85 per cent of the crop was safe and fortunately over the western half of the State, where the frost was most severe, the greater per cent of the crop was out of danger of frost and much was in the shock.

The precipitation occurred principally during the first nine days but periods of general precipitation also occurred on the 23d and 26th but the amounts on these days were mostly light. The greatest precipitation occurred over about one third of the State in a strip running north and south in the middle section. Over much of the eastern and western sections the precipitation which had been deficient in previous months continued deficient during September and over large areas the soil was too hard and dry to prepare for winter grain, but where wheat had been seeded under favorable conditions the early sown was up in good condition at the end of the month.

Strong winds prevailed generally from the 20th to the 25th which blew down corn and many fields were in a badly tangled condition, but they hastened the maturity of the corn.

A very strange meteor was observed by Mr. Arthur Betts, at Nora Springs, during the early evening of September 6th. It was at an elevation of about 30° in the west-southwest and of about the brilliancy of Venus. It gradually faded out of existence, leaving no trail behind it.

Pressure. The mean pressure (reduced to sea level) for the State was 29.98 inches. The highest recorded was 30.43 inches, at Sioux City and Omaha, Neb. on the 29th, and the lowest was 29.38 inches, at Sioux City, on the 23d. The monthly range was 1.05 inches.

Temperature. The mean temperature for the State, as shown by the records of 94 stations was 66.5°, or 3.1° higher than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 65.1°, or 3.3° higher than the normal; Central, 66.6°, or 3.1° higher than the normal; Southern, 67.7°, or 2.7° higher than the normal. The highest monthly mean was 70.0°, at Burlington, and the lowest was 62.8°, at Northwood. The highest temperature reported was 98° at Onawa, on the 19th, and Maquoketa on the 20th, and the lowest was 24° at Little Sioux and Sanborn, on the 30th. The temperature range for the State was 74°.

Humidity. The average relative humidity for the State at 7:00 a. m. was 83 per cent and at 7:00 p. m. was 61 per cent. The mean for the month was 72 per cent, which is 2 per cent below normal. The highest monthly mean was 80 per cent at Charles City, and the lowest was 67 per cent at Sioux City.

Precipitation. The average precipitation for the State, as shown by the records of 102 stations, was 3.30 inches, or 0.06 inch below the normal. By divisions, the averages were as follows: Northern, 3.54 inches, or 0.49 inch more than the normal; Central, 2.86 inches, or 0.60 inch less than the normal; Southern, 3.51 inches, or 0.05 inch less than the normal. The greatest amount, 7.21 inches, occurred at Afton, and the least, 0.69 inch, at Cedar Rapids. The greatest amount in 24 consecutive hours, 3.77 inches, occurred at Boone on the 9th.

Wind. The prevailing direction of the wind was from the south. The highest velocity reported from a regular Weather Bureau Station was at the rate of 53 miles an hour from the south at Sioux City, on the 25th.

Sunshine. The average per cent of the possible amount of sunshine was 68, which is 5 per cent above normal. The per cent of the possible amount

at regular Weather Bureau Stations was as follows: Charles City, 56; Davenport, 68; Des Moines, 68; Dubuque, 59; Keokuk, 66; Sioux City, 78; Omaha, Neb., 73.

Miscellaneous Phenomena. Aurora, 7th, 10th, 17th, 28th, 30th. Fog, 2d, 3d, 4th, 5th, 6th, 9th, 10th, 11th, 12th, 20th, 27th, 28th, 30th. Frost (light), 28th, 29th, 30th, (heavy), 29th, 30th, (killing), 29th, 30th. Hail, 3d, 4th, 5th, 10th 26th, 29th. Halos (lunar or solar), 1st, 10th, 14th, 21st, 22d. Meteor, 6th, 20th. Thunderstorms, 1st, 2d, 3d, 4th, 5th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 19th, 23d, 24th, 25th, 26th.

Rivers. On the principal rivers low, slowly falling stages prevailed during practically the entire month. On the interior rivers a few slight rises occurred resulting from locally heavy rainfall but during the greater part of the month low, and nearly stationary stages prevailed.

COMPARATIVE DATA FOR THE STATE—SEPTEMBER.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	59.3	—4.1	96	23	2.97	—0.39	4.85	1.36	------	7	13	10	7
1891	67.3	+3.9	104	28	1.33	—2.03	3.60	0.13	------	4	20	7	3
1892	64.7	+1.3	99	29	1.53	—1.83	4.15	0.16	------	4	16	8	6
1893	64.7	+1.3	102	18	2.34	—1.02	5.49	0.74	------	4	20	6	4
1894	65.1	+1.7	100	26	3.57	+0.21	7.43	0.67	------	8	15	10	5
1895	66.8	+3.4	103	22	3.03	—0.33	7.43	0.85	------	5	18	8	4
1896	58.5	—4.9	95	22	4.09	+0.73	9.96	1.82	------	10	11	9	10
1897	70.9	+7.5	106	26	2.04	—1.32	5.88	0.00	------	4	23	5	2
1898	65.3	+1.9	99	29	2.69	—0.67	8.45	0.41	------	7	16	9	5
1899	62.5	—0.9	104	15	0.93	—2.43	4.32	T.	------	4	16	9	5
1900	64.4	+1.0	99	26	4.98	+1.62	8.82	2.48	------	9	15	8	7
1901	63.3	—0.1	102	26	4.77	+1.41	13.62	1.71	------	9	13	9	8
1902	59.1	—4.3	88	23	4.35	+0.99	10.41	1.65	------	9	15	6	9
1903	60.8	—2.6	94	28	3.81	+0.45	8.79	1.42	------	10	14	6	10
1904	64.0	+0.6	94	30	2.78	—0.58	8.33	0.09	------	7	13	8	9
1905	65.8	+2.4	96	36	3.81	+0.45	13.18	0.50	------	8	14	8	8
1906	67.2	+3.8	100	27	4.16	+0.80	11.10	0.64	------	8	16	8	6
1907	62.8	—0.6	98	25	2.75	—1.61	6.06	1.38	------	8	15	9	6
1908	67.9	+4.5	98	20	1.20	—2.16	3.46	0.25	------	3	21	6	3
1909	62.4	—1.0	94	30	3.58	+0.22	7.34	1.39	------	9	14	8	8
1910	63.2	—0.2	99	30	3.59	+0.23	7.43	1.18	------	9	14	7	9
1911	65.8	+2.4	103	32	5.12	+1.76	13.73	1.19	------	10	11	9	10
1912	62.1	—1.3	104	24	3.98	+0.62	10.12	0.28	------	11	12	8	10
1913	64.5	+1.1	107	19	3.31	—0.05	7.44	0.45	------	9	15	8	7
1914	64.5	+1.1	99	30	7.88	+4.52	16.24	2.48	------	10	16	7	7
1915	63.7	+0.3	91	30	6.03	+2.67	12.45	2.88	------	11	11	8	11
1916	62.5	—0.9	98	21	3.89	+0.53	9.71	1.45	------	7	17	8	5
1917	62.6	—0.8	97	28	2.90	—0.46	8.68	0.39	------	7	15	7	8
1918	58.6	—4.8	93	20	1.87	—1.49	4.62	0.48	------	6	16	8	6
1919	67.5	+4.1	99	33	5.34	+1.98	11.82	1.49	------	8	16	6	8
1920	66.5	+3.1	98	24	3.30	—0.06	7.21	0.69	------	8	17	8	5

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

OCTOBER.

October, 1920, was next to the warmest October of record for the State as a whole. In 1900 the October mean temperature was 59.3° which is 1.6° higher than the current month. Cold weather at the beginning was followed by warmer on the 3d, after which temperatures continued above normal till the first part of the last week. Killing frost or freezing temperatures occurred at most stations on the 1st, except along the Mississippi River in the central and southern divisions. On the 29th, killing frost covered these sections also. Not more than 10 per cent of the corn crop was damaged by frost. There was some damage to late truck crops. Unusually favorable conditions during the last two-thirds of September and the greater part of October, matured the greatest corn crop of record in Iowa. During the latter half of October, corn husking made good progress generally but high temperatures in connection with locally heavy rains in the north-central district made it unsafe to crib corn in large quantities in that section.

The first 10 days were practically rainless and conditions were unusually favorable for farm work and harvesting sugar beets, potatoes, onions, etc. After the 10th precipitation was frequent but the amounts were generally light to moderate and did not hinder farm work materially. Winter wheat made a vigorous growth and pastures improved greatly.

Pressure. The mean pressure (reduced to sea level) for the State was 30.04 inches. The highest recorded was 30.54 inches at Dubuque and Charles City, on the 5th, and the lowest was 29.54 inches, at Sioux City, on the 13th. The monthly range was 1.00 inch.

Temperature. The mean temperature for the State, as shown by the records of 101 stations, was 57.7°, or 6.9° higher than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 55.9°, or 6.9° higher than the normal; Central, 58.0°, or 7.1° higher than the normal; Southern, 59.3°, or 6.7° higher than the normal. The highest monthly mean was 61.6°, at Keokuk, and the lowest was 54.0°, at Northwood. The highest temperature reported was 90°, at Waterloo, on the 11th, and the lowest was 15°, at Decorah, Earlham, Pella, Sigourney and Williamsburg, on the 29th. The temperature range for the State was 75°.

Humidity. The average relative humidity for the State at 7 a. m. was 81 per cent, and at 7 p. m. it was 60 per cent. The mean for the month was 70 per cent, or 2 per cent less than the normal. The highest monthly mean was 81 per cent, at Charles City, and the lowest was 64 per cent, at Omaha, Neb. The lowest observed was 22 per cent, at Davenport, on the 4th.

Precipitation. The average precipitation for the State, as shown by the record of 106 stations, was 2.13 inches, or 0.33 inch less than the normal. By divisions the averages were as follows: Northern, 2.51 inches or 0.17 inch more than the normal; Central, 2.27 inches, or 0.22 inch less than the normal; Southern, 1.62 inches, or 0.92 inch less than the normal. The greatest amount, 4.64 inches, occurred at Charles City, and the least, 0.48 inch, occurred at Williamsburg. The greatest amount in 24 consecutive hours, 2.82 inches, occurred at Charles City, on the 14th-15th.

Snow. Light snow flurries occurred in each division during the last few days of the month, but Dubuque, with 0.1 inch, was the only station that reported more than a trace of snow.

Wind. The prevailing direction of the wind was south. The highest velocity reported from a regular Weather Bureau Station was 36 miles per hour, from the south, at Sioux City on the 13th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 65, or 3 per cent greater than the normal. The per cent of the possible amount at the regular Weather Bureau stations was as follows: Charles City, 53; Davenport, 62; Des Moines, 69; Dubuque, 59; Keokuk, 71; Sioux City, 72; Omaha, Neb., 69.

Miscellaneous Phenomena. Aurora, 7th, 9th, 10th, 17th, 18th, 22d. Fog, 2d, 6th, 16th, 17th, 18th, 21st, 23d, 25th, 26th, 29th. Frost (killing), 1st, 2d, 24th, 28th, 29th. Hail, 11th, 12th, 13th, 14th, 26th. Halos (lunar or solar), 17th, 19th, 20th, 22d, 23d, 24th, 30th. Haze, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 19th, 20th, 22d, 29th. Meteors, 1st, 3d, 6th, 9th, 10th, 13th, 16th, 18th, 19th, 24th. Rainbows, 15th, 20th, 22d. Thunderstorms, 10th, 11th, 12th, 13th, 14th, 15th, 19th, 20th, 21st, 22d.

COMPARATIVE DATA FOR THE STATE—OCTOBER.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	49.2	—1.6	86	16	3.48	+1.02	6.62	1.59	------	7	11	11	9
1891	50.0	—0.8	92	19	2.77	+0.31	6.53	0.85	------	6	18	7	6
1892	54.5	+3.7	96	14	1.55	—0.91	2.58	0.09	0.0	4	21	6	4
1893	52.4	+1.6	94	10	1.28	—1.18	4.56	0.02	0.0	4	16	9	6
1894	51.7	+0.9	90	20	2.67	+0.21	5.25	0.03	0.2	8	14	8	9
1895	46.0	—4.8	88	4	0.47	—1.99	1.38	0.00	T.	2	19	8	4
1896	47.9	—2.9	88	12	3.13	+0.67	5.05	1.51	T.	5	18	6	7
1897	46.8	+6.0	97	12	1.14	—1.32	3.30	0.03	0.0	4	17	8	6
1898	47.5	—3.3	88	17	3.56	+1.10	5.75	1.27	3.6	8	7	9	15
1899	50.7	+5.9	95	17	1.73	—0.73	4.64	0.15	0.0	5	17	8	6
1900	59.3	+8.5	90	21	3.91	+1.45	8.00	1.20	0.0	7	16	7	8
1901	54.2	+3.4	88	20	1.98	—0.48	4.23	0.45	T.	6	17	7	7
1902	53.5	+2.7	83	20	2.54	+0.08	6.66	0.28	T.	5	16	8	7
1903	52.2	+1.4	90	16	1.95	—0.51	4.50	0.32	0.0	5	19	6	6
1904	53.1	+2.3	96	16	1.67	—0.79	4.43	0.14	T.	6	15	8	8
1905	49.2	—1.6	95	16	3.40	+0.94	5.56	1.29	1.5	8	13	6	9
1906	50.5	—0.3	87	7	1.96	—0.50	4.25	0.50	0.1	6	14	7	10
1907	50.4	—0.4	85	10	1.50	—0.96	3.71	0.30	0.0	5	20	5	6
1908	51.1	+0.3	89	17	3.38	+0.92	8.83	0.58	2.6	8	16	6	9
1909	49.7	—1.1	97	10	2.22	—0.24	4.70	0.48	T.	6	16	6	9
1910	55.2	+4.4	93	10	0.77	—1.69	1.73	T.	0.1	4	21	4	6
1911	48.7	—2.1	87	14	3.34	+0.88	7.03	0.73	0.6	10	12	8	11
1912	52.2	+1.4	92	16	2.98	+0.52	5.72	1.03	T.	6	21	3	7
1913	49.2	—1.6	89	—2	3.03	+0.57	7.29	0.35	1.2	9	15	8	8
1914	55.9	+5.1	88	14	3.23	+0.77	6.64	0.74	T.	9	16	6	9
1915	54.4	+3.6	86	19	1.31	—1.15	3.25	T.	T.	5	19	6	6
1916	50.9	+0.1	92	6	2.00	—0.46	4.33	0.39	2.0	8	16	7	8
1917	42.9	—7.9	85	0	1.41	—1.05	4.00	0.15	2.2	6	10	11	10
1918	55.1	+4.3	93	21	3.64	+1.18	7.56	1.36	0.8	7	13	7	11
1919	50.7	—0.1	89	8	3.02	+0.56	8.65	0.45	T.	10	11	8	12
1920	57.7	+6.9	90	11	2.13	—0.33	4.64	0.48	T.	6	19	6	5

T. Indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

NOVEMBER.

The mean temperature for the State as a whole averaged less than one half degree above the normal the excess being confined to the northern and central divisions, though there were small areas in both these divisions with the temperature below normal. Most of the first week was above normal, but on the 10th the first cold wave of the season spread over the State and the temperature remained below normal till the 17th, when a decided change to warmer occurred and during the rest of the month mostly mild weather prevailed. The first part of the month was favorable for farm work and good progress was made in gathering corn until the 19th, when the fields became too soft for wagons. As a result of this unfavorable condition only 77 per cent of the corn crop had been gathered at the end of November while the usual amount at this time is 90 per cent. However this warm weather and an ample supply of moisture was favorable for winter grain, which made good growth, and at the end of the month was well established. The weather was also favorable for harvesting sugar beets which was completed before the close of the month. The maximum temperature for the State was 71° and the minimum 5°, making an absolute range of 66° which is the least ever recorded since state wide records began in 1890.

Precipitation was evenly distributed throughout the month with an average of 8 rainy days for the State, which has been exceeded but once in November in 31 years. The per cent of sunshine was decidedly below normal and the number of cloudy days is the greatest in the history of the State.

Pressure. The mean pressure (reduced to sea level) for the State was 30.16 inches. The highest recorded was 30.82 inches, at Sioux City, on the 12th, and the lowest was 29.54 inches, at Davenport and Dubuque, on the 21st. The monthly range was 1.28 inches.

Temperature. The mean temperature for the State, as shown by the records of 93 stations was 35.4°, or 0.4°, higher than the normal. By divisions, three tiers of counties to the division, the means were as follows: Northern, 33.5°, or 0.7° higher than the normal; Central, 35.7°, or 0.1° lower than the normal. The highest monthly mean was 39.2°, at Burlington and Keokuk, and the lowest was 32.4°, at Fayette and Sanborn. The highest temperature recorded was 71° at Oskaloosa, on the 19th, and Fairfield, on the 20th, and the lowest was 5°, at Sanborn, on the 11th, West Bend on the 12th and Earlham on the 16th. The temperature range for the State was 66°.

Humidity. The average relative humidity for the State at 7 a. m. was 84 per cent and at 7 p. m. 73 per cent. The mean for the month was 78 per cent or 2 per cent above normal. The highest mean was 81 per cent at Charles City, and the lowest was 72 per cent, at Keokuk.

Precipitation. The average precipitation for the State as shown by the records of 98 stations, was 2.18 inches, or 0.67 inch above the normal. By divisions the averages were as follows: Northern, 2.69 inches, or 1.28 inches greater than the normal; Central, 2.23 inches, or 0.70 inch greater than the normal; Southern, 1.62 inches, or 0.04 inch greater than the

normal. The greatest amount, 4.45 inches occurred at Humboldt, and the least, 0.73 inch, at Lamoni. The greatest amount in 24 consecutive hours, 1.60 inches, occurred at Humboldt, on the 29th.

Snowfall. The average fall for the State was 1.2 inches, or 1.3 inches less than the normal. Many stations in all portions of the State reported but a trace and snow did not remain on the ground at any station for more than two days.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported from a regular Weather Bureau station was at the rate of 54 miles per hour, from the northwest, at Sioux City, on the 1st.

Sunshine. The average per cent of the possible amount of sunshine was 37, or 17 per cent less than the normal. The per cent of the possible amount at the regular Weather Bureau stations was as follows: Charles City, 26; Davenport, 41; Des Moines, 50; Dubuque, 34; Keokuk, 41; Sioux City, 32; Omaha, Neb., 38.

Miscellaneous Phenomena. Aurora, 13th. Fog, 6th, 7th, 8th, 16th, 17th, 20th, 23d, 24th, 26th, 27th, 28th, 29th, 30th. Halos, 5th, 17th; 18th; 20th; 23d, 25th, 27th. Meteors, 5th, 9th, 16th. Sleet, 9th, 22d, 23d, 26th. Thunderstorms, 1st, 6th.

COMPARATIVE DATA FOR THE STATE—NOVEMBER.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	38.6	+3.6	78	— 2	1.46	—0.05	3.55	0.71	------	3	15	8	7
1891	30.5	—4.5	84	—24	1.70	+0.19	3.64	0.66	------	7	10	8	12
1892	33.3	—1.7	70	— 3	1.10	—0.41	3.16	0.05	1.8	4	11	8	11
1893	34.0	—1.0	86	—13	1.17	—0.34	2.56	0.05	4.6	4	16	8	6
1894	32.7	—2.3	72	— 5	0.92	—0.59	2.42	T.	0.4	4	9	11	10
1895	34.3	—0.7	86	—12	1.51	0.00	3.01	0.45	4.9	6	9	8	13
1896	29.6	—5.4	82	—15	1.83	+0.32	4.51	0.16	2.9	6	9	8	13
1897	34.3	—0.7	81	—19	0.66	—0.85	2.24	T.	1.2	5	12	8	10
1898	32.2	—2.8	78	—17	1.50	—0.01	3.61	0.33	8.7	6	14	8	8
1899	43.9	+8.9	86	8	1.29	—0.31	2.97	0.13	0.5	5	12	8	10
1900	33.5	—1.5	79	— 6	1.06	—0.45	3.35	T.	3.7	6	12	7	11
1901	35.8	+0.8	77	2	0.86	—0.65	2.30	0.20	2.6	3	18	6	6
1902	41.2	+6.2	79	4	2.13	+0.62	4.19	0.16	1.8	7	9	7	14
1903	34.2	—0.8	76	— 5	0.52	—0.99	1.74	T.	1.1	3	13	8	9
1904	41.0	+6.0	80	4	0.15	—1.36	0.50	0.00	0.5	1	20	6	4
1905	38.4	+3.4	70	—12	2.84	+1.33	5.30	0.90	0.6	5	16	7	7
1906	35.4	+0.4	76	— 5	2.03	+0.52	3.86	0.35	4.4	8	9	7	14
1907	36.7	+1.7	68	— 4	1.03	—0.48	2.27	0.05	0.9	4	17	6	7
1908	39.3	+4.3	80	5	1.56	+0.05	3.31	0.21	1.4	5	14	7	9
1909	42.4	+7.4	84	— 3	5.39	+3.88	11.48	2.07	6.8	10	10	7	13
1910	33.4	—1.6	76	5	0.34	—1.17	1.03	T.	0.7	3	13	9	8
1911	29.9	—5.1	79	— 8	1.42	—0.09	4.99	0.11	1.6	6	11	8	11
1912	40.1	+5.1	77	6	0.98	—0.53	2.38	0.00	T.	2	18	8	4
1913	44.1	+9.1	78	10	1.18	—0.33	3.49	0.20	0.4	6	11	7	12
1914	41.0	+6.0	80	— 4	0.22	—1.29	0.95	0.00	T.	2	19	6	5
1915	40.2	+5.2	83	— 5	1.94	+0.43	4.86	0.30	1.2	6	11	10	9
1916	37.3	+3.3	80	— 8	1.61	+0.10	3.65	0.05	3.6	5	16	6	8
1917	40.7	+5.7	77	3	0.28	—1.23	1.02	T.	1.4	3	14	6	10
1918	39.9	+4.9	76	0	2.11	+0.60	5.19	0.70	4.4	7	13	5	12
1919	33.6	—1.4	68	—12	3.40	+1.89	6.22	1.97	6.3	8	11	7	12
1920	35.4	+0.4	71	5	2.18	+0.67	4.45	0.73	1.2	8	10	5	15

T. indicates an amount too small to measure, or less than .005 inch rainfall, and less than .05 inch snowfall.

DECEMBER.

Mild winter weather prevailed during the greater part of December and the temperature was above normal continuously during the first 16 days. From the 17th to the 28th the only cold weather occurred, with the temperature below normal except on a few days. Cold waves, beginning on the 22d and 26th, spread over the entire State but there were no unusually low temperatures reported. The last three days were warm.

Conditions were generally favorable for out door work and stock. Until the cold weather set in very little frost was in the ground and plowing was reported from many places during the greater portion of the second week. During the cold weather winter grain was well protected by snow and the condition at the end of the month was good.

Rain or sleet fell in the south and east portion of the State on the 3d-4th. On the 13th the first well defined snowstorm reached from southwest to northeast across the State and extended to the Mississippi by the morning of the 14th. Amounts up to 7.0 inches occurred at stations in the central counties. The snowstorm of the 20th-22d covered the entire State except a small area in the east-central division. Considerably more than 10 inches fell in areas in the northern and west-central divisions. At Sioux City the 24-hour fall, 13.6 inches, is the greatest of record in December. This snow drifted badly and resulted in considerable delay to street car and automobile traffic. The snowstorm of the 25th-26th was confined to the eastern half of the State, and the amounts were generally light except over the southeastern district. After the ground became covered it remained so during the rest of the month over practically the entire State, but was becoming bare at the close of the month.

Thunderstorms, though unusual in December, occurred on the 3d, 4th and 13th at a large number of stations, particularly in the eastern portion of the State. At Dubuque thunderstorms occurred on the 3d and 13th. At this station thunderstorms have been recorded only three times in December during the last 46 years and never before have two occurred in one December.

An extensive glaze storm occurred in connection with the storm of the 20th-22d. It was preceded by a general snow cover, so no damage to winter grains and grass is believed to have resulted.

Pressure. The mean pressure (reduced to sea level) for the State was 29.97 inches. The highest recorded was 30.52 inches, at Omaha, Neb., on the 24th and the lowest was 29.00 inches, at Dubuque, (the lowest of record for December) on the 13th. The monthly range was 1.52 inches.

Temperature. The mean temperature for the State, as shown by the record of 99 stations, was 26.4°, or 2.5° higher than the normal. By divisions, three tiers of counties to the division, the mean temperatures were as follows: Northern, 23.6°, or 2.4° higher than the normal; Central, 26.7°, or 2.6° higher than the normal; Southern, 29.0°, or 2.5° higher than the normal. The highest monthly mean was 32.8°, at Keokuk, and the lowest was 20.8° at Inwood. The highest temperature

recorded was 65°, at Burlington, on the 3d, and the lowest was -26°, at Inwood, on the 24th. The temperature range for the State was 91°.

Humidity. The average relative humidity for the State at 7 a. m. was 85 per cent, and at 7 p. m. it was 77 per cent. The mean for the month was 81 per cent, which is practically normal. The highest monthly mean was 90 per cent at Charles City, and the lowest mean was 74 per cent, at Keokuk.

Precipitation. The average precipitation for the State, as shown by the records of 104 stations, was 1.16 inches, or 0.06 inch less than the normal. By divisions, the averages were as follows: Northern, 1.11 inches, or 0.04 inch greater than the normal; Central, 1.17 inches, or 0.08 inch less than the normal; Southern, 1.19 inches, or 0.16 inch less than the normal. The greatest amount, 2.64 inches, occurred at Knoxville and Olin, and the least, 0.26 inch at Denison. The greatest amount in any 24 consecutive hours was 1.40 inches, at Knoxville, on the 13th.

Snow. The average snowfall for the State was 7.4 inches, or 1.2 inches greater than the normal. The greatest amount, 19.3 inches, occurred at Northwood, and the least, 2.0 inches, at Afton, Cumberland and Denison.

Wind. The prevailing direction of the wind was from the northwest. The highest velocity reported from a regular Weather Bureau Station was at the rate of 55 miles an hour, from the west, at Sioux City, on the 15th.

Sunshine and Cloudiness. The average per cent of the possible amount of sunshine was 41, or 7 per cent less than the normal. The per cent of the possible amount at the regular Weather Bureau Stations was as follows: Charles City, 25; Davenport, 39; Des Moines, 53; Dubuque, 29; Keokuk, 45; Sioux City, 42; Omaha, Neb., 56.

Miscellaneous Phenomena. Aurora: 16th. Fog: 1st, 2d, 3d, 4th, 5th, 6th, 9th, 10th, 12th, 13th, 21st, 22d, 26th, 29th, 30th, 31st. Hail: 13th, 21st. Halos, lunar and solar: 13th, 14th, 16th, 19th, 20th, 22d, 23d, 24th, 25th, 26th, 27th, 29th, 31st. Parhelia: 16th, 23d. Parselenae: 23d. Sleet: 4th, 9th, 13th, 21st, 22d, 25th. Thunderstorms: 3d, 4th, 13th.

Rivers. Moderate stages prevailed on all rivers with only slight fluctuations and were generally free of ice until the third week. The interior rivers froze from the 18th to 20th and the Mississippi and Missouri Rivers about a week later.

COMPARATIVE DATA FOR THE STATE—DECEMBER.

YEAR	Temperature				Precipitation					Number of Days			
	Mean	Departure	Highest	Lowest	Total	Departure	Greatest	Least	Snowfall	With pre. .01 in. or more	Clear	Partly cloudy	Cloudy
1890	29.1	+5.2	72	−18	0.45	−0.77	1.40	0.00	------	3	17	7	7
1891	32.3	+8.4	72	−14	2.41	+1.19	4.50	1.21	------	6	14	9	8
1892	18.9	−5.0	68	−29	1.65	+0.43	3.04	0.20	10.9	8	9	8	14
1893	22.0	−1.9	70	−21	1.31	+0.09	2.80	0.46	7.6	7	10	9	12
1894	30.1	+6.2	73	−17	0.55	−0.57	1.75	0.25	1.3	3	15	6	10
1895	25.4	+1.5	63	−16	1.63	+0.41	5.74	0.00	4.1	5	11	9	11
1896	30.8	+6.9	70	−10	0.65	−0.57	1.79	T.	1.6	4	10	8	13
1897	18.0	−5.9	60	−25	1.65	+0.43	3.22	0.61	15.9	6	11	7	13
1898	18.1	−5.8	60	−25	0.48	−0.74	1.70	T.	3.9	3	15	8	8
1899	22.6	−1.3	75	−19	1.61	+0.39	4.28	0.10	4.3	5	12	9	10
1900	26.9	+3.0	63	−10	0.45	−0.77	2.70	T.	2.4	4	13	6	12
1901	20.5	−3.4	64	−31	0.93	−0.29	2.75	0.05	3.4	6	10	9	12
1902	20.1	−3.8	59	−20	2.23	+1.01	5.51	0.67	12.9	8	9	6	16
1903	19.6	−4.3	58	−27	0.41	−0.81	1.96	T.	3.7	4	11	9	11
1904	23.4	−0.5	67	−19	1.44	+0.22	3.68	0.06	12.3	5	12	7	12
1905	27.0	+3.1	62	−11	0.52	−0.70	1.69	T.	4.2	3	19	6	6
1906	25.7	+1.8	65	− 9	1.43	+0.21	2.81	0.37	1.4	6	11	7	13
1907	28.8	+4.9	62	− 9	1.00	−0.22	2.28	0.05	4.7	5	10	7	14
1908	27.2	+3.3	67	−17	0.57	−0.65	2.07	0.05	3.8	3	15	8	8
1909	15.1	−8.8	60	−26	2.18	+0.96	6.10	0.89	13.7	11	10	5	16
1910	23.4	−0.5	57	−14	0.37	−0.85	1.39	0.01	3.0	3	15	7	9
1911	27.9	+4.0	60	−24	2.57	+1.35	4.43	0.62	12.6	7	13	6	12
1912	29.2	+5.3	64	−13	0.74	−0.48	1.75	0.10	1.1	3	18	7	6
1913	32.0	+8.1	65	−13	1.02	−0.20	4.73	0.00	1.3	4	15	5	11
1914	15.7	−8.2	63	−31	1.30	+0.08	2.24	0.57	11.1	9	10	6	15
1915	25.0	+1.1	56	−10	0.69	−0.53	1.70	T.	4.6	5	11	8	12
1916	18.7	−5.2	67	−25	1.04	−0.18	2.00	0.35	6.7	6	15	8	8
1917	14.5	−9.4	62	−40	0.56	−0.66	1.70	0.14	6.7	6	10	9	12
1918	32.7	+8.8	68	− 7	1.30	+0.08	3.30	0.37	5.1	8	9	8	14
1919	15.0	−8.9	52	−36	0.54	−0.68	1.55	0.08	5.8	4	11	7	13
1920	26.4	+2.5	65	−26	1.16	−0.06	2.64	0.26	7.4	5	10	8	13

T. indicates an amount too small to measure, or less than .005 inch precipitation and less than .05 inch snowfall.

MONTHLY STATE DATA FOR 1920.

Month	Barometric Pressure, Inches (Sea level).				Temperature Degrees, F.				Relative humidity, per cent			Precipitation, Inches.			Number of Days			Sunshine	Wind.	
	Mean	Highest	Date	Lowest	Mean	Departure from normal	Highest	Lowest	7 a. m.*	12 noon§	7 p. m.*	Departure from normal §	Average	Departure from normal	Greatest	Least	Snowfall	With .01 inch or more precip.	Clear	Partly cloudy	Cloudy	Per cent of the possible amount.	Departure from normal	Average hourly velocity	Departure from normal	Prevailing direction
January	29.59	30.87	24	29.03	16.7	—1.2	58	—56	86	73	77	0	0.42	—0.63	1.05	T.	4.6	4	12	8	11	47	— 3	8.5	—0.2	NW.
February	29.15	30.74	8	29.48	24.0	+3.5	59	—22	85	72	76	+1	0.56	—0.59	1.75	0.04	4.1	5	9	7	14	39	—17	8.4	—0.9	NW.
March	29.87	30.60	6	29.85	38.0	+4.7	80	—21	79	60	65	—2	3.02	+1.25	5.70	0.47	2.4	7	15	9	7	60	+2	11.6	+1.7	SW.
April	29.58	30.58	24	29.17	42.4	—0.3	78	—32	80	61	61	+4	4.59	+1.73	7.13	1.93	2.0	12	8	9	13	45	—15	10.6	—0.1	NW.
May	30.04	30.50	14	29.56	59.4	—1.1	89	29	75	54	55	—3	3.96	—1.31	5.78	0.62	0.0	2	14	16	8	60	—	7.8	—0.9	SE.
June	29.95	30.33	3	29.46	70.7	+1.6	99	40	75	53	55	—5	3.96	—0.82	8.48	1.25	0.0	0	16	10	4	69	0	7.9	+0.3	SW.
July	30.00	30.32	26	29.64	72.3	—1.8	102	45	78	54	55	—2	4.22	+0.96	7.49	1.11	0.0	0	19	9	3	73	— 1	6.2	—0.5	SW.
August	30.02	30.37	23	29.66	69.3	—2.5	98	39	81	52	55	—2	3.55	—0.33	8.02	0.44	0.0	1	18	8	5	69	— 2	5.2	—1.2	SE.
September	29.98	30.43	29	29.38	60.5	+3.1	98	24	83	54	61	—2	3.30	—0.06	7.21	0.69	0.0	0	17	8	5	68	+ 3	6.9	—0.3	S.
October	30.04	30.54	5	29.54	57.7	+6.9	90	11	81	53	60	—2	2.13	+0.67	4.64	0.48	T.	1	6	19	6	65	+ 3	7.0	—1.1	S.
November	30.16	30.82	12	29.54	35.4	+0.4	71	5	84	69	73	+2	2.18	+0.67	4.45	0.73	1.2	8	10	5	15	37	—17	7.7	—0.5	NW.
December	29.97	30.32	24	29.00	26.4	+2.5	65	—36	85	75	77	0	1.16	—0.06	2.64	0.26	7.4	5	10	8	13	41	— 7	9.0	+0.1	NW.
Means and extremes	30.00	.....	Jan. 24	29.00	48.2	+0.8	102	—36	81	61	64	—1	31.75	—0.22	8.32	T.	21.7	88	107	93	106	56	— 5	8.0	—0.2	NW.
Normals and records	30.05	31.09	Jan† 1905	28.69	47.4	.....	113	—47	.....	.....	66	.....	31.97	.....	19.88	0.00	39.7	85	106	101	98	61	.....	8.2	.....	NW.

†25th. ‡28th. §Local mean time. *Normal central time. 7 a. m. and 7 p. m. observations only.

COMPARATIVE DATA FOR THE STATE—Annual.

Year	Temperature: Mean annual	Highest	Date	Lowest	Date	Precipitation in Inches: Annual	Greatest annual	Least annual	Av. snowfall
1890	48.0	110	July 13	—27	January 22	31.30	45.74	16.00	.....
1891	47.3	106	August 9	—31	February 4	32.90	49.65	23.48	.....
1892	46.6	104	July 11	—38	January 19	36.58	48.77	24.78	34.2
1893	45.7	102	July* 13	—36	January 14	27.59	33.27	19.19	37.2
1894	49.7	109	July 26	—37	January 25	21.94	29.81	15.65	19.2
1895	47.2	104	May 28	—33	February 1	26.77	35.25	18.57	26.0
1896	48.6	104	July 3	—20	January 4	37.23	51.60	28.68	22.6
1897	47.8	106	July* 23	—30	January 25	26.98	36.18	20.21	38.8
1898	47.7	103	August 20	—25	December 31	31.34	55.47	19.51	40.3
1899	47.3	104	September 6	—40	February 11	28.68	42.06	21.79	23.4
1900	49.3	103	August 3	—27	February 15	35.05	47.33	23.06	25.8
1901	49.0	113	July 22	—31	December 15	24.41	37.69	16.35	38.5
1902	47.7	98	July 30	—31	January 27	43.82	58.80	29.14	28.0
1903	47.2	101	August 24	—27	December 13	35.39	50.53	26.41	19.4
1904	46.3	100	July 17	—32	January 27	28.51	38.93	19.34	29.2
1905	47.2	104	August 11	—41	February* 2	36.56	52.26	24.66	38.3
1906	48.4	102	July 21	—32	February 10	31.60	44.34	20.63	32.8
1907	47.4	102	July 5	—31	February 5	31.61	43.90	19.93	24.0
1908	49.5	101	August 3	—18	January 29	35.26	49.98	24.11	22.7
1909	47.4	103	August* 15	—26	February* 15	40.01	53.48	27.20	49.0
1910	48.6	108	July 16	—35	January 7	19.87	27.99	12.11	23.4
1911	49.5	111	July* 3	—35	January 3	31.37	46.77	19.74	35.3
1912	46.4	104	September 8	—47	January 12	28.89	33.13	15.25	39.5
1913	49.7	108	July* 16	—25	January 8	29.95	45.18	20.31	25.4
1914	49.1	109	July 12	—31	December 26	31.93	44.11	23.30	27.5
1915	47.8	99	May 14	—32	January 28	39.53	51.15	27.29	31.3
1916	47.2	106	August 4	—34	January 13	28.90	46.34	22.48	29.5
1917	44.8	106	July 20	—40	December 29	27.81	36.00	20.78	32.4
1918	49.2	113	August 4	—26	February 4	32.78	47.53	25.03	33.4
1919	48.6	104	July 30, 31	—36	December 10	36.76	48.16	26.88	26.6
1920	48.2	102	July 23	—26	Jan. 4-Dec. 24	31.75	44.00	20.95	21.7

*And other dates.

DATES OF KILLING FROSTS, 1920.

STATIONS	Killing Frosts	
	Last in Spring	First in Autumn
Northern Division—		
Algona	May 14	Sept. 29
Allison	May 14	Oct. 1
Alta	May 10	Sept. 30
Alton	May 14	Sept. 30
Belmond	May 14	Sept. 30†
Britt	May 13	Oct. 1
Charles City	Apr. 14	Oct. 1
Decorah	May 14†	Sept. 30
Elkader	----------	Sept. 30
Estherville	May 14†	Sept. 30
Fayette	May 14	Sept. 30†
Forest City	Apr. 28†	Oct. 1
Humboldt	Apr. 28†	Sept. 30†
Inwood	Apr. 28†	Sept. 30
Le Mars	Apr. 29†	Sept. 30
Mason City	May 14†	Sept. 30†
Milford (near)	Apr. 28†	Sept. 30
New Hampton	Apr. 28†	Sept. 30
Nora Springs	Apr. 17	Oct. 1
Northwood	May 14†	Oct. 1
Pocahontas	May 14†	Sept. 30
Postville	May 14	Sept. 30
Rock Rapids	May 14	Sept. 30
Sanborn	May 3†	Sept. 30
Sioux Center	Apr. 28†	Sept. 30
Spencer	Apr. 28†	Sept. 30
Storm Lake	Apr. 28†	Sept. 30
Washta	May 14†	Sept. 30
Waverly	May 14†	Sept. 30
West Bend	Apr. 28†	Sept. 30
Central Division—		
Ames	Apr. 28	Sept. 30†
Audubon	Apr. 28†	Sept. 30
Baxter	Apr. 28†	Sept. 30
Belle Plaine	Apr. 14†	Sept. 30
Boone	Apr. 28	Sept. 30
Carroll	Apr. 28	Sept. 30
Cedar Rapids	Apr. 14†	Oct. 29
Clinton	Apr. 14†	----------
Davenport	Apr. 13	Oct. 29
Delaware	Apr. 18†	Oct. 1†
Denison	Apr. 28†	Sept. 29
Des Moines	Apr. 28	Oct. 1
Dubuque	Apr. 14	Oct. 29
Fort Dodge	Apr. 28†	----------
Grinnell	Apr. 28†	Oct. 1†
Grundy Center	Apr. 28†	Oct. 1†
Guthrie Center	May 14†	Sept. 30
Harlan	Apr. 28†	Sept. 30
Independence	Apr. 28†	Sept. 30†
Iowa City	May 14†	Oct. 1
Iowa Falls	Apr. 28†	Sept. 30†
Jefferson	Apr. 28	Sept. 30
Little Sioux	Apr. 28†	Sept. 30
Logan	Apr. 28†	Sept. 30
Maquoketa	May 14†	Oct. 2
Marshalltown	Apr. 14†	Sept. 30†
Monroe	Apr. 28†	Sept. 30
Olin	May 14†	Oct. 1
Onawa	Apr. 28†	Sept. 30
Perry	Apr. 28†	Sept. 30
Rockwell City	Apr. 28†	----------
Sac City	Apr. 28†	Sept. 30
Sioux City	Apr. 28	Sept. 30
Tipton	Apr. 17†	Oct. 1
Toledo	May 14†	Sept. 30†
Waterloo	May 14†	Sept. 30
Waukee	Apr. 28	Sept. 30
Webster City	Apr. 28†	Sept. 30
Whitten	----------	----------
Williamsburg	Apr. 17†	Oct. 1
Southern Division—		
Afton	May 14†	Sept. 30
Albia	May 14†	Sept. 30
Atlantic	May 14†	Sept. 30
Bedford	Apr. 28†	Sept. 30
Bloomfield	Apr. 17†	Oct. 1
Bonaparte	Apr. 17†	Oct. 29
Burlington	Apr. 14†	Oct. 29
Centerville	Apr. 15†	Oct. 1
Chariton	Apr. 28†	Sept. 30†
Clarinda	Apr. 28†	Sept. 30
Columbus Junction	Apr. 14	Oct. 29
Corning	Apr. 28†	Sept. 30
Corydon	Apr. 28†	Oct. 1
Creston	Apr. 28†	Sept. 30
Cumberland	----------	Sept. 30
Earlham	May 14†	Sept. 30
Fairfield	May 14†	Oct. 1
Glenwood	Apr. 28†	Sept. 30
Greenfield	Apr. 27	Sept. 30
Indianola	Apr. 24†	----------
Keokuk	Apr. 13†	Oct. 29
Keosauqua	May 14†	Oct. 1
Knoxville	May 14	Oct. 1
Lacona	----------	Oct. 1
Lamoni	Apr. 28†	Sept. 30
Lenox	Apr. 28†	Sept. 30
Mt. Ayr	Apr. 28†	Sept. 30
Mt. Pleasant	Apr. 17†	Sept. 30
Murray	Apr. 28†	Sept. 30†
Oakland	Apr. 28†	Sept. 30
Oskaloosa	Apr. 28†	Sept. 30
Ottumwa	Apr. 14†	Oct. 1
Pella	Apr. 15	Oct. 1
Sigourney	Apr. 17†	Oct. 1
Stockport	May 14†	Oct. 1
Thurman	Apr. 28†	Sept. 30
Washington	Apr. 17†	Oct. 1
Winterset	Apr. 28	Sept. 30
Omaha, Neb.	Apr. 13	Oct. 28

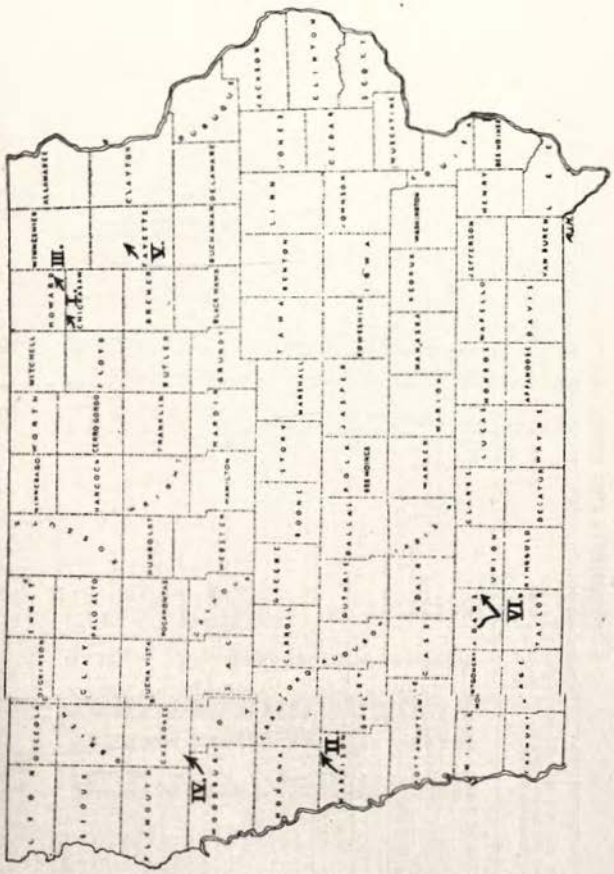
†Date of last temperature of 32° or lower in the spring, or first temperature of 32° or lower in the autumn (as the case may be) when frost was not reported.

TORNADOES IN IOWA DURING THE YEAR 1920.

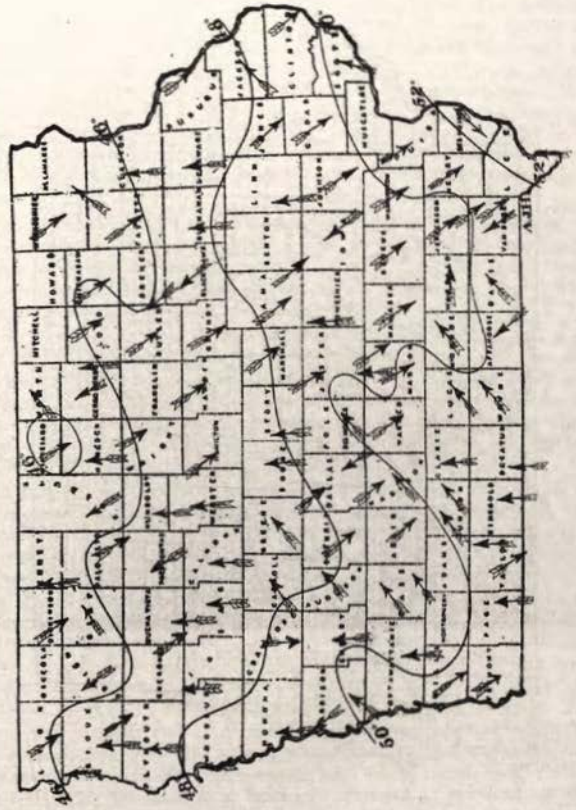
Storm No.	Nearest towns	Date	Hours	Storms moved from	Length of path, miles	Persons killed	Persons injured	Estimated damage
I	Alta Vista to Jerico	May 8	5:00 p. m.	S. W. to N. E.	4	6	0	$ 10,000
II	Dunlap	May 22	5:30 p. m.	S. W. and W.	6	0	1	7,000
III	New Oregon	May 22	5:30 to 6:00 p. m.	S. W. to N. E.	5	0	0	6,000
IV	Correctionville to Pierson	June 8	11 to 11:30 p. m.	S. W. to N. E.	5	0	0	60,000
V	Westgate	June 9	2 to 2:30 a. m.	S. W. to N. E.	Short	0	0	8,000
VI	Corning to Lenox	July 1	5:45 to 6:10 p. m.	N. W. to S. E. to N. E.	20	0	4	100,000
				Totals	34	0	5	$ 191,000

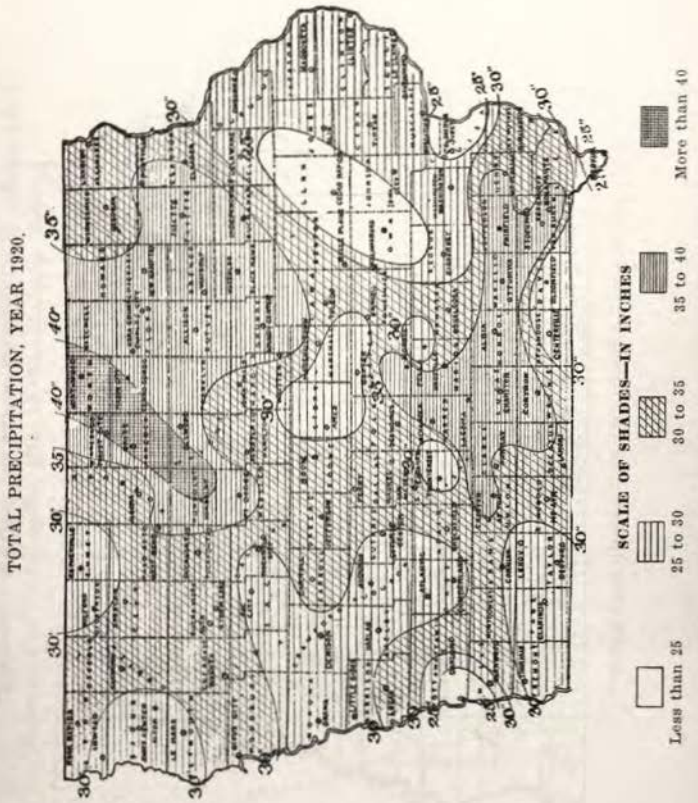
TORNADO PATHS IN IOWA DURING THE YEAR, 1920.

(Numerals Refer to Descriptive Data in Accompanying Table.)



MEAN ISOTHERMS AND PREVAILING WINDS, YEAR 1920.





WEATHER AND CROP REVIEW.

All reference in this publication to the effect of weather on crops, is the result of cooperation between the United States Weather Bureau and the Iowa Weather and Crop Service.

Winter set in early and severely, preceding the crop season of 1920. For the three winter months the average precipitation was the least of record, but that of the early winter fell mostly as snow, giving ample protection to winter grains and grasses during the rigorous, record breaking temperatures of early December. Under the snow covering, the ground froze very little, though cold weather was practically continuous till after the middle of February. There were considerable periods without snow covering in the south central and southeast districts and extending a few counties northward along the Mississippi and Missouri Rivers. About 6 per cent of the winter wheat was winter killed, which is less than the average.

March was wet, warm and windy. The snow cover disappeared in the northern portion about the middle of the second week, having been continuous there since November. By the end of the third week frost had left the ground. Several wind storms seriously damaged farm buildings. The ground was too wet for much field work.

April was cold and wet with a snow storm in the southern third of the State on the 3d-4th. It was too cold for plant growth and too wet for field work. However, a larger oats acreage than last year was sown in the larger producing counties of the west and northwest portions of the State. In the wetter, later, southern districts, oats seeding was prolonged unusually till as late as the middle of May. The development of fruit buds was beneficially delayed by the cold weather.

The season continued cool till about May 20, when a warm spell set in that brought vegetation forward rapidly. Field work progressed slowly, particularly in the south central and southeast districts, where much corn was yet to be planted at the close of May. The most advanced section was the upper Raccoon River watershed where corn planting began about May 4 and was finished before the close of the month. In Union and portions of adjacent counties not more than one-third of the corn had been planted up to June 1. Fruit bloomed generally about the middle of May, with conditions favorable for pollination. Peaches in the southern tier of counties showed more bloom than for the past seven years. Young live stock suffered greatly from the cold, wet, cloudy spring.

June was warmer and drier than usual in most sections of the State. The week ending June 15, with a mean temperature of 80 degrees was the warmest week of the entire season and the warmest June week since June 3-9, 1911. The humidity, however, averaged 20 per cent lower than during a similar hot period last year, with the result that diseases of small grains were much less prevalent, though causing considerable damage to spring wheat in the west central and northern counties. The following week averaged 15 degrees cooler and was very beneficial for small grains, which were in or approaching the critical heading and blooming

period. All crops improved during June but were still below normal development on July 1. More than half of the July rainfall occurred during the first week. Temperatures though generally below normal were high enough, in connection with the heavy rains of the first week, to cause rapid development of diseases of spring wheat which for the second year in succession was almost a failure in the western and northern counties. Hail storms were unusually prevalent the first half of July. The greatest damage, approximately $100,000, occurred in Scott County on the 9th.

Harvest and haying weather was generally favorable. Though oats got a bad start and looked unpromising till late in June, they made a remarkable showing at harvest and thrashing time. The yield was above normal and the quality good. At the close of August, 91 per cent of the small grain had been thrashed, which is 20 per cent more than normal and the largest in the last 10 years. Winter wheat yield was good though slightly less than the 10-year average. Spring wheat was disappointing.

From July 14 to September 8, temperatures were almost continuously below normal. As a result, corn became more and more backward, so that by September 7, the bulk of the crop had only reached the hard dough stage and was considered to be three weeks late. Reports from hundreds of correspondents on September 1, indicated that with normal weather only 42 per cent of the corn would be safe from frost by September 20. But the unexpected happened in that abnormally warm and dry weather, September 9-27, forced the corn to mature rapidly, so that when killing frosts came from September 29 to October 1, they did not damage more than 10 per cent of the crop and this was easily absorbed by feeding on the farms. Killing frost did not visit the southeastern counties till October 29. The corn crop of 1920 is the largest ever produced in Iowa and the quality is very good. Warm and generally dry weather in October dried the corn so that husking made good progress during the last half of the month, except in the north central counties where locally heavy rains and warm weather made cribbing in large quantities unsafe. At the close of November, corn husking was 77 per cent finished. "Hogging down" corn averages 7 per cent this year as compared with 8 per cent last year.

The cool summer was very beneficial for potatoes. The yield per acre averaged 110 bushels, which has been exceeded but twice in thirty years and the total crop is more than twice that of last year on less acreage. It is rather rare that a bumper crop of corn and a bumper crop of potatoes are raised in the same year.

Fruit, truck crops, sugar beets, pop corn and sweet corn were all good crops.

Soil conditions were generally favorable for seeding winter wheat during September and in some counties the acreage was increased over that harvested this year. Growth continued till checked by the abnormally cold weather of November 9-17. Of the acreage seeded, 90 per cent made good growth and became well established; 8 per cent germinated but made

little showing above ground; and only 2 per cent did not germinate up to the beginning of winter. Fall plowing made good progress till checked by dry weather in October.

Bulletin No. 1, April 13, 1920—

Winter set in early and severely toward the close of November, 1919. The first three weeks of December were colder than any other similar period of record. On December 10, local areas in Hardin, Grundy, Poweshiek, Dallas and Fremont counties experienced temperatures of 30 degrees below zero or lower, the lowest being -36 degrees at Thurman. Preceding and during this cold weather the ground was generally snow-covered and but slightly frozen. Later in the winter deficient precipitation and snow cover in the southeast and south-central districts exposed winter wheat, rye, clover and grasses to severe temperatures and considerable damage is believed to have occurred. Strawberries also suffered. Other fruits are believed to have wintered well, except peaches which were injured by the severe cold of early winter. Live stock generally wintered well, feed being abundant in most sections.

During March young clover suffered considerably from heaving due to alternate freezing and thawing, but winter wheat and rye improved, due to general rains and warmer weather toward the close of the month. Excessive precipitation in the south-central and southeast districts delayed farm work so that the spring wheat acreage will be much reduced and the oats acreage will be less than intended, though, probably greater than last year. Corn will absorb most of the decreased acreage of spring and winter wheat.

Seeding was quite general on March 31, but cold and stormy weather following, stopped all field work and the ground has remained frozen ever since in the northern districts. Snow banks still remain in the southern tier of counties from the heavy snows of April 3d and 6th.

Considerable seeding of oats and wheat has been done the past week in the central and northwest portions of the state. About half of the oats seeding is finished in these sections. The rain and snow Sunday and Monday and low temperature Monday night are causing further delay. The season is 7 to 10 days later than last year. The southern counties are even later than this, as a result of the excess of precipitation in March, the snowstorms of April 3d and 6th, and the cold weather so far in April.

Bulletin No. 2, April 20, 1920—

Showers were mostly light and scattered till Saturday night, though moderately heavy rains occurred Thursday night in the Mississippi River counties from Lee to Clinton. Rains were general Saturday night to Monday morning, the heaviest exceeding 2 inches in Calhoun, Sac, Carroll, Greene and northern Audubon and Guthrie counties.

Farm work has been greatly delayed by the saturated soil and deficient sunshine and temperature. During the more favorable weather Friday and Saturday, seeding of oats and spring wheat was pushed rapidly in the central, north-central and northeast counties. Most of the oats have been "mudded" in, but there is a firm determination to maintain or increase the acreage of oats regardless of weather conditions. Oats seeding is nearing completion in the drier counties. Oats are sprouting slowly. Early seeded oats were injured by freezing early in the month and some reseeding has been necessary.

A large acreage is being seeded to grass and more would be, were it not for the fabulously and unprecedentedly high price of medium red clover seed.

Early spring wheat is beginning to show green on the south slopes in Plymouth county which normally is one of the largest spring wheat producing counties. Though very late, some spring wheat seeding was done as far south as Adair, Scott and Polk counties this week.

More damage to winter wheat resulted from the severe freeze of April 4 and the cold days following than was apparent last week. However, the recent rains and slightly higher temperatures have caused some improvement.

Plowing for corn is well under way, especially sod.

An increased acreage of sugar beets for manufacture is probable in the sugar beet district of north-central Iowa if weather conditions permit preparation for seeding. Onion and potato planting began in Mitchell county where these crops are specialties, on the 15th. The extreme scarcity and high price of good seed potatoes and the poor crop realized last year will considerably reduce the acreage devoted to potatoes for the State as a whole. Some planting has been reported in nearly all sections.

Gardens are generally late. Apple buds are believed to have survived the recent inclement weather, but considerable damage to other fruits has probably occurred.

Spring pigs, lambs, calves, chickens and colts have not thrived during the cold wet weather that has prevailed so far in April. The spring pig crop is not as large as usual. There is considerable complaint of small litters.

Grass is starting slowly and winter feed, especially roughage, is becoming scarce in some sections.

Bulletin No. 3, April 27, 1920—

Cool, cloudy, wet weather continued, the sunshine, being about half of the normal. The largest excess in precipitation was in the western half of the State where the total rainfall was above 1.00 inch at many stations. Tuesday and Wednesday were warm, the rest of the week was cold with occasional freezing temperatures, except in the southeast portion. The season is from 10 to 20 days late, but the weather map this morning (27th) indicates increased sunshine and warmth.

Seldom has the oats crop shown such a range of progress, varying from green fields to further acreage to be seeded if the weather permits. Seeded after this date the crop will be in grave danger from hot weather at a critical stage. Soil conditions have been bad and the seed poorly covered. There are many reports of the seed rotting. Many farmers will reluctantly plant some acreage to corn that they intended for oats. Spring wheat is starting very slowly, many fields not showing green and some seed has rotted. Winter wheat though progressing slowly is in fair condition and will improve with the warmer weather and sunshine now in prospect. The same is true of alalfa, clover, grasses and pastures.

Considerable loss of spring pigs, lambs and chicks is reported due to the lack of sunshine and warmth.

Plowing for corn and sugar beets is in progress but the amount accomplished is considerably less than usual for the time of year.

Potatoes that have been in the ground four weeks are not up yet. Considerable planting was done in the northern counties. In Mitchell county not to exceed 15 per cent of the crop has been planted, and about 20 per cent of the onions. Truck and gardens are unusually late. Fruit buds have been beneficially retarded by the cloudy, cold weather and are believed to be in fair condition generally. Peaches and plums are in bloom in the extreme southern counties.

Bulletin No. 4, May 4, 1920—

The week opened cold with heavy to killing frosts and minimum temperatures of 32 degrees or lower, the lowest being 26° at Inwood. Sunshine was below normal, except in the east-central district. Rainfall was above normal in the northwest portion, with frequent showers elsewhere. The month of April was the coldest since 1907 and with that exception the coldest in more than 40 years. The week closed warmer.

Field work has been almost at a standstill due to wet soil and frequent showers. Plowing for corn is probably not one-fourth done and no planting has been done. The soil has been so wet that where plowing has been done it will become cloddy if dry weather comes soon. Toward the close of the week the soil dried more rapidly and worked up better. With normal weather conditions planting of corn and sugar beets will begin within a week.

Oats and barley seeding has progressed slowly. Considerable more barley will be seeded, but it is becoming too late for much further oats seeding. Reports of oats rotting are numerous. Early seeded fields are up and showing green, but the stand is thin and patchy.

Spring wheat is up and doing nicely, but slow. Winter wheat is making fair progress.

Gardening has scarcely begun. Potatoes in the ground more than a month are just beginning to come up. The high price and poor quality of potato seed and the backward season will considerably reduce the potato acreage.

Fruit is believed to have benefited from the lateness of the season. Only in the extreme southern counties are plums, cherries and strawberries in bloom, though in the central portion of the State, buds are just ready to burst into bloom at the first warm, sunshiny period of two or three days. Fruit was probably unharmed by the severe frosts of April 27th and 28th. The first spray is being applied in the central districts.

Losses of young live stock have continued as a result of the cold, damp, dark weather.

Bulletin No. 5, May 11, 1920—

Farm work made rapid progress during the past week under the most favorable weather conditions of the season. Showers were light and scattered till the night of the 10th, when heavy rains fell in the northeast and north-central portions. The soil was dried rapidly by the increased sunshine and decidedly warmer weather toward the close of the week. Ground that had been plowed too wet became cloddy.

Corn planting is furthest advanced in Palo Alto, Pocahontas, Calhoun, Webster and Humboldt counties, where it began about the 4th, and now amounts to 20 to 50 per cent of the acreage. That planted on the 4th and 5th has sprouted. Planting is most backward in portions of Union, Clarke, Madison and Warren counties, where it has scarcely begun.

Early oats are 2 to 3 inches high. Though remarkably late, a considerable acreage was seeded to oats in the southern and northern districts during the week. In the central counties seeding was generally completed the preceding week.

The first planting of sugar beets is over in Kossuth county and about 30 per cent of the sugar beet acreage has been planted in Wright county, with fair conditions of soil and weather. Onions are all planted in Mitchell county, where the acreage is slightly larger than in any former year. Some cabbage has been planted. There was considerable potato planting this week, but the acreage will be smaller than last year. Gardening made rapid progress.

Pastures are sufficiently advanced in many sections so that stock has been turned in, affording much relief from the scarcity and high price of feed and diverting labor from the care of live stock to urgent field work.

Winterkilling of winter wheat amounted to about 6 per cent of the acreage seeded last fall, as shown by the May 1st report of the Iowa Co-operative Crop Reporting Service. The condition of the surviving winter wheat at that time was 85 per cent. This crop has made good progress

during the warm weather of the last few days and hides the ground in Adair county. The condition of rye was 91 per cent; tame hay, 92; pastures, 85.

Fruit in general was in better condition by 7 per cent May 1st than it was a year ago, according to the secretary of the State Horticultural Society. "The condition of apples was 80; pears, 77; cherries, 83; Americana plums, 81; Domestica plums (few grown), 77; Japanese plums (few grown), 75; peaches (south half of state only), 44; grapes, 88; strawberries, 89; currants, 83; gooseberries, 88; black raspberries, 85; red raspberries, 80; and blackberries, 84 per cent of a full crop. It is feared by some that considerable damage was done to the fruit buds by the cold weather some months ago which, if so, would cause a heavy drop of buds later. However, it does not take a large amount of bloom to make a good crop, if a fair amount of the bloom sets fruit and proper spraying is done." Fruit prospects are more promising than for some time. Plums and cherries burst into full bloom this week in the central and southern districts and apples in the extreme south. The accompanying warm, sunshiny days should insure fertilization and a good set of fruit. Peaches in the south tier of counties show more bloom than for the past 7 years.

Bulletin No. 6, May 18, 1920—

Field work was again stopped by heavy to excessive rains of the 11th-12th and has not been generally resumed except in the northeast and north central districts and on the uplands in some other sections. Not more than 30 per cent of the corn has been planted as compared with 40 per cent on the 15th last year. However, about 80 per cent has been planted in Pocahontas county. There are some reports of corn rotting in the cold, wet seed bed. Practically no corn is up yet. Much plowing remains to be done, and in the south-central district on many farms not a furrow has been turned.

Sunshine averaged but 35 per cent of the possible amount, or about half of the normal; rainfall averaged 2.0 inches, or about twice the normal; and the temperature averaged 52°, or 8° below the normal. White frost was general on the morning of the 14th and in the northern districts on the 12th, but serious damage is not believed to have resulted. The lowest temperature reported was 31° at Decorah, Iowa City and Stockport. A return to seasonable weather is indicated by the weather map this morning (18th).

Apples, plums, cherries, pears and strawberries are in bloom in the central districts, but buds are just beginning to open in the northern counties. The second spraying will take place soon in the central districts.

Grass, small grains, truck crops and gardens are making slow progress. Potatoes that have been planted six weeks are just showing the rows.

Bulletin No. 7, May 25, 1920—

Corn planting and preparation therefor made good progress, except where interrupted by heavy rains in the northeast one-fourth of the State and by wet soil in the southern counties. For the State as a whole approximately 70 per cent of the corn has been planted. In Carroll, Buena Vista, Pocahontas and some territory in adjacent counties from 90 to more than 95 per cent of the corn has been planted and the first planted is 2 inches high. Increased warmth and sunshine benefited all vegetation. In nearly all sections of the State there is complaint that early planted corn has rotted and replanting is in progress, but the area is probably not as great as that usually devastated by cut worms which up to this time have been reported in only one county, Audubon, and only in limited numbers there. Considerable plowing remains to be done in most sections.

Winter wheat has improved rapidly, is stooling nicely and is 8 to 12 inches high in the southern half of the State. Oats are catching up rapidly and the prospect is now good. Spring wheat is improving and in fair condition; rye very good, and beginning to joint.

Strawberries and other small fruits promise well, except that there was considerable winter killing of blackberries in Fayette county. Tree fruit prospects are unusually good. The second spray is being applied in the central and southern districts.

Truck crops and gardens made good progress, though all are unusually backward. The later planting of commercial sugar beets has been delayed beyond the usual time.

Pastures and meadows made good progress due to the increased warmth and sunshine. The condition of live stock, especially young pigs, improved appreciably. Local downpours of rain in northern Benton and northwestern Linn counties on Saturday, 22d, drowned several hundred head of live stock and washed out crops, railways, concrete bridges, and highways.

Bulletin No. 8, June 1, 1920—

Corn planting made unusually rapid progress, there being no weather delay except in the northwest and southwest districts where showers occurred. In the extreme northwest counties heavy rains fell Wednesday, causing considerable damage to corn fields by erosion and flooding. Planting is completed in many central and northwest counties, nearing completion in the north-central and northeast districts and averages 75 to 90 per cent completed in the southern districts. In Union and portions of adjacent counties not more than one-third of the corn has been planted. Early planted corn where soil and weather conditions were favorable has received the first cultivation, but much of the early planted seed rotted in the ground and replanting is being done. Cut worms have made their appearance in considerable numbers in the west central counties. In the southern counties where the season has been unusually backward, a considerable acreage that was originally intended for oats, but later would have been planted to corn if the weather and soil had been favorable, will now be planted to sorghum, millet, soudan grass and other late crops.

Abundant sunshine and temperature above normal have been favorable for all plant growth, but vegetation still averages 10 days later than normal. Showers would be beneficial in the central and eastern counties to dissolve the clods resulting from early, wet plowing, and to soften the crust that has formed in some localities.

Winter wheat made good progress. It is stooling generally, but not up to normal development for this date. Spring wheat and oats show steady improvement, but are considerably below normal. Pastures and hay have made good progress. Alfalfa will be ready to cut in about a week in the southern counties.

Small fruit prospects continue very good. The petal drop spray was applied to apples in the northern counties during the week. More spraying is being done than heretofore. Apple prospects are good. Peaches will yield a small crop this year for the first time in several years. Cherries promise a good crop.

The second planting of commercial sugar beets is about finished. Late potatoes were planted during the week, but the potato acreage in general will be reduced. An increased acreage of commercial tomatoes is indicated. Commercial cabbage will be set in large quantities this week. There is some complaint of onion maggots in Mitchell county.

Sheep shearing made rapid progress, and is completed in some counties. Livestock has improved considerably with the improved condition of pastures.

Bulletin No. 9, June 8, 1920—

Though too cool for the best growth of corn, the crop made good progress. In the more advanced sections most of it has been cultivated once and cross cultivation has begun. In the more backward southern counties

10 to 15 per cent is yet to be planted and there is some plowing to be done on the lower bottoms. Cut worms, wire worms and bill bugs have damaged corn, but probably not as much as usual for the State as a whole. Dry soil is preventing germination of corn in southern Benton and portions of Linn counties and hard, baked and cloddy soil is interfering with cultivation in sections that were too wet earlier in the season. Fields are generally clean of weeds. In many sections of the State showers would be beneficial, but in the Coon River Valley and south to the south line and east through the southern two tiers of counties the rains of the week have been heavy to excessive; also at Washta in Cherokee county.

Winter wheat has made good progress and is heading in the sections having the largest acreage. Oats have improved, but the color is bad on account of bad soil conditions in the southern counties.

The first crop of alfalfa has been cut in some counties and will soon be cut in all portions of the State. The crop is good. Clover is in bloom in the south half of the State. It with other hay promises well except in a few dry localities. Pastures have made excellent growth, but in the west-central counties are generally under stocked.

Apples have been seriously attacked by canker worm in localities but the crop in general promises well where sprayed. The small fruit crop will be good. Strawberries are ripe in the south and beginning to ripen in the northern districts.

The weather has been favorable for planting and cultivation of sugar beets, though too cool for best growth and the plants are small. The acreage has been greatly increased. Potatoes, truck and gardens are slow.

The secretary of the State Horticultural Society reports the condition of fruit on June 1 as follows: "Apples 85; Americana plums 78; cherries 81; pears 69; strawberries 90; grapes 85; red raspberries 82; black raspberries 87; blackberries 83; gooseberries 80; currants 82; peaches, (few grown) 40; Domestica plums, (few grown) 69; Japanese plums, (few grown) 62 per cent. The average for all fruit is 76 per cent, which is 14 per cent higher than the condition reported one year ago and 3 per cent lower than the May 1, 1920, report. At the present time it would seem that Iowa will have the best crop of fruit she had at any time."

Bulletin No. 10, June 15, 1920—

Hot, dry weather, with abundant sunshine prevailed, except scattered showers, mostly light, though excessive rain fell in Lyon county accompanied by damaging hail and wind on the 11th. Maximum temperatures of 90° or higher occurred on nearly every day and many stations had 95° or higher on the 13th. The mean temperature, 80°, is 12° above normal, 3° above the corresponding week last year, and the warmest June week since June 3-9, 1911.

Corn made rapid progress but varies from the just breaking through the ground, to some more than a foot high. There is yet about 5 per cent of the acreage to be planted in some southern counties. The earliest corn has been cultivated twice. Fields are mostly clean of weeds except where there is a shortage of labor.

Winter wheat is generally in head and is entering upon the most critical period—the filling period. Spring wheat is beginning to head and oats are jointing, though both are short. Oats are showing much red discoloration of the leaves, but otherwise small grain diseases are not as prevalent as at this date last year, due probably to the dry weather. The humidity of the past week has been about 20 per cent less than during the corresponding week last year.

Small fruits are badly needing rain, especially strawberries which are ripening in the south half of the State. Cherries are beginning to turn in the central counties. Grapes are in full bloom and are quite promising. Apples are dropping badly where not properly sprayed.

Gardens and truck crops need rain, but are making good progress. There is some complaint of a thin stand of onions in Mitchell county. About 75 per cent of the commercial cabbage has been planted and the acreage has been considerably increased. Late and replanted sugar beets are awaiting rain to germinate the seed.

Alfalfa is being cut generally and is a fair crop. Red and white clover is in bloom except in the northern counties. The hay crop is being reduced a certain amount by each day the hot, dry weather continues. Pastures are holding their own well in spite of the unfavorable weather.

Reports tabulated by the Iowa Weather and Crop Service show that on May 15, 36 per cent of the intended corn acreage of the State has been planted as compared with 40 per cent on that date last year and that on June 1, 91 per cent had been planted as compared with 95 per cent last year. The percentage condition of the crop on June 1 was 88 as compared with 95 per cent last year and a ten-year average of 92. The condition of potatoes was 90 as compared with 97 last year. Reports to the Iowa Cooperative Crop Reporting Service June 1 show the condition of oats as 92; spring wheat, 88; winter wheat, 83; barley, 92; rye, 90; all hay, 93; pastures, 93; alfalfa, 90; all of which are below the average of the last 10 years. The condition of winter wheat is the lowest since 1903.

Telegraphic reports Tuesday morning show good showers over the northern part of the State.

Bulletin No. 11, June 22, 1920—

Much cooler weather beginning Wednesday, 16th, was beneficial for small grains which were in or approaching the critical heading and blooming period. Reports are somewhat conflicting as to the effect of the hot weather of the preceding week on small grains, but in general no serious damage occurred. Spring wheat and oats are in fair to good condition and heading generally, but short. Winter wheat is blooming and filling and promises nearly an average condition generally. All small grains need rain badly in the southern and to some extent in the central districts, where in many places the ground is baked hard and large cracks have appeared.

Corn cultivation was pushed rapidly, except where delayed by rain in some northern localities. The earliest is knee high and has been cultivated three times, while the second cultivation is far advanced except in the backward southern districts. Fields are generally clean of weeds and grass in spite of the shortage of farm labor. A light touch of frost, but no damage, was reported from lowlands in some north-central and northeast counties on the night of the 17th. The nights were generally too cool for the best growth of corn.

Clover harvest is beginning but the crop was considerably reduced by the recent hot, dry weather in the south and central districts. Other hay is reduced by the same causes, except alfalfa, most of which has been cut the first time and yields well. The weather has been ideal in most sections for harvesting alfalfa and clover, and the crop, so far, has been put up in splendid condition.

Strawberry picking is about over in the southern counties where the crop was somewhat reduced by heat and drouth. Early cherries are on the market except in the northern districts. All fruits need rain, except in the northern counties.

Bulletin No. 12, June 29, 1920—

Cool weather continued till Saturday, 26th, when it turned much warmer. Hot, strong, southerly winds Sunday and Monday, caused the corn leaves to roll and wilted garden truck in the central district and east and south where precipitation has been generally deficient for the past few weeks. Good rains Monday night, 28th, over most of the drouthy area will be of

great benefit to all crops. The rain came too late for the hay and strawberry crops, but will improve the later small fruits, cherries and truck. Early potatoes are in bloom as far north as the central district.

Corn has made very good progress and now averages nearly up to normal development for this date. The earliest is reported waist high, or too high to cultivate, in Blackhawk and Jasper counties and the latest is just showing through the ground where three plantings were necessary due to cut worm damage in some west-central and southwest counties, and very short where wet soil delayed planting in the south-central district. Considerable corn is being "laid by."

Small grain benefited greatly by the cool period 16th-25th. Winter wheat has headed and filled well, is beginning to turn in color in the south half of the State and promises a good yield. Spring wheat has improved somewhat but is heading on short straw, shows a very uneven stand, poor color and the yield will be below the average. Oats also headed short and the yield will be only fair.

Clover harvest is in progress and good yields are reported except in the drouthy area. Haying will become general after the Fourth of July and a good crop is indicated in the north and most of the west portion of the State.

Pastures are in good condition, more as a result of under stocking than of favorable weather. All indications point to a diminished live stock production, especially pigs.

Bulletin No. 13, July 6, 1920—

Corn has made wonderful progress, due to rainfall and temperature both being above normal. Much has been laid by; considerable is growing so rapidly that by the time the present rainy period is over it will be too large to cultivate and lay by in the usual manner; and there are scattered reports of tasseling. In Hardin county the prospect is the best in 25 years. As a whole the crop is up to normal for this date, though unusually variable in stage of development over the State. The south three sections are still backward, but catching up rapidly.

Winter wheat harvest will soon become general. Cutting began in Mahaska county on Saturday, 3d. A good yield is now indicated. Spring wheat is turning color in places, but is unusually variable in development and stand, and in general promises a yield below the average. Oats are headed on short straw and the earliest are beginning to ripen. The yield will be considerably below the average. Barley is turning and will be ready to cut in a week.

Haying has been delayed by rains, though considerable clover has been cut. The yield is below the average. The second crop of alfalfa is making excellent progress.

Severe windstorms occurred in many sections of the State on the afternoon and night of July 1, accompanied in some cases by hail. The worst wind was in Lee, Adams and Union counties. In Adams county there was a well defined tornado that caused complete destruction over a limited area. The windstorm flattened the small grain so that it can be cut only one way, broke off considerable corn, blew off much tree fruit and broke down large numbers of trees of all kinds.

A large crop of late cherries is being harvested. Blackberries and raspberries are being harvested and good yields are reported. Truck crops have shown great improvement during the past week.

The secretary of the State Horticultural Society reports the condition of the fruits on July 1, as follows:

"Summer apples, 54; fall apples, 67; winter apples, 55; Americana plums, 67; cherries, (final crop), 82; pears, 58; strawberries, (final crop), 70; grapes, 85; red raspberries, 76; black raspberries, 86; blackberries, 74; gooseberries, (final crop), 84; currants, (final crop), 80; peaches, 30; Domestica plums, 61; Japanese plums, 53 per cent. The average for all fruits is 68 per cent which is 21 per cent higher than the condition report of one year ago, and 8 per cent lower than the June 1, 1920 report."

Bulletin No. 14, July 13, 1920—

Abundant rains and moderate temperatures have been generally favorable for crops, though haying has been delayed and some clover damaged by the rains.

Corn has made excellent progress, in spite of the cool weather. It is farther advanced than usual in the central and northern districts and averages not more than a week later than normal in the backward southern districts, where it is catching up rapidly. Tassels are showing all over the State and most of the crop is laid by with the fields generally clean of weeds and in good condition. The soil is abundantly stored with moisture. Corn could now stand considerable drouth and yet mature a good crop if future sunshine and temperatures are favorable. It is yet too early to say that the corn crop is assured.

Winter wheat harvest is in full progress northward to the central counties when the weather will permit. The cool weather has favored the filling of the heads and good yields and quality are indicated. Early oats harvest is well along in the southern counties and beginning as far north as Polk county. Though the straw is short and the stand thin and patchy, early harvest reports indicate that this crop will be better than expected, the recent cool, moist weather having filled the heads. Late oats have likewise been benefited and are now quite promising. Barley is turning and will soon be ready to cut.

Diseases of small grains which have been conspicuous by their absence this season, became noticeable this week, but too late in the season to cause serious damage. Black stem rust is reported in Woodbury and some other counties and closed smut in the central Mississippi counties.

Hail storms were unusually prevalent particularly on the 7th, but also on the 8th and 9th. Large damage to crops occurred in Clayton, Dallas, Davis, Mahaska, Polk, Scott and Winneshiek counties and lesser damage in Buena Vista, Clinton, Fayette, Harrison, Marion, Pottawattamie and Union. The damage will probably total more than a half million dollars. That in Scott county alone approximates $100,000, mostly covered by insurance.

Late potatoes were greatly improved by the cool rainy weather of the week. Early potatoes are being used in the south half of the State though the quality and yield are not satisfactory.

Reports to the Co-operative Crop Reporting Service showed the following percentage condition of crops on July 1: Corn, 90; oats, 83; spring wheat, 85; winter wheat, 86; barley, 88; rye, 90; flax, 90; potatoes, 90; hay, 88; pastures, 96; alfalfa, 94 per cent. All crops were below the 10-year average except hay and pastures. The high condition of pastures is accounted for by the decrease in the numbers of live stock. Corn acreage is about 2 per cent greater than last year and approximates 10,200,000 acres.

Bulletin No. 15, July 20, 1920—

Rainfall averaged nearly normal, though excessive downpours occurred in Monroe and Wayne counties. Some overflow occurred along the lower Des Moines River, but the damage to crops is relatively small. The soil is well filled with moisture and no place in the State is suffering from a deficiency. Temperatures so far in July have averaged low for the time of year, but warm enough in connection with frequent showers to cause considerable increase in the diseases of small grain in the west-central and northwest portions of the State.

Spring wheat, in particular, is affected by black stem rust, red rust and blight, and the yield and quality will be fair to poor in those portions of the State and not very good elsewhere. Winter wheat harvest is far advanced and threshing begun northward to Warren county. Good yields and excellent quality are indicated.

Early oats are headed on short straw and the heads are small, but the quality is generally good. Early oats harvest is practically completed in the south and well advanced in the north portions of the State. Late oats have improved generally with the moist and relatively cool weather, though attacked by red rust in the western counties. The straw is longer and the heads larger and better filled than the early oats. They are now ready for harvest in the southern counties.

Barley harvest is in progress and the yield will be good.

Corn shows steady improvement and now averages slightly above normal. The late corn in the southern counties is catching up rapidly and can scarcely be distinguished from the earlier corn. Tasseling will be general in all portions of the State during the coming week. Silks have already appeared in the earlier fields. The color of the plants is a luxuriant dark green. Prospects for a corn crop are now good.

Haying and harvest have been somewhat hindered by the rains. Timothy and clover are light crops except in the northern counties where rainfall was abundant and temperatures lower during the critical June period. Second crop alfalfa harvest is beginning in the southwest counties and good yields are again reported.

Truck crops have improved. New potatoes of unusual size and abundance are on the market in the northern counties, though somewhat disappointing in the south. At Des Moines the retail price is $1.35 per peck. Commercial tomatoes give promise of an early and abundant crop.

Bulletin No. 16, July 27, 1920—

Showers were mostly light and scattered, except that moderate to heavy rains were general in the Raccoon valley Tuesday night the 20th-21st. Soil moisture is generally sufficient though rain is needed in a few localities in Lyon, Dubuque and Scott counties. Hot weather prevailed the first of the week but turned cool toward the close. Maximum temperatures of 100 degrees or higher occurred at a few stations in the western portion of the State.

Crop prospects in general are very good. Corn over two-thirds of the State is above the normal condition. Tasseling is general, ears are shooting and silks appearing. It is entering the critical, pollination stage with moderate temperatures and ample soil moisture in most sections. A good, general rain in the next few days would be beneficial.

Early oats and winter wheat are all harvested and late oats and barley harvest well advanced. Considerable winter wheat has been thrashed in the southern half of the State which is the largest producing section. The yields so far run from 20 to 45 bushels per acre, testing 61 to 62 pounds per bushel, grading No. 2 or higher and selling for $2.50 to $2.53 per bushel. No thrashing returns have been received from spring wheat, but the yield will undoubtedly be light and the quality poor, especially in the western and northern portions of the State where scab, smut, rust, blight and other diseases have been nearly as prevalent as last year. The yield and quality of oats are better than expected, being about the average of the last 10 years.

Haying made excellent progress and much of the crop was cured without rain. Considerable timothy was cut for seed, but the yield of seed is probably below the average in the principal producing areas. First crop clover cut for seed in Henry county is yielding up to three bushels per acre. Second crop alfalfa harvest is in progress and good yields are again reported.

Truck crops and gardens are good in nearly all portions of the State though early potatoes are not very good in the southern portion. In the large potato producing counties of the north-central portion of the State new potatoes are so good and plentiful that they are being sold at reduced prices, while at Des Moines and Marshalltown the retail price is $4.00 per bushel and further south the price is still higher. All truck crops would be benefited by rain.

Bulletin No. 17, August 3, 1920—

Cool nights with dry weather in most of the state, were unfavorable for the best development of corn. The drouth is most marked in the extreme northwest, east-central and Mississippi River counties, where on thin soils corn is curling and firing, but would fully recover if rain comes soon. Though the surface is dry, considerable moisture remains in the subsoil. Corn and other deeply rooted crops are therefore not as a rule suffering seriously.

Harvesting, haying and thrashing progressed rapidly during the dry weather of the past two weeks. Only occasional fields of late oats, barley or spring wheat in the northern tier of counties remain unharvested. The yield of winter wheat has been satisfactory. Thrashing returns from oats, mostly in the southern half of the state where the crop in its early stages was thought to be the poorest, show yields averaging slightly above 40 bushels per acre, or about 3 bushels per acre above the state-wide 10-year average. In most of the northern part of the state the crop is reported as turning out better than expected. Reports on spring wheat, especially in the northern and western portions of the state, continue poor. The quality of small grains other than spring wheat is good to excellent. This is partly due to the excellent harvest weather. Thrashing is progressing rapidly and less than the usual amount of stacking will be done.

Truck crops, pastures and meadows in the drier areas are seriously needing rain. The rains of early July in most sections of the state gave newly seeded clover and grasses an excellent start. Some new clover fields in the central part of the state have made such rank growth that a crop of hay yet this season or much good pasturage is possible, if further rains are timely.

Bulletin No. 18, August 10, 1920—

Rains of the week were local and mostly insufficient. From Emmet county southeast to Blackhawk and in portions of Dallis, Polk, Decatur, Scott and Winneshiek counties the rains were copious and will insure a corn crop so far as moisture is concerned. In the western districts the extreme southeast counties and a few other small areas the drouth continues.

Corn has fired and curled badly on uplands and thin soils in many portions of the State, yet most of the crop has not suffered beyond recovery. Roasting ears are reported in the earlier fields, but the cool weather for a long period prior to this week has had its effect and the crop as a whole is at least a week later than normal for this date. Unless temperatures are somewhat above normal during the next month there will be considerable soft corn.

Shock thrashing made good progress. Yields of oats, winter wheat, barley and rye continue satisfactory and the quality is good, but spring wheat is generally poor in yield and quality. Coal shortage has interfered with thrashing in some localities and therefore caused more stacking than was intended. Car shortage has retarded shipment and the elevators are filled to capacity.

Fall plowing has started where soil moisture is sufficient. There is less complaint of shortage of farm labor than for several years. Unsettled conditions of finance and transportation are causing cattle feeders to hesitate in embarking upon their usual programs.

Late potatoes and truck crops have suffered considerably from drouth. Sugar beets for manufacture in the north central counties have been favored with sufficient moisture, but the fields are weedy and prospects are not the best.

The Iowa Co-operative Crop Reporting Service gives the conditions of the principal crops on August 1st as follows: Corn, 94 per cent, indicating a total production of 412,284,000 bushels; winter wheat average yield per acre, 20 bushels; total crop, 8,620,000 bushels; spring wheat condition, 70 per cent.

Truck crops and gardens are good in nearly all portions of the State indicating a yield of slightly above 13 bushels per acre and a total production of 5,480,000 bushels; oats yielding nearly 38 bushels per acre and a total crop of 208,010,000 bushels; potatoes, condition 90 per cent, indicating about double last year's crop.

The secretary of the State Horticultural Society reports the condition of fruit on August 1st as follows: Summer apples, 59 per cent; fall apples, 64; winter apples, 60; Americana plums, 65; pears, 63; grapes, 85; red raspberries, 74; black raspberries, 73; blackberries, 63; peaches, 35; Domestica plums, 55; Japanese plums, 50 per cent.

Bulletin No. 19, August 17, 1920—

Deficient temperature, sunshine and rainfall were unfavorable for growing crops this week. Scattered localities had good rains from the 10th to 13th, but most of the area of the State had light showers or none.

Corn made slow progress. The bulk of the crop for the State as a whole is only in the roasting ear stage and so far even the earliest has not been reported as beginning to dent. Unusually favorable weather is necessary during the next month to avert frost damage. A good yield is indicated, but with normal weather from now on and normally early frost a considerable per cent of the ears will be soft. The cool, cloudy weather arrested the firing and curling, especially where accompanied by showers.

Shock thrashing is practically completed in many southern counties. This week a number of correspondents report less stacking than usual. Much of the small grain is being held on the farm because of the unsatisfactory prices to the farmer and the poor transportation facilities. Yields of oats and barley in the northern counties are generally normal or above, quality good, thrashing nearly half completed.

Pastures in many localities are becoming short as a result of the dry weather. A slight movement of feeder cattle into the State is noted this week.

Truck crops and potatoes are generally suffering for rain. Commercial tomatoes are being harvested in Mahaska county with good yields in prospect. The first field of commercial onions harvested in Mitchell county yielded 550 bushels per acre. Late fruit prospects continue very good.

Bulletin No. 20, August 24, 1920—

Rains of the 19th-21st covered most of the State, ranging from none at a few stations in the southeast, to excessive from Mills, Montgomery and Adams counties northeastward over Carroll, Greene, Humboldt and Worth counties. At Humboldt, 5.93 inches fell and at Carroll, 5.72. The week opened warm but turned much cooler during and after the rains. Temperatures low in the forties prevailed on Sunday morning, 22d, the lowest reported being 41, at Washta, Cherokee county. Light frost was reported in the Big Sioux bottom on the morning of the 21st and on the lowlands in Franklin and Marion counties on the morning of the 22d.

Corn will be benefited by the rain where not injured beyond recovery on the thinner soils and uplands by the preceding drouth. There is the possibility, however, that the added moisture will start new growth and delay maturity if cool weather continues. From many sections the stalks

are reported to be of unusual height. Only the earliest has begun to dent, while the latest is still in the milk. A warm month is imperatively needed to place the bulk of the crop out of danger from frost. Wind on the 20th blew down considerable corn in Adair, Audubon and Polk counties.

Thrashing was considerably delayed by the rains, particularly in the north where nearly half of the shock thrashing remains to be done. In the north central counties shocked grain was damaged by the excessive rains.

Plowing has started vigorously where the soil has been made sufficiently moist. In the southeast and part of the south-central district the ground is too hard to plow. In the southwest and west-central districts the moisture makes possible the preparation of a good seed bed for winter wheat and it is probable that more than the normal acreage will be seeded in those sections.

Pastures, late potatoes, sweet corn, and late truck crops were greatly benefited by the rains. Onion harvest in Mitchell county made good progress. The yield will average about 500 bushels per acre. Cabbage is also being harvested. Early grapes are ripening; early plums are being harvested; and winter apples in sprayed orchards promise a good crop.

Bulletin No. 21, August 31, 1920.

Another cool week with deficient rainfall has been unfavorable for crops.

Corn has remained practically at a standstill. Reports of denting have been received from only a few localities, mostly in the northern half of the State. The bulk of the crop is yet in the roasting ear stage and much is yet in the milk. The damage referred to in last week's bulletin as resulting from wind on the 20th has been extensively discussed with township crop reporters visiting the State Fair this week. It appears that for some unknown reason corn in nearly all portions of the State has not put out strong brace roots. Some correspondents state that the corn root worm has been working extensively and others that some sort of a rot or fungus has attacked the roots. The heavy rains of the 19th-21st over much of the western and northern portions of the State loosened the soil and weighted down the corn stalks which were unusually tall and heavy. As a rule the stalks lie in all directions in a tangled mass and not in one direction as is usual when blown down by wind. The damage was equally as great on new ground as on old. Approximately a half million acres have been damaged in this way and with the crop in its present backward condition the value will be reduced at least half over that area for it has little chance to recover. Moreover, it is believed that over much of the State the same poor rootage prevails and that heavy rains or moderately strong winds would produce the same result.

Shock thrashing is practically completed. Only stack thrashing remains to be done and this is but a relatively small portion of the crop.

Fall plowing made good progress during the week, particularly where moisture is sufficient. Considerable was done even in dry, hard soil by the use of tractors.

In anticipation of considerable soft corn this fall and because of the shortage of cars for transporting grain to market, there has been a considerable movement of feeder stock, mostly cattle and sheep, into the State recently. Pastures and new seedings of clover and timothy are in good condition except in the southeast portion of the State where the drouth continues generally.

Late apples have dropped badly where not sprayed, but in orchards that are well cared for, there is a fair crop of good quality. Grapes are abundant and of good quality.

Commercial truck crops are being harvested and marketed. The yield is good where rain has been sufficient. Late potatoes are suffering for rain in the south-central and southeast districts.

Bulletin No. 22, September 7, 1920—

For the fourth consecutive week temperatures have averaged below normal. Rain fell in all portions of the State during the week exceeding an inch over a belt extending from the south-central district northward over portions of the north-central and northeast districts. In some of the south-central counties nearly four inches occurred. Sunshine was deficient.

Corn has made slow progress. In the south-central and southeastern districts the rain aided the development of the late-planted corn, but early corn, which in some sections had begun to show signs of drying and maturing, was made green again. Denting is general in the earlier fields of the northern half of the State, yet the bulk of the crop is only in the hard dough stage and much late corn is still in the milk. A little will be ready for the silo in 10 days to two weeks. The prostrate and tangled condition of the crop in many west and north-central counties will make the use of corn binders nearly impossible.

Only abnormally warm and dry weather during the next 30 days can save the corn crop from serious frost damage. Reports received from nearly 500 township correspondents showed that with normal weather from September 1st to September 26th only 42 per cent of the crop would be safe from frost on that date, and to September 30th, 67 per cent. If frost holds off till October 15th, 87 per cent will be safe, and if it holds off till October 31st, 96 per cent will be safe. As the average date of killing frost is October 10th and another cool week has farther retarded the development since the above estimates were made by our correspondents, it now seems fairly certain that 20 to 40 per cent of this year's great and otherwise promising crop will be frosted and soft.

Pastures, potatoes, truck crops and new seedings of grasses and clover were greatly benefited by the rains. Commercial tomatoes and sweet corn are turning out well. Canning has been in full progress for more than two weeks.

Fall plowing and preparation for winter wheat seeding made good progress, except where delayed by frequent and heavy rains, or in some localities in the southeast portion of the State where the soil is too dry from lack of rain.

At the close of August, 91 per cent of the thrashing had been done, which is about 20 per cent more than normal and the greatest in the last 10 years.

The acreage of timothy cut for seed this year is about 250,000, and the yield is good, though exact figures are not yet available.

Bulletin No. 23, September 14, 1920—

Cool weather at the beginning of the week was followed by four days of warm, sunshiny weather that brought the mean temperature of the week up to 71 degrees, which is 4 degrees above normal and corresponds to the usual temperatures of the last week in August. Maximum temperatures around 90 were general on the 11th. Rainfall generally exceeded an inch, except in the east one-fourth of the State, where it was mostly light, and in some of the west-central and northwest counties, where there was none.

Corn was at about the stage of development usually expected on August 25th when the warm weather came and started it to advancing more rapidly. The bulk of the crop is now denting, but the heavy rains will have a tendency to prolong its vegetative activity and retard maturity. The earliest planted corn is being cut for silage in some localities, though much difficulty is being experienced in the use of corn-cutting machinery because of the tangled condition of the stalks in large areas and the wet soil. Early corn is now far enough advanced to gather for seed and without delay a supply of this corn should be selected and given proper care.

Commercial sweet corn is yielding better than usual and the quality is very good. Canneries are putting up a generous pack. The stage of development of the crop is indicated by the fact that at this time of the year factories are usually rejecting many hard ears, but this year practically no hard ears are found, while some are being rejected as too milky. Ear worms have thus far been less numerous than usual. A large pack of tomatoes is also reported.

Sugar beets have been greatly benefited by the rains, but they now need warm, dry, sunshiny weather to promote ripening. The cool, wet weather has been favorable for potatoes.

Winter wheat seeding is far advanced in Adair and Madison counties with about the normal acreage. The acreage in Warren county, which is the principal producing county, will be above normal. Fall plowing has made rapid progress and is finished in some localities.

The percentage condition of corn on September 1 was 90; potatoes, 90; flax, 90; and pastures, 89. A year ago the conditions were: Corn, 96; potatoes, 60; flax, 83; and pastures, 90. It is probable that the corn crop will rank third among the larger total productions in the State, but unfortunately a large per cent is almost certain to be caught by frost. The production of potatoes will be more than double that of last year.

The Secretary of the State Horticultural Society reports the condition of fruit on September 1 as follows: Fall apples, 68 per cent; winter apples, 61; Americana plums, 47; pears, 64; grapes, 82; peaches, 27; Domestica plums, 50; Japanese plums, 47.

Bulletin No. 24, September 21, 1920—

Corn advanced rapidly toward maturity as a result of the warm, dry and sunshiny weather with strong breezes that prevailed in most sections of the State during the past week. The average temperature, 72 degrees, is 9 degrees above normal and places it among the warmer weeks of the season. Temperatures around 90 on the afternoon of the 14th were followed by cooler in the middle of the week and warmer again at the close. Heavy to excessive rain fell in southeast Iowa on the 14th-15th and moderate showers in the northeast portion the night of the 19th.

Approximately half of the corn crop is now safe from frost. Silo filling and fodder cutting is general. Hogging down has begun in some localities. Every day of warm, dry, sunny weather adds greatly to the value of the crop.

Winter wheat seeding is being pushed rapidly and the earliest is up and showing green. The soil is becoming too dry to plow in many sections of the State.

Sugar beets have been greatly benefited by the recent weather. While the yield in tons per acre is not unusually large, the beets are ripening up rich and harvest will begin about October 1. The factories will start operation about October 4.

Sorghum has matured a good crop and the factories are busy manufacturing syrup.

The Mitchell county truck crops section is marketing a bountiful crop of potatoes, cabbage and onions. About 20 car loads per day are being shipped from the town of St. Ansgar alone and more would be shipped if cars were available.

Bulletin No. 25, September 28, 1920—

Abnormally high temperatures, abundant sunshine, generally light to moderate rainfall and strong southerly breezes have rushed the belated corn crop toward maturity. For the State as a whole 80 to 85 per cent of the crop is safe from frost, ranging from as little as 50 per cent in some

south-central and southeast counties to practically all safe in some central and northeast counties. Silo filling and fodder cutting is completed in the earlier localities and is getting well under way where the crop is late. Much seed corn was saved during the week. In a few places early corn is dry enough to crib in limited quantities. Locally heavy rains and high winds blew down and tangled the corn and in some cases caused other destruction, particularly in Carroll, Sioux and Ringgold counties. The tangled condition of the corn in the western half of the State is proving to be a serious handicap in cutting for fodder and for silos. In some cases machines do not get more than half of it. In some sections the corn is so tall and heavy that it is difficult to handle.

Temperatures around 90 degrees prevailed on Saturday afternoon, the 25th, followed by much cooler Sunday night with minimum temperatures around 40 degrees. The mean temperature, 71 degrees, is 11 degrees above normal and is among the higher temperatures of record so late in the season.

Winter wheat seeding has made good progress, except in a few localities where the soil is too dry to prepare the seed bed. Hessian fly has appeared in troublesome numbers in Pottawattamie county and farmers are there waiting till about October 1 before beginning to sow wheat. Much of the crop is up and looking well.

Sweet corn canneries are drawing their operations to a close. The pack has been large and of excellent quality. Many yields of 6 to 7 tons of ears per acre are reported. The ear worm has become troublesome during the past week, but the cool, backward season seems to have checked its depredations considerably.

Apples are abundant but many were blown from the trees by winds or are falling as a result of disease or worms. In Warren county, and no doubt elsewhere, much of the crop is rotting on the ground for lack of a profitable market.

Bulletin No. 26, October 5, 1920—

All vegetative activity, except in the southeast portion of the State, was brought to a sudden halt by a decided change to colder weather. Light frost on the morning of September 29 in the north and west counties was followed by heavy frost on the 30th and general killing frosts and freezing temperatures on the morning of October 1. Reports from about 500 correspondents on October 1, show that 84 per cent of the corn was safe from frost damage. More than 90 per cent was safe in most northeast and east-central counties and some western counties, while in some south-central and southeast counties less than 70 per cent was safe. In the latter sections the frost was not severe enough to do much damage, and it is probable that for the State as a whole not more than 10 per cent of the crop will be soft. This will be easily absorbed by feeding on the farms. The abnormally warm and dry three weeks in September worked wonders in saving the crop. Cribbing of the earlier corn will start in about two weeks if the weather continues favorable. "Hogging down" has begun. Six cents per bushel is being offered for husking where the corn stands up well.

Winter wheat seeding continues where the soil is moist enough, but the later seeding lies ungerminated in the ground and needs rain. The earlier seeded wheat is looking green and fine.

Pastures have been cut short by the dry weather and live stock has been put on winter feed. Some fourth crop alfalfa is being cut. Where money is available for loans to stockmen, large numbers of feeding stock have been shipped in to consume the abundant forage, but in many sections money is not available for such loans and this very desirable agricultural enterprise is at a standstill.

About 60 per cent of the potatoes, cabbages and onions have been harvested and the yields are very good. Potatoes are selling in Crawford county for 60 cents per bushel and in Mitchell and Franklin counties for 75 cents; onions, $1.10 per cwt.; cabbage, $10 per ton.

CROP SEASON WEATHER, 1920, BY WEEKS.

Average rainfall, mean temperature and mean sunshine with departures from the normal, as derived from the records of 24 selected stations.

Week ending	Rainfall (inches)		Temperature (Deg. Fahr.)		Sunshine	
	State average	Departure	Mean	Departure	Per cent	Departure
April 6	0.7	+0.1	35	— 8	54	— 7
April 13	0.4	—0.3	40	— 7	64	+ 4
April 20	1.7	+1.0	46	— 4	40	—20
April 27	0.9	+0.1	50	— 3	31	—31
May 4	0.5	—0.4	50	— 5	34	— 5
May 11	0.3	—0.7	60	+ 2	63	— 1
May 18	2.0	+1.0	52	— 8	35	—31
May 25	0.8	—0.2	65	+ 3	72	+ 6
June 1	0.4	—0.6	68	+ 3	68	+ 3
June 8	0.9	—0.2	65	— 2	64	— 3
June 15	0.5	—0.5	80	+12	84	+15
June 22	0.7	—0.4	65	— 5	52	—17
June 29	1.0	0.0	74	+ 2	74	+ 4
July 6	2.2	+1.3	74	+ 1	60	— 2
July 13	0.8	—0.2	60	— 5	66	— 8
July 20	0.8	—0.1	72	— 3	76	+ 2
July 27	0.2	—0.6	75	0	78	+ 5
August 3	0.1	—0.7	72	— 3	89	+16
August 10	0.6	—0.2	75	+ 1	60	— 3
August 17	0.6	—0.2	71	— 2	59	—12
August 24	1.5	+0.7	68	— 3	61	— 8
August 31	0.5	—0.3	68	— 2	79	+12
September 7	1.0	—0.2	64	— 4	49	—16
September 14	1.1	+0.3	70	+ 4	63	— 1
September 21	0.2	—0.6	72	+ 9	87	+24
September 28	0.8	0.0	71	+11	72	+10
For season	21.2	—1.9	64.3	— 0.6	64	— 2

+ excess; — deficiency.

MONTHLY PERCENTAGE CONDITION OF CROPS, 1920, AND YIELD PER ACRE

Crops	Apr. 1	May 1	June 1	July 1	Aug. 1	Sep. 1	Oct. 1	Yield per acre
Corn			88	90	94	90	93	46.0 bu.
Oats			92	83	89			29.6 bu.
Spring wheat			88	85	70			11.3 bu.
Winter wheat	55	85	83	86				19.7 bu.
Barley			92	88	89			27.5 bu.
Rye	90	91	90	90				16.2 bu.
Flax				90	90	90	85	10.0 bu.
Potatoes			90	90	92	90	90	110.0 bu.
Tame hay		92	93	88	90			1.44 tons
Wild hay				93	88	90		1.27 tons
Alfalfa			95	94	98			2.84 tons
Pastures		85	93	96	94	89	90	

FINAL CROP REPORT OF THE STATE, 1920.

The following estimates of acreage, yield and value of the crops of the State, derived from the reports of hundreds of correspondents well distributed in each county, are the result of the joint effort of the U. S. Bureau of Crop Estimates, of which Mr. Frank S. Pinney is Agricultural Statistician, and the Iowa Weather and Crop Service. The table showing the total value of crops does not include or take into account live stock products.

Corn.—The estimated acreage was 10,300,000; average yield, 46.0 bushels per acre; total yield, 473,800,000 bushels; average price $.47 per bushel; total value, $222,686,000. Only 10 per cent of the crop was reported to be soft or immature and 77 per cent had been husked on December 1. The total production of corn in Iowa this year is the greatest of record. The quality is very good.

Oats.—The estimated area harvested was 5,893,600 acres; average yield, 39.0 bushels; total yield, 229,850,400 bushels; average price 36 cents; total value, $82,746,144.

Spring Wheat.—Area harvested, 400,000 acres; average yield, 11.3 bushels per acre; total yield, 4,520,000 bushels; price per bushel, $1.35; total value, $6,102,000.

Winter Wheat.—Area harvested, 431,000 acres; average yield, per acre, 19.7 bushels; total yield, 8,490,700 bushels; average price $1.41 per bushel; total value, $11,971,887.

Barley.—Area harvested, 284,000 acres; average yield per acre, 27.5 bushels; total yield, 7,810,000 bushels; average price, 63 cents per bushel; total value, $4,920,300.

Rye.—Area harvested, 80,000 acres; average yield, 16.2 bushels; total yield, 1,296,000 bushels; price per bushel, $1.17; total value, $1,516,320.

Flax Seed.—Average yield, 10.0 bushels; total yield, 120,000 bushels; total value at $1.80 per bushel, $216,000.

Timothy Seed.—Area harvested, 270,000 acres; average yield, 4.9 bushels; total yield, 1,323,000 bushels, total value at $3.00 per bushel, $3,969,000.

Clover Seed.—Area harvested, 134,000 acres; average yield 2.0 bushels; total value at $11.65 per bushel, $3,122,200.

Potatoes.—Area harvested, 104,500 acres; average yield, 110 bushels; total yield, 11,495,350 bushels; average price, $1.22; total value $14,024,327.

Hay (Tame).—Average yield, 1.44 tons per acre; total yield, 4,349,620 tons; average price, $16.24 per ton, total value, $70,637,829.

Hay (Wild).—Average yield, 1.27 tons; total yield, 647,700 tons; average price, $12.69; total value, $8,219,313.

Alfalfa.—Area harvested, 200,000 acres; average yield, 2.84 tons, total yield, 568,140 tons; average price, $19.23 per ton; total value, $10,925,332.

TABULATED CROP SUMMARY, 1920.

Crop	Acres	Average Yield	Average Price	Total Yield	Total Value
Corn	10,300,000	46.0 bu.	$ 0.47	473,800,000	$ 222,686,000
Oats	5,893,600	39.0 bu.	0.36	229,850,400	82,746,144
Spring wheat	400,000	11.3 bu.	1.35	4,520,000	6,102,000
Winter wheat	431,000	19.7 bu.	1.41	8,490,700	11,971,887
Barley	284,000	27.5 bu.	0.63	7,810,000	4,920,300
Rye	80,000	16.2 bu.	1.17	1,296,000	1,516,320
Flax seed	12,000	10.0 bu.	1.80	120,000	216,000
Timothy seed	270,000	4.9 bu.	3.00	1,323,000	3,969,000
Clover seed	134,000	2.0 bu.	11.65	268,000	3,122,200
Potatoes	104,500	110.0 bu.	1.22	11,495,350	14,024,327
Hay, tame excluding alfalfa	3,020,850	1.44 tons	16.24	4,349,620	70,637,829
Hay, wild	510,000	1.27 tons	12.69	647,700	8,219,313
Alfalfa	200,000	2.84 tons	19.23	568,140	10,925,332
Pasture and grazing	10,137,680		7.01		71,065,136
Ensilage, estimated					25,000,000
Sweet corn, subject to revision					1,960,000
Pop corn	30,000	30.0 bu.	3.23	900,000	2,907,000
Buckwheat	7,500	17.0 bu.	1.34	127,500	170,850
Fruit crop estimated					7,000,000
Garden truck, estimated					4,000,000
Sugar beets for manufacture	17,250	9.2 tons	11.34	158,750	1,801,000
Miscellaneous crops estimated					5,500,000

Total value, not including live stock products, for the year, 1920.....$560,460,638
Total value for the year, 1919.....$950,056,002

Frank S. Pinney, Agricultural Statistician, U. S. Bureau of Crop Estimates.

Charles D. Reed, Director, Iowa Weather and Crop Service

IOWA CROPS 1920, ESTIMATED NUMBER OF ACRES BY COUNTIES.

	Corn	Oats	Spring Wheat	Winter Wheat	Barley	Rye	Flax	Potatoes	Tame Hay	Wild Hay	Alfalfa	Pastures
Adair	117,700	49,300	5,240	4,500	8,280	650		781	22,050	4,770	140	112,340
Adams	72,200	26,400	870	5,700	1,450	600	10	484	16,800	2,260	1,150	97,820
Allamakee	46,000	43,200	5,390	1,100	5,270	450	45	1,518	55,650	1,330	20	187,310
Appanoose	50,000	15,400	2,560	7,430	30	950	70	176	28,140	870	50	127,630
Audubon	95,100	49,400	6,170	890	7,250	30		517	22,890	1,850	1,580	73,440
Benton	138,500	99,400	1,810	580	5,850	1,090		1,056	50,295	1,970	90	122,080
Black Hawk	112,200	72,600	1,810	410	3,990	2,000	45	1,397	29,400	8,920	130	92,810
Boone	135,000	84,100	3,040	310	880	80	10	264	19,215	6,120	590	83,920
Bremer	68,400	56,500	450	40	1,630	800	10	1,683	21,525	20,800	100	71,770
Buchanan	108,500	72,300	760	40	3,190	1,310		836	36,540	12,200	120	102,680
Buena Vista	141,300	102,000	2,220	10	720	210	125	1,265	22,890	7,900	1,100	68,200
Butler	106,800	86,200	760	0	1,130	1,000	10	1,375	29,505	11,308	30	95,620
Calhoun	141,900	114,200	630	20	450	220	10	451	20,055	3,030	420	54,740
Carroll	116,900	75,000	7,880	440	2,460	150	10	1,870	27,825	6,240	360	80,090
Cass	125,800	46,600	5,970	14,300	10,730	2,000		913	23,205	1,180	960	105,760
Cedar	99,400	44,200	2,200	2,700	9,320	740		825	51,450	170	90	119,850
Cerro Gordo	91,000	82,100	3,200	0	2,080	50	205	1,474	33,705	9,770	40	82,530
Cherokee	135,000	87,900	1,470	0	1,080	100		1,144	25,935	8,000	3,230	81,700
Chickasaw	72,700	61,800	5,030	40	3,600	220	295	1,122	30,030	11,800	10	86,880
Clarke	59,500	24,300	380	7,000	150	340	75	165	24,675	80	20	112,650
Clay	118,100	89,800	550	20	1,450	170	325	561	24,465	11,400	630	82,290
Clayton	79,700	72,100	4,290	1,190	9,210	540	5	2,442	69,090	910	70	189,760
Clinton	112,800	46,300	3,000	2,840	8,550	2,550		726	61,215	2,000	350	143,260
Crawford	138,400	69,900	21,000	1,170	4,750	150	15	1,771	47,250	5,290	8,060	123,960
Dallas	137,700	64,200	2,970	10,700	1,230	500		176	18,270	2,000	850	100,400
Davis	49,300	18,200	1,200	4,900	70	1,050		506	51,660	40	30	153,250
Decatur	69,700	25,000	1,170	11,700	90	1,100		154	30,870	140	130	136,970
Delaware	89,800	64,500	1,700	60	9,320	2,160		1,012	44,625	6,020	50	116,660
Des Moines	58,100	24,200	1,410	10,400	520	1,790	20	858	29,505	20	350	83,280
Dickinson	64,800	55,200	2,860	0	1,980	180	560	506	15,750	11,700	210	54,040
Dubuque	73,500	50,000	4,290	460	4,830	330		2,574	70,245	900	120	137,150
Emmet	71,000	60,800	620	0	1,640	340	595	506	21,840	6,340	60	50,920
Fayette	96,800	82,700	2,570	220	7,040	700	15	1,815	57,750	12,630	10	154,750
Floyd	97,200	78,900	2,170	10	1,840	660	60	1,342	35,595	4,670	360	78,330
Franklin	119,300	89,700	680	0	1,600	270	40	1,815	35,280	7,720	20	85,170
Fremont	129,700	13,800	880	18,500	460	690	5	407	10,080	6,100	13,200	77,170
Greene	155,000	86,300	1,600	270	550	40		275	21,105	4,420	170	80,350
Grundy	115,000	84,600	1,050	150	1,170	60		2,398	26,880	5,550	130	73,110
Guthrie	118,200	56,600	5,250	1,760	1,600	80		319	26,040	3,480	510	116,710
Hamilton	135,400	103,200	1,590	140	610	80	35	594	21,525	5,260	170	71,920
Hancock	106,400	91,500	2,640	20	1,860	220	250	1,089	28,980	16,100	280	82,300
Hardin	119,600	84,600	660	40	1,440	120	25	814	25,515	4,160	90	79,650
Harrison	155,500	32,800	26,500	12,600	2,850	330	15	1,034	8,400	7,980	22,520	105,220
Henry	69,200	28,600	550	3,370	190	1,130		341	26,565	10	110	101,570
Howard	49,600	58,000	2,850	60	4,890	270	1,000	1,144	37,905	14,160	10	84,780
Humboldt	104,000	75,600	1,530	150	2,160	210	100	484	18,375	5,540	120	42,270
Ida	94,200	60,700	3,320	70	2,140	30	5	1,133	25,200	1,890	2,680	64,220
Iowa	94,500	44,700	1,520	1,310	1,240	460		1,584	37,905	490	50	120,140
Jackson	61,200	30,100	3,980	1,550	2,540	880		1,309	65,730	1,700	130	186,180
Jasper	160,200	66,100	9,430	5,320	520	600		605	40,635	600	150	145,840
Jefferson	66,900	21,100	720	4,470	170	540		473	35,595		250	112,020
Johnson	103,300	47,700	1,130	2,050	1,290	1,500		1,419	48,195	900	210	128,650
Jones	81,600	41,000	850	260	6,130	820	10	924	56,700	190	390	149,560
Keokuk	106,200	45,000	3,330	3,700	550	740		693	42,525	40	80	127,590
Kossuth	194,000	167,100	1,870	10	5,000	4,200	1,100	1,716	38,745	30,400	270	118,620
Lee	55,400	20,700	1,230	13,800	500	8,740		1,540	32,865	50	460	145,260
Linn	118,400	67,700	1,480	430	2,450	1,520	20	1,782	47,880	2,800	130	172,190
Louisa	66,500	24,500	500	11,800	240	3,270		462	18,375	110	60	78,190
Lucas	51,300	21,200	1,000	8,500	50	510	30	143	22,575	100	120	117,300
Lyon	134,100	112,400	2,530	10	4,850	80	15	2,442	15,225	19,300	3,770	63,260
Madison	88,500	27,600	1,440	16,800	3,000	610	90	264	20,790	1,070	480	132,960
Mahaska	118,200	48,500	3,420	5,240	220	750	5	605	33,600	140	140	122,520
Marion	93,900	36,300	4,370	14,360	880	550		484	23,730	930	840	126,680
Marshall	115,000	74,500	2,120	630	800	90		847	34,860	210	70	90,530
Mills	107,200	18,800	3,330	10,960	1,000	590		561	9,135	4,420	13,960	70,490
Mitchell	68,800	85,900	2,900	80	2,080	110	735	5,137	23,390	3,420	30	72,350
Monona	126,100	27,600	22,000	21,600	2,150	140		880	9,135	16,600	18,700	102,290
Monroe	44,500	16,300	3,350	10,050	140	600	60	220	28,350	60	40	131,280
Montgomery	89,200	21,800	1,940	17,000	1,810	2,000	20	539	19,950	530	4,870	69,960
Muscatine	82,600	22,300	1,520	6,970	2,670	4,000		1,353	24,570	590	500	77,430
O'Brien	119,100	91,700	1,500	30	4,700	80	85	1,133	25,725	6,750	1,420	75,550
Osceola	82,500	74,900	510	10	2,900	30	215	1,067	17,640	7,890	280	48,740
Page	97,600	21,700	750	21,460	940	1,510		809	23,520	910	5,930	100,680
Palo Alto	140,000	89,300	840	0	1,370	430	1,130	594	17,325	18,760	180	66,270
Plymouth	200,000	96,400	31,500	460	2,910	80		1,980	25,200	19,470	16,600	110,180
Pocahontas	135,200	113,800	910	90	1,750	830	90	1,001	21,000	7,680	260	57,780
Polk	117,500	48,500	10,000	15,700	100	820	70	539	17,430	2,490	600	79,360
Pottawattamie	220,000	56,900	16,440	14,400	11,800	1,750	30	5,170	26,460	6,470	21,700	133,140
Poweshiek	112,200	59,600	2,520	260	1,070	200		616	26,225	90	80	117,180
Ringgold	83,100	35,300	860	4,030	250	520		165	23,625	470	60	139,420
Sac	125,200	87,100	650	0	5,430	30		891	26,565	2,840	580	75,770
Scott	87,800	27,100	5,340	14,500	20,000	2,750		3,850	28,350	1,470	1,460	79,640
Shelby	178,200	62,800	10,300	680	7,130	170	175	1,001	31,500	6,400	3,980	94,680
Sioux	179,100	123,500	18,400	200	11,000	30	30	1,716	23,100	14,610	9,040	80,710
Story	144,300	86,200	390	350	150	240	20	77	24,675	2,290	180	67,390
Tama	133,400	81,900	3,770	4,690	4,490	120	230	1,298	47,250	830	100	132,499
Taylor	100,400	28,100	1,240	8,530	380	1,110		506	22,575	960	840	119,450
Union	68,900	32,800	980	2,200	1,760	760	50	682	19,110	1,000	160	111,640
Van Buren	54,200	16,100	320	6,670	80	2,000		253	25,910	30	390	144,240
Wapello	58,600	15,600	3,310	11,200	310	1,000		704	27,720	40	260	103,180
Warren	85,500	22,500	3,210	8,500	890	950	300	319	25,725	720	310	129,820

IOWA CROPS, 1920, ESTIMATED NUMBER OF ACRES BY COUNTIES—Continued.

	Corn	Oats	Spring Wheat	Winter Wheat	Barley	Rye	Flax	Potatoes	Tame Hay	Wild Hay	Alfalfa	Pastures
Washington	100,500	46,000	1,020	2,060	160	340	10	605	39,270	30	170	123,880
Wayne	73,800	34,300	440	5,520	310	710	40	44	33,600	40	50	120,080
Webster	125,400	130,000	4,870	80	880	50	65	638	24,990	8,720	680	87,770
Winnebago	73,200	57,000	5,280	0	3,590	110	1,050	968	22,050	20,650	70	57,500
Winneshiek	73,200	77,000	11,300	560	9,330	350	690	1,738	56,700	5,160	10	152,700
Woodbury	175,200	85,100	25,000	7,830	1,800	440	75	2,068	17,850	9,380	27,200	106,210
Worth	67,100	64,000	4,920	50	2,230	200	1,570	1,177	27,980	14,880	30	62,830
Wright	111,700	95,600	1,770	40	1,920	110	30	836	29,610	5,840	70	67,900
Total	10,300,000	5,868,800	400,000	431,000	284,000	80,000	12,000	104,500	3,020,850	510,000	200,000	10,137,080

AVERAGE AND TOTAL YIELDS OF IOWA CROPS, 1920, BY COUNTIES—PART I.

Counties	Corn		Oats		Spring Wheat		Winter Wheat		Barley	
	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels
Adair	43	5,061,000	39	1,922,700	9	47,200	18	81,000	27	223,560
Adams	42	3,032,000	41	1,082,400	10	8,700	17	96,900	29	42,050
Allamakee	47	2,162,000	43	1,857,600	13	70,000	22	24,200	30	158,100
Appanoose	41	2,050,000	34	523,600	12	30,700	15	111,450	30	900
Audubon	41	3,899,000	35	1,729,000	11	67,900	20	17,800	29	210,250
Benton	49	6,786,000	40	3,976,000	18	32,600	23	13,340	24	140,400
Black Hawk	44	4,937,000	39	2,831,400	15	27,200	15	6,150	29	115,710
Boone	47	6,345,000	41	3,448,200	14	42,600	20	6,200	30	24,900
Bremer	50	3,420,000	37	2,090,500	13	5,500	22	880	34	55,080
Buchanan	41	4,448,000	38	2,747,400	14	10,700	18	720	30	95,700
Buena Vista	51	7,206,000	38	3,876,000	15	33,500	16	160	29	22,910
Butler	48	5,126,000	41	3,584,200	11	8,400	----	----	27	29,700
Calhoun	49	6,953,000	42	4,796,400	13	8,200	18	360	30	13,500
Carroll	51	5,962,000	45	3,375,000	11	86,700	19	8,360	28	68,880
Cass	44	5,535,000	39	1,817,460	11	65,700	20	284,000	29	310,300
Cedar	51	5,069,000	46	2,083,200	15	33,000	23	62,100	27	251,640
Cerro Gordo	47	4,277,000	41	3,366,100	12	38,400	----	----	26	54,080
Cherokee	50	6,750,000	37	3,252,300	9	13,200	----	----	32	34,560
Chickasaw	39	2,835,000	38	2,348,400	10	50,300	10	400	27	97,200
Clarke	40	2,380,000	30	729,000	13	5,000	12	84,000	32	4,800
Clay	50	5,905,000	36	3,232,800	10	5,500	21	420	28	40,600
Clayton	49	3,905,000	44	3,172,400	14	60,100	22	26,180	25	230,250
Clinton	51	5,753,000	37	1,713,100	15	46,400	20	56,800	22	188,320
Crawford	45	6,228,000	41	2,865,900	11	231,000	22	25,740	29	138,040
Dallas	49	6,747,000	40	2,568,000	12	30,800	22	235,400	29	35,070
Davis	40	1,972,000	33	600,600	14	16,800	16	78,400	35	2,450
Decatur	38	2,649,000	28	700,000	14	16,400	14	163,800	25	2,430
Delaware	42	3,772,000	32	2,064,000	16	27,200	17	1,020	23	214,360
Des Moines	52	3,021,000	38	919,600	14	19,700	22	228,800	35	18,200
Dickinson	43	2,786,000	37	2,042,400	9	25,700	----	----	24	47,520
Dubuque	49	3,802,000	35	1,760,000	17	72,900	15	6,900	24	116,640
Emmet	40	2,840,000	38	2,310,400	12	7,400	----	----	24	39,360
Fayette	47	4,550,000	39	3,225,300	12	30,800	23	5,060	30	211,200
Floyd	45	4,374,000	39	3,077,100	9	19,500	16	160	27	40,680
Franklin	49	5,846,000	47	4,215,900	13	8,800	----	----	30	48,000
Fremont	52	6,744,000	50	690,000	15	13,200	25	462,500	40	18,400
Greene	46	7,130,000	41	3,538,300	9	15,200	20	5,400	30	16,800
Grundy	54	6,210,000	45	3,807,000	13	13,700	24	3,600	25	29,250
Guthrie	40	4,728,000	38	2,150,800	13	68,300	17	29,920	30	48,000
Hamilton	55	7,447,000	40	4,128,000	13	20,700	30	4,200	27	16,470
Hancock	42	4,469,000	48	4,392,000	11	29,000	17	340	28	52,080
Hardin	49	5,860,000	40	3,384,000	14	9,200	22	880	31	44,640
Harrison	42	6,531,000	42	1,377,600	12	318,000	26	327,600	35	99,750
Henry	47	3,252,000	41	1,172,600	12	6,600	10	64,030	24	4,560
Howard	36	1,786,000	40	2,320,000	9	25,600	10	300	30	146,700
Humboldt	47	4,888,000	40	3,024,000	15	22,000	20	3,000	31	66,960
Ida	45	4,239,000	39	2,367,300	9	29,900	15	1,050	28	59,920
Iowa	43	4,064,000	37	1,653,900	14	21,300	22	28,820	23	28,520
Jackson	48	2,938,000	35	1,053,500	17	67,700	22	34,100	29	73,660
Jasper	43	6,889,000	42	2,776,200	13	122,600	21	111,720	37	19,240
Jefferson	40	2,676,000	31	654,100	5	3,600	16	71,520	25	4,250
Johnson	51	5,268,000	41	1,955,700	18	20,300	23	47,150	27	34,830
Jones	50	4,080,000	40	1,640,000	16	13,600	22	5,720	29	177,770
Keokuk	48	5,098,000	38	1,710,600	10	33,300	21	77,700	22	12,320
Kossuth	45	8,730,000	49	6,684,000	15	28,000	23	230	30	150,000
Lee	42	2,827,000	39	807,300	13	16,000	16	220,800	27	13,500
Linn	44	5,210,000	39	2,640,300	13	19,200	20	8,600	24	58,800
Louisa	48	3,192,000	40	980,000	14	7,000	22	259,600	32	7,680
Lucas	39	2,001,000	32	678,400	16	16,000	14	119,000	32	1,600
Lyon	49	6,571,000	34	3,821,600	10	25,300	12	120	28	136,080
Madison	49	4,336,000	46	1,269,600	11	15,800	19	319,200	31	93,000
Mahaska	47	5,555,000	37	1,794,500	15	51,300	23	120,520	20	10,400
Marion	46	4,319,000	36	1,306,800	15	65,600	18	258,480	36	31,680
Marshall	49	5,635,000	40	2,980,000	18	38,200	23	14,490	33	26,400
Mills	49	5,253,000	39	733,200	12	40,000	19	208,240	30	35,700
Mitchell	44	3,027,000	43	3,693,700	9	26,100	19	1,520	29	69,220
Monona	39	4,918,000	36	993,600	8	176,000	20	422,000	25	53,750
Monroe	39	1,736,000	31	505,300	11	36,900	17	170,850	30	4,200
Montgomery	44	3,925,000	39	850,200	9	17,500	19	323,000	31	56,110

AVERAGE AND TOTAL YIELDS IOWA CROPS, 1920, BY COUNTIES—PART I—Continued

Counties	Corn		Oats		Spring Wheat		Winter Wheat		Barley	
	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels
Muscatine	44	3,634,000	39	869,700	14	21,300	20	139,400	28	74,760
O'Brien	50	5,955,000	35	3,209,500	9	14,300	20	600	26	122,200
Osceola	43	3,548,000	38	2,846,200	9	4,600	16	160	27	78,300
Page	43	4,197,000	40	868,000	14	10,500	22	472,120	21	19,740
Palo Alto	45	6,300,000	43	3,839,900	13	10,900			27	36,990
Plymouth	41	8,200,000	28	2,699,200	8	252,000	18	8,280	20	58,200
Pocahontas	49	6,625,000	37	4,210,600	16	14,600	18	1,620	30	52,500
Polk	50	5,875,000	39	1,891,500	13	130,000	23	361,100	33	3,300
Pottawattamie	45	9,900,000	41	2,332,900	14	230,000	25	360,000	30	354,000
Poweshiek	45	5,054,000	38	2,264,800	15	37,800	21	5,460	25	26,750
Ringgold	40	3,324,000	38	1,341,400	11	9,500	12	48,360	25	6,250
Sac	49	6,135,000	39	3,396,900	14	9,100			39	211,770
Scott	52	4,566,000	44	1,192,400	17	90,800	21	304,500	23	460,000
Shelby	41	5,256,000	39	2,449,200	13	132,900	22	14,960	30	213,600
Sioux	56	8,955,000	31	3,828,500	8	147,000	17	6,630	25	275,000
Story	50	7,215,000	40	3,448,000	17	6,600	20	7,000	35	5,250
Tama	47	6,270,000	39	3,194,100	18	67,900	23	15,870	29	130,210
Taylor	36	3,614,000	32	899,200	10	12,400	21	187,530	25	9,500
Union	39	2,687,000	31	1,010,600	10	9,800	15	33,000	24	42,240
Van Buren	40	2,168,000	33	531,300	16	5,900	19	126,730	29	2,320
Wapello	43	2,520,000	38	592,800	12	39,700	19	212,800	30	9,300
Warren	45	3,848,000	42	945,000	13	41,700	18	513,000	35	31,150
Washington	46	4,623,000	35	1,610,000	13	13,300	21	43,260	25	4,000
Wayne	41	3,026,000	31	1,063,300	17	7,500	12	66,240	28	8,680
Webster	49	7,786,000	40	5,200,000	10	43,700	20	1,600	30	26,700
Winnebago	47	3,440,000	47	2,702,500	11	58,100			22	78,980
Winneshiek	50	4,160,000	38	2,960,200	10	113,000	19	10,640	27	251,910
Woodbury	40	7,004,000	38	2,549,800	7	175,000	21	164,430	28	50,400
Worth	51	2,815,000	40	2,560,000	9	44,300	21	1,050	30	69,606
Wright	50	5,885,000	42	4,015,200	15	26,600	19	760	36	69,120
	46.0	473,800,000	39.0	229,850,400	11.8	4,520,000	19.7	8,490,700	27.5	7,810,000

AVERAGE AND TOTAL YIELDS OF IOWA CROPS, 1920, BY COUNTIES—PART II.

Counties	Rye		Flax Seed		Potatoes		Hay, Tame		Hay, Wild		Alfalfa	
	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Tons per acre	Total Tons	Tons per acre	Total Tons	Tons per acre	Total Tons
Adair	12	7,800			79	61,699	1.4	30,870	2.0	9,540	1.0	140
Adams	16	9,600	10	100	78	37,752	1.5	25,200	1.6	3,616	2.8	3,220
Allamakee	16	7,200	14	630	139	211,662	1.7	94,900	2.1	2,793	2.3	46
Appanoose	15	14,250	10	700	79	13,904	1.9	28,140	1.1	957	3.5	175
Audubon	18	540			101	52,217	1.7	38,910	2.0	3,700	3.5	5,530
Benton	18	19,620			110	116,116	1.5	75,440	1.5	2,955	4.0	360
Black Hawk	15	30,000	10	450	120	167,640	1.4	41,160	1.2	10,704	3.0	390
Boone	22	1,760	10	100	137	36,168	1.6	30,740	1.0	6,120	2.5	1,475
Bremer	12	9,600	10	100	125	210,375	1.5	32,890	1.3	27,040	3.0	300
Buchanan	16	20,960			96	80,256	1.5	54,810	1.5	18,300	3.0	360
Buena Vista	25	5,250	12	1,500	123	155,595	1.5	34,330	1.5	11,850	3.2	3,520
Butler	17	17,000	9	90	99	136,125	1.4	41,300	1.2	13,560	2.8	84
Calhoun	17	3,740	10	100	114	51,414	1.6	32,090	1.1	3,333	3.0	1,260
Carroll	19	2,850	10	100	101	188,870	1.4	38,960	1.3	8,112	2.7	972
Cass	16	32,000			120	109,560	1.4	32,490	1.4	1,652	2.8	2,688
Cedar	18	13,320			100	82,500	1.4	72,030	1.2	204	3.0	270
Cerro Gordo	15	750	10	2,050	155	228,470	1.6	37,930	1.1	10,747	3.0	120
Cherokee	18	1,800			145	165,880	1.4	36,310	1.3	10,400	3.6	9,690
Chickasaw	15	3,300	8	2,360	97	108,834	1.5	45,040	1.0	11,800	3.2	32
Clarke	15	5,100	10	750	76	12,540	1.3	32,080	1.0	80	3.0	60
Clay	15	2,550	17	5,525	124	69,564	1.7	41,590	1.2	13,680	2.4	1,512
Clayton	17	9,180	14	70	150	366,300	1.4	96,720	1.0	910	3.0	210
Clinton	16	40,800			70	50,820	1.5	91,820	1.0	2,000	4.0	1,400
Crawford	20	3,000	10	150	122	216,062	1.4	66,150	1.5	7,935	3.1	24,955
Dallas	21	10,500			123	21,648	1.3	23,750	1.4	2,800	3.1	2,635
Davis	16	16,800			86	43,516	1.3	67,160	1.0	40	2.8	84
Decatur	12	13,200			74	11,396	1.4	43,220	0.5	70	3.5	455
Delaware	12	25,920			70	70,840	1.3	58,010	1.1	6,633	3.0	150
Des Moines	20	35,800	10	200	91	78,078	1.3	38,350	1.2	24	2.9	1,015
Dickinson	17	3,060	10	5,600	100	50,600	1.5	23,620	1.0	11,700	3.7	777
Dubuque	18	5,940			94	241,956	1.6	112,390	0.9	810	2.2	264
Emmet	11	3,740	9	5,355	112	56,672	1.6	34,940	1.0	6,340	3.5	210
Fayette	19	13,300	9	135	114	206,910	1.6	92,400	1.2	15,156	3.5	35
Floyd	17	11,220	10	600	115	154,330	1.3	46,270	1.3	6,071	2.0	720
Franklin	14	3,780	8	320	113	205,095	1.3	45,860	1.1	8,492	2.9	58
Fremont	18	12,420	10	50	69	28,083	1.6	16,130	2.0	12,200	3.0	39,600
Greene	22	880			142	39,050	1.4	29,550	1.0	4,430	3.0	510
Grundy	20	1,200			131	314,138	1.3	34,940	1.2	6,660	3.0	390
Guthrie	23	1,840			88	28,072	1.4	36,460	1.4	4,872	2.7	1,377
Hamilton	25	2,000	10	350	133	79,002	1.4	30,130	1.0	5,260	3.0	510
Hancock	18	3,960	9	2,250	173	188,397	1.3	37,670	1.1	17,710	3.5	980
Hardin	12	1,440	8	200	112	91,168	1.3	33,170	1.5	6,240	3.2	288
Harrison	16	5,280	10	150	106	109,604	2.0	10,080	1.8	14,364	3.1	69,812
Henry	14	15,820			60	20,460	1.3	34,530	1.0	10	3.1	341
Howard	15	4,050	8	8,000	116	132,704	1.3	49,280	1.1	15,576	3.4	34
Humboldt	19	3,990	11	1,100	112	54,208	1.3	22,880	0.9	4,986	2.5	300
Ida	15	450	10	50	127	143,891	1.7	42,840	1.3	2,457	3.2	8,576
Iowa	17	7,820			96	152,064	1.5	56,860	1.0	400	2.9	145
Jackson	19	16,720			115	150,535	1.3	85,450	1.8	3,060	2.7	351
Jasper	20	12,000			102	61,710	1.6	65,020	1.8	1,080	3.9	585
Jefferson	14	7,560			69	32,637	1.4	49,830			3.0	750
Johnson	18	27,000			90	127,710	1.7	81,930	0.8	720	2.6	546
Jones	20	16,400	10	100	126	116,424	1.6	90,720	1.5	285	4.0	1,560
Keokuk	15	11,100			102	70,686	1.4	59,530	1.2	48	3.0	240
Kossuth	16	67,200	9	9,900	125	214,500	1.3	50,370	1.1	33,440	2.5	675
Lee	16	139,840			86	132,440	1.4	46,010	1.2	60	2.9	1,334
Linn	14	21,280	10	200	108	183,546	1.4	67,030	1.0	2,800	2.7	351
Louisa	14	45,780			71	32,802	1.3	23,840	1.6	176	3.4	204
Lucas	15	7,650	10	300	106	15,158	1.3	29,350	1.1	110	3.0	360
Lyon	15	1,200	10	150	93	227,106	1.6	24,360	1.4	14,420	2.7	10,179
Madison	17	10,370	10	900	113	29,832	1.4	29,100	1.3	1,391	2.4	1,152
Mahaska	16	12,000	10	50	107	64,735	1.2	40,320	1.5	210	3.0	420
Marion	16	8,800			93	45,012	1.1	26,100	1.7	1,581	3.0	2,520
Marshall	20	1,800			121	102,487	1.3	45,320	1.3	273	3.0	210
Mills	16	9,440			137	76,857	1.6	14,620	1.3	5,746	3.2	44,672
Mitchell	17	1,870	12	8,710	146	750,080	1.5	50,080	1.8	6,156	3.0	90
Monona	18	2,520			136	119,680	2.0	18,270	1.7	28,220	3.1	57,970
Monroe	14	8,400	10	600	123	26,180	1.3	36,850	1.2	72	3.1	124
Montgomery	21	42,000	10	200	98	52,822	1.5	29,920	1.0	530	3.3	16,071

AVERAGE AND TOTAL YIELDS OF IOWA CROPS, 1920, BY COUNTIES—PART II—Continued.

Counties	Rye		Flax Seed		Potatoes		Hay, Tame		Hay, Wild		Alfalfa	
	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Bushels per acre	Total Bushels	Tons per acre	Total Tons	Tons per acre	Total Tons	Tons per acre	Total Tons
Muscatine	14	56,000	....	.....	91	123 123	1.4	34,400	1.5	885	3.5	1,960
O'Brien	20	1,600	10	850	116	133 428	1.7	43,730	1.2	8,100	4.4	6,248
Osceola	20	600	10	2,150	125	132 375	1.5	26,460	1.2	8,868	2.2	616
Page	19	28,690	....	.....	65	56 485	1.6	37,630	1.2	1,092	3.0	17,790
Palo Alto	19	8,170	9	10,170	119	76 686	1.2	20,790	1.1	20,636	3.5	630
Plymouth	17	1,360	....	.....	103	205 940	1.5	37,800	1.3	25,311	3.2	53,120
Pocahontas	18	14,940	10	900	120	13,000	1.6	33,600	1.3	9,584	3.2	832
Polk	15	12,300	10	700	89	47,071	1.3	22,660	1.2	2,988	2.3	1,380
Pottawattamie	20	35,000	10	300	117	604,890	1.8	47,630	1.6	10,352	3.1	67,270
Poweshiek	16	6,240	....	.....	92	56,672	1.4	50,710	1.4	126	2.5	200
Ringgold	16	8,320	....	.....	94	15,510	1.3	30,700	1.0	470	2.0	120
Sac	16	480	....	.....	76	67,716	1.5	39,850	1.3	4,992	2.8	1,624
Scott	16	44,000	....	.....	85	327,250	1.4	39,690	1.5	2,205	3.1	4,526
Shelby	19	3,230	10	1,750	95	95,095	1.3	40,950	1.3	8,320	2.7	10,746
Sioux	14	280	10	300	156	267,696	1.9	43,890	1.6	23,376	3.2	28,928
Story	20	4,800	10	200	106	8,162	1.3	32,080	1.2	2,748	2.3	414
Tama	20	2,400	10	2,300	91	118,118	1.5	70,870	1.2	996	2.0	200
Taylor	15	16,650	....	.....	54	27,324	1.4	31,000	1.2	1,188	2.2	1,848
Union	12	9,120	10	500	76	44,308	1.4	26,750	1.2	1,236	2.2	352
Van Buren	16	32,000	....	.....	88	22,264	1.3	46,080	1.0	30	2.9	1,131
Wapello	13	15,990	....	.....	119	83,776	1.4	38,860	1.1	44	3.0	780
Warren	17	16,150	10	2,000	96	30,624	1.2	35,870	1.3	936	2.3	713
Washington	17	5,780	10	100	68	41,140	1.5	58,900	1.1	33	3.0	516
Wayne	16	11,360	10	400	86	3,784	1.3	43,680	1.0	40	3.5	315
Webster	21	1,050	11	715	112	71,456	1.4	34,980	1.1	9,502	3.2	2,176
Winnebago	17	1,870	10	10,500	149	144,232	1.5	33,080	1.2	24,780	4.0	280
Winneshiek	19	6,650	10	6,600	74	128,612	1.6	90,720	1.2	6,192	3.8	38
Woodbury	20	8,800	10	750	116	239,888	1.9	33,910	1.4	13,146	2.6	70,720
Worth	16	3,200	11	17,270	103	121,231	1.6	44,690	1.1	16,368	3.3	98
Wright	16	1,750	10	300	133	111,188	1.5	44,410	1.2	7,008	2.5	175
	16.2	1,296,000	10.0	120,000	110.0	11,495,350	1.44	4,349,620	1.27	647,700	2.84	568,140

THE MATHEMATICIAN, THE FARMER AND THE WEATHER.

By THOMAS ARTHUR BLAIR.

Meteorologist, U. S. Weather Bureau.

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It may have been true when Mark Twain said it, "Everybody talks about the weather, but nobody does anything," but now-a-days the mathematicians are doing something. They are hitching the weather to the engine of a formula, measuring it with the yardstick of an equation, and weighing it in the balances of a co-efficient. They can tell how many million dollars a half inch of rain on the fifth of August will add to the corn crop of Ohio; how many additional automobiles the farmers can purchase as a result of a week of warm weather while the wheat heads are filling; and how much smaller the world's supply of cotton will be because of an August drought in Georgia.

Aspiring poets used to lament that all the possible figures of speech were long since exhausted, but the poets of to-day still find something new to say and new ways to say it. So the prosaic, practical scientists are saying something very new about three of the oldest subjects of human thought, weather, farming and mathematics. The weather is the oldest of them all as a basis of observation and remark; the practise of agriculture began early in the history of civilization, and the development of mathematics began soon after, notably among the Egyptians, and was carried to a high degree of excellence in some lines by the Greeks. Yet each of these is the subject of an extremely new and modern science. Meteorology, the science of the weather, is one of the newest of the sciences, and is yet in its infancy. Its beginnings date back to some observations made by Benjamin Franklin, but its application began a century later, just after the Civil War. Something of the growth of the modern science of agriculture, principally due to the work of the agricultural experiment stations, is known to all. In the old science of mathematics new theorems, processes and devices are constantly being developed. But now appears a group of men with an original idea. Knowing something of the modern aspects of each of these sciences, they are combining them and using the refined and elegant processes of mathematical statistics to determine the effect of various kinds of weather upon the crops in their different stages of development, to ascertain the farmer's risk from unfavorable weather, and to find definite relations between weather happenings in different parts of the globe.

The mathematical processes are due largely to Professor Karl Pearson, of England, who has applied them primarily in the fields of biology and anthropology. In this country, the leader in the application of these methods to the problem of determining the influence of the weather on the crops is Professor J. Warren Smith, of the United States Weather Bureau, whose work in this line began in Ohio several years ago. For example, he has shown that the yield of corn in Ohio is very largely dependent upon the amount of rain in June, July and August. When the July rainfall is

less than three inches, the average yield is 30 bushels per acre, when it is five inches or more, the yield is 38 bushels; which means that these two inches of rain have added 27,300,000 bushels to the corn crop of this State, worth at 1919 prices about $35,000,000. When the July rainfall is three and a quarter inches, the yield is 15,000,000 bushels greater than when it falls short of this amount by half an inch. Each quarter of an inch increase between the totals of two and four inches means an added value of about $7,800,000. Taking the four great corn-growing states of Indiana, Illinois, Iowa and Missouri, the addition of half an inch to a total of two and three quarters inches adds ten bushels per acre to the yield on the average. This thin layer of water is worth at present prices about $13 an acre, or a total for these four states of the Corn Belt of the significant sum of $4,000,000,000. Truly, if corn is king in this region, water is the power behind the throne.

But not content with this victory, the agricultural meteorologist advances to the next line of defense with the relentless weapons of statistical analysis, the machine guns of mathematics, and finds that the most important twenty-day period in Ohio is from July 21 to August 10; and finally goes over the top and locates the critical period in the first ten days of August. This is the time when the half inch or the quarter inch of rain is of the most value, and when you must have it if you are to get a big crop of corn. And this is the period immediately following the blossoming of the corn. Now, this idea of "critical periods" is new, the idea being that there are certain short periods of time in the growth of any crop during which its future prospects are largely determined, "a tide which, taken at the flood, leads on to fortune." In short, favorable weather at these times will produce a good crop and unfavorable weather a poor one. In some crops this is a single short period; in some temperature is the most important, in others it is rainfall or sunshine.

Food is brought to the plant by the moisture in the soil and is converted into vegetable tissue by heat and by the direct action of the sun's rays. For every species of plant there are certain best temperature and moisture values, varying at different periods of growth. If these best values occur at the critical periods, excellent crops are certain, barring accidents. And here we arrive at a practical application; the climate of most places in the United States is pretty well known and completely exhibited in published tables. When tables of the critical periods of plant growth, together with the meteorological factors, whether temperature, rainfall or sunshine, most affecting growth at these times, likewise become available, we shall have but to compare the two sets of tables to determine whether a specific crop is climatically well adapted to a particular district. Further, there are ways of advancing or retarding, within certain limits, the time of occurrence of the critical periods, thus bringing them into the time when favorable weather is more likely to occur. This may be done by the use of an earlier or later variety, by varying the time of seeding, by cultivation, or by the use of fertilizers. Moreover, by cultivation, a quarter or even a half inch of moisture may be conserved, if the farmer knows just when it is most important to conserve it. If these methods fail, and the weather is still frequently unfavorable at critical periods, it will be necessary to substitute some other crop. In some cases these important periods are far enough ahead of harvest to enable increased attention to be given to other crops in the same year. For instance, the rainfall of May is the most important factor in the hay crop in most of the northern United States. If at the end of May the rainfall has been light, other forage crops may be planted to take the place of hay. The application of all this to farming under irrigation is obvious. In our arid and semi-arid west, the sun may be depended upon to supply an abundance of energy, and if just the right amount of water is applied at the right time, remarkable crops result. Hence the importance of knowing the right time.

I have referred principally to Professor Smith's study of the effect of the weather on the yield of corn in Ohio, but many other interesting results have been obtained, both by him and others, and both in this country and in Europe. Take wheat for example, one of the oldest and probably the most important of cultivated crops. In the growing of winter wheat, which is exposed to all sorts of weather for nine months, through fall, winter, spring and summer, the weather of three or four ten-day periods in May and June is found to influence the crop to a much greater extent than that of all the rest of the time combined. These are the critical periods in the development of winter wheat, and they are associated with certain definite stages in the growth of the wheat plant. When the wheat is "jointing," that is, growing rapidly in height, cool weather is demanded, but later, while the heads are filling, it must be warm, and in between these periods, during the ten-days when the "boot" from which the head emerges is forming, dry weather is necessary for the best growth. There is indication also that cool weather is advantageous while the wheat is blossoming, and warm while it is ripening. In addition, a weight of evidence is accumulating that a heavy March snowfall is decidedly detrimental, contrary to the prevailing popular opinion.

In the great spring wheat centers of North and South Dakota, it has been shown that the yield depends largely on the rainfall of May and June and the temperature of June, but no shorter critical periods have as yet been established. To obtain a large crop, the rainfall of May and June should be above the average and June should be cooler than the average. In North Dakota, which is the drier and cooler of the two states, a good rainfall is more important than cool weather, but in South Dakota temperature is in a great measure the determining factor, while in the neighboring State of Minnesota, variations in either temperature or precipitation during these months have little effect on the yield. No general rules for the entire country can be made, but each section must be studied with reference to its normal climate.

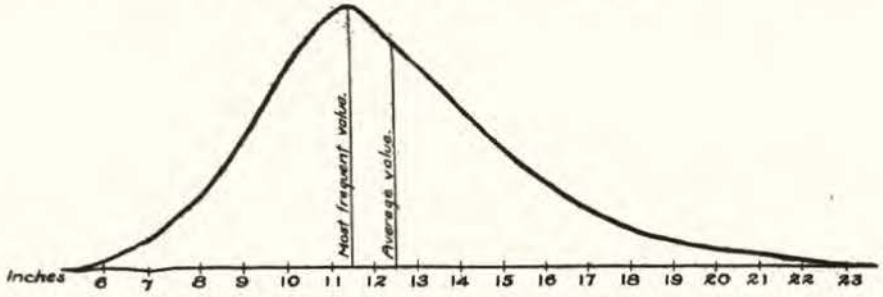
Consider, as another example, that staple of our dinner tables, the potato. A cool and wet July makes the potato crop in the Mississippi Valley. Cool weather is desirable all summer and wet weather during June, July and August, but July is the most important month and the first ten days of July the most important short period. This is the ten days following blossoming. If it is cool during this time with a good supply of moisture, and in addition the moisture supply has been fairly good during the previous two or three weeks, the prospects for a large crop of potatoes are ex-

cellent. If these conditions have not obtained, the yield will be small. If the water supply can be controlled by irrigation, it is of the greatest importance that it be sufficient at this period.

In the great Cotton Exchange in New York and in the primary cotton markets of the South the price of cotton has always fluctuated from day to day during the growing season with the daily reports of weather conditions in the Cotton Belt, where the world's supply of this staple is largely produced. But it has fluctuated erratically and without any solid knowledge of the exact amount of influence the weather may have upon the yield. Recently, however, a well-known American economist and statistician has shown that he can predict the total yield with remarkable accuracy by mathematical analysis from a knowledge of the average weather conditions from May to August, an accuracy greater than that of the estimates based on the condition figures of the Government crop reports. The favorable weather conditions differ somewhat in the different sections of the Cotton Belt, extending from Texas to South Carolina, but the most important requirements are that May shall be dry, June both warm and dry, and August cool and wet, a cool and wet August being of most importance. Sitting in his New York office, without even having seen a cotton plant growing and without receiving any reports as to the progress of the crop, the master of the newer statistics can at the end of August insert these weather values in his formula and tell how much cotton will be ginned in the South during the following autumn and winter. Such, in the hands of experts, is the magic in those bugbears of our school days, arithmetic and algebra!

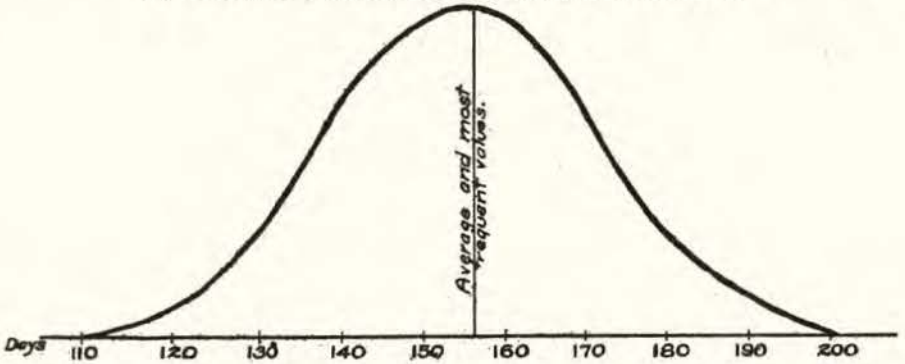
There is another phase of weather, not directly connected with crop yields, towards which the powerful weapons of the mathematician have been directed. This may be called the application of frequency curves to climatic phenomena. A frequency curve offers a systematic method of examining the variations in a series of events, and, as applied to weather and climate, may be used to determine how often the summers will be too hot or too dry for a particular crop, or the winters too cold, or the growing season too short. The simple average, as usually given in climatic tables, is not sufficient. We must know how the individual years arrange themselves around the average. For, though these climatic events occur according to the laws of chance, they do not all follow the simple law by which, if you flip a coin a large number of times, heads and tails will appear with equal frequency. On the contrary, some of these happenings form "skew" curves; the rainfall, for example. In parts of the semi-arid west an annual precipitation of twelve inches is considered sufficient for the growing of dry land grains, but that average will probably be made up of a few years with much more than twelve inches and many years with amounts somewhat less than twelve. Though twelve is the average, it is not the most probable amount, and falls of less than twelve are more likely to occur than those of more than twelve. In such cases the distribution of events about the average is unsymmetrical, askew, and the average does not mean much, does not tell us what we want to know.

SKEW FREQUENCY CURVE SHOWING DISTRIBUTION OF ANNUAL PRECIPITATION AT CORRINE, UTAH.



Average value, 12.5 inches; most frequent value, 11.5 inches.

SYMMETRICAL FREQUENCY CURVE SHOWING VARIATION IN LENGTH OF GROWING SEASON AT DENVER, COLORADO.



Average and most frequent values coincide in 156 days.

The farmer or buyer wants to know not only what the average amount is, but how often in the course of ten or fifty years the amount will fall so far short of the average as to be entirely inadequate. This the makers of the frequency curve can tell him much more accurately than he could do for himself by simply counting the number of times it has been insufficient in the past ten or fifty years. In the northern portion of the orange-growing section of Florida, once in a good many years the trees are killed or badly frozen back by a winter cold wave. To know how often this is liable to occur is of prime importance in fixing the value of the land for orange-growing purposes. Similarly, in peach-growing sections, farther north, peach trees or the buds for next year's crop are subject to winter killing, and in nearly all fruit-growing sections the crops are liable to injury by late spring frosts. In early vegetable farming, the farmer frequently wants to take the risk of having his crops killed once in five or ten years in order to be in the market early in the other years. Is it better for him to go it blindly, depending on his own impression of the proper date of planting, or to rely on the theoretical determination of the risk, which in 73 per cent of the cases will lead to no unexpected losses,

and in 94 per cent to not more than one such loss in a period of twenty to thirty years?

In such cases as these the object is to determine the average interval between the occurrence of certain unfavorable conditions, such as insufficient rain, late spring frosts, early autumn frosts and other adverse events. This is the question that is answered by these curves, for by a little additional calculation the "frequency" curve becomes an "average interval" curve. By use of these devices of the mathematician, it becomes possible from the examination of a limited number of observations to obtain a reasonable estimate of events as they will occur in an unlimited series of observations and hence to predict what is going to happen on the average in the next 20 or 100 or 1,000 years. Of course, it is not possible to tell by these means, nor by any others now known, just when such unfavorable events will happen. They may occur in two successive years and not again for 20 years. But, though they appear to happen fortuitously, in the long run they will occur the number of times indicated by the curve, and it is the performance of the land and the weather in the long run that determines values, though to the individual farmer the events of a few specific years may be of first importance.

The application of the statistical method to this individual phase of the problem, in what has been called "weather insurance," offers a legitimate opportunity for an extension of the field covered by insurance companies. We now have marine insurance, which includes perils of the sea due to storms, also hail and tornado insurance in certain parts of the country, but the idea may be greatly extended. Basing the work upon the methods I have described and upon the accurate climatological data collected by the Weather Bureau, there should be a statistical determination of the farmers' many risks from unfavorable weather conditions. Then the proper charge against the weather hazard can be made, and unseasonable and unusual weather will cease to be a calamity to the individual, just as the financial losses by fire and death are minimized in fire and life insurance, and the burden which is at present carried by individual losses and by depreciation of land values will be more widely distributed.

With such insurance well established it will be applicable in a wider field than the distribution of the individual risk. The insurance rate quoted on a farm will give the purchaser valuable information. The country banker and storekeeper, who frequently carry the farmer through bad years, will be able to insure themselves against a great drain upon their resources in any one year. Instead of the haphazard, unbusinesslike method of taking unknown chances, which characterizes much of the present practice, the weather becomes a determinate risk in farming, a risk that can be stated more easily and more accurately than most other business risks.

Turning now from the numerous climatic problems of the agriculturist to those even more extensive fields of investigation, the physics of the atmosphere as a whole and the interrelations of its various parts, we find that the mathematical weather men have brought to light another series of interesting and curious facts. When an English scientist announces that it will be warm in Cairo, Egypt, tomorrow, since it was cold in London today, and that the rainfall will be unusually heavy in England this winter, since it was unusually light in Cuba last summer; when another says that a light rainfall in Chile during the period from May to August will be followed during July to October by more than ordinary floods on the Nile; when a Japanese mathematician says that the rice crop in northern Japan will be large this fall, since the barometer was unusually high last spring over China; when the scientists begin making such long range and curiously disconnected forecasts as these, it would seem that they are beginning to understand something of how this complicated atmosphere of ours works. As a matter of fact, they are conservative, and do not make any such forecasts for individual periods, but they have shown that on the average and to a great extent such relations do hold.

Many such correspondences between weather happenings in widely separated parts of the world have been shown. The rainfall of the central United States shows a direct correspondence to that of central South America, and both show an inverse relation to the rainfall of Australia. A forecast of the temperature at Berlin in March and April is possible at the end of December from the temperature at Christiana, Norway. When the April temperature at Irkutsk, Siberia, is higher than the normal, we may expect with a high degee of probability that the temperature at San Francisco in the following July will be abnormally low, and conversely. The higher the barometric pressure in the Argentine and Chile during March and April the greater will be the monsoon rainfall of India the following July and August. Florida and southern California refuse to pull together in the matter of weather. Especially in the winter months, when one is warmer than normal, the other insists upon being cooler. Starting with San Diego as a basis of comparison and moving east and north, we find that the temperatures show a decreasing correspondence to those at San Diego, until, in the Mississippi Valley, the relation changes from positive to negative, and the eastern part of the country generally has temperature conditions opposite to those in southern California, culminating at Jacksonville, Florida, in a high degree of contrariness. Thus, it is fortunate for the orange market that freezes are not likely to occur in Florida and California in the same winter.

Such are some of the curious but apparently unimportant facts which have been revealed by the application of these novel methods of investigation to the study of climatic data. They are evidence that our entire atmosphere functions more or less as a unit, and though some of the results may seem at first sight to be of little moment, they promise in the end to prove of the greatest value. Their significance lies in the fact that they are leading toward an understanding of those great motions and shiftings of the atmosphere which cause our changeful weather, and make one winter to differ from another winter in severity as one summer differeth from another summer in torridity. A thorough understanding of these movements should, in time, lead to the solution of that fascinating problem of the climatic forecast, now the realm of charlatans, but the dream of real scientists, which aims at predicting the general character of a season months in advance. When that time comes, the mysteries of the weather largely will have vanished, and the meteorologist may say with the Wise Man in Yeats's play, "I have made formations in battle with Arithmetic that have put the hosts of heaven to the rout."

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