as follows: Class "A," 3 cents; class "B," 3½ cents; class "C," 4 cents, and for children 12 years of age or under, one-half the rate above prescribed; a charge of ten cents may be added to the fare of any passenger, when the same is paid upon the cars, if a ticket might have been purchased within a reasonable time before the departure of the train.

SEC. 2078. The executive council shall at its regular meeting on the second Monday in July in each year classify the different railways, as provided by section two thousand and seventy-six (2076) of the code, from information as to gross earnings obtained from the annual reports of railways made to the executive council for assessment and taxation, if it shall be satisfied of the correctness of same, or from information obtained by said executive council from any other source, and, when there shall be any change in classification, shall issue a certificate to any corporation or corporations affected by such change, certifying the class to which they are respectively assigned; any change of rates by any corporation pursuant to any change of classification shall take effect and be in force from and after the date of such certificate.

U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU.

IN CO-OPERATION WITH THE

Iowa Weather and Crop Service.

ANNUAL REPORT FOR 1904.

GEO. M. CHAPPEL,
Local Forecaster, Ass't Director.

JOHN R. SAGE,
Director.

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LETTER OF TRANSMITTAL.

STATE OF IOWA.
OFFICE OF THE WEATHER AND CROP SERVICE,
DES MOINES, May 20, 1905.

To His Excellency, ALBERT B. CUMMINS, Governor of Iowa:

SIR—In accordance with the requirements of the law, we have the honor to submit herewith the fifteenth annual report of the Iowa Weather and Crop Service, for the year 1904.

We are, sir, very respectfully,

Your obedient servants,

JOHN R. SAGE,
Director.

GEO. M. CHAPPEL,
Local Forecaster, U. S. Weather Bureau,
Assistant Director.

ANNUAL REPORT, 1904.

Climatic data and statistics of soil products of the state, for the year 1904, have been compiled in condensed form in this report for future reference and comparison.

During the year meteorological reports have been received from regular United States Weather Bureau stations at Des Moines, Davenport, Dubuque, Keokuk, Sioux City, Charles City, Iowa, and Omaha, Nebraska. The station at Charles City was opened November 1, 1904. Reports have been received also from 132 stations in charge of co-operative observers of the service These auxiliary reports are of inestimable value, affording a great mass of recorded observations for the benefit of students of climatology, and persons engaged in various branches of business. The county and township crop reporters, most of whom have become experts in estimating the condition and yield of the staple crops, render a most valuable service to the public.

During the year this office has issued about 70,000 copies of weekly Climate and Crop Bulletins, 31,500 copies of the Monthly Review, and 5,000 copies of the annual report for 1903.

There has been a steady increase in the dissemination of daily weather forecasts by telephone and rural mail. Something over fifty-five thousand farmers now receive forecasts by rural telephone lines. It is estimated that seven thousand forecast cards are distributed by rural mail carriers, and a much larger number of farmers are patrons of daily papers which publish the forecasts.

CLIMATOLOGY OF THE YEAR 1904.

BAROMETER.—The mean pressure for the year was 30.04 inches. The highest observed pressure was 30.85 inches on February 10th, at Sioux City; lowest pressure, 29.09 inches on December 27th, at Dubuque. Range for the state 1.76 inches.

TEMPERATURE.—The mean temperature for the state was 46.3°, which is 0.4° below normal. The highest temperature reported was 100° on July 17th, at Marshalltown. The lowest temperature reported was 32° below zero on January 27th, at Elkader and Fayette. Range for the year 132°.

PRECIPITATION.—The average amount of rain and unmelted snow for the year, as shown by complete records of 96 stations, was 28.74 inches, which is 2.68 inches below the normal, and 6.92 inches below the average amount

in 1903. The greatest amount recorded at any station for the year was 38.93 inches at Keokuk. Least amount recorded 19.34 inches, at Vinton. The greatest monthly rainfall was 11.97 inches, at Thurman, in July; least monthly amount, none, at Rockwell City, in November. The greatest amount in any 24 consecutive hours was 7.73 inches, at De Soto, July 19th. The average number of days on which .01 of an inch or more of rain fell was 75.

WIND AND WEATHER.—The prevailing direction of wind was northwest. Highest velocity reported, 68 miles an hour, in Sioux City, from the northwest on March 2d. Average daily movement, 216 miles. There were 164 clear days, 97 partly cloudy, and 105 cloudy days; as against 156 clear days, 100 partly cloudy, and 109 cloudy days in 1903.

MONTHLY SUMMARIES.

JANUARY.

The monthly mean temperature for the state, as shown by records of 111 stations, was 14.0°, which is 4.2° below the normal. By sections the mean temperatures were as follows: Northern section, 10.1°; central section, 14.1°; southern section, 17.8°. The highest monthly mean was 21.6° at Red Oak; the lowest monthly mean, 6.6° at Charles City. The highest temperature reported was 57°, at Red Oak, on the 19th; lowest temperature reported, 32° below zero, at Elkader and Fayette, on the 27th. The average monthly maximum was 45.4°; average monthly minimum, 23.2°. Greatest daily range, 49°, at Atlantic and Villisca; average of greatest daily ranges, 34.2°. Average precipitation for the state, as shown by records of 122 stations, was 1.18 inches, which is 0.21 of an inch above the normal. The averages by sections were as follows: Northern section, 0.49 of an inch; central section, 1.06 inches; southern section, 2.00 inches. The largest amount reported was 3.68 inches, at Lacona; least amount reported, .02 of an inch, at Storm Lake. The greatest daily rainfall reported was 2.45 inches, at Belle Plaine, on the 20th. Average number of days on which .01 of an inch or more was reported, 6. Prevailing direction of the wind, northwest; highest velocity reported, 50 miles per hour, from the southeast, at Sioux City, on the 18th. Average number of clear days, 12; partly cloudy, 8; cloudy, 11.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. Intensely cold last decade of the month. Fine solar halo with brilliant parhelia and upper contact arch all forenoon of the 23d.

Audubon—GEO. E. KELLOG. Coldest day of the season was the 24th, temperature did not rise above 14° during the day.

Bedford—E. E. HEALY. Heavy sleet on the night of the 20th did much damage to trees.

Belknap—A. W. RANKIN. Sleet storm on 20th caused much damage to trees and shrubbery.

Bonaparte—B. R. VALE Cold at each extreme, but mostly a pleasant month.

Britt—GEO. P. HARDWICK. Coldest January in eight years; about average snowfall.

Chariton—C. C. BURR. Sleet did great damage to trees and telegraph lines; some telephone plants destroyed.

Clarinda—A. VAN SANDT. Sleet on 19th and 20th did some damage to trees

Clinton—LUKE ROBERTS. Mean temperature 3.8° below normal. Snowfall 7 inches, with 4 inches to commence on. Sleigh could be used every day in the month. There have been nine colder Januaries in the last 26 years. Nine days with temperature below zero.

Corydon—MRS. CLARA MILLER. Ice formed on trees half to three-fourths inch thick, causing damage to fruit and shade trees.

Grand Meadow—F. L. WILLIAMS. Last nine days of the month were bitter cold.

Indianola—JOHN L. TILTON. Storm on 20th left a sheet of ice 1.3 inches, coating trees and vines with heavy layer, remaining firmly till end of month.

Leon—MILLARD F. STOOKEY. Thunder and lightning on 20th; fruit and shade trees much damaged by sleet.

Mt. Ayr—A. F. BEARD. Sleet on 20th caused much injury to trees, telephone wires and poles.

Mt. Vernon—JOS. W. HUBBARD. The ice on 20th caused much damage to trees and great peril to pedestrains.

Ridgeway—ARTHUR BETTS. Coldest January on record here, but a pleasant month; 61 per cent of sunshine.

Villisca—C. E. MATTESON. A fair and pleasant month up to 23d; hail, snow and sleet the last week injured the peach crop.

Waukee—E. J. LEONARD. Month favorable till 20th; sleet and ice with zero weather balance of month.

Wilton—J. M. RIDER. Very heavy sleet on 20th, covering trees and wires with ice and icicles, making a beautiful scene; sleet remained until end of month.

FEBRUARY.

The monthly mean temperature for the state, as shown by recor ds of 10 stations, was 14.8°, which is 4.8° below normal. By sections the mean temperatures were as follows: Northern section, 10.7°; central section, 15.0°; southern section, 18.8°. The highest monthly mean was 21.6° at Keokuk; lowest monthly mean, 7.2°, at Estherville. The highest temperature reported was 70°, at Keosauqua, on the 6th; lowest temperature reported, -26°, at Fayette, on the 1st. The average

monthly maximum was 51.3°; average monthly minimum, 14.4° below zero. Greatest daily range, 60.0° at Denison; average greatest daily ranges, 41.0°. Average precipitation for the state, as shown by records of 118 stations, was 0.41 of an inch, which is 0.63 of an inch below normal. The averages by sections were as follows: Northern section, 0.63 inch; central section, 0.35 inch; southern section, 0.25 inch. The largest amount reported was 1.99 inches at Ridgeway; least amount reported, trace at Osceola and Thurman. The greatest daily rainfall reported was 0.84 of an inch at Ridgeway, on the 17th and 18th. Average number of days on which .01 of an inch or more was reported, 4. Prevailing direction of the wind, northwest; highest velocity reported, 61 miles per hour, from the northwest, at Sioux City, on the 2d. Average number of clear days, 10; partly cloudy, 9; cloudy, 10.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. Month cold and mostly cloudy; mean temperature, 5.2° below normal for the past fourteen years.

Amana—C. SCHADT. Month cold, northwest wind prevailing. But little snow on the ground and frost penetrated the ground, causing freezing in pipes several feet in depth. Ice formed on trees January 19th; did not melt until February 5th. Thunderstorm on 6th.

Belknap—A. W. RANKIN. Only half an inch of precipitation in February, and ground frozen two to four feet.

Bonaparte—B. R. VALE. Uniformly solid month. Good roads, and conditions good for feeding stock. Thawing at close of month.

Britt—No severe storms, and but little snow; roads fine and live stock wintering well.

Clinton—LUKE ROBERTS. Mean temperature 16.1°, or 5.9° below normal; rainfall, .95 of an inch, or 1.05 below normal. Wind, 5,000 miles; cloudiness, 60 per cent; first decade cold.

Grand Meadow—F. L. WILLIAMS. Mercury below zero fifteen days; dry and roads good most of month.

Hanlontown—MISS G. M. PASCHEN. Only a few drifts of snow remained at close of month.

Humboldt—H. S. WELLS. No blizzards; month 2° warmer than January.

Ida Grove—J. E. CONN. Month very cold; the mean temperature, 13.7°.

Logan—MRS. M. B. STERN. Month cold; with but little snow and no bad storms; fine winter weather.

Olin—NATHAN POTTER. Good sleighing first half of the month.

Ridgeway—ARTHUR BETTS. The month gave 170 hours of sunshine; rain on four dates; good month for the farmer; sleighing generally good. December, January and February gave thirty-five days below zero temperature, and twenty-five thawing days. January was the coldest month; mean for the winter, 13.5°.

Villisca—C. E. MATTESON. A dry and cold winter month; stock doing well; roads fine.

Washta—H. L. FELTER. But little snow in patches at end of the month; zero or below on fourteen mornings; no bad storms.

MARCH.

The monthly mean temperature for the state, as shown by records of 116 stations, was 34.8°, which is 2.4° above normal. By sections the mean temperatures were as follows: Northern section, 32.4°, which is 2.8° above normal; central section, 34.9°, which is 2.7° above normal; southern section, 37.0°, which is 1.1° above normal. The highest monthly mean was 38.6°, at Burlington, Guthrie Center, Glenwood, Keokuk, Osceola and Ottumwa; lowest monthly mean, 27.0° at Cresco. The highest temperature reported was 78.° at Ottumwa on the 23d; lowest temperature reported 3° at Columbus Junction on the 3d. The average monthly maximum was 62.9°; average monthly minimum, 4.6°. Greatest daily range, 55.0° at Sioux City; average of greatest daily ranges, 36.8°. Average precipitation for the state as shown by records of 127 stations, was 2.18 inches, which is 0.35 of an inch above normal. The averages by sections were as follows: Northern section, 1.74 inches, which is 0.12 of an inch above normal; central section, 2.05 inches, which is 0.17 of an inch above normal; southern section, 2.74 inches, which is 0.77 of an inch above normal. The largest amount reported was 4.57 inches at Bedford; least amount reported, 0.50 of an inch, at Ida Grove and Sioux City. The greatest daily rainfall reported was 2.35 inches at Bedford on the 30th. Average number of days on which .01 of an inch or more was reported, 7. Prevailing direction of the wind, northwest; highest velocity reported, 68 miles per hour, from the northwest, at Sioux City, on the 2d. Average number of clear days, 8; partly cloudy, 8; cloudy, 15.

OBSERVERS' NOTES.

Amana—CONRAD SCHADT. No farm work done; hardly a vestige of growing vegetation; thunderstorm on the 24th and 30th.

Bonaparte—B. R. VALE. Precipitation, 2.73 inches; muddy fields and bad roads; no farm work done; subsoil not very wet.

Clinton—LUKE ROBERTS. Mean temperature was normal, but was 7.6° colder than March, 1903; precipitation, 1.61 inches, or 2 inches above normal; 1.06 inches came in form of snow on 24th, with strong wind.

Elkader—CHAS. REINECKE. Ice went out of the Turkey river March 1st.

Grand Meadow—F. L. WILLIAMS. Month very disagreeable and backward; no field work done; roads bad; stock doing well.

Grundy Center—E. S. King. Only five clear days; no farm work done.

Olin—N. POTTER. First half of month fine, up to 13th; last half changeable, with mud; spring backward, and no farm work done.

Pacific Junction—H. H. MCCARTNEY. On the 2d, at 2 P. M., temperature was 68°; at 7 P. M. it had fallen to 20°; strong wind from southeast changed from gale to northwest, almost in a moment. Fall in temperature of 62° between 2 P. M. on 2d to 7 A. M. on 3d.

Ridgeway—ARTHUR BETTS. Only 149 hours of sunshine; big snowstorm on 13th and 14th, but an agreeable month; wild geese and robins came early in the month.

Rock Rapids—W. C. WYCKOFF. Seeding began on 29th on ridges and up near state line; stopped by rain on 30th.

Waukee—E. J. LEONARD. An inch more snow fell in March than in February; since January 1st have had 17.5 inches of snow; coldest day of winter was January 25th; temperature ranged 8° to 18° below zero.

APRIL.

The monthly mean temperature for the state, as shown by records of 115 stations, was 44.1°, which is 5.2° below normal. By sections the mean temperatures were as follows: Northern section, 42.4°, which is 4.9° below normal; central section, 44.4°, which is 4.4° below normal; southern section, 45.5°, which is 6.7° below normal. The highest monthly mean was 47.8° at Ottumwa; lowest monthly mean, 40.2°, at Sibley. The highest temperature reported was 86°, at Sigourney and Forest City on the 22d and 23d; lowest temperature reported, 13°, at Primghar on the 11th. The average monthly maximum was 77.1°; average monthly minimum, 20.9°. Greatest daily range, 48°, at Forest City; average of greatest daily ranges, 37.2°. Average precipitation for the state, as shown by records of 126 stations, was 3.63 inches, which is 0.74 of an inch above normal. The averages by sections were as follows: Northern section, 2.73 inches, which is .11 of an inch above normal; central section, 3.48 inches, which is .58 of an inch above normal; southern section; 4.68 inches, which is 1.57 inches above normal. The largest amount reported was 8.97 inches, at St. Charles; least amount reported, 1.52 inches, at Elkader. The greatest daily rainfall reported was 3.11 inches, at Sigourney on the 25th. Average number of days on which .01 of an inch or more was reported, 7. Prevailing direction of wind, northwest; highest velocity reported, 56 miles per hour, from the northwest, at Sioux City on the 11th. Average number of clear days, 15; partly cloudy, 6; cloudy, 9.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. April was unusually cool, and the season is fully two weeks late.

Amana—CONRAD SCHADT. Cold unseasonable weather, with frequent frosts; field work much delayed.

Atlantic—J. W. LOVE. Farm work much hindered by cold and wet weather.

Baxter—W. S. THORP. At close of April, plowing for corn was two-thirds completed; small grain was coming up and grass was short.

Bonaparte—B. R. VALE. Cold month; vegetation two weeks later than normal; rains not excessive, but cold and mixed with snow; much cloudy weather.

Britt—GEO. P. HARDWICK. Frost in ground at end of month; spring ten days late; no bloom yet.

Clinton—LUKE ROBERTS. Month abnormally cold; no cherry trees in bloom at close of month. There were thirteen mornings, from 2d to 21st, when water froze. The mean temperature was 44.1°, being 7.9° below normal. This breaks all April records during the past 26 years. The rainfall was 3.40 inches, which is half an inch in excess of normal.

Forest City—J. A. PETERS. Seeding begun April 4th, much delayed by rains and cold weather; oats about all in by the 23d; last ten days fine for work.

Inwood—G. M. LARSEN. Heaviest snow of season fell on night of the 19th, the amount being 3.5 inches. Last week of the month was fine.

Mount Vernon—JOS. W. HUBBARD Temperature below normal; season late, but favorable at the close.

Ridgeway—ARTHUR BETTS. Coldest April on record; last ten days delightful; 262 hours of sunshine; anemones on 16th, and buttercups, 25th; 8 days totally devoid of clouds.

MAY.

The monthly mean temperature for the state, as shown by records of 114 stations, was 59.6°, which is 0.8° below normal. By sections the mean temperatures were as follows: Northern section, 58.2°, which is 1.1° below normal; central station, 59.9°, which is 0.3° below normal; southern section, 60.6°, which is 1.4° below normal. The highest monthly mean was 62.4°, at Burlington, Onawa, Keokuk and Ridgeway; lowest monthly mean, 56.4° at Sibley. The highest temperature reported was 93°, at Ridgeway, on the 22d; lowest temperature reported, 27°, at Charles City on the 15th. The average monthly maximum was 85.8°; average monthly minimum, 34.3°. Greatest daily range, 47°, at Monticello and Northwood; average of greatest daily ranges, 37.3°. Average precipitation for the state, as shown by records of 126 stations, was 3.78 inches, which is 0.35 of an inch below normal. The averages by sections were as follows. Northern section, 4.01 inches, which is .19 of an inch above normal; central section, 3.41 inches, which is .68 of an inch below normal; southern section, 3.92 inches, which is .43 of an inch below normal. The largest amount reported was 8.15 inches at Onawa; least amount reported, 1.50 inches at Clear Lake. The greatest daily rainfall reported was 3.33 inches at Florence, on the 24th and 25th. Average number of days on which .01 of an inch or more was reported, 8. Prevailing direction of the wind, southeast; highest velocity reported, 51 miles per hour, from the south, at Sioux City, on the 4th. Average number of clear days, 13; partly cloudy, 10; cloudy, 8.

OBSERVERS' NOTES.

Allerton—REX SHRIVER. Corn was nearly all planted at close of month.

Audubon—GEO. E. KELLOGG. Nearly 6 inches less rainfall this month than in May, 1903.

Bonaparte—B. R. VALE. Rain, 4.17 inches. Corn planting was very tardy. Corn culture was hardly begun at end of month.

Britt—GEO. P. HARDWICK. Corn was planted in favorable conditions from 9th to 24th; grain thin from poor seed; fruit prospects mostly poor.

Clinton—LUKE ROBERTS. May mean temperature slightly above normal; rainfall about two inches below normal. A month of ideal weather for

farm work; but one frost (on 15th) that was harmless; though late vegetation was in good condition, except where poor seed was planted.

Forest City—J. A. PETERS. Though dry, the crops look fine at close of the month.

Hanlontown—MISS G. M. PASCHEN. Corn planting begun on 4th; on 5th the ground white with hail; planting finished about 21st.

Ida Grove—J. E. CONN. An exceptionally fine month; crop prospects good.

Inwood—J. M. LARSEN. A fair month; promise of a large crop of grain and fruit.

Larrabee—H. B. STREVER. Wind caused some damage to outbuildings at Meriden on afternoon of the 5th. Several barns were damaged.

Olin—N. POTTER. May has been an ideal month for farm work. Conditions are normal.

Ridgeway—ARTHUR BETTS. A perfect May; entirely frostless; 312 hours of sunshine; 13 days calm; no gales nor windstorms.

Waukee—E. J. LEONARD. Rainfall 3.46 inches, or less than one-third the amount in May, 1903; too cool and cloudy for normal growth of crops.

JUNE.

The monthly mean temperature for the state, as shown by records of 114 stations, was 67.1°, which is 2.5° below normal. By sections the mean temperatures were as follows: Northern section, 65.7°, which is 2.6° below normal; central section, 67.5°, which is 2.0° below normal; southern section, 68.2°, which is 3.1° below normal. The highest monthly mean was 70.6° at Monticello; lowest monthly mean, 63.7° at Sibley. The highest temperature reported was 94° at Clinton, Larrabee, Ridgeway and Ruthven on the 23d and 24th; lowest temperature reported, 35° at Charles City on the 2d. The average monthly maximum was 88.1°; average monthly minimum 45.9°. Greatest daily range, 45 at Pocahontas; average of greatest daily ranges, 33.4. Average precipitation for the state, as shown by the records of 126 stations, was 3.45 inches, which is 1.05 inches below normal. The averages by sections were as follows: Northern section, 4.53 inches, which is .15 of an inch below normal; central section, 2.74 inches, which is 1.56 inches below normal; southern section, 3.08 inches, which is 1.33 inches below normal. The largest amount reported was 8.35 inches at Humboldt; least amount reported, .44 of an inch at Gilman. The greatest daily rainfall reported was 3.67 inches at Charles City on the 19th. Average number of days on which .01 of an inch or more was reported, 7. Prevailing direction of the wind, southeast; highest velocity reported, 58 miles per hour, from the northwest, at Sioux City, on the 28th. Average number of clear days, 13; partly cloudy, 10; cloudy, 7.

OBSERVERS' NOTES.

Allerton—REX SHRIVER. An ideal month for all crops; fruit generally good.

Alta—DAVID E. HADDEN. June cool, with rainfall about 2 inches below normal of preceding 14 years.

Amana—CONRAD SCHADT. Month was cool and dry, favorable for small grain, but not so good for corn and grass.

Atlantic—J. W. LOVE. Did not have one clear day in June, and nights were cool; severe storm and some hail on the 20th, but not much damage resulted. Crops are doing well.

Bonaparte—B. R. VALE. Rain 4.41 inches, against 2.30 inches in June, 1903. Up to date we have 1.48 inches in excess of last year, but crops are much better. Month too cool for corn.

Britt—GEO. P. HARDWICK. But three clear days in June; corn acreage large, but stand thin. Oats short and thin; meadows and pastures below average; potatoes good.

Chariton—C. C. BURR. No floods or severe storms in June; nights abnormally cool.

Clarion—J. H. DUBOIS. Clover in blossom June 11th; strawberries ripe 13th; new potatoes on 18th; oats heading 20th.

Forest City—J. A. PETERS. Corn varies from four to twenty-four inches high; too cool and cloudy for corn; hay crop good.

Oskaloosa—JOS. BOYD. June was cool and free from severe storms.

Pocahontas—F. E. HRONEK. On night of 28th a hailstorm caused much damage in a strip 3 to 5 miles wide and 8 to 10 long. Damage to corn 10 to 40 per cent.

Ridgeway—ARTHUR BETTS. A very pretty June; 315 hours of sunshine; temperature normal; vegetation made rapid growth and is of good color; 16 days calm.

Waukee—E. J. LEONARD. June remarkably free from severe storms; small fruit abundant; crops doing well.

JULY.

The monthly mean temperature for the state, as shown by records of 119 stations, was 70.6°, which is 3.6° below normal. By sections the mean temperatures were as follows: Northern section, 69.1°, which is 3.9° below normal; central section, 71.0°, which is 3.1° below normal; southern section, 71.70, which is 3.9° below normal. The highest monthly mean was 74.0°, at Keokuk; lowest monthly mean, 66.5°, at Cresco. The higest temperature reported was 100°, at Marshalltown on the 17th; lowest temperature reported, 38°, at Fayette on the 2d. The average monthly maximum was 93.1°; average monthly minimum, 46.8°. Greatest daily range, 43°, at Logan; average greatest daily ranges, 33 4°. Average precipitation for the state, as shown by records of 117 stations, was 4.41 inches, which is 0.18 of an inch above normal. The averages by sections were as follows: Northern section, 3.77 inches, which is 0.41 of an inch below normal; central section,

4.47 inches, which is 0.38 of an inch above normal; southern section, 5.00 inches, which is 0.54 of an inch above normal. The largest amount reported was 11.97 inches, at Taurman; least amount reported, 1.28 inches, at Plover. The greatest daily rainfall reported was 7.73 inches, at De Soto on the 19th. Average number of days on which .01 of an inch or more was reported, 10. Prevailing direction of the wind, southwest; highest velocity reported, 42 miles per hour, from the northwest, at Sioux City on the 3d. Average number of clear days, 16; partly cloudy, 9; cloudy, 6.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. July mean temperature was 3° below normal, and rainfall about 1.50 inches less than average of preceding fourteen years.

Amana—C. SCHADT. Nights were cool, and weather very favorable for ripening grain and harvesting, with sunshine and rain enough to promote growth of corn.

Bonaparte—B. R. VALE. Rain, 4.43 inches, but latter half of month was dry; good harvest weather after the 10th.

Britt—GEO. P. HARDWICK. Wind and hail on 14th and 17th lodged grain and blew off apples. Wheat, barley and potatoes good.

Clinton—LUKE ROBERTS. A fine month for all crops, out of door work and personal comfort. Rain, 3.18, barely enough for crops; corn, potatoes and fruit doing well; grain and hay mostly secured.

Forest City—J. A. PETERS. Harvesting oats began about 23d; early corn in tassel on 25th; oats about one-third in shock at close of month.

Inwood—G. M. LARSON. The month was very favorable for farm work; abundant crop of good hay put up; corn looking well.

Logan—M. B. STERN. Month changeable, cool and warm, but crops have grown finely.

Olin—NATHAN POTTER. Good month for farm work, which was well advanced at its close.

Pocahontas—F. E. HRONEK. Excellent weather for haying and harvesting; corn tasseling and silking at close of month.

Ridgeway—ARTHUR BETTS. Coolest July on record here; 341 hours of sunshine; just enough rain, and crops are promising; hard windstorm on the 18th, with some damage to orchards, etc.

AUGUST.

The monthly mean temperature for the state, as shown by records of 115 stations, was 69.1°, which is 2.7° below normal. By sections the mean temperatures were as follows: Northern section, 67.3°, which is 3.2° below normal; central section, 69.2°, which is 2.4° below normal; southern section, 70.7°, which is 2.9° below normal. The highest monthly mean was 73.3°, at College Springs; lowest monthly mean, 65.0°, at New Hampton and Sibley. The highest temperature reported was 97°, at Mt. Ayr and Waukee, on the 13th; lowest temperature reported, 35°, at Earlham, on the 8th. The

average monthly maximum was 91.4°; average monthly minimum, 44.0°. Greatest daily range, 45°, at Rock Rapids; average of greatest daily ranges, 35.1°. Average precipitation for the state, as shown by records of 126 stations, was 3.43 inches, which just equals the normal. The averages by sections were as follows: Northern section, 2.89 inches, which is 0.16 of an inch below normal; central section, 3.24 inches, which is 0.29 of an inch below normal; southern section, 4.15 inches, which is 0.45 of an inch above normal. The argest amount reported was 6.75 inches at Fort Dodge; least amount reported, 0.66 of an inch, at Sibley. The greatest daily rainfall reported was 4.00 inches at Fort Dodge on the 29th. Average number of days on which .01 of an inch or more was reported, 7. Prevailing direction of wind, southwest; highest velocity reported, 42 miles per hour, from south, at Sioux City, on the 3d. Average number of clear days, 17; partly cloudy, 8; cloudy, 6.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. The rainfall for August was .88 of an inch above the 14 years' normal; temperature about normal.

Allerton—REX SHRIVER. Favorable month for all kinds of work; fall pastures starting well; apple crop good.

Amana—C. SCHADT. First and second decades very dry and favorable for threshing; corn made good progress.

Ames—THOS. S. HUNT. Corn backward at close of August, needing 3 or 4 weeks without frost.

Atlantic—J. W. LOVE. A peculiar month; only one thunderstorm in August; light, harmless frost on morning of 8th.

Bonaparte—B. R. VALE. Rain, 4.40 inches, well distributed; temperature below normal; pastures good.

Britt—GEO. P. HARDWICK. Generally fair, with no severe storms; cool nights, with two light frosts on low lands (8th and 22d); wheat rusted badly; oats yielded 28 to 30 bushels, of good quality; barley about same; corn uneven.

Chariton—C. C. BURR. A month of bright, pleasant days and cool nights; corn needing 30 days after close of August.

Clinton—LUKE ROBERTS. Mean temperature of August, 2.4° below normal; rainfall 2.34 inches in excess of normal; crops made good growth; lightning did some damage in this county.

Forest City—J. A. PETERS. Light frost in low places on 8th; no damage; not over 25 per cent of corn in full roasting ears at close of month.

Inwood—G. M. LARSEN. August generally fair; nights were cool; oats and barley made good yield; wheat damaged by rust, and poor; large fruit crop; lightning has done much damage.

Keosauqua—J. H. LANDES. Remarkably cool nights have been most marked features of the month.

Larrabee—H. B. STREVER. On the 17th lightning struck barn of Jas. Main, a few miles northeast of Cherokee. Martin Main was killed instantly.

Olin—N. POTTER. Rain sufficient for fall pasture and for fall plowing; corn has done well, but is ten days late.

Ridgeway—ARTHUR BETTS. Warmest August since 1901, with 354 hours of sunshine; rainfall light, more than half falling on 9th; a pretty fog-bow observed on the 20th; mirages on the 2d and 6th; crops will compare favorably with 1898.

SEPTEMBER.

The monthly mean temperature for the state, as shown by the records of 114 stations, was 64.0°, which is 0.4° above normal. By sections the mean temperature was as follows: Northern section, 61.8°, which is 0.5° below normal; central section, 64.3°, which is 1.1° above normal; southern section, 65.6°, which is 0.2 above normal. The highest monthly mean was 68.6° at Belknap; lowest monthly mean, 59.0° at Sibley. The highest temperature reported was 94° at Wilton Junction on the 11th; lowest temperature reported, 30° at Atlantic, Earlham, Hanlontown and Rock Rapids on the 14th, 15th and 21st. The average monthly maximum was 88.9°; average monthly minimum, 34.7°. Greatest daily range, 54° at Estherville; average of greatest daily range, 36.5°. Average precipitation for the state, as shown by the records of 122 stations, was 2.78 inches, which is 0.52 of an inch below normal. The averages by sections were as follows: Northern section, 2.67 inches, which is .74 of an inch below normal; central section, 2.13 inches which is 1.13 inches below normal; southern section, 3.53 inches, which is 0.28 of an inch above normal. The largest amount reported was 8.33 inches at Keokuk; least amount reported, .09 of an inch at Ida Grove. The greatest daily rainfall reported was 3.01 inches at Keokuk on the 18th and 19th. Average number of days on which .01 of an inch or more was reported, 7. Prevailing direction of the wind, south and southwest; highest velocity reported, 39 miles per hour from the northwest at Sioux City on the 1st. Average number of clear days, 13; partly cloudy, 8; cloudy, 9.

OBSERVERS' NOTES

Afton—N. W. ROWELL. A month of great anxiety to all; we have alternated between hope and fear as sunshine and shadows came and went. But a kind Providence has so tempered the winds that no blighting frost has fallen. Our corn crop is secure and our pastures green, with ripe fruit upon tree and vine. Let us give thanks.

Alta—DAVID E. HADDEN. The mean temperature for September was about 1° below the normal; no killing frost occurred during the month.

Amana—C. SCHADT. Weather favorable for maturing corn; no real killing frost; only about 5 per cent lost by late planting from effect of frost on the 15th on low ground; grapes, plums and apples abundant.

Bonaparte—B. R. VALE. Rain 6.73 inches; too wet for farm work or the good of the corn; subsoil full of water; pasture good.

Britt—GEO. P. HARDWICK. Frost damaged corn on low lands and slightly on high lands; injured about 35 per cent.

Chariton—C. C. BURR. Month passed without a killing frost; on 15th frost did some harm to corn on low land; some corn yet needs ten days to ripen; pastures better than average.

Clinton—LUKE ROBERTS. Mean temperature 2° above normal; rainfall .55 of an inch below normal; per cent of cloudiness, 50; frost affected corn only in places and but slightly; crop as good as in 1903, possibly better.

Forest City—J. A. PETERS. No killing frost in September; frost on the 15th damaged corn only on low land and creek bottoms; ground in good condition for plowing.

Greenfield—J. G. CULVER. No frost sufficient to injure vegetation except in few places on lowest bottoms; very little damage to corn.

Grinnell—A. O. PRICE. No serious damage by frost; large amount of corn cut; plowing well advanced.

Grundy Center—E. S. KING. A variable month; corn practically safe; potatoes yield 200 to 300 bushels per acre.

Hopeville—M. T. ASHLEY. Eighty per cent of corn safe at close of month; late fields need 10 to 15 days of good weather.

Inwood—G. M. LARSEN. Month favorable for corn, and crop will be heavy; pastures good.

Larrabee—H. B. STREVER. Corn touched by frost on low lands on 21st; bulk of crop safe at end of month.

Logan—MRS. M. B. STERN. Frost on 15th killed very tender precipitation, but did not do much injury to corn.

Mt. Vernon—J. W. HUBBARD. Season closes favorably; small grains and root crops good; corn crop large, with an unusual percentage of soft ears.

Olin—NATHAN POTTER. A fine month; frost damaged corn on low land; apple and potato crops large.

Ridgeway—ARTHUR BETTS. Warmest September since 1898; sunshine 262 hours; on night of 5th nine fires were kindled by lightning in sight of this station. Hail on 17th, and hailstones averaged size of plums.

Waukee—E. J. LEONARD. Month free from heavy storms; some corn frosted on low lands, but bulk of crop is now safe.

Waverly—H. S. HOOVER. Upland corn untouched by frost; last ten days worked wonders in ripening corn.

Whitten—FRANK P. BUTLER. Frost did but little damage and corn is now practically safe.

OCTOBER.

The monthly mean temperature for the state, as shown by records of 111 stations, was 53.1°, which is 1.0° above normal. By sections the mean temperatures were as follows: Northern section, 51.1°, which is 0.4° above normal; central section, 53.0°, which is 1.6° above normal; southern section, 55.2°, which is 0.7° above normal. The highest monthly mean was 58.4°, at Belknap; lowest monthly mean, 49.2°, at Estherville. The highest

temperature reported was 96°, at Waukee on the 4th; lowest temperature reported; 16°, at Earlham on the 27th. The average monthly maximum was 81.9°; average monthly minimum, 23.2°. Greatest daily range, 51°, at Waukee; average of greatest daily range, 36.9°. Average precipitation for the state, as shown by records of 120 stations, was 1.67 inches, which is 0.73 of an inch below normal. The averages by sections were as follows: Northern section, 2.50 inches, which is .29 of an inch above normal; central section, 1.60 inches, which is .78 of an inch below normal; southern section, 0.90 of an inch, which is 1.73 inches below normal. The largest amount reported was 4.43 inches, at Sioux Center; least amount reported, .14 of an inch, at Bonaparte and Corydon. The greatest daily rainfall reported was 3.00 inches, at Olin on the 9th. Average number of days on which .01 of an inch or more was reported, 6. Prevailing direction of the wind, southeast, south and northwest; highest velocity reported, 52 miles per hour, from the northwest, at Sioux City on the 21st. Average number of clear days, 15; partly cloudy, 8; cloudy, 8.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. October rainfall occurred during the middle decade; last decade was ideal weather; frost on the 6th was only heavy in low places; first general killing frost came on night of 22d.

Amana—C. SCHADT. Weather very favorable for ripening and drying corn, and a considerable part of the crop is harvested; despite apparently unfavorable season nearly all crops have been abundant; fall sown fields look green and healthy; first killing frost October 23d.

Atlantic—J. W. LOVE. A very fine month for farm work; farmers husking corn and report heavy yield of good quality. Ducks made southward flight on 2d and wild geese the 4th.

Baxter—W. L. THORP. Corn matured without damage by frost.

Bonaparte—B. R. VALE. A royal month for farm work and maturing the corn crop; rainfall 0.14 of an inch—the lowest record in years.

Britt—GEO. P. HARDWICK. First killing frost here on October 6th, with but few mornings of frost temperature; corn husking began the 25th, though much was unfit to crib.

Chariton—C. C. BURR. Month favorable for farm operations, and work is well advanced; some corn being cribbed.

Clinton—LUKE ROBERTS. A very fine month with twenty clear days and no killing frost until 23d; rainfall only 0.59 of an inch—the least October rainfall in the last 26 years, except in 1897 when it was only 0.37 of an inch.

Forest City—J. A. PETERS. Very little corn cribbed; not dry enough; first killing frost here October 6th.

Garden Grove—F. L. WILLIAMS. Very favorable month for ripening corn; but little in crib yet; pastures fine as in June; plowing well along.

Grinnell—A. O. PRICE. First killing frost October 23d; weather fine; corn dry enough to crib.

Grundy Center—E. S. KING. A remarkable month; best kind of weather for corn and harvesting potatoes; some began to crib corn on the 19th.

Humboldt—H. S. WELLS. Corn all right and turning out good; pastures still good.

Ida Grove—J. E. CONN. An exceptionally warm and dry October; corn husking began on the 20th.

Inwood—G. M. LARSEN. A fine month. Good yield and quality of corn; considerable clover threshing.

Larrabee—H. B. STREVER. Frost killed corn on 6th, but flowers were in bloom till 23d.

Leon—M. F. STOOKEY. Freezing temperature forming ice on night of 21st-22d. Not much frost on account of wind.

Logan—MRS. M. B. STERN. A remarkable month for mildness; killing frost came later than usual.

Olin—NATHAN POTTER. An ideal month for fall work; corn picking began with better crops than usual.

Ridgeway—ARTHUR BETTS. Coolest October since 1898; 212 hours sunshine; first killing frost on 6th; very heavy thunder on 10th, struck in several places.

Sheldon—A. W. BEACH. First killing frost on 6th; corn all safe; husking generally began on 24th.

Stockport—C. L. BESWICK. Least rainfall for any month since these records began, over three years ago.

Waukee—E. J. LEONARD. Fine month for maturing corn; no frost sufficient to kill tomato vines till 23d, and frost every night after that except one.

Whitten—FRANK P. BUTLER—Morning of 23d ice formed; it was the first killing frost; the one on the 6th was light.

Zearing—H. E. BURKHART. Frost on the 6th did no damage; corn being cribbed last of month, and yield reported to average 50 bushels per acre.

NOVEMBER.

The monthly mean temperature for the state, as shown by records of 110 stations, was 41.0°, which is 6.3° above normal. By sections the mean temperatures were as follows: Northern section, 39.3, which is 7.0° above normal; central section, 40.7°, which is 6.1° above normal; southern section, 43.1°, which is 5.4° above normal. The highest monthly mean was 45.8°, at St. Charles; lowest monthly mean, 37.4°, at Maquoketa. The highest temperature reported was 80°, at Ruthven and Waukee, on the 18th; lowest temperature reported, 4°, at Britt, on the 30th. The average monthly maximum was 71.1°; average monthly minimum, 9.6°. Greatest daily range, 56°, at Rock Rapids; average of greatest daily ranges, 37.8°. Average precipitation for the state, as shown by records of 119 stations, was 0.15 of an inch, which is 1.25 inches below normal. The averages by sections were as follows: Northern section, 0.17 of an inch, which is 1.19 inches below normal; central section, 0.15 of an inch, which is 1.28 inches below normal;

southern section, 0.14 of an inch, which is 1.30 inches below normal. The largest amount reported was 0.50 of an inch, at Bonaparte and Glenwood; least amount reported, none, at Rockwell City. The greatest daily rainfall reported, was 0.50 of an inch, at Bonaparte and Glenwood, on the 9th and 10th, respectively. Average number of days on which .01 of an inch or more was reported, 1. Prevailing direction of the wind, northwest; highest velocity reported, 43 miles per hour, from the northwest, at Sioux City, on the 29th. Average number of clear days, 20; partly cloudy, 6; cloudy, 4.

OBSERVERS' NOTES.

Alta—DAVID E. HADDEN. An ideal November. One of the finest on record here. The daily mean temperature of the month was 8° above the average of the preceding 14 years. There was only one storm of rain and snow during the month and the greatest number of clear days and the least number of cloudy days on record.

Amana—CONRAD SCHADT. Indian summer weather prevailed throughout the month. The nights were cool and often foggy and the days mild and hazy. The ground seems to be as dry as ever at this time of the year. The roads are dry, hard and even as paved streets.

Atlantic—J. W. LOVE. This has been the finest November of which I have any record. Pasturage good for this season of the year. Roads never were in better condition. Dandelions in bloom on the 29th.

Bonaparte—HON. B. R. VALE. A pleasant and profitable month. Only .64 of an inch of rain since September 27th.

Britt—GEO. P. HARDWICK. An ideal month. But one cloudy day.

Chariton—C. C. BURR. November was a month of sunshine; no storms. Farm work is well advanced; but a trace of rain during the entire month.

Clinton—LUKE ROBERTS. The month was almost rainless and cloudless.

Forest City—J. A. PETERS. The most delightful November for years—no snow. Most of corn cribbed and fall work on farm well finished.

Grundy Center—E. S. KING. A very remarkable month for lack of storms.

Iowa Falls—J. B. PARMELEE. A twelve-year record does not show such fine weather for November.

Larrabee—H. B. STREVER. November has been very mild and clear, enabling farmers to carry forward fall work at a good pace.

Mt. Vernon—REV. JOS. W. HUBBARD. Remarkable for clear skies, moderate temperature and small amount of rainfall.

Oskaloosa—JOS. BOYD. November was a very dry and pleasant month. The least precipitation I have recorded for the past 14 years.

Ridgeway—ARTHUR BETTS. Wild geese going south on 17th. There were 13 days without a cloud and 15 days of uninterrupted sunshine.

Rock Rapids—W. C. WYKOFF. Finest fall in 23 years.

Sheldon—A. W. BEACH. First snow on 9th. Ground not frozen to prevent plowing.

Washta—H. L. FELTER. Unusually fine weather all during the month. All clear days but one. Could plow up to the 30th.

Waukee—E. J. LEONARD. Weather remarkably fine all the month. One light rain and no snow. Only 3 cloudy days and 2 partly cloudy since October 21st, or 36 clear days out of 41.

DECEMBER.

The monthly mean temperature for the state, as shown by records of 114 stations, was 23.4°, which is 0.5° above normal. By sections the mean temperatures were as follows: Northern section, 20.6°, which is 0.5° above normal; central section, 23.5°, which is 0 3° above normal, southern section, 26.1°, which is 0.4° above normal. The highest monthly mean was 29.9°, at Keokuk; lowest monthly mean, 18.2°, at Forest City. The highest temperature reported was 67°, at Albia on the 22d; lowest temperature reported, -19°, at Elkader on the 14th. The average monthly maximum was 55.5°; average monthly minimum, -8.8°. Greatest daily range, 57°, at Maquoketa; average of greatest daily ranges, 36 8°. Average precipitation for the state, as shown by records of 119 stations, was 1.44 inches, which is 0.15 of an inch above normal. The averages by sections were as follows: Northern section, 1.19 inches, which is 0.16 of an inch below normal; central section, 1.66 inches, which is 0.32 of an inch above normal; southern section, 1.48 inches which is 0.32 of an inch above normal. The largest amount reported was 3.68 inches, at Newton; lowest amount reported, .06 of an inch at Storm Lake. The greatest daily rainfall reported was 2 53 inches, at Newton on the 27th. Average number of days on which .01 of an inch or more was reported, 5. Prevailing direction of the wind, northwest; highest velocity reported, 57 miles per hour, from the northwest, at Sioux City on the 27th. Average number of clear days, 12; partly cloudy, 1; cloudy, 12.

OBSERVERS' NOTES.

Afton—N. W. ROWELL. The blizzard commenced at 8 P. M. on 26th and continued to the 28th; the worst in my ten years' record.

Allerton—REX SHRIVER. The blizzard on the 27th blocked roads and paralyzed traffic.

Alta—DAVID E. HADDEN. Ideal weather most of the month; the blizzard on 27th raged all day, but was quickly followed by fine weather.

Atlantic—J. W. LOVE. Month was very mild except during the heavy wind and snowstorm on 27th.

Bonaparte—B. R. VALE. Precipitation, 2.25 inches; a pleasant month with a bad storm on 27th; ground bare and without frost at close of month.

Britt—GEO. P. HARDWICK. The summer of 1904 was cool; autumn warm and late, with insect life until close of December; very high wind, blizzard and drifting snow on 27th and 28th.

Chariton—C. C. BURR. On 26th had light sleet, some rain with thunder, followed by one of the worst blizzards on record.

Clarinda—A. VAN SANDT. Storm on 26th and 28th was a hard one, with wind 35 to 40 miles, and snow drifts above fences.

Clinton—LUKE ROBERTS. Temperature normal; precipitation, 2.85 inches. Most of it coming on 26th and 27th.

Cresco—L. G. KRUMM. The blizzard on 27th was the worst in recent years; the papers say it was the worst since 1873.

Elkader—CHAS. REINECKE. Mean temperature for the year, 44.4°; total precipitation, 25.36 inches; highest temperature, 99° on July 17th; lowest, 32° below zero on January 27, 1904; total snowfall for the year, 44 inches.

Estherville—EARL W. PETERSON. Beginning on the 26th at 3 P. M., we had the worst blizzard that visited this place during the past twelve years; storm ceased during night of 27th.

Greenfield—J. G. CULVER, A blizzard, commencing 9 P. M. on the 26th and ending on the 28th, was the worst storm for years; roads and railway lines badly blocked by drifts.

Hampton—E. C. GRENELLE. Hard blizzard all day the 27th; worst since 1880.

Hanlontown—MISS G. M. PASCHEN. The blizzard on the 27th was the most severe storm in this section since 1885. Drifts ten feet high where wind had full sweep, and objects were invisible four rods distant.

Hopeville—M. T. ASHLEY. Very severe storm on 27th and roads were blockaded.

Independence—E. F. WULFKE. On 27th the heaviest blizzard in 20 years visited this section; all roads blocked.

Larrabee—H. B. STREVER. The month was mild and pleasant, except during the blizzard on 27th.

Logan—GLEN H. STERN. Fierce blizzard visited Logan on 27th; drifts in places 5 feet deep.

Pocahontas—F. E. HRONEK. The blizzard on 27th reminded us of old times; not enough snow to do much damage.

Ridgeway—ARTHUR BETTS. Warmest of eight Decembers, except in 1900. There was 148 hours of sunshine. The blizzard on 27th was the worst since December 11 and 12, 1899.

Sheldon—A. W. BEACH. A splendid month; only one bad storm, and that lasted but 24 hours.

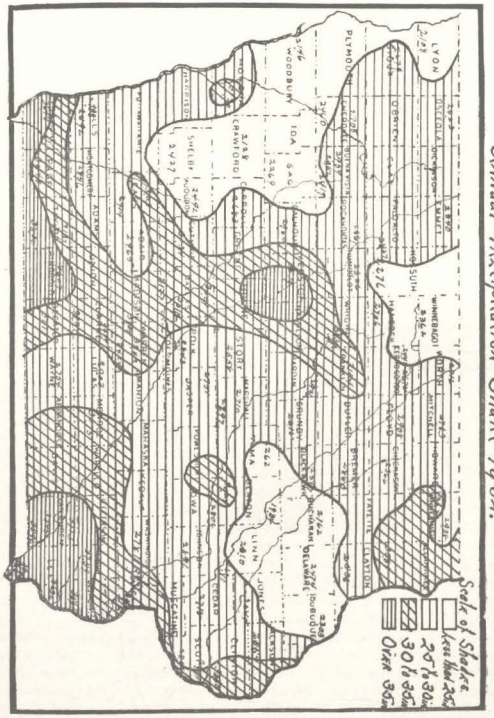
Stockport—C. L. BESWICK. A fine month, except on 26th and 27th, the latter being equal to any bad day on record here.

Waterloo—M. L. NEWTON. The storm on 27th was the worst in 20 years.

Waukee—E. J. LEONARD. The sensational feature of the month was the blizzard on the 27th; stock suffered much and roads drifted full in many places.

Waverly—H. S. HOOVER. A very heavy blizzard all day the 27th and snow drifted badly.

What Cheer—R. S. ALEXANDER. Worst blizzard in years on 27th and 28th; terrific wind; roads blocked several days.



CLIMATE AND CROP REVIEW.

Season of 1904.

The year 1904 was slightly cooler than usual, the mean temperature being 46.3° which is 0.4° below normal. The average precipitation was 28.74 inches, which is 2.68 below normal.

The winter was colder than usual. In January the average daily temperature was 14°, which is 4.2° below the state normal. The lowest temperature recorded was 32° below zero, on January 27th, at Elkader and Fayette. In February the mean temperature was 4.8° below normal, and the lowest was 26° below zero on the 1st. The soil was frozen to an unusual depth. March brought moderate temperature, but the prevalence of cloudiness prevented rapid thawing of the soil, and the ground was generally too wet for seeding operations.

April was abnormally cold, the records of 115 stations showing a daily deficiency of 5.2° in temperature. The average rainfall was 3.63 inches, which is an excess of .74 of an inch above the April average. There were some dry periods, however, with sufficient sunshine to afford ample opportunity for seeding and preparing the ground for planting corn. Seeding of spring wheat, oats and barley begun generally from the 1st to the 4th, and that work was practically completed in the larger part of the state about the 20th or 23d. Germination of seed was unusually slow, but at the close of April there were indications of a good stand, except on low, wet fields. Fruit buds appeared healthy and promising, but there were only a few blossoms visible prior to the 1st of May. The pastures and meadows were unusually late in starting, and there was but little grass for stock at the end of the month. On the whole, though the growth of vegetation was much belated, the month was more favorable than the corresponding month in 1903.

May was nearly normal, the daily mean temperature showing a deficiency of only 0.8°. The average rainfall, 3.78 inches, was .35 of an inch below the May normal. In portions of the west central district, and in some of the southern counties, there were some heavy downpours, which caused much delay in planting, the great excess of moisture being due in large part to the saturated condition of the subsoil, resulting from abnormal rainfall in the preceding season. On the whole it was a favorable month, with sufficient warmth and moisture for grass and small grain, and general conditions favorable for farm work and the germination of the better qualities of seed. Except in quite limited areas, the corn crop was planted about as early as usual, and the soil was in very good condition. The month was especially favorable for the growth of grass in meadows and pastures, and for the small grain crops on well drained lands. The hay crop was well assured; oats and spring wheat stooled out fairly well, potatoes made a fine start; garden truck was well advanced at close of the month, and the fruit promised a better yield than has been produced in recent years.

June was cooler than usual, with less than the normal amount of rainfall, and a large percentage of cloudiness in portions of the state. The daily average temperature was 2.5° below normal. The precipitation was quite unequally distributed; the northern section receiving an average of 4.53 inches, the central section 2.74 inches, and the southern section 3.08 inches. The week ending June 6th brought excessive rains in all parts of the state, except portions of the east central district. The wet and cloudy weather of that week caused much delay in the cultivation of corn, and in large portions of the state the fields became weedy and the growth of corn was considerably retarded by cold nights and wet, cloudy weather. The second week was generally very favorable for field work and the growth of crops, the days being bright and warm with ideal conditions for cleaning out the cornfields. The week ending the 20th was also favorable, though the temperature was below normal. There was but little interruption of work, and fair progress was noted in the growth of all crops. From the 20th to the close of the month the temperature was abnormally low and there was more than usual cloudiness in the larger part of the state. Despite all drawbacks, however, the corn crop advanced steadily, and at the close of the month the fields were generally clean and the stand was but little below the average of the past fifteen years. The month as a whole was favorable especially to small grain, which headed out about the usual time, though short in straw. The hay crop was well advanced and fairly good, especially in quality. Potatoes and garden vegetables were usually promising.

July was unseasonably cool, the mean temperature being 3.6° below normal. The warmest period was the second decade. The average rainfall for the state, 4.41 inches, was .18 of an inch above normal. The northern section received an average of 3.77 inches; central section, 4.47 inches; southern section, 5.00 inches. Rain in measurable quantity fell at one or more stations every day during the month. And yet the average number of clear days was 16; partly cloudy, 9, and cloudy, 6. Generally there was sufficient sunshine to promote plant growth. The days were warm, and nights unusally cool. The heaviest storm of the month, in respect to rainfall, occurred on the night of the 19th, but the excessive downpour was limited to a few counties. On the whole the month was favorable for crops and field work. Corn was laid by from the 4th to the 15th,—about a week later than usual. During the showery period in the early half of the month spring wheat and oats were attacked by rust. The wheat crop was damaged seriously, but oats were not very badly injured. The latter half of the month was favorable for harvest operations and most of the small grain was in shock or stack before August 1st. Haying progressed quite favorably and though the yield was lighter than the average the quality was superior, and most of it was secured in good order. Corn made notably fine progress, despite the cool weather, and at the close of the month that crop was much more advanced than was deemed possible earlier in the season. Potatoes, garden truck, apples, small fruit and all minor crops made normal advancement.

The average temperature of August, 1904, was exactly the same as August, 1903, 1902 and 1891. The mean temperature was 2.7° below the August normal. In the southern section it was 67.3°; central, 69.2°; southern section, 70.7°. The month was mostly clear and warm by day, though unseasonably cool at night. The average rainfall was normal for the state, but in its distribution the larger amount was received in the south and eastern districts, where it was most needed. The bulk of the rainfall came about the 17th to 21st and the 29th. There were, on the average, 17 clear days, 8 partly cloudy, and 6 cloudy, affording an ample amount of fair weather for harvesting, stacking, threshing, cutting wild hay, millet, etc., and fall plowing. In all these farm operations very good progress was made. The pastures were revived and made green as in June by the copious showers in the latter half of the month. The corn crop made fair advancement during the month, though in view of its belated condition its progress was not as rapid as seemed desirable. The most advanced portion of the crop was well filled and dented at the close of the month. Reports at that time indicated that about one-third of the crop, with favorable conditions, would be mature by September 20th, while the balance required abundant warmth and sunshine until October 1st to be safe from harm by killing frost. The crop was unusually rank, green and heavily eared. The minor crops were in good condition. Potatoes made heavy yield, and early apples were especially good and abundant. The yield of tomatoes and green corn for canning has been better than usual. Garden truck, cucumbers for pickling and melons yielded abundantly

The average temperature for September was about normal for the state, the southern and central sections showing an excess, and the northern section a small deficiency. The coldest period was from about the 11th to the 22d. The average rainfall for the state was 2.78 inches, which amount is about 0.52 of an inch below the normal for September. In its distribution there was much inequality, ranging from less than a tenth of an inch at one station in the northwest to over eight inches in the southeast district. The southeast and northeast districts received the heaviest rainfalls. The week ending September 12th was normal in temperature and sunshine, with very light rainfall, and generally favorable conditions for ripening the belated corn crop, a considerable portion of which was well dented, with husks and blades putting on the brown shade of autumn. The week ending the 19th brought several days of good ripening weather, but much anxiety for the safety of the immature portion of the corn crop was caused by the occurrence of light to heavy frosts on the mornings of the 12th, 14th and 15th, the cold wave extending to all districts in the state. A few stations also reported frost on the 21st. The lowest temperature recorded was 30° at four stations. The observed effects proved that the frosts were not "killing", and that the damage to the corn crop was limited to late planted fields in the bottom lands of the central valleys of the state. Broadly stated, the actual damage by frost affected less than one-fourth of the area planted, and the shrinkage of the frosted portion of the crop was probably less than 20 per cent. This would indicate possible loss of 5 per cent of the crop for the state, as the direct result of frost. The cold weather of that period, however, retarded the development of the crop, and made it desirable to extend the ripening weather beyond the 1st of October. During the month good progress was made in the usual farm operations, such as plowing, seeding fall wheat and rye, harvesting potatoes, apples and millet, and threshing small grain. The yield of potatoes, and fall apples has been very satisfactory. The grape crop was heavy, and there has been a good yield of plums. The growth of all kinds of garden truck has been unusually heavy. The pastures have been much better than usual for September. At the close of the month it was estimated that ninety per cent of the corn crop was practically safe.

October was warmer and drier than usual, the daily mean temperature being about 1° above normal, and the average rainfall of the state, was 0.73 of an inch below normal. The northern section received the largest amount, the average being about 0.29 of an inch above the October normal. The first frost of the month occurred on the morning of the 6th, and was heavy enough to kill vines and most of the cornstalks remaining green in the northern half of the state. In the southern half the frost was light, causing no damage. The first general killing frost covering the state occurred on the morning of the 23d, all crops being safe at that time. The bulk of the rainfall came in the first and second decades—mainly between the 5th and 20th, the balance of the month being dry and favorable for farm work, for drying out the corn crops and harvesting the minor crops. No better weather could be desired for preparing corn for cribbing than was prevalent from the 20th to the 31st. Good progress was made in harvesting the corn during the last week though the heavier ears contained considerable moisture. But the weather was cool by night, though moderate and clear by day. The heavy potato crop was harvested in good condition, the quality of the product being unusually good. Pastures were very good throughout the month. Good progress was made in fall plowing. The small acreage in fall wheat and rye showed an excellent growth and good stand. On the whole, October was a very mild and favorable month, crowning a fairly productive crop season.

The month was unusually warm and the driest November on record for the state. The mean temperature, as shown by records of 110 stations, was 41°, which is 6.3° above normal. The average in 1902 was .2 of a degree higher, and 2.9° higher in 1899. The average precipitation for the state at 119 stations, was .15 of an inch, which is 1.25 inches below normal. Nine stations reported no rain in measurable amount. Practically all the precipitation fell on the 9th and 10th, and the average number of clear days was 20. The conditions were ideal for husking corn and drying out the surplus moisture. At the close of the month the bulk of the crop was harvested. Conditions were also favorable for fall plowing and general farm work of the late autumn period. The pasturage was better than usual, though the fields were brown. Winter wheat and rye suffered some damage for want of moisture.

The first decade of December brought continued fine weather with favorable conditions for gathering the corn and cribbing the entire crop. The season as a whole was favorable for the production of a fair output of the staple crops. Though germination and growth were belated, the warmth and dryness of the autumn brought ample compensation to the patient and faithful tillers of the soil.

WEATHER AND CROPS IN UNION COUNTY.

The close of this year of crop reports finds us with clear skies and warm air. This has been a whole season of anxiety as to the outcome of our crops. Today finds our corn crop ripening except the belated plantings, and even this is turning color in husk and blade, and with present indications is likely in this part of the state to make corn. Taking it all together we have an average crop for ten years. Hay not so good as last year, but oats equally as good. Potatoes much better, and corn very much better; and during all the year pastures have been fine. The rainfall last year, from May to September, inclusive, was 37.43 inches, while this year it was only 19.01 inches; and yet for the farmer this has been as wet a season as last. This is from the fact that we had frequent rains, and some quite heavy. We have had no great downpour at any one time In May last year we had 11.90 inches while this year we had 4.20. In August, 1903, we had 12.34; this year 4.66 inches. This excess for 1903 is from two great rains, one in May and one in August. The average temperature has been lower this year than last. With the promise of high prices for farm products (except meats) the farmers are quite as well off as they have been in the best seasons.

N. W. ROWELL,
Crop Observer.

Afton, Iowa, October 1, 1904.

CLIMATE AND CROP BULLETINS.

SUMMARIES OF WEEKLY CROP BULLETINS ISSUED DURING THE SEASON, 1904.

BULLETIN NO. 1. WEEK ENDING APRIL 11, 1904.

The past winter was abnormally cold, and the ground was frozen to an unusual depth. The frost has yielded slowly, and the surface has been too wet for field work, except on the driest lands. The season is ten days later than the average in all parts of the state. A fair start has been made in seeding small grain in the more favored localities, but the general storm of rain and snow on the 7th, 8th and 9th retarded all farm operations. There is a much larger than usual area of fall-plowed ground in readiness for seeding and planting, and the acreage of oats, spring wheat, barley and corn is likely to be quite large if the weather conditions are favorable. Reports indicate considerable damage to fall wheat by winter killing. Grass is making a fair start. So far as can be ascertained at this time the prospect is favorable for fruit. The general condition of live stock is good, and there is an abundant supply of forage.

BULLETIN NO. 2, APRIL 18.

The week ending Monday A. M., April 18th, was unseasonably cold, the daily mean temperature ranging from 9° to 12° below normal. The precipitation was very light, and mainly in the form of snow flurries in the northern section. The conditions have been favorable for drying the surface and the resumption of field work in all districts of the state. In the northern section seeding of spring wheat, oats and barley is in progress, and well advanced in the dry uplands of the north central and northwest districts. Reports from the central and southern sections show great activity in farm operations, and excellent progress in seeding small grain and preparing the ground for planting corn. The acreage of oats is likely to be larger, and the soil is generally in better condition for working than last year. The weather has been too cold for germination of seed or growth of vegetation, but there has been no apparent damage from freezing. The season has been unfavorable for the early pig crop. The peach crop of the southern counties has been mainly killed, but other fruits are as yet uninjured.

BULLETIN NO. 3, APRIL 25.

Very unseasonably low temperature prevailed the first half of the past week, causing nightly frosts and deeply frozen soil, checking germination and retarding field work in the early morning hours. The last three days were warmer, and the week closed with heavy showers which brought considerable excess of moisture in the central and southern sections. The heaviest amount reported was 3.35 inches for the week at Des Moines. In portions of the state rain was timely and beneficial, but in a larger area the amount was greatly in excess of present needs.

Reports indicate that good progress has been made sowing small grain and in preparation of soil for corn planting. In fully three-fourths of the state seeding has been practically completed, but in limited portions of all districts this work has been somewhat retarded by unfavorable conditions of the soil. Quite probably this may result in some decrease in acreage of the oats crop, in comparison with the area that would have been sown under better conditions. Very good advancement has been made in plowing and preparing ground for the corn crop, the acreage of which promises to be much larger than last year. Germination has been much retarded by cold weather, and some fears are expressed of damage to early sown grain by freezing, but the loss from that cause will be very small. On the whole conditions are materially better than at the close of April, 1903.

BULLETIN NO. 4, MAY 2.

For the week ending Monday A. M., May 2d, the daily mean temperature was from 2° to 5° below normal. The weather, however, was mostly fair, and at the close the conditions were about all that could be desired for

farming operations and the germination of cereals. Reports are generally favorable as to the condition of oats, spring wheat and barley, which appear to be generally coming up in good time and promising a fair stand.

Good progress has been made in plowing and preparing ground for corn, and a very large area is now in readiness for the planters. In some favored localities planting was begun on the last two days of April, and with continued good weather a very considerable acreage will be planted the first week in May. Conditions are much more favorable than at the corresponding date last year for the cereal crops and all kinds of fruit, except peaches. The season is ten days late as to germination of seed and growth of vegetation, but the general outlook has not been more encouraging at the first of May within the past five years.

BULLETIN No. 5, MAY 9.

The past week was very favorable for farm work and normal growth of vegetation. There was an average excess of 3° to 8° in the daily mean temperature, and generally sufficient rainfall to moisten the surface and quicken growth of grain and grass. Except in a few localities the rainfall has not been sufficient to materially delay field work. At the close of the week the temperature fell very near the frost line in northern districts, but there are no reports of damage.

Very satisfactory advancement has been made in plowing and preparing ground for corn, and reports from all districts indicate that a considerable acreage has been planted under very good conditions of soil. The bulk of the corn area is likely to be planted earlier than in recent seasons, and the acreage will be increased. Oats and other spring grain crops are making a fairly good stand. Pastures and meadows are doing well. Except peaches and raspberries, the prospect is very good for an abundant yield of fruit. A considerable acreage of potatoes is being planted.

BULLETIN No. 6, MAY 16.

The week has been cooler than usual, the average daily temperature ranging from 3° to 5° below normal, with light frosts in nearly all parts of the state. Except in limited areas the rainfall was below the normal for this time of the year. The first half of the week was moderately warm, and conditions were favorable for field work and the growth of vegetation. The low temperature and rain in the latter part checked germination and retarded corn planting, especially in the southern section; but no material injury resulted from frost.

Reports indicate very good progress in corn planting, wherever the soil has been dry enough for field work. The bulk of the crop has been planted in extensive portions of the northern and central sections, and in the drier lands of the southern section. For the whole state 70 to 75 per cent of the entire corn area is planted under fairly good conditions of soil and tilth. Warm and dry weather is needed to complete planting and insure normal growth. Thus far the germination has been good as could be expected. Generally grass and small grain are doing well. Reports as to the more important fruits are quite favorable. Though the season is late, the general outlook is encouraging.

BULLETIN No. 7, MAY 23.

The first half of the week was cool and cloudy, with light rainfall. The last half was mostly clear and sufficiently warm to bring the average temperature about up to the normal The conditions were generally favorable for field work, and the time has been well improved.

Reports indicate that the bulk of the corn area has been planted in the greater part of the state. But in a few counties, mainly in the southern districts, field work has been delayed by wet soil, and plowing and planting operations are likely to be continued for a week or more. In the aggregate the acreage is unusually large. There are numerous reports of replanting, necessitated by defective seed or too deep planting. Complaints of this kind, however, have been heard quite frequently in all seasons. Cultivation of early planted fields is in progress.

Small grain and grass are doing fairly well, but would be much benefited by light showers and warmer weather. A large acreage of potatoes has been planted. Reports as to the fruit crop are mostly encouraging.

BULLETIN No. 8, MAY 30.

The mean temperature of the past week was slightly below normal, except in portions of the eastern districts. There was a large percentage of cloudiness, and the rainfall was above normal in the larger part of the state, the excess being greatest in portions of the central and northern sections. The rains were timely and beneficial, except in the localities visited by heavy and destructive downpours. In sections where the rainfall was moderate very good progress has been made in finishing planting and beginning cultivation of the corn crop. Reports are variable as to the stand of corn, but there is general agreement as to the increased acreage planted. In some of the southern counties planting operations are likely to be continued another week.

The weather conditions have been very good for grasses and small grain crops, which are showing improvement. The hay crop, especially, has been much benefited by wet and cloudy weather, and in many sections reports indicate that a good yield is assured. Potatoes, garden truck and fruit are doing well.

BULLETIN No. 9, JUNE 6.

The average temperature of the week was about normal. There was a general excess of cloudiness, and very heavy showers in portions of the north central and western districts, causing considerable local damage on flat lands and river bottoms, and delaying the necessary work of cleaning out the weedy cornfields. Probably about two-fifths of the area of the state received excessive downpours during the week, and field work has been much retarded by wet weather and prevalent cloudiness. The corn crop has made fair growth wherever conditions have been favorable for cultivation, and the stand, though quite variable, is not materially short of the average of the past ten years at the corresponding date. Replanting and belated planting are still in progress in some localities. The conditions have been generally favorable for the growth of grass, small grain, potatoes and garden

truck. Reports indicate that the apple crop is quite promising, especially in the districts where commercial orchards are most abundant.

BULLETIN NO. 10, JUNE 13.

There was a general prevalence of favorable weather and almost ideal conditions during the six working days of the past week. The average temperature was slightly below normal, the nights being rather cool; but the days were mostly bright and warm, and the time was well improved in cleaning out the previously weedy cornfields. Reports show very satisfactory progress in this line of work, nearly all of the unusually large corn area having been cultivated once, with good progress in the second plowing. The stand is probably somewhat below the normal, but it is generally better than previous reports indicated. Though the surface is dry, there is sufficient moisture in the soil for present needs.

The conditions have been favorable for the other cereal crops. The hay crop is well assured, but the pastures will need rain in the near future. Potatoes, garden truck and all fruits are making good advancement. The reports are all quite favorable for the apple crop.

BULLETIN NO. 11, JUNE 20.

The average temperature of the past week was slightly below normal, but the weather conditions were favorable for field work and the general improvement of all crops. The six working days of the week were mostly fair, dry and warm, and the scattered showers on the 18th and 19th were timely and beneficial to all growing crops. In portions of the central and north central districts there was considerable excess of rainfall on the 19th, but generally the amount has been below normal.

All reports show excellent progress in cultivation of the corn crop, and the fields are now well cleaned, the plants having a healthy color, and the stand is nearly up to the average of former years. The larger part of the crop has been cultivated twice, and a portion is receiving its third plowing. Though late and somewhat below the normal height, the general condition of the crop is promising.

Early seeded oats and barley are heading. The meadows show a variable stand and condition; and the hay crop will be somewhat lighter than in the last two seasons, but the quality is likely to be better. The potato crop has made fine progress and promises a heavy yield. All crops are doing notably well.

BULLETIN NO. 12, JUNE 27.

The average temperature of the week was slightly below normal, but there was sufficient warmth to promote the healthy growth of all crops. The only material drawback was excessive rainfall in about two-fifths of the state, the heaviest amounts being reported from stations in the north central district, and in the northern counties of the central district. In the larger part of the state the showers were timely and beneficial. Except in localities visited by excessive rains, good progress has been made in cultivation of corn, and the crop is generally making satisfactory growth. As a whole the

condition of corn is materially better than at the corresponding date last year, and in 1902.

The pastures, potatoes and garden vegetables are making excellent growth. Reports indicate extra good yield of cherries and strawberries. Early potatoes are being used and sold in the markets. There are but few reports of apples dropping, and the condition of that staple fruit crop is still promising. The condition of oats, wheat and barley is quite variable, the best prospects being indicated in early seeded and well drained fields.

BULLETIN NO. 13, JULY 4.

Though the average daily temperature was 5° to 8° below normal, yet there was sufficient warmth and sunshine during the week to maintain a healthy and vigorous growth of corn and other cereal crops. Conditions were better, especially for oats, spring wheat and barley, than would have been the normal heat and moisture of the first of July. The small grain crops are now generally free from rust, and though short in straw the heads are filling well, giving promise of a fair yield of well developed grain. The corn crop has made fairly good progress, being generally well cultivated, and many of the most advanced fields have been laid by in good condition as to size and vigor of plant.

The stand is materially below a perfect stand, or 100 per cent, and this has been measurably true of every corn crop grown in the state in the past twenty years. The final output of the crop, whether it shall be up to or below the actual average of the past decade, depends wholly upon future weather conditions. Haying is in progress, with variable reports as to the yield; all accounts agreeing that the quality is good. Potatoes, apples, berries, and the minor crops generally, are doing well.

BULLETIN NO. 14, JULY 11.

This has been a cool, wet and cloudy week. The daily average deficiency in temperature was about 5°. In all parts of the state showers were frequent, and the fields were too wet for farming operations four or five days. With haying and harvesting at hand, and the corn crop needing more cultivation, this hindrance to field work caused some anxiety and depression. The crop outlook, however, is materially brighter than at the corresponding date in 1902 and 1903.

The corn crop in the southern and central sections has made fair progress, more than half being laid by in good condition. In the northern districts there is need of considerable more cultivation, and a smaller percentage has been laid by. The cool weather has been favorable for small grain generally. Oats, spring wheat and barley have not suffered material damage as yet from rust or lodging, and these crops give promise of an average yield of good grain. The meadows and pastures have been materially improved. Potatoes are very thrifty. Apples are still promising.

BULLETIN NO. 15, JULY 18.

For the rapid growth of corn and other belated crops this has been the best week of the season. The average temperature has been about normal, and except in a limited area there was no excess of moisture to retard farm

work. The advancement of the corn crop has been all that could be desired in fields that are well drained and have been well cultivated. Early planted corn has attained about the normal height, and tassels are beginning to appear. Except in low and moist lands the crop has been well cleaned and laid by in good condition. On account of defective seed the stand is generally below the average. Haying is in progress, and reports indicate an extra quality, though the average yield may be less than usual. The harvest of early oats, barley and rye is progressing favorably. Spring wheat is filling well, and will soon be ready for the binders. Generally there has been less than the usual amount of damage to grain crops by rust and blight. The early potato crop is quite heavy, and late potatoes are promising. Apples are doing nicely.

BULLETIN No. 16, JULY 25.

The daily average temperature of the past week was 3° to 4° below normal. On the 18th and 19th very heavy local showers swept over portions of the central and southwest districts, the area of excess comprising about one-fifth of the state. The heaviest downpours, ranging from 4 to 7.50 inches, are reported from stations in Dallas, Polk, Jasper, Warren, Madison and Page counties. The greatest damage reported was suffered by the hay crop, or the portion of it that was cut on the 18th. The aggregate of loss is relatively small. In the larger part of the state conditions were favorable for work in hay and grain harvesting four to five days during the week. The bulk of the hay crop has been secured in fair condition. In the southern and central sections oats and barley are nearly all in shock. In the northern section late oats will soon be ready to cut. There are reports of damage to oats and wheat by rust that cause some apprehension. Corn is doing notably well in all districts. Potatoes, apples and the minor crops are making good progress.

BULLETIN No. 17, AUGUST 1.

Though slightly cooler than usual, the last week in July was generally favorable for harvest operations and normal advancement of immature crops. The rainfall was light in four-fifths of the state, and excessive in small areas in the central and northern sections.

Except in scattered localities, the weather conditions were favorable for securing the bulk of the hay crop in excellent condition, and all reports indicate that the quality is superior to the output of recent years. The oats harvest is practically completed except in the northern counties, and threshing from the shock is in progress. The quality of the grain is up to the average. The wheat harvest is nearing completion, and numerous reports are received of serious damage by blight and rust, which will materially lessen the yield and impair the quality of the grain. The barley crop is fairly good.

Corn is making very good progress in all parts of the state, the more advanced portion of the crop being about normal in size and earing heavily. The potato crop is doing well, except in a few localities where it is affected by rot. The apple crop maintains its early promise, except where the fruit has been blown off by high winds.

BULLETIN No. 18, AUGUST 8.

The daily mean temperature of the past week was 2° to 4° below normal. The nights were cool, and some of the northern stations reported the minimum below 40° on the night of the 7th. The amount of rainfall was very small, except in a limited portion of the north central district.

The dry weather, with generally clear warm days, made favorable conditions for finishing the harvest of oats, spring wheat and timothy (for seed), and for stacking and threshing operations. Reports from threshers in northern and central districts indicate fairly good yield and quality of oats and barley, with some local exceptions. Spring wheat is quite disappointing in sections where the acreage is largest, the rapid decline in condition being caused by rust and blight. Reports as to the corn crop are generally more cheerful in tone than were received in previous weeks. Though late and somewhat below normal in stand, the crop as a whole has made fair progress, and with favorable conditions in the future the output is likely to be up to the average of the past fifteen years. Dry weather has checked potato rot. The pastures need more rain. The apple crop is doing well.

BULLETIN No. 19, AUGUST 15.

The week has been very favorable for all growing crops, and for stacking or threshing small grain. The well distributed showers on 8th and 9th were timely and beneficial to corn, pastures, late potatoes and other minor crops. The latter part of the week was bright and warm, affording ideal conditions for the growth of corn, which has made very good progress. This crop on the average is in a promising condition, being more heavily eared than usual, and showing dark green color from tassels to roots. With a normally warm and frostless September the crop will be a full average. More than the usual amount of oats and barley will be stacked. Threshing returns of these cereals indicate fair yield and quality. Spring wheat is very poor in the greater part of the sections where the the acreage is largest Good progress has been made in putting up wild hay, which is generally heavy. Reports show no material damage to the apple crop. More rain is needed for all unripened crops and to facilitate fall plowing.

BULLETIN No. 20, AUGUST 22.

The temperature of the past week was about normal. Well distributed showers in nearly all parts of the state relieved apprehensions of damage by drought, and revived the pastures. The conditions have been especially favorable for the healthy development of the corn crop, a considerable portion of which is now in the roasting ear stage, and quite heavy in stalk and ear. Good progress has been made in the northern districts in stacking and threshing small grain. Reports continue to indicate fair yield and good quality of oats that have been threshed. Cutting wild hay and millet in progress. The late potato crop is doing well. A good start has been made in plowing. The early apple crop is unusually heavy. General crop conditions fairly good.

BULLETIN No. 21, AUGUST 29.

The week brought six warm and generally dry, clear days, closing with well distributed showers and ample moisture for the present needs of immature crops. The mean temperature was below normal, the days being quite warm and bright, and the nights cooler than usual. Conditions were especially favorable for threshing grain from the shock, which is about completed. And it was ideal weather for securing wild hay and millet, which yielded abundantly. The corn crop is doing very well, though not ripening as rapidly as may seem desirable in view of its general lateness. The most advanced fields show ears well filled and dented, while the bulk of the crop is mostly in the roasting ear stage. Reports indicate that with normal weather about one-third of the crop may be fairly well matured by September 20th, and that to ripen the full crop there is need of abundant warmth and sunshine till October 1st. Good progress has been made in plowing, and harvesting potatoes and early apples. Pastures have been improved.

BULLETIN No. 22, SEPTEMBER 5.

The past week was slightly cooler than usual, the daily average temperature being 1° to 2° below normal. The state was copiously watered in all parts, which will insure ample fall pasturage and put the soil in good condition for plowing. Some local damage resulted from severe wind squalls, but the aggregate of loss will not be heavy. The bulk of the corn which was prostrated came up quickly, with favorable conditions following the storms. As a whole the corn crop has done fairly well during the week. The progress of the crop toward maturing has been more uneven than usual in the same localities and in the same fields. Reports from all sources confirm the previous statement that two-thirds or more of the corn crop will need normally warm weather till the close of September to be safe from damage by killing frost. The more advanced fields show signs of earlier maturity.

Fall plowing is being pushed. Cutting wild grass and second crop of tame hay in progress. Apples and potatoes yield abundantly.

BULLETIN No. 23, SEPTEMBER 12.

The temperature of the past week was normal, with abundant sunshine and very light rainfall in the larger part of the state. Conditions were very favorable for the corn crop, which made as rapid progress as could be desired for its normal development. The sudden fall in the temperature at close of the week resulted in light frosts in exposed localities, and possible damage to tender vegetation on low ground; but reports do not indicate material damage to the corn crop. A considerable percentage of the crop is now well dented, with change in color of husk, indicating nearness to maturity; but the crop as a whole needs immunity from killing frost until October 1st. The growth has been unusually heavy in stalk, blade and ear, and the fields are mostly deep green color, indicating need of more days of ripening weather. There are some reports of cutting corn in the early planted fields, and this work will likely be general in portions of the state within the next two weeks. Pastures are unusually good for the middle of September. Cutting wild hay is about completed; threshing well advanced. Potato crop being harvested. Late apple crop maturing well.

BULLETIN No. 24, SEPTEMBER 19.

The week was quite variable in temperature, the daily average being 3° to 4° below normal; but there were several days of good ripening weather. On the morning of the 12th the frost line was reached and on the 15th light to heavy frost visited all districts in the state. The greatest injury to late planted corn is reported to have occurred on the bottom lands of the Iowa river valley. The "killing" effects of the frost were noted in the low lands, and limited to tender vegetation and the blades of the most immature corn plants. Broadly viewed for the whole state, the actual damage to the corn crop by frost does not appear to be serious, though it is not possible at present to determine to what extent the quality of the frosted portion has been impaired. Reports indicate that more than half the crop is now fairly well matured, and that ten days of favorable weather will assure the safety of the larger portion of the area planted. In the most hopeful estimates due allowance has been made for somewhat more than the average percentage of soft or unmerchantable corn. Considerable progress has been made in cutting and shocking the most advanced fields.

Harvest of potatoes and apples in progress, fall plowing is well advanced; pasturage is very good.

BULLETIN No. 25, SEPTEMBER 26.

The past week brought a continuance of intermittent temperature characteristic of this season, the average being nearly normal. The frost line was reached on the morning of the 21st, but clouds and vapor prevented damage to immature crops. In a limited area considerable injury resulted from heavy wind and hail on the evening of the 19th. Reports show more than usual variableness in the condition of the corn crop; but for the state at large it appears that about three-fourths of the entire area planted is now practically safe. With a week of warm and dry weather the bulk of very late or immature portion of the crop may be fairly well matured; but at best there is likely to be somewhat more than the usual percentage of corn failing to reach full maturity.

Conditions have been favorable for field work; good progress has been made in plowing, and harvesting vegetables and fruit.

SPECIAL CROP BULLETIN, OCTOBER 3, 1904.

The week ending October 3d was warmer than usual, with some local excess of rainfall. Conditions were more favorable to growth than ripening of vegetation. But the cornfields have been quite rapidly transformed in color, and fully ninety per cent of this great staple crop is now practically safe. A general killing frost at any time before the 10th would unquestionably impair the quality of about ten per cent of the corn crop of the state; but with that percentage entirely destroyed the output of sound corn would be above the average of the past fifteen years. A period of drying weather

is now needed to prepare the crop for cribbing, and to prevent damage to the portion of the crop that is lying on the ground.

Reports indicate an unusually good yield of timothy seed, but clover seed is very light. The pastures are extra good for the time of the year. New seeding of grain and grass has done notably well. As a whole the crop season of 1904 has been favorable.

IOWA CROP REPORT, JUNE 1, 1904.

ACREAGE OF STAPLE CROPS, AND AVERAGE CONDITION OF CROPS, FRUIT AND LIVE STOCK.

Reports received June 1st from county and township correspondents of the State Weather and Crop Service show the following results as to the number of acres and average condition of staple farm crops; also the condition of fruit and live stock.

CORN.—Total number of acres, 9,052,450;—an increase of about 7 per cent as compared with the average of the past six years, and 1,500,000 acres in excess of the area actually harvested in 1903. The average condition of corn about June 1st was 90 per cent, or about fifteen points above the estimated condition at corresponding date last year.

WHEAT.—The area of spring wheat sown this season appears to be only 775,040 acres, a decrease of about 377,000 acres as compared with the acreage of 1902. The winter wheat acreage is about 71,030. Condition of spring wheat, 94 per cent; winter wheat, 85 per cent.

OATS.—Area seeded, 4,018,980 acres; a decrease of about 190,000 acres compared with the acreage of 1901, or about 5 per cent below the normal area. The condition is placed at 92 per cent.

BARLEY.—Area seeded, 493,370 acres; decrease since 1901, about 38,300 acres. Condition June 1st, 93 per cent.

RYE.—Area seeded, 99,590 acres; decrease since 1901, about 25,000 acres. Condition June 1st, 91 per cent.

FLAX.—Area seeded, 51,370 acres; decrease since 1901, 23,130 acres. Condition of crops, 85 per cent.

POTATOES.—Area planted, 113,250 acres; condition 95 per cent. Acreage about normal.

MEADOWS.—Area, 2,797,640 acres; an average of recent years. Condition 96 per cent. Condition of pastures 97 per cent.

CONDITION OF FRUIT.—Apples, 91; plums, 89; peaches, 48; grapes, 87; cherries, 83; strawberries, 94; raspberries, 88; blackberries, 77 per cent.

CONDITION OF LIVE STOCK.—Cattle, 94; swine, 93; sheep, 97; horses, 95; foals, 93; spring pig crop, 85 per cent.

CONDITION OF CROPS JUNE 1, 1903.—Corn, 75; wheat, 93; oats, 93; barley, 96; rye, 84; potatoes, 91; flax, 84; meadows, 109; pastures, 107; apples, 70; cherries and plums, 35 per cent.

CROP REPORT, JULY, 1904.

Following is a summary of reports received from correspondents of the State Weather and Crop Service, estimating the condition of the staple farm crops July 1, 1904. The reports generally show that the stand of corn and oats is materially lighter than the average, owing to defective seed; and all crops are several days later than usual, as a result of the late advent of spring. The general condition, however, is several points better than at the corresponding date last year; as will be seen by the figures below.

CONDITION JULY 1, 1904: Corn, 90 per cent; spring wheat, 91; winter wheat, 87; oats, 91; barley, 93; rye, 94; flax, 89; meadows, 90; pastures, 94; potatoes, 101; apples, 85; plums, 7; grapes, 89.

CONDITION LAST YEAR: Corn, 77 per cent; spring wheat, 88; oats, 87; barley, 89; rye, 98; flax, 85; meadows, 104; pastures, 107; potatoes, 96; apples, 70; plums, 49; grapes, 78.

IOWA CROP REPORT, AUGUST 1, 1904.

Tabulated reports received from correspondents of the Iowa Weather and Crop service show the following estimates of the condition of the staple crops on August 1, 1904:

Spring wheat, 75 per cent; corn, 88; oats, 89; flax, 94; pastures, 96; potatoes, 101; apples, 73; grapes, 86.

At corresponding date last year the estimates were as follows: Spring wheat, 82 per cent; corn, 73; oats, 77; flax, 84; pastures, 104; potatoes, 80; apples, 65; grapes, 80.

Compared with the estimates of conditions on July 1, 1904, spring wheat shows a decline of 16 points, on account of the serious attack of rust and blight during the latter part of July. The estimates are two points lower on corn and oats as compared with the July rating. As a matter of fact, however, the general outlook of the corn crop is better than it was about the first of July, though it is still relatively about eight to ten days later than usual.

Secretary Greene, of the Iowa Horticultural Society, gives the following report of the fruit crop for August 1, 1904:

Summer apples, 62 per cent; fall apples, 64; winter apples, 54; peaches, 10; American plums, 60; domestic plums, 38; Japan plums, 45; grapes, 82. The best crop of apples is grown this year in the eastern part of the state.

IOWA CROPS—FINAL REPORT, 1904.

Total Yield For the State—Value of Soil Products at Farm Prices December 1st.

Despite somewhat adverse conditions at the outset, and belated growth of the cereal crops, the final report for the season of 1904 makes a satisfactory exhibit of the agricultural resources of the state. The warmth and dryness of the autumn made partial amends for low temperature and slow progress during the summer.

Corn.—The area planted this season was 9,052,450 acres. The loss of acreage from various causes was relatively small compared with recent seasons, and it is probable that practically about nine million acres were harvested. The average yield for the state appears to have been about 36 bushels per acre. The total yield is 323,952,330 bushels, which is 93,342,000 bushels above the yield last year and the largest crop produced since 1900. During the past fifteen years there have been two larger crops, viz: 345,000,000 bushels in 1900, and 335,000,000 bushels in 1901. This year's output is 62,000,000 bushels above the fifteen year average.

The average price per bushel, at the farms December 1st, was about thirty-five cents; total value of the crop, $113,348,665.

Wheat.—This crop was badly damaged by rust and blight. The area of winter wheat was about 71,030 acres, and the average yield 14.3 bushels per acre; total yield, 1,017,000 bushels. The acreage of spring wheat was 775,040 acres, yield 9.1 bushels per acre; total output for the state, 7,080,430 bushels. Farm prices, winter wheat, 92 cents; spring wheat, 86 cents: Total value of wheat crop, $7,024,809.

Oats.—Area seeded, 4,018,980 acres; yield per acre 29.4 bushels; total bushels, 118,435,570. The farm value, 26 cents; total value December 1st, $30,793,284.

Rye.—Area seeded, 99,590 acres; yield per acre, 15 bushels; total yield, 1,517,090 bushels. Value, at 54 cents per bushel, $819,228.

Barley.—Area seeded, 493,370 acres; yield per acre, 25 bushels; total yield, 12,317,710 bushels. Value, at 34 cents per bushel, $5,188,021.

Flax.—Area, 51,370 acres; yield, 11 bushels per acre; total yield, 591,140 bushels. Value, at $1.15 per bushel, $679,811.

Potatoes.—Yield per acre, 125 bushels; total output, 14,255,680 bushels. Value, at 28 cents per bushel, $3,991,590.

Hay (tame).—Area harvested, 2,797,640 acres; total yield, 4,499,090 tons. Value, at $5.62 per ton, $25,284,885.

Hay (wild).—Total amount cut, 1,091,590 tons. Value, at $4.50 per ton, $4,912,155.

Pasturage and Grazing.—The value of pasturage and grazing, harvested by live stock, in pastures and in grain fields, cornfields and meadows after harvest, is placed at $90,000,000, or about $400 per farm of 160 acres. This is believed to be a low estimate.

TABULATED CROP SUMMARY.

Crops.	Total Products.	Farm value December 1st.
Corn	323,853,330 bushels	$113,347,665
Wheat	8,097,430 bushels	7,023,809
Oats	118,435,570 bushels	30,793,284
Rye	1,517,090 bushels	819,228
Barley	12,317,710 bushels	4,188,021
Flax	591,140 bushels	679,811
Potatoes	14,255,680 bushels	3,991,590
Hay (tame)	4,499,090 tons	25,284,885
Hay (wild)	1,091,590 tons	4,912,155
Pasturage and grazing (cornfields, etc.)		90,000,000
Buckwheat (estimated)		250,000
Sweet potatoes		350,000
Sorghum and broom corn		260,000
Timothy seed		950,000
Clover and millet seed		175,000
Flax seed		679,810
Fruits and garden truck		7,500,000
Total soil products		$291,207,258

In this estimate no account is made of the profits derived from the consumption of the staple crops in the dairy and live stock industry.

The average farm value of milch cows is $28, and of horses, $92 per head.

The following table gives the yield of staple crops by counties:

FINAL CROP REPORT, 1904.

TOTAL YIELD AND AVERAGE PER ACRE—BY COUNTIES.

Counties.	Winter Wheat.		Spring Wheat.		Corn.		Oats.		Rye.		Barley.		Flax Seed.		Potatoes.		Hay (tame).		Hay (wild).	
	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.	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
Adair	15	4,050	8	75,200	36	3,754,440	25	774,500	18	3,060	26	9,360	..	.....	110	128,700	1.5	68,410	1.2	2,230
Adams	18	18,080	12	38,640	30	2,182,500	22	337,700	19	8,930	...	.....	..	.....	100	58,000	1.7	77,530	1.0	2,140
Allamakee	9	1,080	10	31,900	37	1,491,740	35	1,771,350	15	18,750	26	162,500	8	3,280	120	130,800	1 6	62,830	1.5	3,460
Appanoose	15	18,300	....	....	33	1,823,250	28	287,000	12	21,720	....	.....	....	.....	150	162,000	1.7	71,580	1.2	1,080
Audubon	....	.....	6	114,960	35	3,309,950	30	934,500	15	310	30	68,400	....	.....	90	88,200	1.5	38,790	1.0	4,130
Benton	....	.....	10	15,200	33	3,969,240	30	1,918,800	15	10,650	28	451,920	...	.....	140	249,200	1.2	46,930	1.0	7,210
Black Hawk	....	.....	8	3,260	37	3,596,400	29	1,522,790	15	24,750	29	107,010	....	.	150	207,000	1.8	72,270	1.4	12,050
Boone	....	.....	8	27,320	35	3,556,350	34	1,695,240	15	5,100	30	9,300	....	.....	150	175,500	2.0	42,940	1.5	22,100
Bremer	....	.....	8	3,360	36	2,198,520	35	1,817,300	18	22,860	28	46,840	10	7,400	130	174,200	1 5	25,890	1 5	19,140
Buchanan	....	.....	12	4,920	33	2,885,850	33	1,628,880	19	9,690	32	52,240	9	720	130	137,800	1.5	53,770	1.2	14,240
Buena Vista	..	.....	10	72,300	31	3,389,540	32	1,959,680	16	5,020	25	81,500	8	4,160	110	144,100	1.5	27,850	1.3	21,200
Butler	.	.....	10	3,600	32	3,592,000	28	2,039,800	17	22,270	24	19,680	8	3,600	160	208,200	1.7	31,600	1.2	16,920
Calhoun	....	.....	10	41,900	33	3,653,430	34	2,127,880	20	4,600	27	114,120	....	.... .	125	132,500	1.8	29,610	1.5	19,160
Carroll	....	.....	12	196,320	41	4,599,380	32	1,555,840	20	4,800	28	85,960	....	.....	130	223,600	1.6	33,930	1.5	22,680
Cass	20	10,200	8	174,000	35	4,068,750	30	822,300	15	5,700	25	24,000	....	.....	110	174,900	1.5	51,780	1.2	4,110
Cedar	20	13,400	10	14,200	42	4,654,860	35	1,233,750	15	22,200	28	321,480	....	..... .	160	193,600	1.8	70,470	1.5	1,220
Cerro Gordo	...	.....	9	10,530	33	3,275,910	30	2,154,300	15	7,350	20	41,000	7	5,670	120	160,800	2.0	46,300	1 5	16,800
Cherokee	....	.....	10	193,200	40	4,502,000	35	1,756,300	14	1,260	28	132,360	8	960	140	175,000	1.8	41,670	1.5	19,800
Chickasaw	....	.....	12	12,960	35	2,369,050	40	2,414,800	17	10,710	32	80,320	12	50,160	110	138,600	1.8	34,110	1.3	13,170
Clarke	20	6,400		.....	32	1,847,040	20	317,000	15	7,050	...	.....	....	.....	150	81,000	1.7	77,320	1.2	600
Clay	....	.....	10	52,500	33	3,118,830	37	2,007,640	15	13,650	27	439,600	8	2,880	120	116,400	1.6	30,570	1.4	29,700
Clayton	14	17,500	12	68,760	37	2,845,670	34	2,135,540	19	76,760	33	195,030	...	.....	130	245,700	1.8	81,370	1.5	3,130
Clinton	20	8,400	11	36,960	42	4,397,240	35	1,324,250	20	46,200	30	142,500	....	.....	120	140,800	1.4	61,990	1.0	4,180
Crawford	....	.....	9	363,680	36	4,348,080	34	1,428,340	18	10,620	30	65,400	..	.. .	110	209,770	1.8	58,840	1.5	12,480
Dallas	12	17,160	10	43,200	40	4,431,200	29	934,480	17	8,160	20	16,400	....	.....	115	110,400	1.6	39,450	1.5	12,690
Davis	15	23,100	...	.....	35	2,043,650	28	427,000	15	30,600	..	.....	..	.....	105	70,350	1.4	65,290	1.0	210
Decatur	20	12,400	....	.....	32	2,245,760	20	322,200	18	11,520	....	.....	....	.....	100	67,000	1.4	76,130	1.0	890
Delaware	20	24,200	....	.	37	3,308,910	33	1,513,710	22	40,920	30	124,500	....	.....	120	139,700	1.2	44,950	1.2	6,400
Des Moines	15	45,600	8	3,680	38	1,927,260	30	725,400	20	15,600	28	505,680	....	.....	95	102,600	1.5	30,210	1.0	1,100
Dickinson	....	.....	9	74,970	24	1,044,240	27	728,190	20	6,400	25	380,250	12	25,440	100	52,000	2.0	15,840	1.5	27,350
Dubuque	18	1,980	15	54,300	39	2,656,490	40	2,046,400	21	39,690	33	80,520	.	. .	130	240,900	1.5	67,680	1.4	3,820
Emmet	....	.....	12	35,160	30	1,611,600	45	1,631,700	20	4,400	35	287,350	11	15,070	90	44,800	1.8	20,610	1.5	23,410
Fayette	20	2,600	8	24,080	30	2,763,600	31	2,236,080	20	19,200	33	193,380	9	9,360	110	180,400	1.5	71,860	1.2	8,210

Floyd	....	....	9	5,220	31	2,585,490	30	2,044,200	21	24,570	22	103,620	8	15,440	95	188,100	2.0	34,320	1.2	9,020
Franklin	....	.....	13	18,860	36	3,592,440	35	2,607,850	18	9,720	25	26,500	9	8,280	130	137,800	1.6	32,200	1.3	18,110
Fremont	12	26,760	8	12,880	35	3,866,100	22	244,640	15	9,150		.....	..	.....	150	103,500	1.8	25,390	1.5	8,560
Greene	....	.....	12	29,400	41	3,715,420	23	964,510	15	1,800	25	51,250	....	.....	120	90,400	1.7	30,970	1.2	14,120
Grundy	....	.....	8	18,160	38	3,720,960	25	1,598,250	16	1,760	24	219,120	....	.....	150	229,500	2.0	42,420	1.2	7,560
Guthrie	15	4,800	9	60,390	33	2,711,280	30	1,116,900	20	2,800	25	52,500	...	.....	150	85,500	1.5	43,050	1.0	7,850
Hamilton		.....	15	60,300	39	3,699,930	30	1,527,300	20	1,200	25	24,500	12	5,400	150	216,000	2.0	37,220	1.5	28,250
Hancock	....	.....	8	32,160	25	2,203,000	28	2,057,440	18	4,680	25	62,750	9	9,540	160	152,000	1.3	22,690	1.0	20,130
Hardin	....	.....	12	36,720	33	3,237,630	28	1,556,350	12	2,520	26	18,980	....	.....	120	166,800	1.5	30,480	1.5	21,120
Harrison	20	420	9	280,890	38	4,955,960	33	495,550	15	13,650	30	31,800	....	.	110	169,400	2.0	24,570	1.8	20,130
Henry	14	28,840	12	480	43	2,805,750	35	990,850	20	70,800	25	38,250	....	.	140	74,200	1.8	37,870	1.0	210
Howard	....	.. ..	12	14,280	26	1,322,760	30	1,805,100	20	2,240	30	105,600	12	48,960	100	95,000	1.5	44,550	1.5	15,210
Humboldt	....	.....	12	94,080	38	2,588,560	35	1,277,200	20	2,800	33	63,030	12	11,040	160	73,600	1.5	22,660	1.2	18,210
Ida	..	.....	10	190,100	37	3,427,680	40	1,286,000	20	5,200	30	123,900	.	.....	100	95,000	2.0	40,420	1.5	7,210
Iowa	28	5,880	13	21,840	41	3,530,920	32	1,059,840	14	7,280	27	106,650	...	.....	150	184,500	1.5	66,120	1.5	1,900
Jackson	12	3,120	10	32,200	40	2,844,800	28	957,040	16	33,280	25	96,250	....	.....	110	128,700	1.5	66,030	1.5	3,200
Jasper	10	8,200	9	62,190	37	4,266,840	24	991,440	22	11,660	25	16,250	....	..... .	120	241,200	1.3	44,340	1.2	2,610
Jefferson	15	29,400	12	600	43	2,541,730	32	726,700	16	65,120	30	61,800	....	.... .	120	70,800	1.5	45,520	1.0	2,310
Johnson	16	11,420	13	13,390	42	4,448,640	31	1,317,810	16	45,920	32	185,920	....	.....	130	170,300	1.7	62,260	1.0	1,910
Jones		.....	10	9,800	40	3,665,200	31	1,086,550	18	31,500	30	154,200	....	.....	130	126,100	1.3	58,810	1.0	2,100
Keokuk	14	19,740	10	9,200	37	3,570,500	27	949,050	14	42,980	20	91,200	....	.	140	120,400	1.4	55,560	1.0	470
Kossuth	....	.....	12	194,160	28	4,161,360	34	4,258,500	15	3,150	28	177,800	12	38,640	160	254,400	1.5	32,340	1.2	68,000
Lee	15	96,150	....	.....	35	1,869,850	28	628,600	15	72,160		.....	....	.....	120	141,600	1.5	57,310	1.0	180
Linn	....	.....	10	12,100	34	3,771,280	32	1,611,520	15	16,200	25	23,000	....	.....	110	208,500	1.5	60,420	1.0	4,110
Louisa	15	33,600	....	....	40	2,407,400	33	666,930	16	48,640	30	46,800	...	.....	90	53,100	1.6	27,360	1.2	1,520
Lucas	14	8,680	....	.....	30	1,521,300	25	345,250	14	8,680	22	7,480	....	.....	85	44,200	1.3	54,730	1.0	220
Lyon	....	....	8	290,600	28	2,443,560	33	1,443,850	16	2,560	25	1,131,750	9	1,980	120	148,800	1.5	13,660	1.5	20,550
Madison	10	7,500	5	20,600	40	3,178,000	25	478,750	15	7,350	26	39,260	....	.....	150	103,500	1.8	69,150	1.5	6,150
Mahaska	15	22,800	9	16,290	40	4,087,600	30	964,200	15	27,150	25	75,500	....	.....	110	100,110	1.5	51,180	1.0	910
Marion	18	37,980	10	30,900	39	3,642,990	30	844,800	17	24,480	25	20,250	....	.....	120	117,700	1.5	42,150	1.2	1,530
Marshall	....	.....	11	55,110	42	4,630,340	33	1,707,420	15	6,450	24	60,240	...	.....	140	161,000	1.4	39,420	1.2	2,800
Mills	12	21,600	7	42,840	35	2,625,350	20	229,600	10	3,200	....	.....	....	.....	90	75,600	2.0	32,280	1.0	2,410
Mitchell	....	.....	12	29,640	35	2,152,150	34	2,215,440	12	6,120	28	334,880	10	88,400	110	191,400	1.5	36,180	1.0	2,410
Monona	21	14,900	10	287,100	36	4,523,400	35	632,100	16	14,560	30	152,400	....	.....	110	134,200	1.9	8,320	1.5	27,630
Monroe	15	3,750	8	960	37	1,897,360	25	280,750	16	13,280		.....	....	.....	100	62,000	1.5	45,310	1.0	480
Montgomery	12	33,720	7	102,970	35	3,363,850	22	294,800	12	6,120	....	.....	....	.....	80	72,800	1.5	48,610	1.5	2,240
Muscatine	18	28,620	12	176,520	40	3,048,400	33	720,060	14	70,140	28	171,360		.	100	212,000	2.0	48,040	1 5	2,210
O'Brien		.. ..	10	147,100	30	3,307,500	33	1,757,910	15	3,300	25	650,750	9	2,520	110	136,400	1.5	26,860	1 5	18,030
Osceola		.....	11	101,420	30	2,440,500	34	1,115,900	15	1,650	26	704,860	8	5,360	120	78,000	1.7	18,920	1.5	16,410
Page	15	128,550	8	38,720	31	3,570,890	20	325,400	12	14,400	22	18,040	....	...	120	108,200	1.8	61,570	1.5	4,050
Palo Alto		.....	10	38,100	30	2,457,300	30	1,652,700	15	4,650	30	156,300	9	18,090	140	124,600	1.2	12,130	1.2	42,140
Plymouth	....	.....	10	901,200	40	6,555,600	35	1,786,050	14	5,460	25	239,250	10	2,100	110	212,300	1.5	26,940	1.0	26,150
Pocahontas	....	.....	12	33,720	27	2,927,070	36	2,467,440	15	6,150	28	87,080	10	16,200	100	108,800	1.8	21,970	1.2	36,160
Polk	15	13,950	10	51,110	40	4,432,800	32	1,239,040	12	11,340	....	.....	....	.....	100	192,000	1.8	38,350	1.2	10,670
Pottawattamie	15	13,050	8	905,520	40	8,051,200	32	903,840	12	6,120	20	16,600	....	.....	120	312,200	1.6	53,580	1.0	13,200
Poweshiek	13	910	12	27,120	40	4,352,800	30	1,203,300	15	5,850	25	86,250	....	.....	140	149,800	1.4	58,950	1.0	650
Ringgold	13	9,360	10	850	25	1,982,000	20	416,400	15	9,300	....	.....	....	.....	100	51,000	1.5	78,280	1.2	910
Sac		.....	12	94,080	34	4,094,280	35	1,756,300	20	2,800	30	143,100	12	960	150	160,500	1.7	42,680	1.5	21,910
Scott	17	35,020	14	85,680	43	3,350,130	30	641,700	15	27,150	22	518,760	....	.	150	721,500	1.4	36,660	1.2	6,330
Shelby	....	.....	10	30,120	40	4,808,400	30	818,400	15	1,350	25	34,500	10	3,100	140	193,200	1.5	31,810	1.5	6,240

FINAL CROP REPORT—CONTINUED.

Counties.	Winter Wheat.		Spring Wheat.		Corn.		Oats.		Rye.		Barley.		Flax Seed.		Potatoes.		Hay (tame).		Hay (wild).	
	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.	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.
Sioux	....	....	7	421,260	33	4,920,960	35	1,754,200	....	....	30	864,300	8	3,280	120	169,200	1.5	15,610	1.5	30,910
Story	20	1,800	10	17,400	42	4,721,200	32	1,645,120	20	9,800	30	15,300	....	....	150	123,000	1.5	33,780	1.0	18,380
Tama	20	800	8	50,480	40	4,807,600	33	1,719,630	15	6,150	25	720,250	....	....	140	245,0[illegible]0	1.5	60,270	1.0	5,240
Taylor	15	47,400	5	400	25	1,828,000	15	25[illegible],200	12	14,850	20	18,400	...	....	120	78,000	2.0	68,220	1.5	2,100
Union	15	2,700	8	720	29	1,853,40[illegible]	23	408,760	16	2,720	20	10,200	....	....	120	97,200	1.7	74,250	1.0	1,290
Van Buren	13	28,860	.	.....	42	2,105,140	30	5[illegible]7,200	12	45,960	...	....	....	....	150	63,000	1.8	65,010	1.0	1,520
Wapello	15	31,050	10	1,100	41	2,575,620	40	647,200	20	83,200	25	39,500	....	....	100	92,000	1.5	48,420	1.0	210
Warren	16	9,760	10	30,800	40	3,644,800	26	1,532,520	15	18,900	20	26,600	....	......	140	113,400	1.7	69,730	1.2	420
Washington	20	18,400	10	2,800	43	3,177,270	30	978,300	15	42,150	21	84,210	....	....	130	89,700	1.8	47,280	1.0	240
Wayne	20	1,800	...	.....	28	1,857,800	22	336,380	15	12,300	...	....	...	......	130	72,800	1.7	100,980	1.0	460
Webster		....	12	61,400	35	4,241,300	40	3,021,200	20	3,600	22	21,100	10	8,100	120	135,600	2.0	38,440	1.0	24,110
Winnebago	....	....	8	66,000	25	1,253,000	28	1,125,880		....	25	81,000	6	11,340	105	64,050	1.5	18,150	1.2	26,110
Winneshiek	15	1,350	7	42,840	39	2,627,820	33	2,276,670	20	5,200	30	307,800	10	73,100	110	129,800	1.8	58,860	1.0	11,200
Woodbury	....	....	9	379,620	41	6,979,020	35	996,450	12	7,920	30	1[illegible]7,700	7	1,470	120	177,600	2.0	22,180	1.2	14,120
Worth	....	....	10	30,200	30	1,298,400	40	2,287,600	15	1,650	35	192,850	12	75,480	150	111,000	1.8	28,990	1.0	14,240
Wright	..	....	14	68,180	36	3,593,520	33	2,274,030	15	1,800	20	30,600	11	18,260	110	92,400	1.9	35,910	1.5	28,160
Totals, state	.	1,017,000	....	7,080,430	...	323,853,330	...	118,435,570	....	1,517,090	....	12,317,710	....	591,140	....	14,255,680	....	4,099,090	...	1,091,590
Av. per acre	14.3	....	9.1	....	36	....	29.4	....	15	.	25	....	11	......	115	....	1.5	....	1.2	....

A VALUABLE SERVICE.

From the Chicago Drovers' Journal.

That the government climate and crop service as conducted under the auspices of the weather bureau of the United States Department of Agriculture is playing an important part in the economic conditions of the farmer is forcibly called to mind in the review of the annual Iowa report for the year 1903 as it has been issued by the director of the Iowa bureau at Des Moines. It is interesting to note that during the year there were issued 10,000 copies of the 1902 report, 32,000 monthly reviews, 70,000 weekly climate and crop bulletins, not to mention an appendix of 185 pages in connection with the annual report. This shows the magnitude of the service in one state from the standpoint of printed matter distributed.

Fortunately, in Iowa, the state and the federal governments have been enabled to unite their forces, thus insuring better results to the farmer by virtue of this consolidated service. It is interesting to note that at the end of the fiscal year ending June 30, 1904, there were 50,000 rural patrons of telephones in Iowa who were daily receiving the benefit of the climate and crop service. In addition to these there were 7,000 farmers getting the reports from the bureau through the mails direct, not to mention the tens of thousands who had the information placed before them through the agency of the daily press.

The Iowa service has six-regularly equipped stations in different portions of the state, from which accurate information regarding climatic changes is always available. In addition to this there are 132 correspondents in various portions of Iowa who are in close touch with local conditions and report weekly their observations to the main office at Des Moines, from which the officials of the service are enabled to summarize the important details in making up their weekly crop reports.

Every year farmers are learning the value of this service. With the advent of the telephone and the rural mail their value to the man in the country is to be rapidly enhanced until the time is here when no progressive farmer will be without daily, and, if necessary, hourly information relative to possible climatic changes.

CONCERNING WEATHER FORECASTS.

From Iowa Monthly Review, November 1904.

Benjamin Franklin was a pioneer in meteorology, as well as in the correlated science of electricty. His kite experiment, demonstrating the identity of lightning with artificial electric sparks, gave him world-wide fame; but no

less important from a scientific point of view, and of greater practical value, was his discovery of the rotary circulation of winds in the general storms of the Atlantic coast, and a progressive movement in a northeasterly direction. By inquiries addressed to numerous correspondents and travelers in the colonies he reached the conclusion that the northeast storms of that region began at extreme southwest points about a day earlier than at Boston. From a careful study of the mass of facts thus laboriously collected he formulated his tentative philosophy of storms.

Franklin's contemporaries, and the people generally, were not deeply impressed by this new theory. There was nothing spectacular about it, appealing to the popular imagination like his famous kite flying experiment performed amid thunder and lightning. He was a century in advance of his age. And the bulk of the people were biased by the teachings of the oldtime astrologers that the moon is the dominant force, with the planets as adjuncts, in the production of storms and weather changes. But Franklin was unique among the philosophers of the eighteenth century. Though a great reader of books and current literature, in scientific studies he consulted chiefly the book of nature. His methods were characterized by simplicity and directness. He was richly endowed with the genius of common-sense. He gave little heed to the occult doctrines and mysticisms of ancient philosophy. To him the vaporings of the oldtime astrologers were of less value than the soughing of the east wind, which was a portent of a coming storm from the westward.

In the field of meteorology Franklin was essentially an explorer, setting up landmarks for guidance of future investigators. Following his line of research, in the first half of the nineteenth century a number of able scientists brought some measure of order out of chaos, and were able to discern regular lawful sequence in the apparently erratic sweep of wind currents and storm-eddies. With the rapid advance of settlements to the westward, and construction of railways and telegraph lines, conditions were made favorable for collecting and making a scientific analysis of climatic data. This was done by scores of observers and scientists under the auspices of the Franklin Institute of Philadelphia, and the Smithsonian Institution, aided in some measure by the government. Upon the foundation thus prepared the structure of the National Weather Bureau was begun in 1870. From a small beginning, with an initial expenditure of $20,000, this branch of the public service has been enlarged in its scope until it has become of vital importance to all interests and all classes of people. The annual appropriation for its support is about a million and two hundred thousand dollars, and this great Bureau has won the admiration of the civilized world. Its field of observation now embraces the continent from the Arctic circle to the northern coast of South America. And today marine interests, inland commerce and agriculture share about equally the benefits of the service.

It is a Bureau of applied science, with ample provision for original research. It is both progressive and conservative—proving all things and holding fast that which is good. It has been founded upon well-attested scientific principles. All the discoveries and generalizations in meteorology made by the most eminent scientists of America and Europe have been utilized and reduced to practical form in the work of the forecast division. Inventive skill has been called into requisition to construct instruments for

recording automatically the most minute changes in atmospheric pressure, temperature, humidity, precipitation, wind velocity and direction, sunshine, etc. These complex and almost infallible instruments have been installed at about 200 regular stations within the territory covered by this service, in charge of thoroughly trained observers who have become experts in this line. Simultaneous observations are collected by telegraph twice daily, and oftener when needed; and by this means the forecast officials are enabled to note the actual weather conditions in all parts of the continent. On prepared maps lines are drawn showing areas of low and high pressure, noting differences of temperature and direction of wind at the various stations Storm centers are thus located, and the graphic pictures show the area of disturbance, energy and direction of movement. Upon this basis of actual conditions, thus graphically presented to the eye of the official in charge the forecast is made as to the weather changes that are likely to occur in the different parts of the country within the coming twenty-four, thirty-six or forty-eight hours.

In the methods of forcasting there is nothing even remotely akin to occult science or the practice of astrology. No storm forecast is issued until a storm actually appears, or is in the initial stage of development. When the weather map reveals the outlines of a storm at the far west or northwest the problem to be solved by the forecaster relates to its probable course, its velocity of translation, its increase or decrease in extent and force, and the disturbance of elements likely to be caused during its progress across the continent. This is something of a complex problem, requiring in its solution a very thorough study and the application of well established principles of meteorological science. Due consideration must be given to the results of experience and observation of weather processes in previous storms, but that does not insure perfect accuracy of the forecast. There are different types of storms, and those belonging to a certain type of form and combination of lows and highs on the map frequently display very eccentric behavior in their trans-continental movement. Nature's great law of diversity holds true in the weather to a remarkable degree. No exact duplicate of any general storm has been issued. And this extreme variability of movement, under quite similar conditions at the outset, has prevented an overproduction of perfectly successful weather forecasters. It is indeed marvelous that in this country, with its widely variant storm-types, they have achieved from 80 to 90 per cent of accuracy in their work.

Well now, having made so good a record at short range, why not extend the period a full week or month? This is a question often propounded. The answer of experience is that those who venture further usually fare worse. Just beyond what is shown on the daily weather chart is an illimitable realm of uncertainty, wherein those who enter must walk by faith not by sight. Forecasters take large risks if they attempt to hit storm centers offhand, or by random shots; to hit even at short range they must take very deliberate aim with the weather map as a rest.

Unquestionably there is a general desire for the extension of the range of forecasts, to cover the near future, and if possible the coming season. If some explorer in meteorology and astronomy should discover a fundamental law, whereby he could accurately calculate the time of arrival, the force and pathway of all storms for weeks and months in advance, and could warn

the people of future floods or drouths in defined localities, he would at once take rank as the greatest scientist in the world. And then if he would reveal the secret of his discovery for the benefit of future generations, he would be honored as the greatest of philanthropists as well as the wisest of mankind. But alas, up-to-date this great man has not arrived, and as yet we have not even a postal card notification of the date of his coming.

In ancient times astrologers worked a profitable "graft" to satisfy the public demand for knowledge of the future, representing that all human events, and even weather changes, were due to the influence of the moon and planetary bodies, and that they alone knew how to read the celestial cipher. Isaiah, the great Hebrew prophet, referred to that guild in rather uncomplimentary terms, as "Stargazers, astrologers and monthly prognosticators." Since the middle ages this practice has fallen into disrepute, but we have some "modern instances" indicating a survival of the superstitious beliefs which formed the basis of old-time astrology. Our modern stargazers and monthly prognosticators refer in mysterious phrase to the moon, Mercury, Venus, Saturn and even the hypothetical Vulcan, as the powers of the air which brings storms and all weather changes and earthquakes. These men peddle their long range forecasts in almanacs and other publications, profiting by practice on human credulity and ignorance of natural laws. Their alleged predictions are usually very indefinite as to the exact date of arrival of storms and their line of travel when they arrive; and by skillful ambiguity of language they may claim a verification if a storm crosses the continent anywhere between Hudson's Bay and the Gulf of Mexico, at any time within an alleged storm period of three to five days.

Some of the ablest scientists of this country and Europe have devoted much time and labor to the study of this problem. They have consulted weather records of all countries, taking note of the dates of heavy storms, making comparison with the position of the moon and planets, to determine if there is any discoverable connection between the movement of those minor bodies and the sweep of storm-eddies in earth's atmosphere. The consensus of opinion has been that there is no foundation of fact or philosophy for that system of long range forecasts. So thus far there has been an entire failure to establish a scientific and practical basis for any kind of trustworthy predictions as to the occurrence of storms, floods or drouths in specified localities and at certain dates in future months or seasons. Though such foreknowledge is very desirable, yet at the present stage of human progress it is beyond possibility of realization. In this field of scientific research the wisest students have been most deeply sensible of the limitations of human knowledge; but charlatans and pretenders claim to hold a key to mysteries in earth and the heavens that are hidden to the balance of mankind. Quackery in meteorology as well as in medicine is indicated by the extravagant pretensions of its practitioners.

Modern astrologers, following closely the lines of their ancient prototypes, give the sun a minor or passive role, while the moon and planets form an all-star aggregation in the ever-shifting scenes of earth's drama. To each planet is assigned some specialty act on the stage, each producing a different type of weather; and when two or three act in conjunction the complex results are startling. In the program as presented by a long range almanac the leading role in developing regular storm periods is given to "Vulcan",

though that hypothetical planet modestly keeps out of sight. The almanac says: "The Vulcan period is the foundation and frame work around which all storm disturbances grow."

According to this almanac the planet Mercury is in control of the sprinkling apparatus, causing mist and drizzles in summer, and damaging sleet in winter. Just how Mercury produces such an effect on the earth is one of the curious things in occult science. The almanac says: "Mercury moves and operates at such distance from the sun as to admit of much vapor and humidity. At the same time its nearness to the sun causes perpetual evaporation and steam and vapor in its atmosphere and skies, and this is in some as yet indefinable way communicated to our own and other planets in our system. * * * This peculiar infection infused into the sun by the Mercury perturbation, we hold, may reasonably take on such forms as to be thrown out by the solar energy, being reconverted into something like its original elements in our own globe and atmosphere. Hence our thick prolonged cloudiness, our mist and drizzling rains and sleet storms during the Mercury disturbances.

This abstruse statement translated into plain English signifies that the planet Mercury, when it gets into a "disturbance," throws water into the face of the sun, and that body retaliates by turning his hose on the whole planetary family! That relieves great Jupiter Pluvius from some measure of blame for excessive humidity.

Another extract from the almanac will throw more light on this problem. It says: "The disturbances of each and all the planets are communicated to all the rest of the planets, not directly, but through the perturbations caused by the planetary equinoxes to the sun. * * * When the plane of each planet's equator cuts the sun, this force is violently antagonized, the center of energy is put out of balance in the great solar orb, and perturbing waves react upon all bodies in our system, resulting in the phenomena which we witness in our earth and skies and which we denominate as meteorological."

There we have the gist of the system,—straight! The planets are dynamos revolving swiftly in space, each projecting from its equator tremendous electric force. When that equinoctial stream of planetary thunder and lightning strikes the sun squarely in the face it makes old Sol hot, and of course he strikes back! Who wouldn't? It's no very pleasant thing to be cut in the face by that sort of electric buzzsaw! This theory accounts not only for terrestrial storms and extreme heat, but also for the great spots that appear occasionally on the sun's face. The noxious planetary equinoxes cause all that disfigurement. Science is a great thing when it aids us in solving such problems as that! In reading over this almanac's dramatic story of how the planets are continually "perturbing" the sun, and how the sun hurls it back at all creation, one is reminded of a lot of boys poking sticks into a mammoth hornet's nest, and the stinging "reactionary disturbance" issuing from that previously passive body!

Really, it is difficult to treat such ludicrous matter with becoming dignity and seriousness. The chapter of the almanac descriptive of "Each planet's peculiar phenomena" is absolutely irresistible as a mirth-provoker to any reader who possesses a sense of the ridiculous and some elementary knowledge of meteorology and astronomy. One is impressed by the evident earn-

estness of the author, and yet it seems that he must be too intelligent to believe in his absurdly fantastic theories. They are no more believable than the myths and legends of the ancients. It is inconceivable that a learned astronomer and meteorologist actually believes that the sun is passive except when it is "perturbed" by some planet's equinox; that mists and vapors are injected and infused into the sun by Mercury's perturbation, and then thrown out by solor energy to form mists and sleet on earth; and that during the so-called "Jupiter period" the carrying capacity of earth's atmosphere becomes disordered and weakened, so that it can not transport any diffuse humidity, thereby causing consuming drouths in places and destructive cloudbursts in other localities. One who actually believes that kind of absurdity is beyond the reach of influence by evidence and argument. The bare statement of such propositions is a sufficient refutation.

Students in the primary class in meteorology learn that the ever changing phenomena of the weather are all referable to the action of the sun upon the earth and its atmosphere, vapors and gasses; that the constantly radiated energy of the sun supports heat, light and electric force in the solar system. The planets possess no form of independent energy whereby they may "perturb" the sun and increase its potency. Gravitation is only a name given to the statical relation of all matter in the universe, and it is a physical constant. There is absolutely no proof of any "perturbation" or increase in storm energy when the sun crosses the equator of the earth or any other planet. That is merely a hypothesis, supported by a priori assumptions and occasional coincidences. People often confound coincidence with consequence.

Planetary weather forecasts are too far-fetched to be practicable. The prophets in that line work at the wrong end of the problem. When there is more than the usual degree of heat or storminess, they peer into the nebular space to see what caused the disturbance on earth, and then allege that it was done by Jupiter, or was the malign work of Saturn, which in their philosophy causes epidemics and pestilential contagious disease. Possibly also they may in time discover that it is due to Saturnian potency that we have rings and combines in human affairs; why not?

True science, in the last analysis, is plain common sense applied to the study of nature's problems. In erecting philosophical structures the foundation should rest on the earth. Begin with facts as the solid basis of theories. Reason from the known to discover the unknown. In forecasting a storm, observe the good old recipe of the cook book for cooking a hare—first catch your storm, and then predict its future course and time schedule. A storm in hand (i. e., on the map), is worth two in some nebular hypothesis! It's mighty easy forecasting storms if one is allowed a broad range as to the exact locality and a long range as to the date. Storms are coming and going all the time, somewhere; on all dates as well as the specified days of the almanac's storm period.

It is probably true that cyclones or storm eddies, are as much in evidence one day as another, considering the earth as a whole. So one may safely predict storms for every day in the year with the certainty that they will rage somewhere. It would keep the moon and planets mighty busy with their equinoxes to maintain the continual stream of atmospheric eddies flowing over the face of the earth. But really the moon and planets are not charged

with that duty. In respect to light, heat and power of gravitation these bodies are infinitesimal as compared with the sun, which is the prime cause of weather phenomena on earth.

J. R. SAGE.

OUR GOOD SOIL AND CLIMATE.

Joseph E. Wing, in Breeders' Gazette.

We who live in America and in the corn belt little realize how much we have to make us thankful. First there is the soil, which is richer than England has or Scotland, except in favored spots. Next there is the climate. Granted that our climate has in it violent extremes and is trying to live in if we do not fit it right, yet it means well and really blesses us. I never knew how much we have to make us glad until I shivered in England, France and Scotland for nearly two months of their summer.

It was a constant wonderment to me that things grew so well as they did with so little heat. Coming home, the maize standing rank and green, twice as high as the fences, looks mighty good to me. And this sets me thinking. Corn grows mostly from the sun. True, there must be soil and water in that soil, but sun power makes the golden grains and sunbeams coiled up within those grains are ready to give out again their stores of energy or warmth in winter time. That sun that pours down its fervent rays is not to be lightly spoken of. It comes to bless. It is our own fault if he overcomes us. To eat simply, drink properly, hot water at meal times and little at other times, to dress comfortably and to take exercise regularly out of doors will be to insure robust health during the hottest weather.

And those heated nights when the corn blades whisper to each other and the katydids cry warnings from out the thickness of the trees, they are a blessing, too. It is your own fault if you swelter in stuffy chambers. There is the Great Outdoors calling to you. Provide each of you a cot that you can take out beneath the trees, sleep there or under canvas, see if you do not find your sins forgiven in the morning and new store of life and energy in you.

This is the glorious good land here, and the sun shines!

Thank God for the heat that fills the cribs with gold!

VALUE OF LAND DRAINAGE.

PREPARED BY THE DEPARTMENT OF SOILS OF THE IOWA STATE COLLEGE.

Tile drainage is no longer an experiment. Over sixty years have elapsed since John Johnson first introduced underdrainage into New York as a means of improving soil conditions, and ever since that time its value has been demonstrated over and over again in many sections of this country.

However, in spite of this fact, during the past year many farmers and landowners have made inquiry regarding the ways in which the land is really benefited by tile drainage. The following explanations have been written for the benfiet of those farmers who are anxious to gain information regarding this important question, which sustains such vital relation to profitable agriculture in the central west. Many farmers realize that drainage benefits the land in one or possibly two ways, but there are comparatively few who have thought of all of the sources of benefit which are referred to in this brief article.

1. Drainage firms the soil—Adequate drainage increases the firmness of the soil and thus renders it fit for cultivation earlier in the season. The surplus water readily percolates into the drained soil and permits the surface to become firm and solid. This firm soil can not be secured when the spaces between the soil grains are filled with water, for then there is a lack of surface tension and the soil grains move very easily upon one another.

2. Drainage increases aeration—Oxygen in the soil is as essential for the life of the plant as it is for the animal. Without free oxygen in the soil the seed fails to germinate and in a short time rots; the roots of plants fail in their appointed tasks; the innumerable host of soil bacteria, whose work it is to change the nitrogen of decaying organic matter into an available form, perish and the germs on the roots of the red clover and other leguminous crops, which supply available nitrogen at the lowest cost, do not accomplish their important work.

When the soil is full of water to within a few inches of the surface there can be no circulation of air among its particles. Drainage ventilates the soil by lowering the ground water three or four feet and thus makes it possible for the roots of plants to penetrate the soil more deeply. In time these roots die and decay and afford passageway throughout the soil for the ready movement of the air. The conditions are secured which promote the growth of plants, facilitate the work of the unlimited host of soil bacteria and hasten the formation of available plant food.

3. Drainage increases the temperature of the soil—Wet soils are cold soils. This is true for the reason that a large amount of heat is used in the process of evaporation of surplus water. Therefore a well tiled field from

which the water is drained must necessarily prove warmer than one which is water logged.

In early spring it often occurs that a drained soil is ten or twelve degrees warmer than an undrained soil. This is due to the circulation of air in the soil and the absence of evaporating water. An early, dry, warm seed bed is an essential factor in successful farming.

4. Drainage increases the feeding area of roots—When a field is poorly drained at the time of germination and early growth of the crop, the root system must of necessity develop near the surface. The result is that the feeding area is too restricted, and later, when the crop needs a large supply of water the surface soil becomes very dry because capillarity can not act with sufficient rapidity to meet the demand for moisture. In a well drained field the deeper soil is occupied by the roots earlier in the season and not only is the ground water more accessible, but the upper soil is not so readily dried out by a multitude of roots near the surface, and hence capillarity more easily maintains favorable moisture conditions.

5. Drainage increases the available moisture in time of drouth—The experience of farmers shows that crops suffer less in time of drouth on well-drained clay or alluvial soils than they do on the same type of soils not drained. Undrained soils dry out very completely near the surface in time of drouth and therefore water rises by capillarity in them very much more slowly than in moister soils. For this reason it is very important that the soil just beneath the surface be kept as moist as the growing crop will permit. Furthermore in a well drained soil the roots of plants spread out and go deeper in the early spring and summer. For this reason they are located nearer the ground water supply and do not exhaust the moisture near the surface to such an extent that capillarity is seriously impaired. This supply of water furnished by the action of capillarity aids in bringing the plant food into an available form and in carrying it to the plant while the deeper growing roots secure from the ground water supply much of the water given off by transpiration. Hence, well drained soils are better fitted for crop production in time of drouth than the same class of soils not drained.

6. Drainage prevents heaving of soils—In many sections of the central west serious losses frequently occur owing to the heaving grass and cereal crops. Proper drainage of the soil is doubtless the most effective remedy for this difficulty. When water freezes it expands, the surface is raised and the roots of the plants are torn from their places of growth. Shallow rooted plants are thus left on top of the ground after the surface soil has thawed and settled into position. It is not an uncommon occurrence after a series of freezes and thaws, in the latter part of the winter or early spring, to find the roots of clover, wheat and some other crops partially or wholly exposed. The percentage of plants thus destroyed in many field in a single winter is so great that the farmer is compelled to reseed the land. Soil which has been drained and is free from surplus water, is well supplied with interspaces filled with air. Therefore, when the soil moisture freezes, abundant room is afforded for expansion and thus the plant roots are protected in the largest measure from the injurious results which it has been shown follow the expansion and contraction of the surface of the soil.

7. Drainage benefits rolling land—Again many farmers do not appreciate the value of draining rolling land. They do not understand the results which follow tiling land of this character. On hillsides having a clay subsoil, the water which falls upon the surface will sink into the soil and be carried off underground instead of over the surface if an underdrain has been located in the subsoil at the depth of three or four feet. When these hillsides are drained this surplus water will be readily carried off, with the result that the soil will not become so thoroughly saturated and and surface washing will, in a large measure, be prevented. In a few years this well drained land will be greatly improved by the accumulation of humus within the surface soil by the circulation of the air among the soil particles and by the action of the soil bacteria, which, now for the first time, finds within its depth a suitable and congenial home. On hillsides not fully drained the surface soil permeable by water is very thin and frequently underlaid by a stiff and almost impervious clay. The result is that when beating rains fall they carry more or less of this surface soil into the valleys below. This action annually removes a considerable portion of the most fertile soil and is one of the most potent factors in keeping these rolling lands less productive than they would be under more rational management.

8. Drainage lessens the cost of production—One of the important items in the profit of drainage is found in the diminished expense of the management of the land. Drained fields are unbroken by sloughs and wet places and by unnecessary ditches. Every farmer has noted the fact that an exceedingly large uumber of fields in this state are difficult to plow, cultivate and harvest because of the irregular sloughs and wet spots of various sizes which can not be tilled. These wet places can not be crossed at many times during the year with a plow or cultivator. They are not only unproductive, but are also a source of great annoyance and expense. Their presence in the field often makes short rows and badly shaped lands necessary. As a result a great deal of time and money is lost in operating plows, cultivators and harvesters.