

froze over on the night of February 12, and the river at Harrisburg closed at the pumping station of the city waterworks at 12:15 a. m., February 14, with 13.5 feet of water on the gage, the highest point at which the river here was ever known to become icebound. The gorge was caused by floating ice lodging on the gorges below Harrisburg, the ice backing up gradually, and covering the surface of the river to a depth of several feet. This gorge extended to Duncannon, about 18 miles above Harrisburg, by the night of February 16.

No material changes occurred in the general conditions during the remainder of the month. One cold period closely followed another, and the gorged ice became more and more solidified. The month closed with the people of the towns and lowlands along the river waiting for the general break-up, and hoping for such weather conditions as would remove the threatened danger with the least possible loss of property.

No danger line stages occurred, except those caused by the gorges in the North branch.

There were no changes of consequence in any of the New York or New England rivers, except an increase in the thickness of the ice. There were no ordinary, free-running floods during the month, except in northern California, where the continued heavy rains caused marked and rapid rises in all of the rivers. Warnings were issued from San Francisco on February 16, 22, 23, 24, and 27. At Red Bluff a stage of 28.2 feet was recorded on February 16, the highest stage on record with the exception of that of 29.5 feet on February 4, 1881. At

Marysville, on the Yuba River, a stage of 20 feet was reached at 3 a. m., February 25. This was 1 foot above the danger line, as well as the highest recorded stage. The highest stage reached at Sacramento was 27.9 feet on February 26. This was 2.9 feet above the danger line for the reclaimed lands south of the city, some of which were overflowed. It is difficult to estimate the total damage due to the floods. Many thousands of acres were overflowed, but it is doubtful if much damage was done to the crops, and there is an offset in the increased fertility due to alluvial deposits. The warnings issued were very accurate, and they afforded occasion for the expression of many words of commendation from the press and others interested, particularly along the upper Sacramento River.

The highest and lowest water, mean stage, and monthly range at 202 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, District Forecaster.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions during February are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—First two decades cool, wet, and unfavorable for plowing, except in northern counties, where rainfall was light; last decade dry, warm, and favorable, and farm work pushed; considerable land prepared for cotton and corn; a little corn planted; oats and wheat did well; acreage in oats about average; large acreage in Irish potatoes. Gardening well advanced; some early vegetables up. Peaches and plums blooming freely in southern and middle counties at close of month; strawberries promising.—*F. P. Chaffee.*

Arizona.—Though there was some cold weather early in February, the greater part of the month was warm. Drought conditions continued to prevail, and there was but little snow on the mountains at the end of the month. Crops did well where sufficient water was obtainable, but generally the month was unfavorable to agricultural interests. Droughty conditions greatly diminished the acreage of grain. Stock interests suffered and greater suffering was feared.—*M. E. Blystone.*

Arkansas.—There was an excess in temperature during the month, the last week being unusually warm. The precipitation was below normal, but was sufficient to put the ground in fine tilth. More than the usual amount of plowing was done, and considerable progress was made in sowing small grains. Stock wintered nicely and was generally thrifty. Fruit sustained no material injury from severe weather.—*Edward B. Richards.*

California.—The remarkably heavy rainfall in the central and northern sections was in a measure beneficial to all crops, but materially changed estimates of the yield of grain in portions of the San Joaquin and Sacramento valleys; many thousand acres of wheat and barley were flooded by high waters, and it is doubtful if any crops will be raised there. Elsewhere, and especially in the southern districts, the rain was of immense benefit and crop prospects are very fair.—*Alexander G. McAdie.*

Colorado.—The month was very favorable for stock, and losses were small, although in localities in the north-central and south-central counties and along the Divide the ranges were poor and stock-water scarce. Good pasturage was general throughout the eastern counties. There was little frost in the soil of the eastern slope, and some plowing and seeding were done, but dryness and high winds were unfavorable. The snowfall, while greater than during January, was much less than normal, and will not materially increase the supply of water for irrigation.—*F. H. Brandenburg.*

Florida.—The month was favorable for farm work, which was well advanced. Land was prepared for cotton and corn; some early planted corn in southern counties was above the ground. The bulk of the cane crop was planted and about the last of the orange crop shipped. Vegetable shipments were light. Citrus trees showed a heavy bloom and groves generally were in a splendid condition. Pineapples made a fair growth and the prospect for peaches was good. An increased acreage of cotton was indicated.—*A. J. Mitchell.*

Georgia.—The temperature was practically normal; a prominent feature was the absence of cold waves, but there were several periods of low

temperatures. The precipitation was below the normal except over a limited area in the southwest. Farm work was retarded by the prevailing weather. The outlook for wheat was favorable, but fall oats were inferior. The prospects for fruit were bright.—*J. B. Marbury.*

Idaho.—The month was unusually mild, permitting grass to make a good start and causing fruit and shade trees to bud in sheltered valleys. Precipitation was heavy, the average exceeding all previous records for February. Snow accumulated rapidly in the mountains, giving promise of an abundance of water for placer mining and irrigation. Winter wheat was reported in good condition. Stock wintered well.—*Edward L. Wells.*

Illinois.—The temperature was below normal. Low maxima rather than low minima were the characteristics. Precipitation was deficient and fell mostly in the form of snow or sleet. The ground was well covered until the latter part of month, when a general thaw ensued. The condition of wheat was unpromising. Some fields were reported badly damaged and others winter-killed. Much damp, soft corn remained in hand, and the scarcity of good seed corn is a matter of concern. Meadows and pastures were well preserved in northern and central districts. Peach buds were seriously damaged.—*Wm. G. Burns.*

Indiana.—Severe cold weather caused much apprehension as to the safety of wheat in the northern and greater portion of the central sections, but the high temperature and rain on the 28-29th cleared the fields of snow and ice, and examinations made after March 1 indicated better prospects for a crop than had been expected. In the southern section and a few southeast counties of the central section wheat was thin on the ground, short, and brown, and the prospects were poor.—*W. T. Blythe.*

Iowa.—There has been but one colder February in the past fifteen years, viz, in 1899. The precipitation was generally light, and there were no severe storms to interrupt travel or hinder the usual farm operations. Conditions were favorable for the care of stock, and for preparatory work for spring seeding. The limited area of fall wheat and rye was exposed to low temperature without snow covering and probably suffered some damage.—*John R. Sage.*

Kansas.—The dry moderate weather was quite favorable for outdoor work, and much plowing was done in the southern counties and some in the central. Wheat continued in fair condition in the southern and central counties, but was somewhat damaged in the northern by the cold dry weather. Oat sowing progressed in some of the southern counties. Cattle did well.—*T. B. Jennings.*

Kentucky.—Freezing weather during most of the month, with very little snow, and winter grasses suffered further damage. The prospect for wheat was apparently very poor. Some correspondents stated that the root was good, but the general opinion was that wheat was seriously damaged. As no warm weather occurred of sufficient duration to start the buds, fruit trees were believed to be in good condition. Tobacco beds were burned when weather permitted and a few beds were seeded. Stock wintered well, considering the cold weather.—*H. B. Hersey.*

Louisiana.—Favorable weather for outdoor work prevailed during the greater part of the month. Preparations for cotton planting were pushed vigorously in most sections, and, as a rule, were well advanced. The bulk of the land to be planted in corn was broken and some corn planted in the southern parishes. Stubble and fall plant cane did well; seed cane was in good condition and spring planting well advanced. Rice seeding had commenced. Spring oats were doing well. Truck gardens and berries were growing nicely.—*I. M. Cline.*

Maryland and Delaware.—The month was very cold and precipitation

was deficient, though frequent and well distributed. Outside of the mountain districts wheat and grasses had scant protection from snow and were further damaged, grasses apparently suffering much less than wheat, which was in the worst condition for years at the close of February. Peaches were probably considerably injured in northern districts. Stock were reduced in flesh and dairy products curtailed as a result of the severe weather.—*Oliver L. Fassig.*

Michigan.—Winter wheat and rye were covered with snow and ice all of the month. The thaw of February 5 to 7 melted some of the snow and was immediately followed by a severe cold wave, which formed a sheet of ice over much of the southern and central counties of the State. The continued low temperatures and this ice covering prevented winter growth, and many correspondents expressed the fear that the ice was smothering the plants and damaging them to some extent.—*C. F. Schneider.*

Minnesota.—The month was very cold; minimum temperatures were below zero somewhere in the State daily until the 27th, and maximum temperatures below 32° until the 25th, except on a few days in southern portions. The 27th, 28th, and 29th were much the warmest days of the month. Moderate snows fell during the month, and snow covered the whole State to depths ranging from about 3 inches in the southwest to considerably greater amounts in the timber regions of the northeast. No farming operations were possible except the care of the farm stock.—*T. S. Outram.*

Mississippi.—Owing to the very light rainfall and generally mild temperature the month was unusually favorable for farm work. The soil was in splendid condition and plowing for corn and cotton was in full progress, being well advanced west and south. Oat sowing was nearly completed. Garden truck was up and doing well south and being planted north. At the close of the month fruit trees were in full bloom.—*W. S. Belden.*

Missouri.—In most sections the month was remarkably dry. In portions of the northeast section wheat was fairly well protected by snow and sleet, but elsewhere the ground was bare the greater part of the month, and in many counties the crop was considerably damaged. Except in the extreme southern counties, however, there was but little alternate thawing and freezing, and while the tops of the plants were killed to a considerable extent, the roots were not thought to be seriously injured.—*A. E. Hackett.*

Montana.—Except west of the main range and in the southwestern counties the month averaged considerably colder than usual, especially in the northeastern and north-central districts, due to continuously cold weather rather than to unusually low minimum temperatures. Precipitation was very generally above normal and snowfall was generally heavy in the mountains, but there was a slight deficiency in the northeastern counties and over a small area immediately to the east of the main divide.—*E. S. Nichols.*

Nebraska.—The exceedingly dry weather of February was unfavorable for fall sown grain, but in the absence of severe storms, cold weather, and high winds, the damage to the crops probably was not large. However, the soil is very dry because of three consecutive dry months. The wheat plant seems to have lived well, and with sufficient moisture in the spring will probably largely recover.—*G. A. Loveland.*

Nevada.—The month was very much milder than the average February. Heavy and continuous warm rains in the northern and western sections during the latter part of the month broke all previous records of rainfall for duration and amount. Heavy falls of snow in the mountains from the 4th to 7th made prospects exceedingly bright for a good water supply next summer. Range stock were in much better condition than usual at the close of winter.—*J. H. Smith.*

New England.—February was the coldest month of its name in the history of the New England climate and crop service, the next lowest mean temperature being 18° in 1901. The minimum temperature at Van Buren, Me., —43°, is the lowest of record excepting —44° at West Milan, N. H., in 1889. The precipitation was generally deficient excepting in southeast Massachusetts, where it was somewhat in excess; there was a marked deficiency in northern Vermont and New Hampshire, where a water famine existed. The depth of snowfall was unusually large in all sections.—*J. W. Smith.*

New Jersey.—The mean temperature for the month was within 1° of the coldest February, 1895. Freezing weather almost continuous; ground frozen to the depth of 30 inches in many places; winter grain and grass seriously injured on low fields; soil water-tight; ground bare of snow after the 20th. Apple buds dormant; peach buds badly affected; some pear trees cracked by severe cold. Preparation of hotbeds greatly retarded owing to frozen condition of soil.—*Edward W. McGinn.*

New Mexico.—The drought continued, there having been scarcely any precipitation on the plains since last September, and comparatively little in the mountains. Streams were very low and many good wells dry. Owing to the mild winter, stock continued in good condition, but moisture was needed to start spring growth. Conditions were becoming alarming.—*R. M. Hardinge.*

New York.—The month was abnormally cold with no continuous thaw, and was very windy. Thawing conditions early in month (principally on the 7th) greatly reduced the depth of snow, leaving many fields covered with ice, which was unfavorable for grain and grass. Severe weather

worked greatly to the disadvantage of dairying interests, and it was feared that fruit was damaged, although opinions on this point varied decidedly. The severest winter in sixteen years or longer.—*R. G. Allen.*

North Carolina.—February was continuously cold and without any extended warm periods to stimulate growth. Much winter wheat was cut to the ground, though probably the roots are not killed; much of the crops was hardly up. There was very little improvement in wheat, oats, or rye until toward the close of the month when more abundant precipitation and rising temperatures caused the commencement of growth. Very little plowing was done, and no truck crops were planted. Lettuce under cover and strawberries are in good condition.—*C. F. von Herrmann.*

North Dakota.—The month was the severest for the past thirteen years. Heavy snow so covered the open ranges that stock running at large could get but little to eat, while in sections where hay is put up and stock fed during severe weather the feeding was continued so long that but little hay was left.—*B. H. Bronson.*

Ohio.—There was a marked deficiency in temperature. The highest temperature occurred generally on the 7th or 29th, and the lowest on the 4th, 16th, and 20th. Precipitation was well distributed throughout the month. There was a slight excess in the northern half of the State and a moderate deficiency in the southern. Wheat was injured by the cold weather. There were many reports that the wheat fields presented a brown appearance, and some that the plants were dead.—*J. Warren Smith.*

Oklahoma and Indian Territories.—The month was warm and dry. Crops in ground did well, the subsoil moisture having been plentiful. Wheat made slight growth, but was in fair condition generally; the plant was small, well rooted, and greening up. At the close of the month the ground was in good condition, preparations for planting corn and cotton were in progress, oat seeding was well advanced, early potatoes and garden vegetables were being planted, and fruit trees were budding. Stock did well, notwithstanding scarcity of feed.—*C. M. Strong.*

Oregon.—February was an unusually wet and stormy month, but no damaging cold weather occurred. No progress worth mentioning was made in plowing or seeding and the farmers were generally behind with their spring work. Fall wheat was healthy, none had been winter killed, nor had it made much advancement in growth; it promised, however, to make a good start with the advent of settled weather and sunshine.—*Edward A. Beals.*

Pennsylvania.—With the exception of 1895 and 1901, this was the coldest February in seventeen years. The average precipitation was only about two-thirds the normal. The weather, as a whole, was unfavorable for winter grain and grasses. The ground was frozen to an unusual depth; many fields were unprotected at times by snow, and high winds, rains, and low temperature materially injured the tops of grain. No accurate estimate of the damage done to fruit was possible at the close of the month.—*T. F. Townsend.*

Porto Rico.—Sugar making continued throughout the month and the grade of juice improved somewhat, but was generally below the normal for the season at many haciendas, on account of continued wet weather. Young canes and ratoons generally in good condition. Much cane planted during the month. Tobacco cutting continued during the month; yield generally good. Coffee began to blossom early in the month and continued; first blossoming was rather light. Small crops and fruits were generally plentiful. Oranges began to get scarce toward the close of the month. Some beans were harvested. Pasture poor in the southern districts and cattle suffered.—*E. C. Thompson.*

South Carolina.—Plowing made good progress over the eastern part of the State, but was hindered by wet and cold weather in the western division. Tobacco beds were seeded, and spring oats sown. Some gardening was accomplished. Wheat and oats made slight growth. Fruit trees began blooming in the extreme southern sections; peach buds were slightly damaged by sleet and ice on the 11th.—*J. W. Bauer.*

South Dakota.—The month was unusually cold, with normal and fairly well distributed snowfall. Winter rye and the limited amount of winter wheat sown were favorably protected by snow, except in the extreme southeast, where some injury probably resulted. The continuous cold, especially in the north portion, was unfavorable to live stock on the open ranges, though no material losses were reported. Accumulated snow necessitated steadier feeding than usual in the eastern portion.—*S. W. Glenn.*

Tennessee.—Continued cold and dry weather; no snow protection; unfavorable for the growth of winter grains, in which little or no improvement was noted. Wheat early drilled or planted deep and fertilized withstood the adverse conditions fairly well, but much of the late planting was so poor that it was plowed up for other crops. Fall sown oats and clover mostly winter killed. Seeding oats and plowing in progress during the last week.—*H. C. Bate.*

Texas.—The greater portion of the State received moderate to good rainfall on the 5th, 18th, 19th, and 20th. Moderately cool waves overspread the State on the 10-11th and 19-20th, giving freezing temperatures to near the coast region. Wheat, barley, rye, and fall sown oats made a marked improvement, and these crops were in fair to average condition, except in the extreme west portion, where they were severely damaged by the drought. The sowing of spring oats progressed rapidly. Spring work was never further advanced for time of year. Plowing was generally completed and the ground in first-class condition. During the

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

The mean temperatures for each section, the highest and

Summary of temperature and precipitation by sections, February, 1904.

Section.	Temperature—in degrees Fahrenheit.						Precipitation—in inches and hundredths.							
	Section average.	Departure from the normal.	Monthly extremes.				Section average.	Departure from the normal.	Greatest monthly.		Least monthly.			
			Station.	Highest.	Date.	Station.			Lowest.	Date.	Station.	Amount.	Station.	Amount.
Alabama.....	49.0	+ 1.8	Dothan, Flomaton..	83	27	Anniston, Riverton..	12	1,4	3.80	-1.48	Eufaula.....	9.15	Decatur.....	1.25
Arizona.....	51.6	+ 3.6	Prattville.....	83	27	Flagstaff.....	5	6	0.38	-0.49	Natural Bridge.....	1.34	4 stations.....	0.00
Arkansas.....	44.8	+ 2.9	Parker.....	96	24	Forrest City.....	10	11	2.47	-1.33	Dallas.....	5.01	Pond.....	0.18
California.....	54.5	+ 0.3	New Louisville.....	86	26	Bodie.....	-13	18	7.91	+4.25	Bowmans Dam.....	45.61	3 stations.....	0.00
Colorado.....	33.4	+ 7.8	Imperial.....	93	24	Lay.....	-32	10	0.55	-0.40	Ruby.....	5.73	6 stations.....	0.00
Florida.....	60.8	+ 1.4	Volcano Springs.....	93	23, 24	Middleburg.....	23	2	3.03	-0.45	Fort Meade.....	6.91	Flamingo.....	T.
Georgia.....	47.3	0.0	Blaine.....	90	28	Diamond.....	5	2	4.04	-1.14	Americus.....	9.60	Greenbush.....	1.64
Idaho.....	30.2	.....	Inverness.....	89	19	Paris.....	-31	10	3.10	.....	Soldier.....	8.33	Oakley.....	0.95
Illinois.....	23.2	- 3.7	Orlando.....	89	29	Knoxville.....	-19	1	1.60	-0.77	Halfway.....	3.94	Carrollton.....	0.24
Indiana.....	24.5	- 4.1	Waverly.....	84	7	Northfield.....	-18	4	2.57	-0.48	Angola.....	4.77	Farmersburg.....	0.90
Iowa.....	14.8	- 4.8	Garnet.....	73	26	Fayette.....	-26	1	0.41	-0.63	Ridgeway.....	1.99	Osceola, Thurman.....	T.
Kansas.....	32.6	+ 2.6	Cairo.....	74	28	Wallace.....	-7	10	0.11	-1.03	Atchison.....	1.55	6 stations.....	0.00
Kentucky.....	35.2	0.0	Worthington.....	80	28	Loretto.....	-2	11	2.32	-1.65	Owenton.....	4.02	Burkside.....	1.09
Louisiana.....	57.1	+ 4.7	Keosauqua.....	70	6	Cheneyville.....	20	1	2.27	-2.76	Amite.....	5.70	Lawrence.....	0.53
Maryland and Delaware.....	26.9	- 4.9	Medicine Lodge.....	91	23	Oakland, Md.....	-15	20	1.79	-1.92	Bachmans Valley, Md.....	3.42	Chewsville, Md.....	0.34
Michigan.....	9.0	-10.7	Beattyville.....	75	7	Omer.....	-40	17	2.03	+0.02	Manistee.....	4.70	Baldwin.....	0.35
Minnesota.....	2.3	- 8.3	Cadiz.....	75	28	Pokeyama Falls.....	-55	16	0.62	+0.10	Crookston, St. Charles.....	1.80	St. Cloud.....	0.18
Mississippi.....	51.7	+ 3.4	Franklin.....	75	29	(Austin.....	20	13	2.60	-2.65	Magee.....	5.60	Pontotoc.....	1.19
Missouri.....	30.0	- 0.2	Franklin.....	89	18	Water Valley.....	20	16	.....	.....	Jackson.....	3.80	Grant City.....	T.
Montana.....	17.2	- 4.4	Robeline.....	89	26	Sublett.....	-18	1	0.91	-1.34	Columbia Falls.....	4.62	Augusta.....	0.15
Nebraska.....	24.7	+ 1.7	Oakland, Md.....	70	7	Billings.....	-42	16	1.37	+0.62	O'Neill.....	0.70	3 stations.....	0.00
Nevada.....	35.9	+ 4.2	Berrien Springs.....	50	7	Agate.....	-23	10	0.13	-0.53	Lewer's Ranch.....	18.14	Sodaville.....	0.21
New England*.....	16.6	- 6.5	Mt. Clemons, South Haven.....	50	7	Potts.....	-15	9	2.48	+1.33	New Bedford, Mass.....	4.65	Chelsea, Vt.....	0.51
New Jersey.....	24.8	- 5.8	Beardsley.....	43	27	Van Buren, Me.....	-43	6	2.39	-1.05	New Brunswick.....	3.09	Layton.....	1.36
New Mexico.....	42.2	+ 6.6	Okolona.....	89	27	Layton.....	-16	10	2.45	-1.66	Taos.....	0.90	3 stations.....	0.00
New York.....	15.5	- 7.4	Dean.....	82	28	Winsors.....	0	11	0.16	-0.50	Adams Center.....	6.80	Plattsburg.....	0.50
North Carolina.....	38.1	- 4.6	Fort Harrison.....	57	27	North Hammond.....	-26	2	2.46	-0.31	Edenton.....	5.91	Marshall.....	1.72
North Dakota.....	-2.2	- 8.8	Halsey.....	78	5	Linville.....	-1	2	3.72	-0.64	Palermo.....	2.00	Melville.....	T.
Ohio.....	22.9	- 4.5	Martin's Ranch.....	73	15	McKinney.....	-42	10	0.54	+0.21	Montpelier.....	4.39	Philo.....	0.75
Oklahoma and Indian Territories.....	44.3	+ 5.6	McAfee's Ranch.....	73	22	Bladensburg.....	-18	20	2.69	-0.11	Goodwater, Ind. T.....	4.69	10 stations.....	0.00
Oregon.....	37.2	+ 0.2	Sodaville.....	73	26	Kenton, Woodward, Okla.....	3	10	0.23	-1.07	Buckhorn Farm.....	30.83	Beulah.....	0.90
Pennsylvania.....	21.8	- 5.8	McAfee's Ranch.....	73	22	Pine.....	-5	2	10.31	+4.87	Hawthorn.....	4.80	Scranton.....	0.92
Porto Rico.....	73.5	.....	Waverly.....	82	7	Smethport.....	-27	2	2.41	-1.09	Cidra.....	12.70	Coamo.....	0.06
South Carolina.....	45.2	- 2.3	Rockingham.....	82	7	(Adjuntas.....	48	11	.....	.....	Walterboro.....	5.35	Allendale.....	1.95
South Dakota.....	9.7	- 5.0	Hannaford.....	52	27	Barros.....	48	25	4.23	.....	Silver City.....	2.95	Cavite.....	0.05
Tennessee.....	41.2	+ 1.3	New Richmond.....	75	7	Coamo.....	48	25	.....	.....	Knoxville.....	4.42	Covington.....	0.85
Texas.....	55.4	+ 5.4	Eldorado, Okla.....	98	25	Clemson College.....	15	2	3.59	-0.91	Brenham.....	5.52	Tulia.....	0.00
Utah.....	34.2	+ 5.4	Rockville.....	79	25	Kidder.....	-39	7	0.60	+0.04	Park City.....	5.00	3 stations.....	T.
Virginia.....	31.8	- 4.4	Cape Henry.....	77	7	McDowell.....	-8	2	2.38	-1.20	Hampton.....	4.93	Woodstock.....	0.75
Washington.....	34.3	- 0.8	Zindel.....	64	4	Republic.....	-15	9	5.35	+2.07	Clear Water.....	18.79	Ritzville.....	0.74
West Virginia.....	29.3	- 3.5	Doane.....	80	29	Pickens.....	-13	17	2.37	-1.18	Pickens.....	4.55	Romney.....	0.52
Wisconsin.....	7.3	- 8.8	Darlington.....	56	6	Osceola.....	-47	1	1.17	-0.02	Oconto.....	3.15	Dodgeville.....	0.35
Wyoming.....	26.0	+ 6.3	Marquette.....	73	4	Border.....	-33	10	1.51	-0.13	South Pass City.....	7.50	2 stations.....	T.

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

last week corn planting was begun in all sections. Gardens were made and Irish potatoes were being planted. The fruit crop suffered no damage and peach trees were in bloom. Strawberries were doing well and promised a large yield. Stock generally passed through the winter in fair condition.—L. H. Murdock.

Utah.—Abnormally warm weather prevailed during the latter part of the month. Precipitation was decidedly above the normal over the northern portion, and the prospective water supply in this region was very good. Over the remainder of the section precipitation was slightly deficient, and, owing to the droughty conditions that prevailed all winter, the supply of irrigation water will probably fall far short of the demand. Wheat was generally reported to be in good condition. Stock had wintered well and were thriving.—R. J. Hyatt.

Virginia.—The condition of winter wheat and oats, rye, clover, and fall grasses remained practically unchanged throughout the month. Ample snow protection was had in nearly all localities, but previous severe weather had caused so much damage that crops were not specially benefited thereby. Extensive winter killing of late seeded fall grain occurred. Spring plowing was much behindhand and but little preparation

for tobacco seed beds had been made. Orchards were in good condition.—Edward A. Evans.

Washington.—Although the month was somewhat colder than normal there were no severe freezes. The temperature was very uniform, and not unfavorable to the growth of winter grain, nor to fruit trees. There was heavy rain west of the Cascade Mountains, and heavy snowfall east. Most of the snow remained on the ground, forming a desirable covering for the winter wheat. The winter had been favorable for winter wheat, and, as far as could be judged, it was in good condition; the abundant moisture from melting snow should cause it to grow rapidly when spring arrives, and should also be very favorable to spring-sown crops.—G. N. Salisbury.

West Virginia.—The weather during February continued cold and dry, and the soil was frozen to a considerable depth. Wheat, rye, oats, and grass were generally in very poor condition, having had scarcely any protection from snow, and the prospects were that some fields would be plowed up. No plowing or other farm work was done. Stock were generally in good condition, but feed was becoming scarce in some counties.—E. C. Vose.

Wisconsin.—The month was the coldest February in the central and southern portions of the State since 1885, and probably the coldest February on record in the northwestern counties. Although extremely low temperatures were recorded throughout the State, it is generally believed that no damage to crops resulted, as winter grains and grasses were protected by an ample covering of snow. Stock were reported as wintering in good condition.—*W. M. Wilson.*

Wyoming.—The temperature throughout the State for the month was

in excess of the normal and there were no severe storms. As a result stock continued in excellent condition and very little feeding had to be done. The mild weather started the grass in some sections, so that a green tinge was given to the low places. A good supply of snow accumulated in the mountains of the western and northern portions of the State, but a marked deficiency existed at the close of the month over the southeastern portion.—*W. S. Palmer.*

SPECIAL ARTICLES.

DISPOSITION OF RAINFALL IN THE BASIN OF THE CHAGRES.

By Gen. H. L. ABBOT, U. S. A., retired, dated Cambridge, Mass., March 4, 1904.

The question of what becomes of the precipitation falling from the clouds upon a given catchment basin—what part escapes through the channels of the streams, what part is evaporated, what is absorbed by plant life, and finally what part sinks into the earth as ground water—has received much attention from hydraulic engineers by reason of its important bearings upon the water supply of cities, the irrigation of arid regions, and the development of water power. To be of utility, such studies must be based upon long-continued measurements of the rainfall at localities suitable to afford a true estimate of the average precipitation upon the region in question during each of the different seasons of the year, together with accurate gages of the outflowing streams during the same periods. For a complete solution, further observations to determine the evaporation from land and water surfaces and the absorption of moisture by plants are desirable to furnish a check upon the values found for the other and more important elements, but the extreme difficulty of such studies has usually proved a bar to undertaking them. It must not be forgotten, however, that a portion of the water apparently lost by infiltration into the earth may ultimately find its way into the streams as ground water, and as such may be detected, at least approximately, by a careful investigation of the ratio between down-fall and drainage in different seasons of the year. Even in this simplified form the labor and expense involved in the needful measurements have restricted their application to a few localities, and those generally situated in populous and temperate districts.

In connection with their other technical investigations the engineers of the New Panama Canal Company found it obligatory to study some of these questions with considerable attention, and this paper is written in the hope that the resulting facts and figures may prove useful in throwing light upon the more general problem of the ultimate disposition of rainfall.

The Isthmus of Panama is a locality specially favorable to studies of this character. Ice and snow, which have usually complicated such investigations, are here unknown. The region is practically in its natural condition, densely covered with the luxuriant growth of the Tropics. The temperature of the air, which largely influences evaporation, hardly varies from month to month and from year to year, thus in a great measure eliminating one important element of relative uncertainty. Finally, the rainfall is excessive, and is sharply divided between a dry season of three months and a rainy season of seven months, with two intermediate months of less marked character. This fact, as will appear later, has greatly favored the analysis. It seems not improbable that results obtained under so favorable conditions may not only be applicable to similar regions in the Tropics but may also throw light upon certain elements common to more northern latitudes.

The district covered by these measurements is the basin of the Chagres above Bohio, at which locality will be placed the lower reservoir dam creating a large lake to be traversed by shipping as part of the canal route. Under present conditions all outflow from above passes Bohio. The catchment basin is naturally divided into three subbasins, the lower extending to Gamboa, where the Chagres first joins the canal route; the middle extends thence to Alhajuella, where a second dam should

be placed; the upper includes the valley above this point. The surveys of the Panama Railroad, supplemented by those of the two Panama Canal companies, have well defined the watershed of the two lower subbasins, as well as the western and much of the southern boundaries of the upper subbasin; but a gap exists on the northern and eastern boundary of the latter where the line of demarcation is somewhat uncertain for a distance of about 35 miles. One point nearly in the middle of the unknown portion was determined by a reconnaissance made by a party of the Isthmian Canal Commission coming from the San Blas district to the head of the eastern branch of the upper Chagres, and this point together with the well known general character of the district, low ridges separated by narrow gorges, have enabled the ill-defined part of the boundary to be laid down on the map with fair precision. All the rest of the entire watershed of the basin being accurately determined, no error can exist in the estimated area large enough to sensibly affect any practical conclusions to be based on the study. The following table exhibits, in statute miles, the dimensions of the basin, which is a hilly rather than a mountainous district, and much of it is covered with a dense tropical growth. The highest summits rarely if ever rise more than about 1500 feet above sea level:

Subbasin.	Basin above Bohio.				Length of bed.	Number of affluents.
	Area.	Per cent.	Length.	Width.		
Upper	320	46	18	18	31	?
Middle	130	18	7	18	11	15
Lower	250	36	11	23	20	17
Total	700	100	.....	.....	70	.....

Before stating the general conclusions resulting from the study it will be well to consider in some detail the several important elements upon which they are based.

RAINFALL IN THE BASIN ABOVE BOHIO.

So many data have been collected respecting rainfall upon the Isthmus of Panama that the monthly and yearly precipitation is well understood. The records kept by the Panama Railroad Company at Colon are nearly continuous since 1862, and those kept on the Pacific coast and at various intermediate points by the two Panama Canal companies are nearly continuous since 1881. The figures were published in the MONTHLY WEATHER REVIEW for May, 1899, and March, 1903. Those specially valuable in the present study date from 1895, when the daily measurements of discharge were extended to include Alhajuella, near the site of the projected upper dam. Unfortunately, they were discontinued at this post in 1897 and 1898, but were resumed in 1899 and are still in progress. All rain gages are read and recorded daily. The respective heights above the ground in their vicinity are the following: At Colon, 30 feet; at Alhajuella, 8 feet; at Gamboa, 36 feet; at Bohio, 6 feet; and at La Boca, 2.5 feet.

What is needful in the present study is a knowledge of the average monthly rainfall in each of the three subbasins, from which that in the entire basin may be deduced. Bohio and Gamboa are near each other and at the extremities of the lower subbasin; Gamboa and Alhajuella are also near each other and at the extremities of the middle subbasin; finally, from the fact that the Pequeni, the largest and most important