MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXVI. ANNUAL SUMMARY, 1898. No. 13

INTRODUCTION.

The present Summary, for the year 1898, is based essentially upon data received from about 140 regular Weather Bureau stations and 28 regular Canadian stations; in preparing the charts of mean annual surface temperature and total precipitation, however, many reports from voluntary stations were used. A revised chart of total annual precipitation will be published in the Annual Report of the Chief of the Weather Bureau when the data from all voluntary stations have been received. The tables for thunderstorms and auroras are, as usual, based on reports from both voluntary and regular observers. The statistical tables and charts have been prepared under the supervision of A. J. Henry, Chief of the Division of Records and Meteorological Data.

FORECAST DIVISION.

E. B. GARRIOTT, Chief of Forecast Division.

SUMMARY OF HIGHS AND LOWS FROM 1895 TO 1898, INCLUSIVE.

During a part of 1895 and all the three succeeding years the data regarding the highs and lows of each month have been compiled by one person and under precisely constant or similar conditions. It is not believed that records for four years can give any but approximate results, but it will be of some value to compile averages, and these will serve for a fuller study as the years go by. The average data for 1895 are added, but they should be given less weight, and should be used more to corroborate the averages for other years and not independently or as proving anything in and of themselves. In summarizing the data the following points have been sought for: (1) The average latitude and longitude of the beginning and ending of each months' highs and lows. (2) The velocity of these in miles per hour. (3) The average latitude at which these highs and lows crossed the ninetieth meridian.

Summary of highs and lows.

Month.	Highs.					Lows.					Crosses 90°. W.	
	Mean first.		Mean last.			Mean first.		Mean last.			High.	Low.
	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.	Lat. N.	Lat. N.
1895.	°	°	°	°	°	°	°	°	°	°	°	°
January	48	105	43	74	39	44	103	45	67	33	41	40
February....	49	107	41	90	29	40	103	45	64	25	43	43
March.....	50	112	35	83	27	45	106	43	68	31	38	42
April	42	115	39	83	22	50	112	42	79	27	39	43
May.....	49	103	34	85	22	50	108	47	81	22	40	41
June	45	119	41	81	25	44	110	45	81	19	42	48
July.....	46	108	36	87	18	48	109	44	74	22	40	45
August.....	41	106	39	84	22	45	105	43	73	22	40	47
September..	45	116	42	77	23	49	112	47	74	24	42	47
October.....	47	111	40	77	25	47	107	47	65	28	39	48
November...	46	111	40	67	21	39	101	48	72	34	36	42
December...	53	105	37	80	20	43	109	48	72	31	40	43
Cold.....	49	109	39	78	27	43	105	46	68	30	39	43
Warm.....	45	111	39	83	22	48	109	45	77	23	40	45
Mean.....	47	110	39	80	24	45	107	45	73	26	40	44

Summary of highs and lows—Continued.

Month.	Highs.					Lows.					Crosses 90° W.	
	Mean first.		Mean last.			Mean first.		Mean last.			High.	Low.
	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.	Lat. N.	Lat. N.
1896.	°	°	°	°	°	°	°	°	°	°	°	°
January	48	111	43	79	22.2	44	114	43	77	25.7	45	41
February....	46	111	45	69	29.6	48	115	39	75	26.5	39	42
March.....	51	113	40	73	23.5	46	111	46	67	27.9	41	41
April.....	49	105	40	78	21.2	44	112	47	81	23.6	46	45
May.....	46	99	36	75	23.5	41	110	45	81	21.1	45	44
June	45	115	40	75	23.6	50	112	46	75	24.1	43	49
July.....	51	113	43	83	22.2	49	110	47	76	23.6	43	43
August.....	49	119	43	67	22.5	49	107	48	69	27.6	43	48
September..	50	119	43	68	21.7	46	103	46	72	25.1	42	47
October.....	45	114	45	83	21.9	46	106	48	78	24.4	42	43
November...	48	104	43	63	27.6	43	118	48	65	33.8	39	44
December..	48	104	38	90	24.8	49	116	47	67	31.8	36	45
Cold.....	48	110	42	76	24.9	46	113	45	71	28.4	40	43
Warm.....	48	112	41	74	23.0	47	109	47	76	24.2	44	49
Mean... ..	48	111	42	75	24.0	46	111	46	74	26.3	42	46
1897.												
January. ..	49	108	44	77	27.3	43	111	47	67	29.1	49	46
February....	50	108	43	70	26.1	42	109	46	63	31.3	44	40
March.....	51	107	39	70	25.7	42	108	47	75	27.7	45	39
April.....	46	114	39	78	24.0	47	112	46	69	23.3	41	44
May.....	44	113	39	81	19.4	47	106	46	77	20.6	42	47
June	47	115	36	81	23.7	46	108	44	83	24.4	42	47
July.....	48	123	31	87	20.6	52	113	46	79	19.5	35	44
August.....	49	115	38	81	25.2	49	112	46	70	22.0	42	46
September..	46	112	36	83	21.7	44	109	46	72	25.5	47	49
October.....	44	110	39	75	24.7	46	108	44	75	26.7	44	49
November ..	49	118	39	71	25.8	47	111	48	56	27.7	37	43
December...	48	114	36	78	22.9	42	113	48	64	32.4	40	43
Cold.....	49	111	40	73	25 4	44	110	47	67	29.2	43	43
Warm.....	47	115	35	82	22.4	48	110	46	75	22.5	42	46
Mean.....	48	113	38	78	23.9	46	110	46	71	25.8	43	45
1898.												
January.....	46	109	45	62	30.8	41	113	47	56	36.6	42	44
February ...	48	109	42	74	28.3	48	117	47	66	27.2	43	43
March.....	50	116	45	71	25.3	40	105	48	66	29.1	41	44
April.....	43	123	35	74	25.2	45	115	45	66	25.3	39	39
May.....	49	114	37	84	22.0	40	112	38	76	19.4	45	42
June.	46	109	37	73	23.8	46	110	45	64	24.3	45	45
July.....	44	118	38	74	22.1	49	114	48	67	27.3	45	49
August	45	109	42	69	21.4	46	109	45	71	21.2	44	44
September..	46	118	40	74	24.3	48	105	47	71	22.6	43	45
October.....	46	119	43	69	23.8	42	104	48	67	24.5	39	43
November ..	44	122	40	72	25.5	46	111	46	69	27.8	37	43
December...	46	105	38	74	24.5	46	114	46	63	28.4	38	45
Cold.....	47	114	42	70	26.4	44	111	47	64	28.9	40	44
Warm... .	45	115	38	75	23.1	46	111	45	69	23.3	43	44
Mean.....	46	114	40	72	24.7	45	111	46	67	26.1	42	44

The accompanying table exhibits a compilation of the data on these principles. At the end of each year the average for the six cold and six warm months has been computed, and there is added here a summary of the four years.

Year.	Highs.					Lows.				
	Mean first seen.		Mean last seen.			Mean first seen.		Mean last seen.		
	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.	Lat. N.	Long. W.	Lat. N.	Long. W.	Velocity.
	°	°	°	°		°	°	°	°	
1895	47	110	39	80	24	45	107	45	73	26
1896	48	111	42	75	24	46	111	46	74	26
1897	48	113	38	78	24	46	110	46	71	26
1898	46	114	40	72	25	45	111	46	67	26
Mean	47	112	40	76	24	46	110	46	71	26

Mean velocity by cold and warm months is as follows:

Year.	Mean velocity.			
	Highs.		Lows.	
	Cold.	Warm.	Cold.	Warm.
	Miles.	*Miles.*	*Miles.*	*Miles.*
1895	27	22	30	23
1896	25	23	28	24
1897	25	22	29	22
1898	26	23	29	23
Mean	26	23	29	24

The average velocity of the highs and lows through the four years was remarkably uniform, 24 and 26 miles an hour, respectively. We also see, as is well known, that the velocity during the cold months is greater than during the warm season. On comparing the velocity of the highs with that of the lows during the cold and warm months, we see a uniform greater velocity of lows than of highs in the cold season, but during the warm season the velocity is practically the same. This may be an important point in the study of these conditions.—*H. A. Hazen, Professor.*

RIVER AND FLOOD SERVICE.

By H. C. FRANKENFIELD.

Heights of rivers above zeros of gauges, 1898.

Stations.	Highest water.		Lowest water.		Mean stage.	Annual range.
	Stage.	Date.	Stage.	Date.		
Mississippi River.	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	10.7	June 8,9	2.7	Aug. 15,20; Sept. 8-10	3.7	8.0
Reads Landing, Minn	9.0	June 11	−0.9	Nov. 29	6.5	9.9
La Crosse, Wis	9.9	June 15	1.3	Sept. 15,16,27-29	3.6	8.6
North McGregor, Iowa	10.0	June 19,20	0.1	Nov. 26	3.5	9.9
Dubuque, Iowa	9.4	June 21-23	0.5	Sept. 30	3.6	8.9
Leclaire, Iowa	6.0	June 24-27	0.4	Oct. 1-10	2.4	5.6
Davenport, Iowa	7.4	Mar. 14; June 24-26	0.8	Sept. 30; Oct. 1-11	3.4	6.6
Galland, Iowa	4.4	June 27	0.4	Oct. 6-12,14-16	1.9	4.0
Keokuk, Iowa	9.8	Feb. 13	−2.0	Dec. 4	3.0	11.8
Hannibal, Mo	11.7	May 21	−0.6	Dec. 6	4.0	12.3
Grafton, Ill	18.1	May 23	1.9	Dec. 9,10	7.4	16.2
St. Louis, Mo	27.2	May 23	0.3	Dec. 11	11.4	26.9
Chester, Ill	22.2	May 24	−0.5	Dec. 14	8.5	22.7
Cairo, Ill	49.8	Apr. 6	7.6	Oct. 10	23.7	42.2
Memphis, Tenn	37.3	Apr. 11,12	5.1	Oct. 10,23,24	16.0	32.2
Helena, Ark	49.1	Apr. 17	7.7	Oct. 13	23.0	41.4
Arkansas City, Ark	51.2	Apr. 19-21	9.5	Sept. 12,13	26.3	41.7
Greenville, Miss	46.2	Apr. 21	7.2	Jan. 13	21.8	39.0
Vicksburg, Miss	49.4	Apr. 24,25	7.9	Jan. 1	24.9	41.5
New Orleans, La	17.0	May 1	2.8	Jan. 3	8.8	14.2
Arkansas River.						
Wichita, Kans	5.6	June 10	0.6	Jan. 5-11	1.9	5.0
Fort Smith, Ark	35.0	May 7	1.0	Jan. 11,12	7.4	34.0
Dardanelle, Ark	29.3	May 10	0.2	Jan. 12	7.4	29.1
Little Rock, Ark	27.2	May 11	2.9	Jan. 5	9.3	24.3

Heights of rivers above zeros of gauges, 1898—Continued.

Stations.	Highest water.		Lowest water.		Mean stage.	Annual range.
	Stage.	Date.	Stage.	Date.		
White River.	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Newport, Ark	32.1	May 8	2.1	Jan. 10	10.7	30.0
Des Moines River.						
Des Moines, Iowa	8.6	June 11	2.2	Dec. 22,23,25-28	3.1	6.4
Illinois River.						
Peoria, Ill	19.3	Mar. 31	3.5	July 24	8.6	15.8
Missouri River.						
Bismarck, N. Dak	12.6	June 26	2.0	Oct. 2-8	5.1	10.6
Pierre, S. Dak	11.2	June 28	0.8	Mar. 24	3.2	10.4
Sioux City, Iowa	14.7	June 30; July 1,2	5.0	Oct. 16,18	7.8	9.7
Omaha, Nebr	14.7	July 3	5.3	Mar. 6,7	8.7	9.4
St. Joseph, Mo	10.2	July 4	−3.1	Dec. 9	3.6	13.3
Kansas City, Mo	21.5	June 12	4.0	Dec. 12	9.3	17.5
Boonville, Mo	19.3	June 15	1.7	Dec. 14	8.6	17.6
Hermann, Mo	18.8	June 17	2.1	Dec. 13	9.4	16.7
Ohio River.						
Pittsburg, Pa	28.5	Mar. 24	2.2	Dec. 12,16,17	7.1	26.3
Davis Island Dam, Pa	27.1	Mar. 24	2.0	July 17, Sept. 21; Oct. 6-8	7.1	25.1
Wheeling, W. Va	43.9	Mar. 24	1.5	Sept. 28,29	9.2	42.4
Parkersburg, W. Va	47.8	Mar. 26	2.3	Oct. 7	10.9	45.5
Point Pleasant, W. Va	51.2	Mar. 27	1.7	Sept. 22-24	12.5	49.5
Catlettsburg, Ky	56.0	Mar. 27,28	1.0	Oct. 3	15.8	55.0
Portsmouth, Ohio	57.3	Mar. 28	2.9	Sept. 24, Oct. 3,4	17.1	54.4
Cincinnati, Ohio	61.4	Mar. 29	4.5	Oct. 6	19.7	56.9
Louisville, Ky	36.0	Mar. 30	3.5	Oct. 8	9.4	32.5
Evansville, Ind	44.8	Apr. 2,3	4.1	Sept. 30, Oct. 8	16.5	40.7
Paducah, Ky	47.3	Apr. 6	3.5	July 22; Sept. 26,27	.....	43.8
Alleghany River.						
Warren, Pa	8.2	Feb. 13	0.0	*	2.3	8.2
Oil City, Pa	10.2	Feb. 13; Mar. 24	0.4	Oct. 4-6	2.9	9.8
Parkers Landing, Pa	14.0	Mar. 24	0.3	July 23,24	3.3	13.7
Freeport, Pa	25.3	Mar. 24	0.8	July 18,19; Oct. 4-7	5.6	24.5
Conemaugh River.						
Johnstown, Pa	9.0	Oct. 22	0.8	July 17	2.8	8.2
Red Bank Creek.						
Brookville, Pa	10.5	Mar. 23	0.1	June 8-12	1.0	10.4
Beaver River.						
Ellwood Junction, Pa	13.2	Mar. 23	−1.5	July 24	1.9	14.7
Cumberland River.						
Burnside, Ky	32.6	Jan. 23	−0.1	July 4,15	5.3	32.7
Carthage, Tenn	34.1	Jan. 25	0.8	July 16-19	6.4	33.3
Nashville, Tenn	38.8	Jan. 23	1.5	July 4	9.1	37.3
Great Kanawha River.						
Charleston, W. Va	31.0	Aug. 11	3.0	Feb. 4-6	7.0	28.0
New River.						
Hinton, W. Va	9.0	Aug. 11	1.0	July 14	2.6	8.0
Licking River.						
Falmouth, Ky	27.5	Jan. 23	0.9	Oct. 1-4	3.7	26.6
Monongahela River.						
Weston, W. Va	13.1	Mar. 29	−1.5	Mar. 12,13	1.0	14.6
Fairmont, W. Va	18.4	Mar. 25	−0.3	June 9,10; July 15,16,17,19	2.9	18.7
Greensboro, Pa	21.2	Mar. 25	6.3	July 14-17; Sept. 22-26	8.9	14.9
Lock No. 4, Pa	23.9	Mar. 30	5.6	Sept. 24,25	9.7	18.3
Cheat River.						
Rowlesburg, W. Va	9.4	Aug. 11	0.5	July 13-16	3.3	8.9
Youghiogheny River.						
Confluence, Pa	8.1	Mar. 25	0.5	Oct 3,4	2.7	7.6
West Newton, Pa	10.9	Mar. 24	−0.2	Nov. 5	2.2	11.1
Muskingum River.						
Zanesville, Ohio	35.9	Mar. 24	6.0	July 7-10	10.0	29.9
Tennessee River.						
Kingston, Tenn	13.0	Sept. 4	0.2	June 14-16	2.9	12.8
Chattanooga, Tenn	24.6	Sept. 5	1 6	June 15	15.8	23.0
Bridgeport, Ala	18.2	Sept. 6	0.6	June 12,15,16	4.2	17.6
Florence, Ala	13.8	Jan. 28,29	0.5	June 14	4.1	13.3
Johnsonville, Tenn	29.1	Jan. 24	1.0	Oct. 3-5	6.5	28.1
Clinch River.						
Speers Ferry, Va	10.8	Aug. 11	−0.6	Oct. 2	1.0	11.4
Clinton, Tenn	21.0	Aug. 12	2.4	Oct. 4	6.1	18.6
Wabash River.						
Mount Carmel, Ill	27.0	Mar. 30,31	1.3	Sept. 4,5	7.6	25.7
Red River.						
Arthur City, Tex	21.1	May 8	3.0	Feb. 4,5	6.6	18.1
Fulton, Ark	27.9	May 11	2.5	Jan. 11	8.2	25.4
Shreveport, La	14.9	May 21	−0.1	Nov. 9	6.4	15.0
Alexandria, La	16.9	Feb. 1	−1.0	Nov. 9	7.0	17.9
Atchafalaya River.						
Melville, La	33.9	Apr. 29,30; May 1-4	9.5	Sept. 18	22.8	24.4
Ouachita River.						
Camden, Ark	33.7	Jan. 25	3.2	Sept. 12-14	6.7	30.5
Monroe, La	35.9	Feb. 12,13	0.8	Sept. 13-15	14.4	35.1
Yazoo River.						
Yazoo, Miss	24.4	Apr. 26-28	−1.0	Nov. 9,10	9.9	25.4
Flint River.						
Albany, Ga	17.2	Sept. 2	0.5	June 7-10	4.4	16.7
Cape Fear River.						
Fayetteville, N. C	29.2	Aug. 22	1.0	July 5	6.1	28.2
Columbia River.						
Umatilla, Oreg	21.8	June 17,18	−0.7	Mar. 31	7.9	22.5
The Dalles, Oreg	36.9	June 20,21	−0.8	Dec. 17,18	12.7	37.7
Willamette River.						
Albany, Oreg	16.4	Nov. 20	0.7	Aug. 20-31; Sept. 1-19	5.4	15.7
Portland, Oreg	20.7	June 19-21	0.7	Oct. 25	7.8	20.0
Edisto River.						
Edisto, S. C	5.9	Sept. 12,13	0.4	June 13-16; July 3,4	3.4	5.5