

WEATHER CONDITIONS DURING WASHINGTON'S WESTERN JOURNEY OF 1770.

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In the autumn of 1770 George Washington, at that time a distinguished planter living at Mt. Vernon, Virginia, made his most westward journey into the Ohio country.† On this "tour to the Ohio" he ventured westward into the interior of the continent when very little was known about systematic meteorology. He left Mt. Vernon on October 5 and returned on December 1, being absent from home exactly eight weeks and two days. While there was a chance that very disagreeable weather might be experienced, there was also the possibility that pleasant autumnal days, now known as Indian summer weather, might make the journey an enjoyable excursion.

Washington was not unfamiliar with the weather of autumn in the region of the Upper Ohio Valley, for in 1753, when he was sent by Governor Dinwiddie to deliver a communication to the French Commandant at Fort Le Boeuf, he experienced very severe weather before he returned. He set out on this journey the last day of October and was in the northwestern part of Pennsylvania during the latter part of December, and here he experienced very cold stormy weather. It was not until January 16, 1754, that he returned to Williamsburg, ending a long and tedious journey requiring two and a half months. Certainly it was, from the standpoint of weather, a poor time of the year for travel, but military expediency required that it be not delayed.

The journey of 1770 was begun a little earlier than the trip to the French post, when the country must have been most beautiful, for the forests would at that time change from verdant to the various colors of autumn. As the season advanced the falling of the leaves would facilitate the examination of the terrain, avowedly one of Washington's chief motives in making the journey.

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†Guy-Harold Smith: "Washington's Camp Sites on the Ohio River," Ohio Archeological and Historical Quarterly, Vol. 41, 1932, pp. 1-19.

Washington, in keeping his diaries, included numerous notes on the passing weather, and it is from the record of October, 1770, that we can glean some information regarding weather conditions of that season. For this particular month he kept a separate record as a supplement to his longer journal.

The record of the weather is taken from Hulbert's transcription* of Washington's diary which he kept on his western tour. As a matter of fact he kept an extended journal which he entitled "Remarks and Occurs." in addition to the terse diary labeled "Where and how my time is Spent." His weather record is entitled "Acct of the Weather—in October" and is as brief as his diary. It appears that he did not keep a separate account for the remainder of his journey, but incorporated certain remarks about the weather in his journal.

Since his record for October, 1770, is fairly complete with an entry for every day, it is presented below in order to give continuity to the account. It is unfortunate that a more complete record is not available, but in these brief statements we have a valuable bit of information about the weather. His account is sufficiently detailed to permit an interpretation of the general distribution of the weather elements during the month of October.

"ACCT OF THE WEATHER—IN OCTOBR."

- Octr 1st Wind Southwardly and Warm with flying Clouds.—
 2. Raining, Hailing, or Snowing the whole day—with the Wind Northerly Cold & exceeding disagreeable—
 3. Clear but Cold—Wind being very high from the Northwest—
 4. Clear and pleasant—Wind being fresh.—and very fresh.—
 5. Clear, Warm, & remarkably pleasant with very little or no Wind
 6. Again clear and pleasant still
 7. As pleasant as the two preceeding days
 8. Pleasant forenoon—but the Wind Rising about Noon it clouded & threatned hard for rain—toward Night it rained a little & ceased but contd Cloudy
 9. Exceeding Cloudy & heavy in the forenoon and constant Rain in the Afternoon
 10. Cloudy with Rain & sunshine alternately.
 11. Wet Morning with flying Cloud afterwards—toward the Evening the Wind sprung out at No West—
 12. Rain in the Night with flying Cloud accompanied with a little Rain nw and then all day—cold & Raw—
 13. Clear and pleasant Wind tolerably fresh from the Westward all day
 14. Very pleasant but Wind fresh in the Afternoon.
 15. Exceeding Cloudy & sometimes droppg. Rain but afterwds clear
 16. Frosty Morning—but clear and pleasant afterwds clear
 17. Exceeding warm & very pleasant till the Evening then lowering
 18. Misty & Cloudy in the Evening the Forepart of the day being very warm
 19. Misty & cloudy all day

*Archer Butler Hulbert, Washington's "Tour to the Ohio" and Articles of "The Mississippi Company," Ohio Archeological and Historical Society Publications, Vol. XVII, 1908, pp. 431-488. Transcription on pp. 448-449.

20. Misty—but the Evening clear tho somewhat Cool—
21. Cloudy & very raw & cold in the forenoon—about Mid-night it began to Snow & contd to do so—more or less all the remaining part of the Night & next day
22. Very raw & cold—Cloudy & sometimes Snowing. & sometimes Raining
23. Exceeding Cloudy and like for Snow—& sometimes really doing so—
24. Clear & pleasant Morning but Cloudy & Cold afterwards
25. Rain in the Night but clear & warm till abt Noon—then Windy & Cloudy
26. Clear and pleasant all day
27. A little Gloomy in the Morning but clear, still, & pleast afterwards
28. Much such a day as the preceeding one
- 29th Pleasant forenoon & clear but Cloudy and Wet afternoon.—
30. Raining in the Night—Raw cold & cloudy forenoon but clear & pleasant afternoon
31. Remarkably clear & pleasant with but little wind—

It appears from this account that Mt. Vernon, on the first day of October, 1770, was experiencing the typical warm weather at the front of an approaching cyclone. The next day brought rain and snow, indicating that the cyclone was a well developed storm. Such a storm certainly was more or less unusual as compared with present weather conditions, for it was early for snow in tidewater Virginia. The thermal gradient must have been unusually steep, for Washington describes the winds as warm on the 1st of October and they must have been particularly strong, for he observed that the clouds were flying, certainly indicative of winds of moderate velocity at least. On the second day the winds were northerly and cold. With snow falling the temperature must have fallen to near freezing, though it would not be necessary that the surface temperature be at 32° F. The ground so early in the autumn would still be warm, therefore the lower stratum of the atmosphere would be slightly above freezing. Such a blustering snow squall* is usually one of the first signs of approaching winter and unless it is followed by the cold weather which is sometimes the accompaniment of a stagnant anticyclone there is little danger of frost. Such storms are usually associated with well developed cyclones of autumn and may last from one to three or four days.

The average date of the first killing frosts† of autumn in the vicinity of Mt. Vernon is between October 21 and November 1. Only twice in the 20 years between 1895 and 1914 did the date of the first killing frost occur 15 days earlier than the average. From this record, made with modern

*Charles F. Brooks, "Why the Weather?" New York, 1924, p. 175.

†William Gardner Reed, "Frost and the Growing Season," Section I, Atlas of American Agriculture. Washington, 1920, p. 35.

instruments, it is clear that the Mt. Vernon section of tidewater Virginia experienced a cold snap somewhat earlier than is usual for that region.

The storm which brought snow to Mt. Vernon moved rapidly eastward bringing the area into the cold western portion of the cyclone. The center of the disturbance must have passed almost directly over Mt. Vernon or to the southward, for Washington notes that the wind was northerly. The following day, October 3, it changed to the northwest, indicating a continued eastward movement of the center. On the 4th of October the winds were still "fresh—and very fresh," but the sky was "clear and pleasant" just as we would expect under anti-cyclonic conditions which follow a cyclonic disturbance.

It was on the 5th of October that Washington, Dr. James Craik, a personal friend of his, and their servants set out for Fort Pitt, from which point they intended to embark on their extended journey down the Ohio to the mouth of the Kanawha River. The day was unusually pleasant, for Washington states that it was clear and warm with very little wind. His description of the weather for that day in relation to the conditions which preceded is indicative of high barometer. The sky was clear with very little wind and the next two days brought the same kind of weather. The area of high pressure must have been rather stagnant, tending toward maintaining clear weather for three or more days.

The fair weather ended for Washington on the eighth of October, but he had set a rapid pace and was by that evening well beyond the Shenandoah Valley. On that day the forenoon was fair, but in the afternoon the sky clouded up and in the evening it rained a little. Washington does not give any information about the wind and the temperature, so we cannot be sure that the change in weather was due to an approaching cyclonic disturbance or to a local convectional storm. Since he does not mention thunder and lightning, but does speak of the cloudy condition, particularly on the 9th, when it was "Exceeding Cloudy & heavy in the forenoon," it appears that the eastern part of another well developed storm was extending the eastern border and its accompanying cloud area over the country being traversed by Washington. In the afternoon of the ninth a continuous rain is an additional feature which lends plausibility to the interpretation made above. On the tenth the rain alternated with sunshine, but the morning of the

eleventh was wet. By the afternoon the storm center passed and toward evening the wind came out of the northwest. This is the first time Washington had recorded the direction of the wind since the third, thus we may conclude that the coolness probably moved him to make a note on its direction.

He recorded that the twelfth of October was "cold & Raw" with the wind out of the northwest. The storm had advanced eastward and Washington was again experiencing the cold northwest winds and the accompanying weather conditions characteristic of the westernmost portion of the cyclonic storm of autumn. He must have been reminded of the cold, bitter days which he endured on his journey to Fort Le Beouf in the autumn of 1753.

The wind had changed to westward by the 13th of the month, suggesting that the storm center was advancing toward the northeastward, or it may mean that the normal westerly or southwesterly winds were being established as the cyclonic disturbances became farther removed from southwestern Pennsylvania, the region then being traversed by Washington. It was on this date that he passed over ground familiar because of his engagement with the French at Fort Necessity in 1754. Curiously enough Washington did not commit to paper any reminiscences on his unhappy experiences here. In his journal he wrote briefly about the land and the weather. On the evening of the 13th he arrived at the home of William Crawford, his western agent, who accompanied him on his journey down the Ohio and later surveyed land for him upon the Ohio and Kanawha Rivers.

The fourteenth was also pleasant, the wind freshening in the afternoon, but Washington failed to note the direction. In view of the weather of the following day it is logical to assume that the wind came from a southerly or easterly quarter, presaging the eastward movement of a low pressure area which was then centered somewhat to the westward. The fifteenth was cloudy with occasional but light rain. It is probable that the storm center had moved eastward bringing the area south of Fort Pitt into the southern portion of the cloud cover. In the evening it was clear, permitting nocturnal radiation to lower the temperature to near freezing, for the morning of the 16th of October was "frosty." It was clear that day and later in the afternoon the weather was pleasant. The cyclonic disturbance had moved onward and the day was ideal for the

business Washington had to discuss with Crawford. By evening he was again on his way toward Fort Pitt.

By the 17th of October another storm was approaching, for the day was "Exceeding [ly] warm & very pleasant." Washington does not give the direction of the wind, but the fact that the day was very warm lends plausibility to the assumption that warm air was being imported from the southward as another area of low pressure moved eastward toward western Pennsylvania. He described the evening as "lowering," an expression sometimes used to describe a heavily overcast sky.

The next day it was very warm in the "Forepart," but by evening it was cloudy and misty. This inadequate report on the weather makes it difficult to guess the distribution of the weather elements, but the weather of the 18th seems to have been that which accompanies an autumnal disturbance which is not sufficiently developed to bring heavy precipitation. The storm probably advanced slowly, for the 19th was also "misty & cloudy," and even the 20th continued misty. In the evening, however, the sky cleared and the weather became cool. The sequence of weather events is rather convincing that again Washington, on the day he began his journey down the Ohio River, was experiencing the cool weather which usually follows the passing of a cyclone of autumn.

From his account it is not unreasonable to interpret the weather in terms of the conditions that are related to the more or less regular movement of the low pressure areas eastward across the United States at a season of the year when the tracks followed by these storms lie somewhat southward of the more frequented paths of the summer months. It appears that during Washington's long journey into the interior of the continent of North America several well developed cyclones passed far south of the Great Lakes and as they moved forward brought unseasonably cool autumn weather southward to the latitude of Ohio and Potomac Rivers.

As mentioned above the cold weather accompanying a cyclone greeted Washington as he began his descent of the Ohio River on the 20th of October. For the next five days ill weather was his fortune. It rained and snowed almost every day. He does not mention the direction of the wind, so we are unable to make more than a guess at the general weather conditions. On the 21st it was "very raw & cold" and on the 22nd he made the same notation in his weather

record. The weather had not improved much by the 24th except that it was "clear & pleasant" in the morning. It was cloudy and cold later in the day, but there is not enough information to permit a detailed discussion of the general weather conditions. The long period of cold, raw days seems to indicate that a cold mass of air was spreading southward mixing with a warmer stratum producing in the latter and at the zone of contact sufficient condensation for a heavy cloud cover, but not enough to produce heavy precipitation. The weather conditions were not sufficiently severe to impede the progress of Washington's party, for by the 22nd of October they were 75 miles below Fort Pitt, and also he makes no comments about the river or the tributaries which would indicate that conditions were unusual, except that he recorded on the 22nd that the water was "pretty swift" in places.

The 23rd of October was a rather unpleasant autumn day. He remarks that it was "Exceeding Cloudy & like for Snow— & sometimes really doing so —." The 24th was a little better "Clear & pleasant Morning but Cloudy & Cold afterwards." On the 25 there was "Rain in the Night but clear & warm till abt Noon—then Windy & Cloudy." It seems that during this three day period the approach of autumn was being heralded by cold cloudy weather as the moisture content of the atmosphere was being reduced.

On October 25th Washington noted the effects of a wind storm of earlier date. Some miles below Wheeling he came to a stream entering the Ohio from the west, which the Indians called "broken Timber Creek;* so named from the Timber that is destroyed on it by a Hurricane;" It is interesting to note Washington's use of the term, hurricane. On his voyage with his half-brother, Lawrence, to the Barbadoes in the autumn of 1751 the ship was caught in a severe storm and Washington wrote in his journal on October 19th that "It was universally surmis'd their had been a violent hurricane not far distant." He was not unfamiliar with winds of hurricane velocity.

The stormy weather which Washington experienced on the first six days on the Ohio River soon changed for the better. He was now down nearly as far as the site of Marietta, Ohio. On the night of October 26 he camped just above the mouth of the Little Muskingum where Reno is now located. It was

*Probably Sunfish Creek.

"Clear and pleasant all day." In his extended journal the final paragraph of his entry of October 26 reads "This day provd clear and pleasant, the only day since the 18th that it did not Rain or Snow, or threaten the one or other very hard."

On the 27th he continued down stream. It was "A little Gloomy in the Morning but clear, still, & pleast afterwards," and the 28 was "Much such a day as the preceeding one." The three successive days of pleasant weather indicate that anticyclonic conditions were in control. It is regrettable that Washington failed to record the wind direction so that his position in respect to the pressure areas could be determined.

On the 29th of October Washington rounded the Great Bend and ran into another storm area, or considering his rate of travel, a storm area ran into him. A day described as having a "Pleasant forenoon & clear but Cloudy and Wet afternoon—" was his lot. Of the 30th he wrote, "Raining in the Night— Raw cold & cloudy forenoon but clear & pleasant afternoon." The last day of October was "Remarkably clear & pleasant with but little wind." During the last three days of October he had passed through a storm area into the clear fair weather of an anticyclone. The order of the weather phenomena makes this assertion very plausible.

His systematic record of the weather was concluded with his entry of October 31 but from his journal we may glean a few statements which give some information about the weather during the month of November, 1770. The quotations in the remainder of this paper are taken from Fitzpatrick's transcription* of Washington's journal. His record is devoted to other matters hence his remarks on the weather are incidental and so limited that it is next to impossible to discuss in detail the general distribution of the weather elements.

During the first four days of November he made no comment on the passing weather, but on the 5th, the day he walked across a strip of bottom land below the Great Bend† and camped some miles up stream. He concludes his entry for that date with ". . . we Incamped, the afternoon being rainy, and the night wet." Again it appears that a storm of autumn had overtaken him.

*John C. Fitzpatrick, "The Diaries of George Washington, 1748-1799," Vol. I, Boston, 1925.

†Guy-Harold Smith, "George Washington at the Great Bend of the Ohio River," Ohio Archeological and Historical Quarterly, Vol. 41, 1932, pp 655-667.

For the next three days, November 6, 7 and 8, the weather conditions go unrecorded. The journal from the 7th to the 16 has been mutilated along the edges, so his record is incomplete and can be interpreted only by considerable interpolation. The 8th of November must have been a fine day for Washington, Crawford and an Indian guide explored the hills above the mouth of the Little Kanawha and that night camped about a mile below the mouth of the Muskingum. His entry for the 9th begins with "The Night proving very Rainy, and Morning wet we did not set out till $\frac{1}{2}$ after 10 O'clock . . ." Nearly all of his entry for Saturday, November 10th was devoted to the weather. He wrote, "After a Nig[ht] of incessant Thunder and Lig[ht]ning, attended with heavy [constant] Rain till 11 O'clock [that] day, we set of about Twelve (the Rain then ceasing) and [came] to the lower end of the long [reach]* distant about 12 Miles—little stream, imperceptible [to] the view in our passage [down but] now pouring in her mite, . . . River raising very fast [and] grows so muddy as to ren[der] the water irksome to drink" The "incessant thunder" was a little late in the season, but not an unusual occurrence. It indicates that the temperatures were not unseasonably cold, and perhaps a little above normal.

The stormy weather continued, impeding Washington's upstream journey. For Sunday November 11th he wrote that, "The last Night proved a Night of incessant Rain attended with thunder and lightning. The River by this Morning had raised abt . . . feet perpendicular and was [trav]elling fast. The rain seeming [to] abate a little, and the wind spring[ing] up in our favor we were [te]mpted to set of; but were deceived [in] both; for the Wind soon ceased, and [the] Rain continued without inter[mis]sion till about 4 O'clock when it moderated." In spite of the rain they got to the head of the long reach, but the stormy weather and the strong current made upstream travel very slow and arduous.

The stormy weather continued yet another night. On the 12th he recorded that "There fell a little [rain] in the Night tho nothing to [speak] of." The river was so swift that Washington gave up trying to paddle the canoe all the way to Fort Pitt, and on the next day sent a young Indian

*The word "reach" is supplied by the present writer for it was on this date that Washington and his party had arrived at the sixteen mile section of the Ohio River commonly known as the "long reach."

to bring their horses to Mingo Town, two miles below the modern Steubenville. At Mingo Town he had to wait three days for the horses to arrive, but on the afternoon of the 20th the party set out for Fort Pitt which they reached the following day.

During the period from November 13 to 23 inclusive Washington made no direct statement about the weather. He does state that the level of the river was falling on the 17th, so we may conclude that the rainy spell was over.

It was on the 23 of November that he set out on his journey from Fort Pitt to Mt. Vernon. The next day he arrived at Captain Crawford's, and his brief entry for that date is concluded by the expression, ". . . it either Raining or Snowing hard all day." It is to be expected that snow might fall in the Allegheny plateau of southwestern Pennsylvania in the latter part of November.

On Sunday, November 25 Washington continued his journey and set out early to visit Lund Washington. He made no definite statement about the weather but noted that ". . . the Ground and trees being coverd with Snow . . ." he was unable to form a distinct opinion of the quality of the land. On the 26th he recorded that "The Snow upon the Alligany Mountains was near knee deep." It is clear that snow in considerable quantity had come early to the highlands of the Allegheny Mountains. Here where Washington found the snow nearly a foot deep toward the end of November the average date of the first killing frost* of autumn is about October 1. It is not an uncommon occurrence to have snow in the higher parts of the plateau any time during the month of November, so the weather experienced by Washington was not unseasonably cold. It is a little unusual, however, to have a foot of snow by the 23 of November.

Washington required five more days to reach home arriving at Mt. Vernon on December 1, 1770. He had been gone just four days short of two months, and during that time had made his most western journey into the heart of North America and travelled altogether a distance of nearly 1000 miles. His weather records for this period indicate that the autumn of 1770 probably was characterized by fairly typical cyclonic storms which brought a snow squall to tidewater Virginia the first of October. During that month probably a half dozen

*Reed, *Op. cit.*, p. 35.

distinct cyclonic disturbances can be identified and their movements determined with some degree of accuracy.

Washington certainly had very little systematic knowledge of the passing weather, but his empirical descriptions make it possible to interpret and explain the meteorological phenomena in terms of the modern knowledge of the science of the atmosphere. The well developed cyclonic storms, the origin of which we are not certain but the nature of which we know much more, brought to Washington and his party changeable autumn weather. He faithfully recorded his observations and these now serve as documentary source material for the study of historical meteorology.

The Social Life of Plants.

Although the name was coined in 1896, the term "plant sociology" may arouse some new concepts in the minds of those who have not been accustomed to consider plant life in terms of communities or social units. The original German text, "Pflanzensoziologie," which appeared in 1928, has been entirely translated, revised, and edited with the addition of considerable new material.

Part I consists of a single chapter on "Social Life Among Plants." Part II contains three chapters on the organization of plant communities. The selection of sample plots for study and the statistical analysis of plant communities are some of the important topics discussed. Methods are given for the determination of abundance, cover, space, and weight of species concerned, as well as such characteristics as sociability, periodicity, frequency, constancy, and fidelity of species. The technical sense in which these terms are applied to plant communities is explained in the text.

Part III includes eight chapters (more than half of the entire book), which discuss the general subject of synecology or "community economics." Here there is an attempt to "search for the underlying causes of the social union and the mutual dependence of the component plants." Factors of climate, soil, topography, and the activities of man and grazing animals, as they affect plant communities, are extensively treated. There is much illustrative material from the works of European and American investigators. Practical methods devised for field use are described in this section of the book.

Parts IV, V, and VI consist of the final three chapters on the development, distribution, and classification of plant communities respectively. An extensive bibliography and index complete the volume. Halftones and line drawings are clear cut and are well-chosen to present data in graphic form.

The use of such terms as "Quercetum" for oak forest and "therophytes" for annual plants show that the author and the translators have accepted European systems of nomenclature for plant communities and life forms. With such a terminology, books and papers on plant sociology appear as difficult reading for the general botanist as the literature on psychiatry must appear to the general practitioner of medicine. Perhaps it is a sign of progress in a science when its language becomes more cumbersome.—R. B. GORDON.

Plant Sociology, by J. Braun-Blanquet. Translated, revised, and edited by G. D. Fuller and H. S. Conard. XVIII — 439 pp., 180 figs. McGraw-Hill Book Co., 1932.