By as early an answer as may consist with your convenience you will much oblige me. My object is, if possible, to prepare this report for the next meeting of the British Association, as requested.[3]

Very respectfully Yours.
A. D. Bache

[3] Henry's lengthy reply follows. Despite several reminders from the BAAS, Bache apparently never completed the meteorological report.

TO ALEXANDER DALLAS BACHE

Bache Papers, Smithsonian Archives

Princeton March [19–27][1] 1839

Dear Sir

In answer to your favour of the 16th I commence to day a long letter in which I intend to give you all the ideas which may occur to me from reflection and otherwise and also the facts which I may happen to meet with in the course of reading and conversation. I will present them to you just as they occur to me informally and undigested. Perhaps from the abundance of worthless chaff you may select a few grains of some value.[2]

1 In order that none of my valuable labours in meterology may be overlooked I will refer you to the meterological Reports of the Regents of the University of the State of New York. On the title page of the first numbers I am mentioned as one of the colaborators of the work. You will probably duly appreciate the important service which I then rendered to science when I inform you that my labours principally consisted in reading the proof sheets of the work.[3]

2 Having thus in the first place done justice to myself I will now proceed to give you other information of a less important nature.* The proposition of a series of meterological observations under the direction of the Regents of the university of the state of New York originated with my old Friend the late Simeon DeWitt Esq. This fact is mentioned by Dr T R Beck of Albany in an oration pronounced on the occasion of the death of Mr DeWitt.[5] I have a copy of the printed article which is at your service. The rain

* See note at the bottom of page 7.[4]

[1] Henry dated this long letter March 19 but did not complete it until March 27.

[2] In the 1850s, Henry surveyed the subject in "Meteorology in its Connection with Agriculture," which appeared in the Agricultural Reports of the Commissioner of Patents from 1855 to 1859, and is reprinted in the *Scientific Writings of Joseph Henry*, 2 vols. (Washington, 1886), 2:6–402.

[3] See *Henry Papers*, 1:107n.

[4] i.e., the note at the end of the March 19 portion of the letter.

gages and thermometers were constructed under my direction. Mr Espy has a bound copy of the 1st 10 numbers perhaps the only ones to be procured which I loaned to him some years since, this I will request him to deliver to you. The original copies of observations are deposited in the library of the albany Institute. They contain the daily observations and for some investigations would be found very valuable.

3 Could not some observations be made without occupying much time and immediate results be obtained of some value by taking the temperature of all the wells of a city say of Philadelphia and comparing the mean of the whole with the mean temperature of the place. The temperature however thus obtained would probably be influenced by the geological formation of the place yet the experiment would not be without interest and some results of importance might possibly be obtained. I forgot that your city of hydrants has no wells but the experiment could be made in New York and perhaps would afford an approximation to the mean temperature of places where a series of observations have not been made.[6]

4 Will the temperature of artezian well form a part of your report? You know that there is a very deep one in New York bored for the use of Holts hotel[7] which has never been examined. Also there is one in Albany more than 500 feet deep which should be studied in reference to its temperature. This belongs to an Uncle of mine (by marriage)[8] and any facilities for observation would be given.

5 In a report of the geological survey of the State of Michigan, I find some remarks on the rise of the waters of the great lakes which is a meteorological phenominon and is produced by an unusual rainy season.[9] I have also a paper on the same subject by Mr Geddings[10] of Lockport New York. These documents I will put into your hands.

[5] T. Romeyn Beck, *Eulogium on the Life and Services of Simeon DeWitt . . .* (Albany, 1835).

[6] The idea that the temperature of water at the bottom of a well was an approximation of the mean temperature of a place was not a new one. It is mentioned, for instance, in a book by Samuel Williams cited by Henry later in this letter: *The Natural and Civil History of Vermont*, 2d ed., 2 vols. (Burlington, 1809), *1*:54.

[7] A hotel at the corner of Fulton and Pearl. New York City Directory, 1837.

[8] We have not been able to identify the hotel or its owner.

[9] In Douglass Houghton's second report, dated February 4, 1839, the water level in the Great Lakes is discussed at several places. Because of economic consequences, Houghton thought it important to understand the causes of fluctuation and to determine the maximum and minimum level. Houghton attributed the recent rise to unusually cold and wet seasons. An assistant, S. W. Higgins, mentioned the increased rain and melting snow in the watershed. George N. Fuller, ed., *Geological Reports of Douglass Houghton* (Lansing, 1928), pp. 187–195, 263–266, 294–296, 312.

[10] In *An Inquiry into the Causes of the Rise and Fall of the Great Lakes . . . to Which is Annexed a Letter to Dr. H. H. Sherwood on his Theory of Magnetism* (Lockport, New York, 1838), Edward Giddins pinpointed snow as the major cause of fluctuation. A copy is in the Henry Library.

6 The same Michigan report contains a long extract from one of my earliest papers (without an acknowledgement however) on the topography of the state of New-York[11] and this has brought to my reccollection the fact that the paper in question was written principally in reference to the meterology of the state. I collected all the elevations of the principal places in the s[t]ate inorder to make a topographical map to accompany the Regents report and to determine if possible the influence which altitude and configuration of surface had on the Meterological character of a place. The paper however is confined to the topography of the country. I did intend to extend my study of topography to the whole of the United States but some other hobby was mounted for a time and my removal to Princeton completely threw me out of its track. The subject however is an interesting one and there is no part of the world where the materials for its prosecution are more abundant than in the United States. Every part of the country has been traversed by exploration lines for railways and canals. If the minutes of these were collected and properly arranged they would form the elements of an important topographical map of the country, as correct as could be desired in reference to the elevations and depressions of the surface.

7 You will of course notice what has been written on what is called the Indian summer. Several articles on this I think are to be found in Sillimans Journal.[12]

8 I recollect that there are some remarks on the meterology of this country in general and on that of Vermont in particular in Williams history of that state.[13] Also there are in the Travels of Dr. Dwite[14] (once President of Yale College) some statements relative to the same subject which might be found interesting.

9 An inquiry into the change of the volumn of water which is transmitted to the ocean by a river after the land which gives rise to it has been cleared of woods might be interesting and this inquiry can be made with

[11] The passage, which discusses the height above sea level of Chautauqua Lake and neighboring features, occurs in the report of S. W. Higgins, topographer (Fuller, op. cit., p. 255). It is enclosed in quotation marks but without citation. Higgins prefaced his report by stating that much of his information came from the records of public works in neighboring states. Henry's 1829 "Topographical Sketch of the State of New-York, Designed Chiefly to Show the General Elevations and Depressions of its Surface" was printed in the *Transactions* of the Albany Institute and in the introduction to David H. Burr's *Atlas of the State of New York* (Albany, 1829), pp. 21–29. *Henry Papers*, *1*:250n.

[12] i.e., "On the Cause of the Peculiar Aspect of the Air, in the Indian Summer" (1830, *18*:66–67); "Essay on the Indian Summer" (1835, *27*:140–147); and Lyman Foot, "Remarks on Indian Summers" (1836, *30*:8–15).

[13] In the second edition of Samuel Williams, *The Natural and Civil History of Vermont*, 2 vols. (Burlington, 1809), Williams discussed meteorology and gave tables of magnetic variation, temperature, rainfall, and wind direction in chapters four and five of the first volume.

[14] Timothy Dwight, *Travels; in New-England and New York*, 4 vols. (New Haven, 1821–1822); a copy is in Henry's Library.

a prospect of success in this country because her large forests are in the process of being cleared off.[15]

10 Perhaps you could manage to mention the economical uses of showers which fall on the regions of the sources of our atlantic rivers particularly those on the heads of the Hudson the Delaware and the Susquehanna. Along the small streams which form these, immense rafts of boards and timber are constructed during dry weather and when a shower comes the water rises and the raft is wafted on the swell to the deep part of the river and thence they easily find their way to the ocean.

An interesting anecdote is related of General Sulivan while on his Indian expidition. Wishing to transport his troops and baggage through the wilderness he produced an artificial flood by throwing a temporary dam across the outlet of Cooperstown Lake the head of the susquehanna. When all was ready his men and baggage on rafts the dam was cut away the waters poured forth in an immense wave and the whole flotilla was borne on its crest for miles down the river.[16] If you adopt the plan of modern compilers of chemical text books you can certainly manage to introduce facts more foreign to your subject than the above since they are at no loss to form an encyclopedia of science under the title of elements of chemestry.[17]

11 It is asserted by Jefferson in his notes on Virginia that there is a marked difference in the temperature of places under the same parallel on different sides of the Aleghanies.[18] Dr L. C. Beck has published an article on this point in the transactions of the Albany Institute.[19]

[15] There was a great deal of debate over the effects of timber clearing on climate, particularly on temperature, winds, and runoff. In his "Meteorology in its Connection with Agriculture," Henry noted that "the whole subject of the removal of forests is one which deserves more attention. . . ." Citing floods over cleared land and the benefits of trees as windbreaks, he warned against the "indiscriminate destruction" of forests (*Scientific Writings*, 2:19).

[16] The event took place during General John Sullivan's 1779 campaign against the Iroquois. It was General James Clinton, however, who dammed Otsego Lake at Cooperstown and then broke the dam to float over 200 heavily loaded bateaux down the Susquehanna to join Sullivan's forces. William W. Campbell, *Lecture on the Life and Military Services of General James Clinton* (New York, 1839).

[17] Another facet of Henry's dissatisfaction with contemporary science textbooks. The imponderables (light, heat, electricity) were often taught as part of chemistry and were therefore included in chemistry textbooks. Benjamin Silliman's popular *Elements of Chemistry*, 2 vols. (New Haven, 1831) begins and ends with these subjects.

[18] Based on traveler's accounts, Jefferson wrote that at the same latitude, the climate of the Mississippi Valley was warmer than that of the Atlantic coast. As confirmation, he cited the existence of certain plants and animals in the west which were unknown in the east. Thomas Jefferson, *Notes on the State of Virginia*, 2d London edition (London, 1787), pp. 125–126.

[19] Lewis C. Beck, "An Examination of the Question, Whether the Climate of the Valley of the Mississippi under Similar Parallels of Latitude is Warmer than that of the Atlantic Coast," *Transactions of the Albany Institute*, 1830, *1*:34–54. Because Jefferson's theory had been uncritically adopted and widely circulated in the writings of C. F. Volney and Hugh Williamson, Beck devoted much of his article to the weakness of Jefferson's evidence. He then presented data on mean temperature and flowering plants and concluded that Jefferson was wrong.

12 There is a paper in the american Philosophical transaction on the temperature of the gulf stream.[20] I know not however if it will, in any way, be connected with your report. I may mention in passing that there is a review of the first volums of *our* Transactions in one of the early numbers of the Quarterly review. The paper above mentioned is the only one which finds favour and this appears to be on account of the author's being an Englishman.[21]

13 You will find in Darby's views of the United States published by Tanner in 1828 several chapters on the climate of this country.[22] I think he mentions one fact which I have often noticed namely whole orchards of apple trees leaning in the same direction indicating the course of the prevaling wind at the place.[23] You know that an article has been published by Volney on the Climate of the United States.[24]

14 One of the subtheories of Espy rests on the assumption that air is impervious to the vapour of water and that no diffusion of the latter takes place unless motion be produced in the air. I believe that I have mentioned to you that I have made some experiments on this point[25] and have also collected some references to the experiments of others on the same subject.

15 Some person has proposed to form a table of the weather or rather of the state of the seasons relative to vegetation by cutting sections of large trees perpendicular to the length and noting the width of the rings.[26] Some

[20] William Strickland, "On the Use of the Thermometer in Navigation," APS *Transactions*, 1802, 5:90ff.

[21] The acerbic review of the fifth volume of the APS *Transactions* was by Henry, Lord Brougham. Referring to the articles written by Americans, Brougham wrote, "of all the academic trifles, which have ever been given to the world, these 89 pages are the most trivial and dull." Brougham found Americans to be "proportionally deficient in scientific attainments," and lacking in all but "mercantile and agricultural talents." *The Edinburgh Review, or Critical Journal: for April 1803 . . . July 1803*, 7th ed. (Edinburgh, 1814), 2:348–355.

[22] William Darby's *View of the United States, Historical, Geographical, and Statistical* (Philadelphia, 1828), published by H. S. Tanner, is in the Henry Library. Chapter 10 is on climate.

[23] On page 424, Darby noted that the prevailing winds over North America were from the west with the result that "orchards and forests generally, particularly along the Atlantic slope, invariably incline to the eastward or southeastward."

[24] C. F. Volney, *A View of the Soil and Climate of the United States of America*, trans. C. B. Brown (Philadelphia, 1804), also in the Henry Library.

[25] Espy had advised Henry on how to conduct the experiments; see *Henry Papers*, 3: 533–534.

[26] Henry was probably thinking of Alexander C. Twining. In a letter to Benjamin Silliman (*Silliman's Journal*, 1833, 24:391–393), Twining noted the correlation between variation in annual growth rings and variation in climatic conditions. He suggested that a comparison of cross sections with each other and with meteorological records "would elicit a mass of facts, both with respect to the progress of the seasons, and their relation to the growth of timber, and might prove, hereafter, the means of carrying back our knowledge of the seasons, through a period coeval with the age of the oldest forest trees, and in regions of country where scientific observation has never yet penetrated, nor a civilized population dwelt."

As with eighteenth-century suggestions of dendrochronology by Duhamel and Buffon, Linnaeus, and Burgsdorf, Twining's suggestion was soon forgotten. Dendrochronology was not

years since two large trees were blown down in the college campus. I examined their cross sections and found that they each indicated plainly the years in which the growth had been most luxurient. By counting back from the outer ring these years were readily determined.

16 You will find a number of notices in the transactions of the American Academy[27] of the appearance of brilliant auroras particularly in the oldest volumes. It might perhaps be interesting to settle if possible the question of the periodical activity of the aurora. This you know has been raised and it has been asserted that we are now living in one of the paroxisms of the meteor. Perhaps there may be something in the opinion.[28]

17 Appended to Nuttal's travels into the Arkansa Territory there is a table of observations in that country made during the year 1819.[29] Also Parkers travels beyond the Rocky mountains printed at Ithaca NY 1838, contains a similar table.[30]

18 In the transactions of the Society of arts of the State of New York you will find a Meterological Journal by Dr Eights for 1813 & 14.[31] Dr T R Beck has incorporated this table into a paper on the mean temperature of Albany in the Transactions of the Albany Institute Vol 2 No 1.[32]

19 Would it not be possible for you to collect the data for a map of

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developed into a science until the work of A. E. Douglass in the early twentieth century.

R. A. Studhalter, "Tree Growth: I. Some Historical Chapters," *The Botanical Review*, 1955, *21*:1–72. See also H. C. Fritts, *Tree Rings and Climate* (London, 1976).

[27] i.e., the *Memoirs of the American Academy of Arts and Sciences.*

[28] At this time it was vaguely recognized that there were periods of frequent auroras and periods when they seemed to disappear. In connection with his 1832 article on the aurora, Henry mentioned to Benjamin Silliman that he thought the aurora was in a period of maximum intensity. (*Henry Papers*, *1*:409–410). Henry remained interested in the problem of the determination of the secular periodicity of the aurora. He later published Denison Olmsted's "On the Recent Secular Period of the Aurora Borealis," *Smithsonian Contributions to Knowledge*, 1856, *8*:article 3, and Elias Loomis, "Aurora Borealis, or Polar Light; Its Phenomena and Laws," *Smithsonian Annual Report for 1865* (Washington, 1866), pp. 208–248. Loomis hypothesized a maximum of auroral intensity every 59–60 years and a subordinate maximum every 10 years. He noted the similarity to the periodicity of sunspot activity and magnetic storms. Carl Störmer, *The Polar Aurora* (Oxford, 1955), p. 25, gives these maxima as about 55 years and about 11 years, respectively.

[29] Thomas Nuttall, *A Journal of Travels into the Arkansa Territory, During the Year 1819* (1821; reprint, Ann Arbor, 1966); the fourth section of the appendix gives a daily record of morning and afternoon temperature.

[30] Samuel Parker, *Journal of an Exploring Tour Beyond the Rocky Mountains . . . Performed in the Years 1835, '36, and '37 . . .* (Ithaca, 1838), a copy of which is in the Henry Library. Parker recorded the temperature three times a day and noted whether it was clear, cloudy, or rainy.

[31] Jonathan Eights noted temperature, barometric pressure, and wind direction, and computed mean temperature and barometric pressure. He also recorded sicknesses and auroras. *Transactions of the Society for the Promotion of Useful Arts, in the State of New-York*, 1816, *4*, part 1, pp. 86–108.

[32] "Abstracts of Meteorological Observations Made at the City of Albany, and Calculations Tending to Establish its Mean Temperature," *Transactions of the Albany Institute*, 1833–1852, *2*:1–29. Beck also used observations by Simeon DeWitt in 1795 and 1796 and his own observations from 1820 to 1832.

isothermal lines of this country to accompany your report. An approximation only to accuracy would be valuable.[33] Observations on the temperature of wells might assist you in this.

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* *This should have been inserted at the bottom of the first page* and is intended to explain the modest language of the beginning of this letter.

Note A Painter wishing to commemorate a great public event and inorder to do honor to all engaged in it requested from each a portrait for the purpose grouping the whole into one picture. The piece was finished but instead of giving satisfaction to those whom it honored each thought himself wronged, those in the rear by not occupying a more prominent position and those in the foreground because every part of their person was not fully exhibited without a shadow. The picture however was a good one conceived in the spirit of truth and executed with the skill of a master. It was well received by all unbiased critics, the cause of truth was advanced by it and the painter in due time found his reward in true fame. You take?

Princeton March 27th 1839[34]

My Dear Bache

I was prevented by some college duties from answering yours of the 23d. I received the proof of the last form of my paper on monday morning and sent it back corrected by the return mail. I was well pleased with the note and only made an alteration in one word inorder to make the whole read a litle more like my mode of expression. I have given in this letter a quantity of matter which I fear will scarcely repay the trouble of reading; some part of it however may by association of ideas suggest what may be of use. I will give you in detail and in a state for publication the facts relative to the aurora which I mentioned to you if you still think it worth publishing.[35]

[33] Alexander von Humboldt is usually credited as the originator of isothermal charts based on an 1817 publication. H. E. Landsberg notes, however, that Simeon DeWitt first suggested the idea in 1792. H. E. Landsberg, Early Stages of Climatology in the United States," *Bulletin of the American Meteorological Society*, May 1964, *45*:269.

At the Smithsonian, Henry was concerned with improving the accuracy of isothermal charts. He criticized those produced by the Medical Department of the Army and termed those prepared by C. A. Schott under his direction "the first trustworthy approximation to an exhibition of the temperature of the various portions of the United States which has ever been published." *Smithsonian Annual Report for 1874* (Washington, 1875), p. 13.

[34] The remainder of this letter is in response to Bache's first letter of March 16 (above) and his letter of March 23 (below).

[35] Later in the year, Bache reported to the APS on observations by Henry and Stephen Alexander of the September 3, 1839, aurora (*Proceedings*, 1838–1840, *1*:132–134), but we do not know what Henry is referring to here.