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EIGHTEENTH-CENTURY NEW ENGLAND CLIMATE VARIATION AND ITS SUGGESTED IMPACT ON SOCIETY[1]

Spring, 1773, came early to the rolling hills and fields of Gorham, a farming community a short distance from Portland, Maine. During the third week of April Stephen Longfellow had begun to plow. In early May he sowed his rye and wheat and planted his "sauce" garden. By the middle of the month his potatoes and Indian corn were in and beginning to sprout. Everything was proceeding as it should and prospects were high for a good harvest. Unfortunately for Longfellow and other farmers of the area, late frosts occurred on the nineteenth and twenty-second of May and killed the young sprouting plants. Overnight one month's labor was wasted. It took Longfellow until June 11 to replant his crops. He noted in his diary that planting his fields with seven quarts of Indian corn took him, three boys, and one yoke of oxen eleven days or forty-four man-days. To replant took about a third as much time. Every time there were late spring frosts (which occurred about three years in every ten) he lost considerable labor as well as all his seed, and he ran a greater risk of having his crops cut off early in the fall. If he decided to wait to plant until later in the season, he increased the probability of having his crops killed before reaching maturity by early frosts, which were even more frequent than those of late spring.[2]

Longfellow's situation was not uncommon for any agriculturalist of any time period or geographic locale. It is no great revelation to any agricultural historian that unexpected, severe changes in weather phenomena can disrupt a farmer's careful planning and sometimes bring economic ruin. If our eighteenth-century New England farmer guessed incorrectly concerning when to plant,

when to harvest, how many head of livestock to winter over, or what crops to plant, he would suffer the consequences of labor-costly replanting, frost-damaged produce, dead or missing sheep and cattle, and food shortages. Nor did the weather's caprice make itself felt only with the farmer.

All eighteenth-century New Englanders were forced to deal with potential extremes of weather while making everyday decisions. All had to decide what clothing was best suited to the day's activities, how much wood to cut to heat their houses in the winter, and how best to keep cool during warm summer days. Others had occupational decisions affected by changes in the weather. Weavers and spinners were particularly attuned to changes in humidity. Mill operators had to anticipate stream levels, aware that droughts or floods could spell disaster for their enterprises. Merchants had to consider the possibility of storms at sea disrupting shipping and sinking vessels with badly needed cargoes aboard. Travelers on land had to deal with the problems of deep, drifting snows that blocked roads, and with quick thaws or heavy rains that turned dirt paths into quagmires. In addition there were storms and floods that washed out bridges and destroyed ferries.

To assist in the decision-making process, some New Englanders recorded weather entries, planting and harvesting times, and rain and storm frequencies in their diaries. These entries, along with keen observation of contemporaneous natural phenomena, were used to conduct an informal probability study aimed at predicting the weather for the coming week, season, or year. (The colonial almanac was the most formalized of these attempts at prediction.) The results were combined with other economic and social factors as part of what was an informal "rational choice" decision-making process. An individual's degree

of success in making the right decision often was the difference between a life of prosperity or poverty.[3]

One of the factors that exacerbated the decision-making process for New Englanders during the 1700s was the marked variability of the weather from season to season and year to year. For example, a somewhat warm, snowy winter was followed by a very cold, open one. Fall frosts often fluctuated between occurring very early, sometimes even in August, or very late. There were droughts one year followed by floods the next. Accurate decision-making under such circumstances would be difficult if not impossible.

Historical climatologists have known for some time that during the period 1450 through 1850 the world experienced a climatic pattern distinctly different from the one that has dominated our climate during the present century. The climatological name for this period is the Neoglacial or Neo-Boreal, but many refer to it as the "Little Ice Age." Hubert Lamb, a leading researcher in the field, describes the period as marked by cooler temperatures (up to 1° C colder than today), a prominence of polar anticyclones (high-pressure areas), and a southward displacement of depression tracks in the northern hemisphere. Also, there was considerable blocking of upper winds by pressure patterns. This contributed to a slowing and sometimes a stagnation of weather systems as they moved along the depression track. Although this cool period did not begin or end at the same time for all locations in the northern hemisphere, most suffered the greatest declines in temperature between 1550 and 1690.[4]

In most locations the eighteenth century was a period of change, with steadily increasing yearly mean temperatures. A number of Little Ice Age-like phenomena still prevailed, especially the increased variability of various weather phenomena brought about

by frequent blocking of circulation patterns in the middle latitudes. Data for the period of the Little Ice Age in North America are much more difficult to obtain than data for Europe upon which Lamb based much of his research. However, work by Irving Friedman measuring deuterium, a stable isotope of hydrogen, in the wood of dated tree rings from the bristlecone pines of the White Mountains, California, has developed a proxy temperature record for the West Coast. It shows that the temperature decline reached its limit in the early to mid-1600s. After 1650 there was a steady increase in temperatures until 1800. Additional dendroclimatological work by Harold Fritts and his staff at the Laboratory of Tree-Ring Research, University of Arizona, shows evidence of northerly winds over the western and central portion of North American middle latitudes during the period 1700-1890. These reconstructions also imply a continuation of these cold winds to the Atlantic coast in the form of northwesterly and westerly surface winds. On the basis of these data, Lamb believes the meteorological conditions produced blocking high-pressure cells over Iceland and the northeastern Atlantic. Such blocking patterns contributed to meteorological conformity within seasons but variability from season to season and year to year.[5]

A detailed climate record for New England during the period 1600 through 1980 is being reconstructed by the Northeastern Environmental Research Group at the University of Maine at Orono. This record will be used to test models constructed by Fritts, Lamb, and others as they pertain to climatological conditions in the northeastern United States.[6]

A detailed record for the eighteenth century, using early instrumental records, some proxy data such as tree-ring records from northern and western New England,

and, especially, daily diary materials is being reconstructed. Quantification of the qualitative word pictures contained in the diaries was achieved by the development and use of content-analysis techniques, making the diary materials compatible with other records. Where possible, each record, instrumental, proxy, or diary, was compared with independently reconstructed records of other types for similar time periods and locations. Initially, a record for Boston and surrounding southeastern New England was reconstructed and tested. Reconstructions for other areas in the Northeast are presently in preparation.[7]

The Boston reconstruction supports Lamb's theory that blocking high-pressure cells were predominant during much of the eighteenth century. There is considerable evidence of great variation in a number of climatological parameters over intervals of decades, years, and seasons. For example, the decades of the 1720s, 1750s, and 1760s were cool while those of the 1770s and 1790s were warm. Precipitation accumulations also varied dramatically from decade to decade. The 1720s were dry, the 1730s wet, the 1740s dry, and the 1750s somewhat wet. The 1760s and 1770s were dry, the 1780s average, and the 1790s dry (see figure 1).[8] Growing seasons were shortened considerably in the 1740s, 1760s, and 1780s and were somewhat shorter in the 1730s, 1750s, and 1770s (see figure 2).[9] Fair skies predominated more than usual during the 1720s, but there was an increase in cloudiness during the 1730s and a return to predominantly fair conditions during the 1740s and 1750s.

Marked shifts in the various parameters were not limited to time spans of decades. For example, there were numerous instances when first fall killing frosts occurred one year in November and then in early September or late August in the next. (On the average, first fall frosts

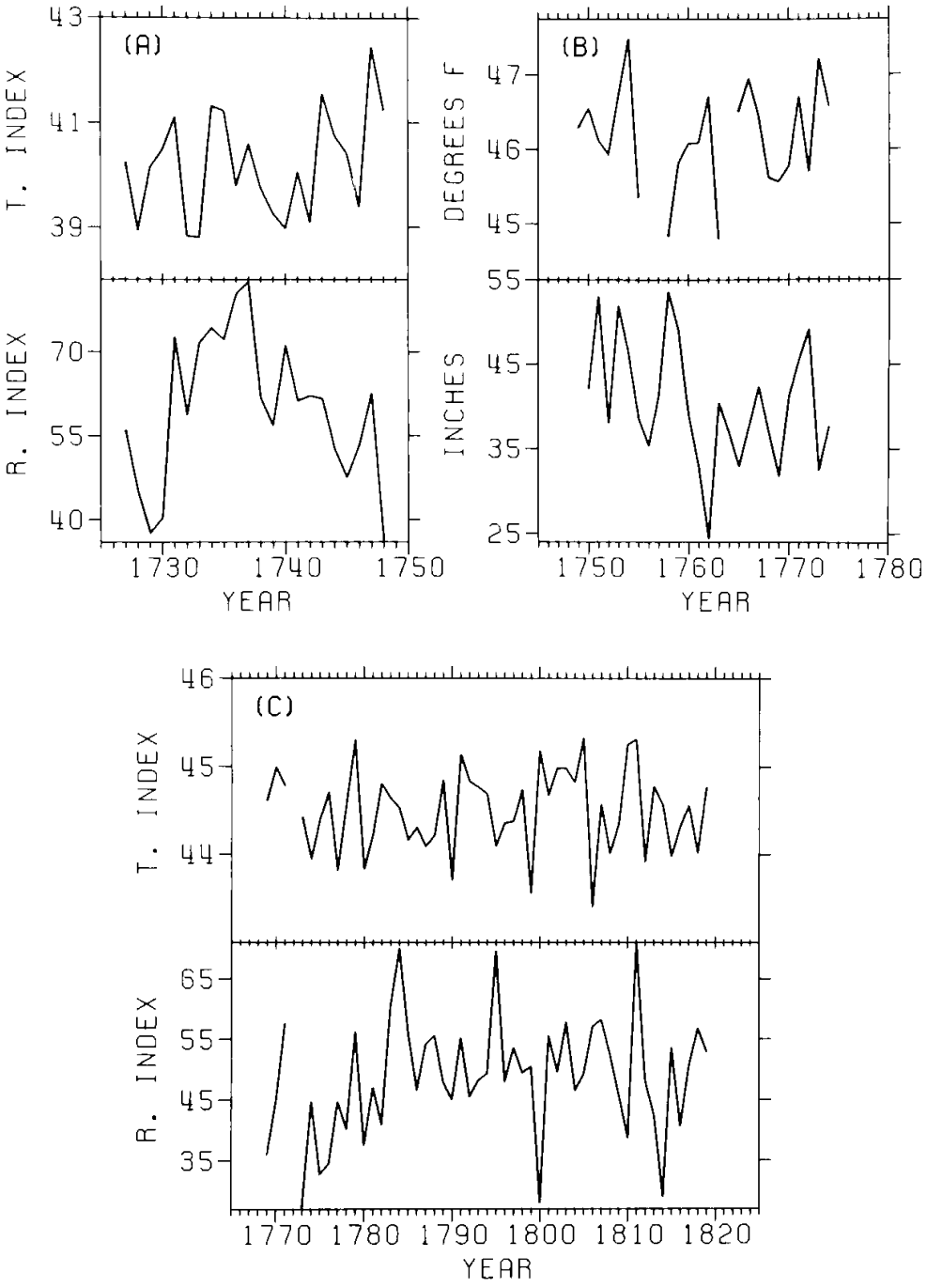

Fig. 1 Eastern Massachusetts Yearly Temperature and Precipitation (A. Walker Diary, Boston; B. Winthrop Record, Cambridge; C. Wight Diary, Medford)

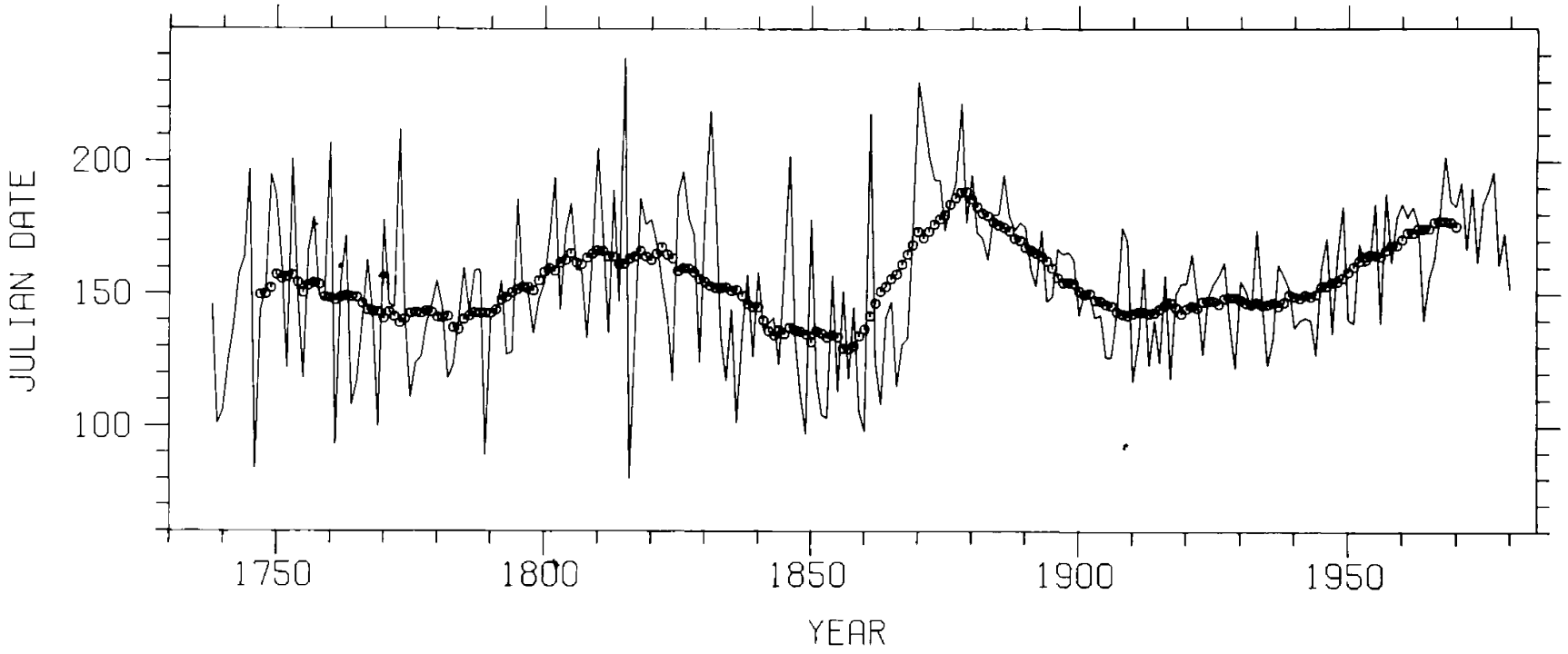

Fig. 2 Eastern Massachusetts Frost-Free Season and 20-Year Running Means

occurred twenty-five days earlier than they do today.) During the decade of the 1740s there were two winters that were very severe (1740/41 and 1747/48) and four that were very mild (1739/40, 1742/43, 1744/45, 1745/46). This was typical of almost every decade in the century except the 1760s. There were also frequent occasions when floods and droughts alternated from one growing season to the next. For example, there were droughts and dry spells in 1749, floods in 1751, droughts in 1752, floods in 1754 and 1755, droughts in 1756 and 1757, floods in 1758 and 1759 and droughts in 1761. There was similar variability from season to season and year to year in storminess, early and late springs, and snowy and open winters (see tables 1 and 2).[10] While research on the variability of New England weather during the nineteenth and twentieth centuries is not yet completed, early results indicate that there has been considerably less variability during the present century.[11]

What sort of an impact did this variability of weather extremes have on eighteenth century New Englanders? There is an abundance of scattered evidence illustrating the impact of weather extremes on various individuals. For example, Rev. William Homes of Chilmark, Massachusetts, reported that considerable rain during August of 1719 "much damaged" the English hay. Because American grasses were not as nutritious for livestock, the reduction of English hay supplies probably forced farmers to slaughter more livestock because they lacked sufficient hay to winter over the usual number of animals. Supplies of meat for the following few years would be reduced as farmers tried to rebuild their herds. In 1724 Homes again reported that supplies of grass and corn were decreased but this time because of drought.[12]

Bad storms also affected colonial life. Jonathan Sanborn, Jr., of Hawke, New Hampshire, reported a

TABLE 1

STORM AND DROUGHT FREQUENCIES FOR EASTERN MASSACHUSETTS, 1730-1819

Decades	Mean Storms* per Year	Year Most Storms	Year Least Storms	Number of Dry Summers per Decade
1700s	—	—	—	3
1710s	—	—	—	2
1720s	—	—	—	3
1730s	4.8	1733 (10)[a]	1734, 37 (1)	0
1740s**	6.2	1742 (11)	1748 (2)	4
1750s	4.0	1759 (12)	1752 (1)	4
1760s	11.3	1764, 65 (18)	1769 (8)	3
1770s	10.2	1772 (18)	1773, 76 (6)	6
1780s	6.1	1781, 87 (10)	1789 (2)	6
1790s	4.2	1790 (8)	1793, 94, 95, 97 (2)	1
1800s	5.9	1805, 07, 08, (9)	1801 (1)	2
1810s	—	—	—	2
1730-1819	6.6	1764, 65, 72 (18)	1734, 37, 52, 1801 (1)	36

[a] number of storms

* excluding thunder storms

** missing data

TABLE 2

AVERAGE SNOWY DAYS PER WINTER FOR EASTERN MASSACHUSETTS, 1730-1820

Decade	Mean # Days Snowed/Winter	Winter Most Days Snowed	Winter Least Days Snowed	Mean Date First Snow	Mean Date Last Snow	Earliest Fall Snow	Latest Spring Snow
1730s	17 Days	1736/37 (33)*	1729/30 (8)	Dec. 4	Apr. 8	Nov. 10, 1732	Apr. 28, 1732
1740s	17 Days	1743/44 (23)	1739/40 (10)	Dec. 2	Apr. 15	Nov. 8, 1746	May 11, 1749
1750s*	23 Days	1758/59 (38)	1756/57 (18)	Nov. 2	Apr. 4	Oct. 26, 1753 and 1758	Apr. 20, 1759
1760s*	18 Days	1765/66 (21)	1763/64 (14)	Nov. 12	Apr. 3	Nov. 7, 1762	May 11, 1769
1770s	20 Days	1769/70 (26)	1770/71 (13)	Nov. 27	Apr. 4	Nov. 9, 1771	May 1, 1777
1780s	19 Days	1784/85 (29)	1782/83 (12)	Nov. 15	Apr. 3	Oct. 19, 1783	Apr. 22, 1787
1790s	19 Days	1798/99 (28)	1791/92, 1792/93, 1795/96, 1797/98, (14)	Nov. 3	Apr. 9	Sept. 27, 1792	May 12, 1799
1800s	20 Days	1805/06 (33)	1802/03 (13)	Nov. 17	Apr. 10	Oct. 28, 1808	May 31, 1808
1810s**	17 Days	1810/11 (25)	1813/14 (13)	Nov. 11	Mar. 27	Oct. 17, 1816	Apr. 12, 1816
1730-1819	19 Days	1758/59 (38)	1729/30 (8)	Nov. 17	Apr. 6	Sept. 27, 1792	May 31, 1808

* days with snow

* some missing data

** does not include summer snows of 1816

series of bad storms during December of 1778 and January of 1779 in which "many people perished" and vessels were wrecked on Rye Beach. Likewise, Rev. Edward Holyoke, president of Harvard, recounted in his diary that a bad storm on March 24, 1765, "did much damage to wharves, warehouses, "and other shorefront properties at Boston and other locations on Massachusetts Bay. Rev. Manasseh Cutler of Ipswich, Massachusetts, reported a storm in October of 1770 that did similar damage and another in 1772 that dropped so much rain that there was "a very great freshet, a vast deal of hay lost, and all the salt hay damaged."[13]

Nor were droughts, floods, and storms the only weather-related phenomena that caused a disruption of normal business, loss of property, or even loss of life. During severely cold winters ice often locked up harbors normally open to commerce. Usually the colonials made the best of the situation, often turning the freezeup into a social occasion, as in the winter of 1740/41. That year, John Tudor of Boston reported that the ice was so thick between Boston and the Castle (set on an island in the harbor) that a tent was erected halfway between the two to provide entertainment for those crossing the ice on horseback and in sleighs. Yet another weather phenomena that had considerable impact on colonial lives was lightning that sometimes burned houses and barns, killed livestock, and, all too frequently, the colonials themselves (see table 3). References to such incidents are numerous in diaries for the period.[14]

Moving from the assessment of possible weather-related impacts on individuals to analyzing possible impacts on society presents some methodological problems that demand considerable additional research. Useful, long-running records are fragmentary and few in number. In addition the researchers must account for a number of factors at work, in addition to meteorological variability.

TABLE 3

MEAN NUMBER OF THUNDERSTORMS PER YEAR
FOR EASTERN MASSACHUSETTS, 1730-1819

Decade	Spring	Summer	Fall	Winter	Total	Year Most Thunderstorms	Year Least Thunderstorms
1730s	1.1	2.8	.2	.1	4.2	1730, 36, 38 (7) [a]	1733 (1)
1740s	.9	2.4	.6	.1	3.9	1740 (9)	1741 (1)
1750s*	1.8	7.4	.4	.4	10.0	1752, 53, 59 (12)	1757 (6)
1760s*	2.0	5.8	.8	.1	8.7	1763 (19)	1765 (2)
1770s	.4	2.1	.2	.1	2.7	1770 (9)	1773, 74, 78 (0)
1780s	.9	.7	.3	0.0	1.9	1788 (5)	1784 (0)
1790s	.6	1.0	.7	.1	2.4	1799 (7)	1792, 93, 96 (1)
1800s	1.2	1.7	.8	.2	3.9	1805, 08 (6)	1800, 02 (1)
1810s*	.2	1.1	.1	0.0	1.4	1819 (6)	1813, 14, 15, 18 (0)
1730 - 1819	1.0	2.8	.5	.1	4.3	1763 (19)	1773, 74, 78, 84, 1813, 14, 15, 18 (0)

[a] number of days with thunderstorms

* missing data

For example, J. D. Post, in his study of meteorological change and food prices during the Napoleonic period, has pointed out that one-to-one comparisons between yearly mean temperatures and food-price indices are too simplistic because they fail to account for all the other variables involved.[15]

Now that a meteorological record for the eighteenth century has been reconstructed, more detailed studies of colonial New Englanders' interaction with the environment are needed. For example, there is a need for a study of the long-term effects that the Little Ice Age may have had on society. Eighteenth-century New Englanders were born and grew up in a climate dominated by a variability of extremes, and their parents and grandparents also lived under the same conditions. Was the cooler climate partially responsible for the development of certain forms of architecture, landscaping, and structure positioning? Was the multi-layered nature of colonial clothing the partial product of a 300-year period of variable weather conditions? How did folk knowledge concerning when to plant or to harvest develop? Was the multicrop system used by the colonials developed, in part, to offset crop losses due to variable weather? Was the practice of planting several food crops with varying meteorological requirements a way for the colonial farmer to insure that at least one or two would reach maturity?

Studies also are needed on the short-term, year-to-year effects of the fluctuations. More indepth research must be undertaken on the subject of colonial agricultural labor practices and requirements. How long did it take to complete a given job? What was the normal cycle and duration of agriculturally related tasks? Research tools developed for use in the field of agriculture and resource economics should be utilized. In this regard M. L. Parry's study of the impact of climate variation on agriculture

and settlement in geographically marginal areas of Scotland and Scandinavia might serve as an example of the type of study that could be conducted on eighteenth-century agricultural communities in the uplands of northern New England. Likewise the work of T. L. Anderson, W. B. Rothenberg, D. E. Ball, G. M. Walter and others on colonial agricultural resources and productivity provide both records for comparison with climate/weather reconstructions and are examples of studies that could be conducted on similar materials from other time periods and New England locales.[16]

Impact studies must be undertaken on storm and flood damage. What impact did such damage have on the economy of a town, region or business? Likewise what was the impact of frequent, severe winters on home-heating requirements, especially in light of rising wood prices in some of the larger towns such as Boston?

These questions and a number of others, as yet unformulated, await answers. The results of all of these studies should provide a variety of socioeconomic records that can be compared to eighteenth-century climate/weather reconstructions to ascertain what, if any, impact the variable weather may have had. An analysis of the links between climate and society is a timely study in light of such recent events as the droughts in California and the Midwest, the storms that destroyed parts of the Texas Gulf Coast, the cold winter of 1978/79 and the New England blizzard of 1978. The mass media has made much of these weather extremes and, in some cases, advanced dire predictions for the future. It is time for historians to help place these recent aberrations in perspective.

NOTES

[1] This paper was presented in somewhat altered form at the Fourteenth Annual Duquense University History Forum, Pittsburg, Pa., Oct. 27-29, 1980. The author thanks William Te Brake, Geoffrey A. Gordon, James T. Moore, and the members of the Climate History Seminar at the University of Maine at Orono, fall semester, 1980, for their helpful comments. Research was partly supported by National Science Foundation Grants ATM 7908415 and ATM 8019514.

[2] Stephen Longfellow (Gorham, Me.), Diary, 1771-1788, Maine Historical Society, Portland, Me., entries for April 21 through June 11, 1773, Sept. 11, 1774, June 15, 1775, and also the preface to the 1776 diary.

[3] For a discussion of colonial methods of weather predicting and the role of almanacs see Silvio A. Bedini, *Thinkers and Tinkers: Early American Men of Science* (New York: Charles Scribner's Sons, 1975), pp. 84-85, and Marion B. Stowell, *Early American Almanacs: The Colonial Weekday Bible* (New York: Burt Franklin, 1977), pp. 92-95. Anthony Heath's small book *Rational Choice and Social Exchange* (Cambridge: Cambridge University Press, 1976) is an excellent introduction to rational choice decision-making processes.

[4] Hubert H. Lamb, "Climatic Fluctuations," in *General Climatology*, vol. 2 of *World Survey of Climatology*, ed. H. Flohn (Amsterdam: Elsevier Publishing Co., 1969), pp. 185-86.

[5] Friedman's research is described in H. H. Lamb, *Climate: Present, Past and Future* (London: Methuen, 1977), vol. 2, p. 429, and Lamb's own assessment follows on pp. 527-28. For a discussion of Fritts's work see his *Tree Rings and Climate* (London: Academic Press, 1976).

[6] David C. Smith and Harold W. Borns, Jr., "Reconstruction of Historic Climates of Northeastern U.S.," National Science Foundation grant proposal, ATM 7908415, Maine Climate Group, University of Maine at Orono, 1978, pp. 5-8.

[7] For a discussion of the source materials and analysis employed consult William R. Baron, "Tempests, Freshets and Mackerel Skies: Climatological Data from Diaries Using Content Analysis" (Ph.D. dissertation, University of Maine at Orono, 1980), pp. 54-175.

[8] Figure 1 is based on the following materials: Benjamin Walker, Diaries, 1726-1749, Massachusetts Historical Society, Boston; John Winthrop Weather Registers, 1743-1779, Harvard University Libraries, Cambridge, Mass.; Helmut E. Landsberg, C. S. Yu, and L.

Hang, *Preliminary Reconstruction of a Long Time Series of Climatic Data for the Eastern United States*, Institute for Fluid Dynamics and Applied Mathematics, Technical Note BN-571 (College Park, Md.: University of Maryland, 1968), and Aaron Wight, Diaries, 1777-1819, Massachusetts Historical Society. The analysis techniques used on these materials are discussed in Baron, "Tempests, Freshets and Mackerel Skies," pp. 54-175. The Walker and Wight records were derived by using content analysis to convert qualitative diary entries into quantitative expressions. The Winthrop register is an instrumental record that was statistically homogenized to insure intra-record integrity.

[9] For a discussion of the methodology employed in the reconstruction of figure 2 consult William R. Baron *et al*, "Frost-Free Season Record Reconstruction for Eastern Massachusetts, 1733-1980" (typewritten). The following manuscript materials were used for the period 1730-1820: Benjamin Walker, Diary, 1726-1749; Jacob Cushing, Diary, 1787; Ezekiel Russell, Diaries, 1761-1762; Cotton Tufts, Diaries, 1763-1794; Moody Follansbee, Diaries, 1765-1766; Dr. Joseph Lee, Diaries, 1769-1789, Lee Papers; Aaron Wight, Diaries, 1769-1819; Jeremy Belknap, Diaries, 1758-1778, Belknap Papers; Samuel West, Diaries, 1766-1805; and Jacob Bigalow, Diaries, 1769-1799, all at the Massachusetts Historical Society; Moses Parsons, Diary, 1737-1740, Parsons Family Papers; David Goddard, Diary, 1741, Goddard Family Papers; Edmund Williams, Diaries, 1742-1765; ? Clark, Diaries, 1817-1829; Jeremiah Green, Diaries, 1770-1780; Dr. Joseph Lee, Diary, 1795; Samuel Bridge, Diaries, 1788-1798; Belcher Noyes, Diaries, 1775, 1782; and Naham Jones, Diaries, 1779-1807, all at the American Antiquarian Society, Worcester, Mass. Also, John Winthrop, Weather Registers, 1743-1779, Harvard University Libraries; Jacob Cushing, Diaries, 1749-1809, Library of Congress; Samuel Tillinghast, Diaries, 1757-1758, Rhode Island Historical Society, Providence, R.I.; Samuel Richards, Diaries, 1755-1760, Dedham Historical Society, Dedham, Mass.; John White, Diaries (typescript), 1774-1790, Maine Historical Society. Published materials include: Francis G. Walett, ed., *The Diary of Ebenezer Parkman*, 2 vols. (Worcester, Mass.: American Antiquarian Society, 1974-), vol. 1: *1719-1755;* William Tudor, ed., *Deacon Tudor's Diary* (Boston: W. Spooner, 1896); "Diary of the Rev. Samuel Checkley, 1735," *Publications of the Colonial Society of Massachusetts, Transactions* 12 (1908-9): 295-306; Jasper Marsh, ed., "Amos Pope and His Almanacs," *Historical Collections of the Danvers Historical Society* 10 (1922): 103-14; Benjamin T. Hill, ed., *The Diary of Isaiah Thomas, 1805-1828*, 2 vols.,

Transactions and Collections of the American Antiquarian Society 9-10 (1909); Leonard Hill, *Meteorological and Chronological Register* (Plymouth, Mass.: M. Bates, 1869); "Diary of Jonathan Larcom of Beverly, Mass.," *Essex Institute Historical Collections* 87 (1951): 65-95 (hereafter cited as *EIHC);* "Diary of Paul Dudley, 1740," *New England Historical and Genealogical Register* 35 (1881): 28-31 (hereafter cited as *NEHGR);* "Diary of John Preston of Danvers, 1744-1760," *NEHGR* 56 (1902): 80-83; "Diary of John Whiting of Dedham, Mass., 1743-1784," *NEHGR* 63 (1909): 185-92, 261-65.

[10] Baron, "Tempests, Freshets and Mackerel Skies," pp. 176-221, 598-648.

[11] In addition to the source material cited in note 8 above, the following manuscripts were utilized to construct tables 1 through 3: William Williams, Jr., Diaries, 1710-1758; Warham Williams, Diaries, 1739-1741; and Stephen Williams, Diary, 1727, all part of the Williams Family Collection; Nathaniel Lovejoy, Diary, 1762-1809, all housed at the American Antiquarian Society. Also, William Homes, Diary, 1716-1745, New England Historic Genealogical Society, Boston; William Stickney, Diaries, 1757-1790, Massachusetts Historical Society; Stephen Williams, Diary, 1749-1750, Library of Congress. Additional published materials include: Worthington C. Ford, ed., *Diary of Cotton Mather,* 2 vols. *(Collections of the Massachusetts Historical Society,* 7th ser., vols, 7-8 [1911-12]; reprint ed., New York: F. Unger, 1957); John Rowe, *Letters and Diary of John Rowe, Boston Merchant, 1759-1762, 1764-1779,* ed. Anne Rowe Cunningham (Boston: W. B. Clarke Co., 1903; reprint ed., New York: Arno Press, 1969); "Diary of Mrs. Mary (Vial) Holyoke, 1760-1800," in George Francis Dow, ed., *The Holyoke Diaries, 1709-1856* (Salem, Mass.: Essex Institute, 1911), pp. 47-138; William Parker Cutler and Julia Perkins Cutler, eds., *Life, Journals and Correspondence of Rev. Manasseh Cutler, LL.D.,* 2 vols. (Cincinnati: R. Clarke and Co., 1888) (hereafter cited as Cutler and Cutler, eds, *Life, Journals and Correspondence);* William Bentley, *The Diary of William Bentley, D.D., the Pastor of the East Church, Salem, Massachusetts,* 4 vols. (Salem, Mass.. Essex Institute, 1905-14; reprint ed., Gloucester, Mass.: Peter Smith, 1962); Edmund Frost, "Notes and Queries, *NEHGR* 55 (1901): 441-42; Richard Brigham Johnson, ed., "The Diary of Israel Litchfield," *NEHGR* 129 (1975): 150-71, 250-69, 361-78; Samuel Sewall, *Diary of Samuel Sewall, 1674-1729,* 3 vols. *(Collections of the Massachusetts Historical Society,* 5th ser., vols. 5-7 [1878-82]); "John Marshall's Diary," *Proceedings of the Massachusetts Historical Society,* 2nd ser., 1 (1884-85): 148-62, 14 (1900-1901): 13-34; "The Diary of Rev. Joseph Green, of Salem Village, *EIHC* 8 (1866): 215-24, 10 (1870): 73-104, 36 (1900): 325-30.

[12] Rev. William Homes (Chilmark, Mass.), Diary, 1689-1746, New England Historic Genealogical Society, entries for Aug. 7, 1719 and July 12, 1724.

[13] Jonathan Sanborn, Jr. (Hawke, N. H.), Diary, 1774-1813, New Hampshire Historical Society, Concord, N.H., entries for Dec. 10, 1778 through Jan. 9, 1779; "Diary of Rev. Edward Holyoke, 1709," in Dow, ed., *The Holyoke Diaries*, p. 28; Cutler and Cutler, eds., *Life, Journals and Correspondence*, I: 28, 40.

[14] Tudor, ed., *Deacon John Tudor's Diary*, p. 2. A typical diary that reports damage by lightning is found in Daniel Wadsworth, *Diary of Rev. Daniel Wadsworth, Seventh Pastor of the First Parish Church in Hartford,* ed. George L. Walker (Hartford, Conn.: Case, Lockwood and Brainard, 1894), pp. 9, 15, 36, 100.

[15] John D. Post, "A Study in Meteorological Trade Cycle History: The Economic Crisis following the Napoleonic Wars, *Journal of Economic History* 34 (1974): 315-49 (hereafter cited as *JEH*).

[16] Martin L. Parry, *Climatic Change: Agriculture and Settlement* (Folkstone, Kent, England: Dawson, 1978); Terry Lee Anderson, *The Economic Growth of Seventeenth Century New England: A Measure of Regional Income* (New York: Arno Press, 1975); Winnifred B. Rothenburg, "A Price Index for Rural Massachusetts, 1750-1855," *JEH* 39 (1979): 975-1001; Duane E. Ball and Gary M. Walton, "Agricultural Productivity Change in Eighteenth Century Pennsylvania," *JEH* 36 (1976): 102-25; Lois G. Carr and Lorena S. Walsh, "Inventories and the Analysis of Wealth and Consumption Patterns on St. Mary's County, Maryland, 1658-1777," *Historical Methods* 13 (1980): 81-104 (hereafter cited as *HM*); David W. Galenson and Russel B. Menard, "Approaches to the Analysis of Economic Growth in Colonial British America," *HM* 13 (1980): 3-18; T. H. Breen, "The Culture of Agriculture: Interpreting Agricultural Work in Early America," paper presented at the Forty-First Conference in Early American History and Culture, April 30 through May 2, 1981, Millersville State College, Millersville, Pa.